ELECTRON (VACUUM) TUBE TEST SET
KS-15560L1 AND L2 HICKOK TUBE TESTERS
DESCRIPTION AND APPLICATION

CONTENTS

1. GENERAL

1.01 This section describes the Hickok KS-15560 L1 and L2 tube testers and gives the methods for operating and maintaining these sets. These sets are capable of testing practically all small sized amplifier and rectifier tube types of Western Electric or other manufacture. The tubes are tested at a fixed plate potential of about 150 volts less the IR drop in the circuits of the set. Similarly a fixed screen grid test potential of about 130 volts is provided. By suitable adjustment of the independent control grid bias supply as prescribed, satisfactory tests may be made both on tubes normally operating at lower plate potentials and on tubes normally operating at plate potentials up to about 300 volts.

1.02 This section is reissued to incorporate material from the addendum in its proper location. In this process marginal arrows have been omitted.

1.03 The KS-15560 L1 and L2 testers incorporate all of the test features found in the previous model KS-5727 L1 tester plus certain improvements and operating advantages which provide in particular superior transconductance (Gm) measuring accuracy and extension of the maximum measurable ranges of indicated transconductance. These basic improvements over Hickok testers of older design are intended to minimize set-to-set transconductance errors hitherto encountered, as well as to make possible testing of the higher Gm tube types of Western Electric Company manufacture under testing conditions adequate and suitable for this purpose. Furthermore, the superior accuracy of the KS-15560 tester will improve the relationship, particularly for amplifier types utilizing a screen grid, between indicated transconductance as measured and the nominal transconductance values usually published in Western Electric electron tube data sheets and in other tube manufacturers' handbooks.

1.04 These and other important test features and circuit innovations included in the KS-15560 L1 and L2 testers are:

(1) Greater precision of Gm measurements and reduction in difference in readings between sets. This is accomplished by:

(a) Introduction of grid signal directly into control grid circuit.

(b) Provision of an independent grid bias supply.

(c) Adjustment of grid bias on a voltage basis by addition of a dc meter.

(2) Extension of Gm measurements to include 30,000 and 60,000 micromhos ranges.

(3) Provision of external binding posts to permit self-bias testing.

(4) Shorts test circuit changed to reduce ac test voltage to a satisfactory peak value.

(5) Jumbo 9-pin test socket added for recent Western Electric tubes such as 418A.

(6) An optional use of the micromhos meter as a microammeter to measure gas or grid leakage current directly in the grid circuit of a tube under test.

(7) Removal of grid signal voltage used in connection with grid current test under separate push switch control.

(8) Provision for the reduction of screen grid voltage as applied for tests of small battery type tubes and older Western Electric types which normally operate at lower screen voltages.

(9) Improved panel layout has been effected by grouping controls and voltmeter for the ac power adjustment and grouping the dc grid bias voltmeter and controls with the self-bias binding posts. The CATH. ACT. switch has been moved to a more central horizontal operating position above the P1-P7 push switch gang to prevent accidental operation.

(10) A new roll chart for commercial type tubes is furnished in which the minimum or reject numerical values of indicated transconductance are listed instead of the nominal Gm values hitherto supplied on previous Hickok charts. Accordingly, the micromhos meter will not have GOOD-REPLACE sectors. Rectifier tubes and other tubes measured on a rectified current basis will be measured by observing the RECTIFIERS & DIODES OK line index on the micromhos meter scale, with an appropriate setting of the SHUNT potentiometer dial.

1.05 The KS-15560 L1 and L2 testers provide means for making the following tests:

(1) Measurement of the "indicated transconductance" in micromhos. The meter reading is directly proportional to the transconductance of the tube under test, but under the relatively fixed plate and screen grid voltage test conditions is not always a true measurement of transconductance. For this reason it is referred to herein as "indicated transconductance."

(2) Test of the cathode (filament) activity in terms of the change in transconductance for a 10 per cent reduction in heater (or filament) voltage.

(3) Tests for internal short circuits by means of a neon lamp continuity test circuit.

(4) Test for excessive grid current due to the presence of gas or grid insulation leakage by direct grid meter measurement.

(5) Transconductance test at approximately one-half normal screen grid voltage for all tube types requiring this test condition for satisfactory Gm measurement.

(6) Rectifier tube plate current tests for thermionic and certain cold cathode types. Western Electric tubes such as cold cathode types (313C group), and coded Western Electric ballast lamps and coded voltage regulator types such as the 423A can not be tested in this set. Small hot cathode thyratrons such as the 884, or 2050 types, are listed on the roll chart. Although not entirely adequate, such tests may be made in the absence of other maintenance tests. In the latter tests, only firing point or ionization voltage control tests are indicated. Tests for small cold cathode rectifier types listed for tubes such as the 0A4G and 0Z4 are satisfactory.

(7) The L2 set has an additional filament voltage tap of 0.6 volt for tests of tubes which may require this voltage.

1.06 The only power supply required is commercial 60- or 50-cycle ac power of 105 to 125 volts. Built-in rectifier circuits supply the necessary dc potentials for the various tests.

1.07 General purpose rejection limits for Western Electric tubes are discussed in Part 7 of this section. Other test limits and other methods of test may be specified in Bell System Practices covering particular applications. Where so given, such limits and methods should be followed in place of those given in this section.

1.08 This tester is intended primarily for general purpose use in the maintenance of electron tubes in apparatus for which other methods of electron tube testing have not been specified in the Bell System Practices for that equipment. Since the indicated transconductance measured by this set is approximately equal, but not necessarily equal, to true transconductance, check tests made with this set should not be used as measures of new tube quality relative to manufacturer's specifications.

1.09 Information regarding the tests for tubes of other than Western Electric manufacture is supplied in the form of a roll chart in the set. The chart, which is replaceable in the set, is revised from time to time by the manufacturer. New superseding charts may be obtained at nominal cost from the Hickok Electrical Instrument Company - 10514 Dupont Avenue, Cleveland 8, Ohio. New issues of this chart will be in combination form to apply not only to KS-15560 L1 and L2 testers but also to KS-15559 L1 testers. Section 100-635-501 listing complete Western Electric tube test data is printed in such form that it can be readily added to or become an integral part of the roll chart of this tester. Tube test data for Section 100-635-502 are handled similarly.

1.10 The description, testing procedures, and data included in this section apply to both L1 and L2 sets except where specifically qualified.

1.11 Modifications applying to L1 testers which were of early manufacture, i.e., sets with serial numbers below about 335 may be made, to improve their anti-sing arrangements, as described in Part 8. This modification information is intended primarily for work to be done locally. Use is made of a parts kit obtainable from the Hickok Electrical Instrument Company. The modification information is not needed if the set has been returned to the Hickok Electrical Instrument Company, 10514 Dupont Avenue, Cleveland 8, Ohio for modification.

2. DESCRIPTION OF SET

(A) General

2.01 There are two models of this set, L1 and L2, each self-contained in a carrying case for portable use. The L1 set is mounted in an imitation leather covered wooden case. The outside dimensions of this case including the removable cover are 18-1/4 by 17 by 7-1/2 (depth) inches. The net weight is about 27 pounds. The L2 set is mounted in an aluminum case with a removable cover and has about the same dimensions and weight. The L2 set is equipped with a 3-conductor power cord. The third conductor provides an external ground connection to the panel and metal case by means of a short clip lead.

2.02 The set is intended to be used in a horizontal position and requires 105-125-volt, 60-cycle ac supply. It is permissible to mount the set permanently in a vertical position where this is desired. Such mounting calls for a careful check, and usually a resetting, of the zero adjuster of the various meters of the set. The electron tube test data are based on 60-cycle operation, for which this set is designed. These data, however, should be satisfactory for all practical purposes when the set is operated on commercial 50-cycle supply. It should not be operated on 25-cycle ac supply.

2.03 Either set is mounted on a metal foundation panel 14-1/2 inches deep and about 16 inches wide, containing the micromhos meter, A.C. VOLTS and GRID BIAS VOLTS meters, and a group of nine electron tube test sockets. The row of selector switches, potentiometer and various selector control dials, a neon lamp for short-circuit tests, an auto bulb fuse, a MICROMHOS switch, three toggle switches, a pilot lamp and a bank of test pushbuttons, are all suitably designated and arranged as shown in the attached panel layouts on Pages 101 and 102. The principal differences are that the L2 set has an OFF and a 0.6-volt position on the FILAMENT selector, and has two lift rings to facilitate removing the chassis from the metal case. A roll chart, provided by the manufacturer below the pushbotton bank, gives the test settings and adjustments for electron tubes of other than Western Electric Company manufacture.

(B) Description of Equipment on Panel of Set

2.04 The principal meter (designated herein as the micromhos meter) is a dc microammeter calibrated in micromhos, with five basic scales corresponding to ranges of 0-3000, 0-6000, 0-15,000, 0-30,000, and 0-60,000 micromhos, to give the measurement of indicated transconductance of the tube under test. In the case of rectifier and diode types, the value of rectified plate current in terms of a minimum (reject) index line on the meter designated RECTIFIERS & DIODES OK is used as a criterion for rejection instead of micromhos. A small slide contact switch designated METER, beneath the micromhos meter, is provided to reverse polarity when required for tests of tubes having two sections with separate cathodes, such as the 117N7 type.

2.05 A small ac voltmeter, designated A.C. VOLTS, is located near the lower left corner of the main panel. This is used to indicate when the line voltage adjustment is correct, and to check the value of the external ac supply voltage.

2.06 A small dc voltmeter, designated GRID BIAS D.C. VOLTS, is located in the upper left corner of the main panel. This voltmeter, and its associated range toggle switch designated BIAS VOLTS (having 5- and 50-volt positions) registers the required grid bias voltage for a transconductance test, under control of the adjacent BIAS ADJUST potentiometer.

2.07 A binding post pair, designated SELF BIAS is located immediately above the GRID BIAS voltmeter. The shorting strap provided may be removed for the insertion of an appropriate self-bias test resistor as required for certain tube tests. These binding posts also can be utilized to measure total space current, or plate current alone in the case of a triode, if desired, by unstrapping the two posts and connecting a suitable external dc milliammeter, properly poled, to the binding posts.

2.08 Nine types of push-type electron tube sockets are provided, which include the standard 4-, 5-, 6-, 7-prong and two 8-prong types for the octal and lock-in type tube bases. The remaining three sockets are for miniature tubes of the 7-pin and 9-pin (Noval) types and the 9-pin Jumbo type. No Acorn tube socket is provided, but a suitable octal based adapter, listed below, can be used for testing 950-type tubes. Roll chart settings for Acorn tubes apply as based in this adapter. Also listed below, are suitable adapters, not provided as part of the set, which must be obtained for testing certain bayonet 4-pin base Western Electric tubes.

	Standard Adapter
101-, 102-, or 104-type (WECo)	Alden No. 944 WEB
205-type (WECo)	Alden No. 978 WEB
215A (WECo)	Alden No. 972
Acorn Tube (950 Series)	Alden No. 978 ATA

2.09 Controls: All of the seven selector switch controls must be given their proper settings for a measurement of indicated transconductance. These selector switch controls are designated according to their functional socket pin code assignments as shown in Fig.10, hence a test may be improvised for basing a tube for which roll chart settings are unavailable. This procedure is covered in Part 6.

2.10 Selector Switches: Seven SELECTORS, so designated, are located across the main control panel. Settings of these switches control the connections for properly basing any tube to be tested, when it is inserted into its proper socket. These settings are obtained from the roll chart or (for Western Electric tubes) from Section 100-635-501. The first two selectors with letter designations control the filament pin assignments, designated FILAMENT, while the remaining five are designated GRID, PLATE, SCREEN, CATHODE and SUPPRESSOR in that order.

2.11 Filament Voltage: Filament (or heater) voltage is supplied from a multiple tap transformer and is controlled by the selector switch designated FILAMENT.

OFF*	2.5	7.5	35
0.6*	3.0	10	50
1.1	4.3	12.6	75
1.5	5.0	20	117
2.0	6.3	25	

* Provided in L2 set only.

The remaining switch position, designated BLST is a special position necessary in making certain tests where the cathode return circuit is disconnected from the midpoint of a resistance normally bridged across a filament (or heater). The accuracy of the voltage for each position

is within ±3 per cent, when the LINE ADJUST control is set properly. For L1 sets heater (or filament) off may be obtained by operating the first selector to A or the second selector to position P. These selector positions are designated FIL. OFF.

2.12 Grid Signal and MICROMHOS Range Switch: The MICROMHOS switch controls the HIGH or LOW grid signal to be applied and the micromhos range scale as specified for a transconductance test. Four positions are associated with the sector designated HIGH SIGNAL for the 5-volt grid signal. The first position, SHUNT, is used for tube tests in terms of the meter scale index line designated RECTIFIERS & DIODES OK. The next three positions, in order, are for the three micromhos scales, 3000, 6000, and 15,000, and give indicated transconductance for the HIGH SIGNAL grid test voltage. The second sector of the MICROMHOS switch designated LOW SIGNAL is used to register four ranges of indicated transconductance in the following order: 60,000, 30,000, 15,000, and 6000 micromhos. The lowest ranges (15,000 and 6000) utilize a 1-volt grid signal while the higher ranges 60,000 and 30,000 use 1/4-volt and 1/2-volt signals, respectively. All tubes are now tested according to a minimum or reject value of indicated transconductance as listed in the roll chart or Sections 100-635-501 and 100-635-502 under the column heading MIN. TRANSCOND. The proper choice of the micromhos switch setting or the SHUNT potentiometer setting is given under the column heading MIC-SW SHUNT on the roll chart.

2.13 SHUNT Dial: The SHUNT dial controls a potentiometer shunt bridged across the micromhos meter to adjust its sensitivity. It is calibrated in an arbitrary scale from 0 to 100. This potentiometer is connected when the MICROMHOS switch is in the SHUNT position only. It is used for tests where the special index scale mark is specified (such as for diodes), as given on the roll chart or in Sections 100-635-501 and 100-635-502.

2.14 BIAS ADJUST Knob: The BIAS ADJUST knob controls an uncalibrated potentiometer, which provides either of two continuously adjustable ranges of grid voltage from 0 to 50 volts or 0 to 5 volts on the GRID BIAS D.C. VOLTS meter, depending on the BIAS VOLTS toggle switch position.

2.15 Line Adjustment: This rheostat designated LINE ADJUST, controls the ac voltage applied to the primaries of the two power transformers in the set. When adjusted so that the A.C. VOLTS voltmeter referred to in Paragraph 2.05 deflects to the red index mark designated TEST on its scale, the voltage applied to the set is 100 volts, which is normal for the test set operation. The L2 set has a more rugged type of rheostat, otherwise operation is the same as with the L1 set.

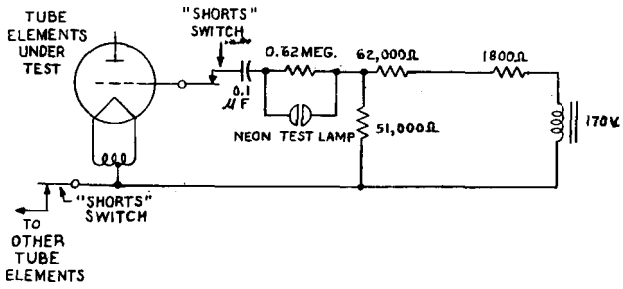


Fig. 1 - Shorts Test Circuit

2.16 SHORTS Test Switch: On a 6-position selector switch designated SHORTS, five steps are provided to make short-circuit tests between various electrodes of the tube under test, using the neon lamp test circuit indicated in simplified form in Fig. 1. This shorts test may be made with the tube filament (or heater) on or off, but usually is made with the filament (or heater) heated. In the sixth position labeled TUBE TEST the neon lamp short test circuit is disconnected and the tube under test is connected for indicated transconductance, cathode (filament) activity, and other tests.

2.17 Toggle Switches: A CATH. ACT. switch is located immediately above the P1-P7 push switch gang and the POWER switch is located below the A.C. VOLTS meter. These two switches function as follows:

(1) The CATH. ACT. switch is required for cathode (filament) activity tests. When operated to NORMAL, the filament (or heater) voltage is the value for which the filament voltage switch is adjusted. When in the TEST position, the voltage applied to the filament (or heater) of a tube under test is reduced 10 per cent below the nominal FILAMENT selector value. The per cent reduction in indicated transconductance observed for this 10

per cent filament (or heater) voltage change is used as a fundamental criterion of the condition of tubes so tested.

(2) POWER: This switch, with ON and OFF positions, controls the commercial ac power supplied to the set. The L1 set utilizes a 5-foot 2-conductor cord and plug attached. The L2 set utilizes an 8-1/2-foot 3-conductor cord and plug equipped with a clip lead for grounding. The single contact lamp bulb in the socket designated FUSE is used to protect the power supply circuits of the set.

(3) BIAS VOLTS: This switch, with positions 5 and 50, controls both voltmeter range and grid bias voltage registered by the GRID BIAS D.C. VOLTS meter under control of the BIAS ADJUST potentiometer.

2.18 Pushbutton Switches: Eight switches are located in line in the front part of the control panel and are operated to make the various tests in conjunction with the selector and potentiometer dials described in the preceding paragraphs. Both functional and numerical designations are provided. The required P1 to P7 switch operations are given in all test setting data.

(1) Two Gm (P4) pushbuttons (colored red) are provided for the transconductance test. These pushbutton switches are connected in parallel and are designated to operate as indicated by NON LOCK (left-hand button) and LOCK (right-hand button). When operated, the proper dc plate and screen grid voltages are impressed on the tube under test, while the plate circuit is connected to the micromhos meter through the MICROMHOS switch. The twist action locking type pushbutton switch is provided to ensure continuously applied operating potentials to a tube during the time required for a cathode (filament) activity test.

(2) Two test (nonlocking) pushbuttons, designated GAS (P5) and SIG. OFF (P6), are provided. Operation of the GAS button (P5) transfers the micromhos meter directly into the grid circuit. Operation of the SIG. OFF (P6) pushbutton removes the grid signal voltage from the grid circuit of a tube under test. The combined operation of the two buttons makes possible a direct reading grid current GAS or grid insulation leakage test using the micromhos meter as a dc microammeter.

(3) Three pushbuttons, designated P1, P2, and P3, are provided for rectifier type tests. P3, identified as RECT, places an ac potential on the plate of the rectifier tube under test. This ac voltage is rectified and measured as direct current on the micromhos meter, where a reading with respect to the RECTIFIERS & DIODES OK index mark gives a measure of the condition of the tube. The P2 pushbutton, designated OZ4, provides a similar test for rectifiers of the cold cathode type. A protective series resistor is employed in this test circuit to limit the rectified current flow through the tube to a value which will not damage it. P1, the DIODE pushbutton, controls a rectified current test for small hot cathode diode sections of multipurpose tubes. This test is similar to the rectifier tests except that a lower ac voltage (about 15 volts) is applied to a diode plate through a protective resistor.

(4) The remaining pushbutton, P7, designated LINE TEST, when operated disconnects the A.C. VOLTS meter from the LINE ADJUST control circuit and connects it to check the external ac supply voltage.

(C) Description of Circuits

2.19 Complete schematic circuit diagrams of the set are given on Pages 103, 104, and 105 for unmodified L1 sets with serial numbers below about 335, for all other I1 sets, and for L2 sets, respectively. To aid in understanding the principles underlying the several tests, reference will be made to a few simplified schematic diagrams. The various circuit arrangements are secured by the proper operation of the controls just described.

2.20 When measuring indicated transconductance or testing cathode (filament) activity, the set is arranged to provide the circuit shown in Fig. 2. The 5Y3GT type full-wave rectifier tube supplies unfiltered (pulsating) dc potentials to the screen grid (if any) of the tube under test. Control grid bias is developed from a full-wave selenium rectifier circuit which derives the ac voltage supply from the screen grid high voltage transformer winding. The unfiltered plate potential is derived from a separate rectifier employing an 8 -type tube with balanced transformer secondaries supplying ac potentials of 170 volts to each plate of the rectifier tube. The 83-type full-wave rectifier tube is of the mercury vapor type and is used

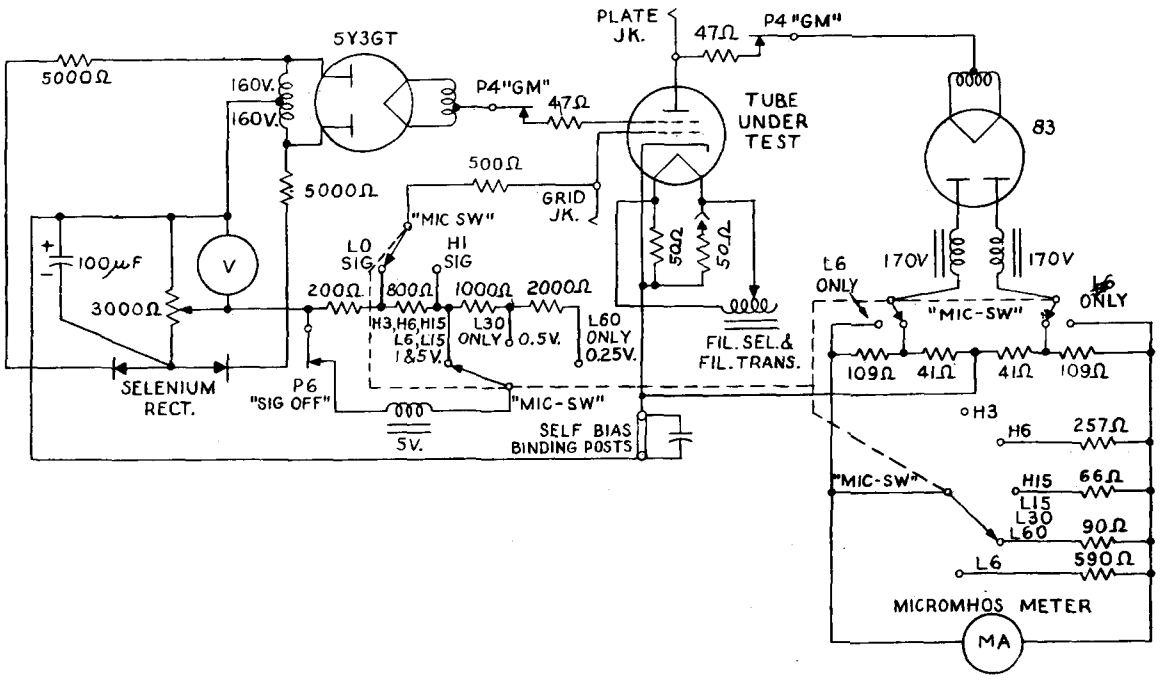


Fig. 2 - Basic Transconductance Circuit

to ensure a minimum internal voltage drop, with better regulation, regardless of load current. The micromhos meter is connected across the potentiometer or resistances in the rectifier circuit as shown. Since the currents in the two resistances are equal, the arrangement is balanced and no potential is impressed on the meter if no ac signal is impressed on the control grid.

2.21 However, the circuit actually is arranged to impress an ac (60-cycle) potential of various values, 5 volts, 1, 1/2, or 1/4 volt on the grid by means of a divider circuit across a transformer winding inserted between the grid and the cathode. This potential appears amplified in the plate circuit of the tube under test, and is in phase with the ac potential impressed by the rectifier transformer on one plate of the 83-type tube, and in opposition to the potential on the other plate. Thus, the rectified current in one side of the 83-type rectifier is increased and in the other is decreased, unbalancing the meter circuit and causing the meter to deflect. The amount of deflection is proportional to the transconductance of the tube under test, but under these test conditions is not a rigorous measurement of the transconductance. For this reason it is referred to herein as "indicated transconductance."

2.22 When testing a rectifier-type tube the set is arranged as shown in Fig. 3. Each anode is tested separately. The 83-type tube has no function in this circuit arrangement, the rectifier plate circuit under test being substituted for one side of it. A current limiting resistance of 150 ohms is in series with the tube under test and the micromhos meter reads directly proportionally to the rectified ac current as indicated on the meter scale.

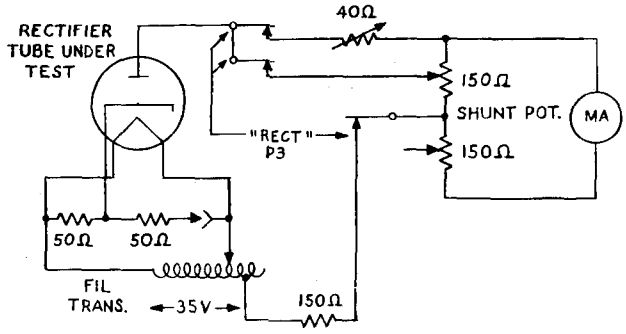


Fig. 3 - Standard Rectifier Test Circuit

2.23 When testing the diode section of a multipurpose tube, or small hot cathode diodes, the circuit (Fig. 4) is the same as that described in Paragraph 2.22 except that the ac potential is decreased from 35 to about 15 volts, and the current limiting resistance is changed to 1200 ohms. Only one plate of the diode is tested at a time. Micromhos meter readings are observed relative to the RECTIFIERS & DIODES OK index mark, readings to the right of the line indicating a satisfactory condition.

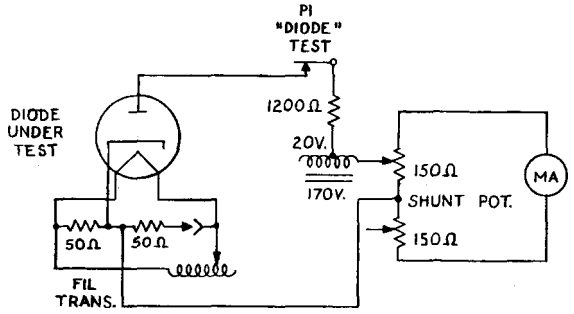


Fig. 4 - Diode Test Circuit

2.24 When testing a cold cathode tube, the circuit (Fig. 5) is similar to that described in Paragraph 2.23 except that two windings of the power transformers are employed in series, applying an ac potential of 290 volts in series with a current limiting resistor to the tube under test.

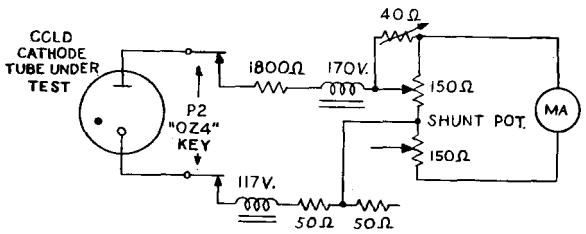


Fig. 5 - Cold Cathode Tube Test Circuit

2.25 Gas current in a tube or grid leakage current due to poor grid to filament insulation may be detected by the switched insertion of the micromhos meter into the grid circuit of a tube under test, as shown in Fig. 6, and described in Paragraph 2.18, Item (2). In this setup the normal dc pulsating voltage is applied to the screen grid (approximately 130 volts) and the normal plate supply (150 volts) by means of the P4 pushbutton switch. This test is made with the standard normal grid bias voltage applied under control of the BIAS ADJUST knob as for a regular transconductance measurement with the P4 switch operated. Then with the P4 switch operated, the SIG. OFF (P6) push switch and then the GAS (P5) switches are operated. The P5 switch transfers the dc micromhos meter from its normal plate circuit position directly into the control grid circuit to measure grid current, if any, directly in dc microamperes. The SIG. OFF (P6) switch removes grid signal for the test, for in certain cases the presence of a grid signal could produce false readings. In this test the micromhos meter, used as a dc microammeter, will read 3-1/3 microamperes per small scale division.

(D) Power Supply

2.26 The set consumes about 60 watts of 60-cycle commercial ac power (105-125 volts). This power supply is protected by a standard No. 81 Mazda 6-volt 3-cp single contact auto bulb. This is used as a fuse, and is replaceable easily from the face of the set panel. When not in use the POWER toggle switch should be operated to OFF to avoid unnecessary heating of the set.

2.27 Adjustment to compensate for power voltage and load fluctuations is provided by the LINE ADJUST knob to maintain a steady voltage as read at the red index line (100 volts) of the A.C. VOLTS voltmeter.

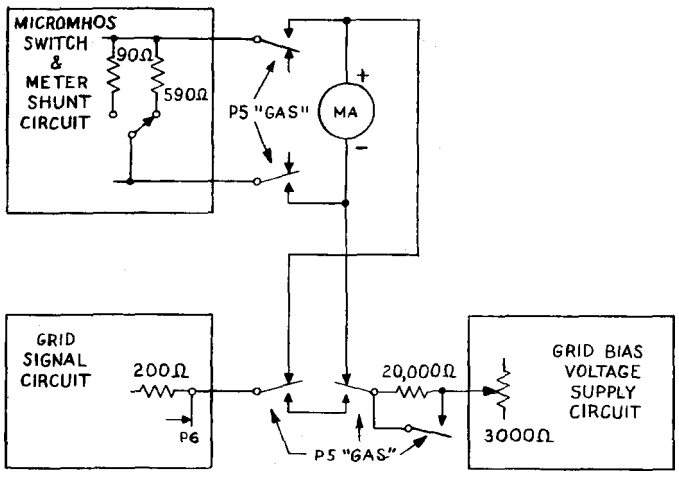


Fig. 6 - Gas Test Circuit

(E) Special Features

2.28 Neon Lamp Shorts Test Circuit: This test circuit locates shorts in any inter-electrode path within a tube, as indicated previously in Paragraph 2.16. The actual method of test is given in Paragraph 3.05. Table I, or the corresponding table in the manufacturer's booklet delivered with the set, provides the necessary information to determine the exact location of a short by observing which of the five positions of the SHORTS selector switch cause the neon lamp to light. While there are minor wiring improvements in the shorts test circuit interconnections obtained in the L2 set, it is deemed unnecessary to incorporate such changes into L1 sets.

2.29 The various short locations given in Table I represent paths commonly encountered for typical tube basing arrangements. In the case of certain octal and miniature types appropriate notations on the chart show neon lamp short positions which will flash because of tube base wiring interconnections. Such short indications should be ignored. The table shows three neon lamp indication combinations, each of which represents two separate short conditions. To a considerable extent a discrimination between these alternate path indications will be evident from a consideration of the basic type of tube under test, e.g., triode vs. tetrode, or cathode type vs. filamentary type. In certain instances a tube chart listing includes a separate "Shorts Test Only" setting as indicated under the column NOTATIONS (or OPERATING NOTES). This is necessary in cases where the regular transconductance measurement selector setting for a given tube has a duplicate electrode appearance (repetition of a selector index number), to prevent tube self-oscillation on a Gm test, or in other cases to avoid false short indications in certain multipurpose 2-section types such as pentagrid converters.

2.30 An added function is incorporated, as shown in Fig. 7, with the operation of the DIODE (P1) push switch to provide half-normal screen grid voltage (about 65 volts) in conjunction only with a regular transconductance test (Gm-P4 switch operated). This test is required principally for small battery powered or older type Western Electric and commercial tubes which normally operate with lower screen grid voltage in the 60 to 100-volt range, to obtain more precise transconductance measurements. The use of half-normal screen grid voltage also minimizes the possibility of exceeding the maximum plate-screen power ratings of such tubes under test.

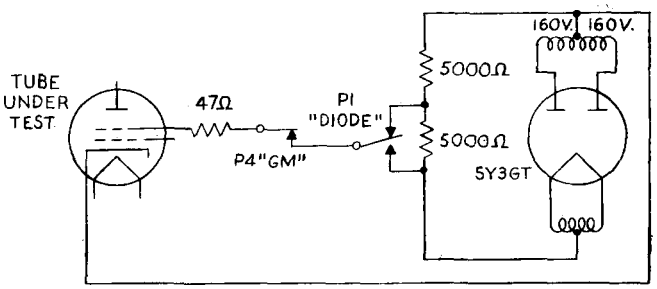


Fig. 7 - Reduced Screen Voltage Test Circuit

2.31 Adapters are required for Western Electric tubes equipped with bayonet type bases, as discussed in Paragraph 2.08. In particular, attention is directed to the omission of the Acorn type test socket in this set, and the need for a suitable adapter, if such tubes required testing, as discussed in Paragraph 2.08.

2.32 A black pin jack designated GRID and a red pin jack designated PLATE are located above the test socket area. These are provided for the insertion of the cap clip lead, furnished separately, for use in testing tubes having a metal grid or plate connection on top. It is important not to connect the cap terminal of the tube to the wrong pin jack. (See Paragraph 3.02, Item (5).)

2.33 Noise Test Circuit: A pair of pin jacks under the selector switch, designated NOISE TEST, is included as part of the noise test to be used in conjunction with a broadcast type radio receiver equipped with a loudspeaker. These pin jacks are connected to the neon lamp test circuit through a small condenser (0.0005 mf). The right-hand jack is for a pin plug connection to the radio receiver's antenna post and the left-hand jack for the ground terminal. The noise test is made with the tube energized by the required filament (or heater) voltage in its proper test socket and connected by means of the required selector settings. The test is made by rotating the SHORTS switch through positions 1 through 5 (no pushbuttons operated), while tapping the tube lightly by hand and listening to the loudspeaker. This test, described in the manufacturer's booklet, is not recommended for Western Electric tubes.

2.34 Lamp Test: The center of the 7-prong socket has a live receptacle for testing miniature screw, bayonet, or candelabra based pilot or indicator lamps for burnouts. The voltage that is applied is under the control of the FILAMENT selector and may be varied in the voltage steps of that selector, as required for the lamp to be tested.

3. METHODS FOR TESTING TUBES

(A) Preliminary Setup Procedure

3.01 Detach the cover of the set when in use or have it properly supported in the open position. When the set is not in use so that the tube under test provides a normal load, the POWER switch always should be turned off to avoid unnecessarily heating up the set.

Caution: To avoid damage to the set or to the tube to be tested, operate the POWER switch to OFF after each test unless the same type of tube is to be tested in close sequence. In the latter case it is necessary merely to unlock the Gm button (P4) and release both P4 buttons while changing tubes.

3.02 Procedure:

(1) With the POWER switch at OFF, plug the attachment cord into a suitable source of 60- (or 50-) cycle, 105-120-volt ac power.

(2) Adjust the FILAMENT selector switch, the SELECTORS switches and the MICROMHOS switch to the proper values for the type of tube to be tested. (See the roll chart and data Section 100-635-501.) Subsequent changes in the roll chart, if required, will be shown in data Section 100-635-502.

(3) If a self-bias resistor is required for the tube (by roll chart or in the data section) turn the BIAS ADJUST knob to the extreme counterclockwise position (0 volt) and insert the resistor in place of the shorting strap across the SELF BIAS binding post pair. The tolerances of the resistors used should be no greater than indicated under "Notations" and preferably should be less.

Note: To expedite easy insertion of the necessary self-bias resistor, when required, a simple combination consisting of a General Radio #274-MB plug with the proper external resistor may be used. The resistor can be connected to this plug without soldering, using a thin screwdriver such as the KS-6854. The nearest 145A (1%) or 145C (5%) Western Electric resistance value should be ordered. The choice between 145A and 145C depends on the precision specified under "Notations." 106A (1%) resistances also are suitable but are more costly.

(4) Insert the tube to be tested into the socket which is proper for the tube base. For certain tubes adapters are required as shown under "Notations" on the roll chart or in the data sections. (See Paragraph 2.08.)

(5) If the tube has a top terminal, plug the clip lead into the required GRID or PLATE jack (this is shown on the chart or in the data section, under "Notations"), and attach the other end to the cap of the tube. The clip on the cap should be vertical on metal shell tubes to avoid a short between the cap and the shell.

Caution: The clip lead necessary for external grid or plate cap tubes always should be removed from the test jack when not required, to avoid subsequent incorrect assignment or short circuiting if left connected. A plate jack connection to the top terminal of a grid cap tube probably would damage the latter.

(6) Operate the POWER switch to ON and adjust the LINE ADJUST potentiometer until the needle of the A.C. VOLTS voltmeter points to the TEST calibration mark (red). This adjustment should be checked from time to time during the tests, particularly as the plate current comes on when one of the Gm pushbuttons is operated.

Caution: The SELECTORS or FILAMENT selector should never be operated with either Gm button in a locked or operated position. Also it should be emphasized that, except in the case of certain tests involving the P1, P3, P5, or P6 pushbuttons, and checks of the line voltage by the operation of pushbutton P7, test procedures usually call for the operation of only one pushbutton at a time.

(7) Note the bias voltage required by the chart or tube data section, and adjust the BIAS ADJUST potentiometer and the 5-50-volt range switch to obtain the proper grid voltage on the BIAS VOLTS meter. This step is not necessary if a self-bias resistor is used in Item (3).

3.03 In following the subsequent detailed instructions, so as to permit the tube to become stable before making any test involving meter readings, an important precaution is to allow a minimum of 1-1/2 minutes for heater types and 1/2 minute for filamentary tubes after turning on the power or after making any change

in the filament (or heater) voltage applied to the tube. Considerable variations in heating and stabilizing time for either filamentary or heater tubes may occur, depending upon the tube design. This time interval precaution should be observed after operating the CATH. ACT. switch to TEST during an activity test as well as after first turning on the power. Filamentary tubes may stabilize in less time after the CATH. ACT. switch is operated to TEST than is required for the initial stabilizing interval. An indication of saturation in the tube is a steady micromhos meter reading (allowing for temporary power voltage fluctuations). Ac power voltage fluctuations may be checked by operating the LINE TEST (P7) pushbutton and observing the A.C. VOLTS meter behavior.

(B) Tests of Amplifier Types of Tubes

3.04 These tests apply to all tubes having control grids whether they are used in service as amplifiers, modulators, demodulators, detectors or oscillators. The basic transconductance test provided by this set may be qualified as a Class A Gm test. In this case the tube being tested operates under normal bias voltage to approximate design center plate and screen current values within the set's limitations (such as the relatively fixed plate and screen voltage supply).

Shorts Test

3.05 Procedure:

(1) Complete the preliminary setup procedure per Paragraph 3.02.

(2) Ordinarily the shorts test is made with the filament (or heater) heated but it can be made with the filament (or heater) cold, i.e., either of the letter designated (the two left-hand) SELECTORS in the FIL. OFF A or P position. In the L2 set the OFF position of the FILAMENT selector provides convenient means for removing heater supply.

(3) Operate the SHORTS test switch slowly through positions 1 through 5.

(4) If the neon lamp, designated SHORTS, lights continuously in any of these positions a short circuit between elements is indicated.

(5) The meaning of the short indication usually can be determined by reference to Table I.

Note: Sometimes, as discussed in Paragraph 2.29, an alternate path may exist. However, false short indications may be observed on certain non-Western types, principally converter or mixer tubes. Such short indications occur after a tube has been under plate load (Gm test) but usually disappear under shorts test conditions after a relatively short time, about 20 seconds. One typical case of false short indication usually involves neon lamp positions 1, 4, and 5, occurring only for tubes with a screen grid. It indicates a screen to cathode short and is due to the temperature condition of the screen grid.

(6) Repeat shorts test switch sequence if necessary to verify fault location.

Requirement: Continuous lighting of the neon lamp indicates an unsatisfactory tube. The nature of the short may be obtained from Table I.

3.06 In certain instances a tube chart listing may include a separate "Shorts Test Only" line in the NOTATIONS or OPERATING NOTES column on the roll chart or in the electron tube test data Sections 100-635-501 and 100-635-502. This is necessary in cases where the selector setting for the regular transconductance measurement for a given tube employs a duplicate electrode appearance (repetition of a selector index digit), to prevent tube self-oscillation on a Gm test. Table I shows three neon lamp indication combinations each of which represents two separate short conditions. Either of these indications may be the correct one. Often the identification of which short path is present may be made by a consideration of the basic type of the tube under test, i.e., triode vs. tetrode or pentode, or cathode vs. filamentary type. Tubes may be tapped lightly with a soft part of the index finger during the short tests to disclose the possibility of intermittent shorts in this test and an intermittent flash may be obtained instead of a steady illumination. However, an instantaneous flash as the switch is moved from one position to another should be disregarded as this flash is caused by the discharging of the condenser in the shorts test circuit.

Transconductance Test

3.07 Procedure:

(1) Complete the basic setup procedure (see Paragraph 3.02) and shorts test (Paragraph 3.05) for the tube to be tested.

(2) Under NOTATIONS on the roll chart, in Section 100-635-501 or in Section 100-635-502 note carefully any special operating notes which may apply, such as a self-bias resistor required or the combined operation of the P1 push switch with the P4 button to obtain a reduced screen voltage transconductance test.

Note: Where a transconductance test is required with half-normal screen grid voltage as discussed in Paragraph 2.30, the symbol, #, will appear in the PRESS column. The complete Gm test should be made in the normal manner except that the P1 push switch should be depressed first and held depressed while the P4 (Gm) switch is operated to obtain a micromhos meter indicated Gm reading.

(3) Set the CATH. ACT. test switch at NORMAL.

(4) Set the SHORTS switch at the TUBE TEST.

(5) Operate the Gm button (right-hand P4).

(6) Recheck the line adjustment voltage reading on the A.C. VOLTS meter.

(7) Read the deflection of the micromhos meter corresponding to the proper micromhos scale designated by the MICROMHOS switch setting.

Requirement: See Paragraphs 3.08 and 3.09.

Note: Although this tester incorporates suppressor elements associated with the test socket circuits to prevent self-oscillation or singing of a tube under transconductance test, circumstances may arise where it is desirable to identify a singing condition. Whenever a fluctuating or unstable transconductance (Gm) reading is observed an unsatisfactory test condition, possibly due to tube self-oscillation, is indicated. Such a condition may be due to set or tube trouble. When this is suspected in connection with the test described in Paragraph 3.07, with the P4 button remaining locked and the bias voltage at the prescribed value, the bias voltage should be increased to obtain near cutoff or minimum micromhos meter reading. Any increase in micromhos meter reading with increased bias voltage will be indicative of self-oscillation. When cutoff is reached the bias voltage should be slowly decreased until normal bias voltage is reached, while carefully observing the micromhos reading. Any sudden change in micromhos meter or bias voltmeter indication which occurs when the bias voltage is being reduced indicates tube oscillation. Touching the external self-bias binding posts in connection with this test to introduce a hand capacitance effect will aid in verifying the singing condition by causing an appreciable change in the micromhos meter reading.

3.08 For Western Electric tubes, the prescribed settings of BIAS volts and MICROMHOS switch are such as to give indicated transconductance readings, under the test conditions obtained with this set, as read on the scale of the micromhos meter indicated by the MICROMHOS switch. These settings are found in Section 100-635-501 under columns headed BIAS VOLTS and MIC-SW SHUNT, respectively. The tube shall meet the minimum micromhos limit given in Section 100-635-501. No nominal values are given (see Paragraph 7.04).

3.09 Tubes of other than Western Electric manufacture are set up and tested according to roll chart test data in the same manner as Western Electric tubes, as outlined in Paragraphs 3.07 and 3.08 preceding. Supplementing the roll chart, other tube test data to cover recent tubes not included on the chart as well as data revisions or alternative tests, may be found in Section 100-635-502. All tubes are passed or rejected on a minimum transconductance basis except for rectifiers, diodes, special cold cathode or a few gas triodes. These exceptions, with the roll chart usually calling for operation of the P1, P2, or P3 push switches and an appropriate SHUNT dial setting as listed under the column heading MIC-SW SHUNT, are passed or rejected with reference to the RECTIFIERS & DIODES OK index mark only. All readings to be observed with respect to this rejection index are identified on the roll chart adjacent to the column heading PRESS by a star or asterisk (*). Other special operating procedures sometimes are included on the roll chart under the "Notations" column.

Grid Current Test

3.10 This test to detect and measure grid leakage or GAS current between control grid and cathode (or filament) usually is made, if required, in conjunction with the regular transconductance test previously described under Paragraph 3.07.

3.11 Procedure:

(1) With the tube set up for test per Paragraph 3.02 depress and lock the P4 LOCK (Gm) switch in place.

(2) Operate and hold the SIG. OFF (P6) button depressed to remove the grid signal.

(3) Operate the P5 (GAS) push switch and observe the micromhos meter for any discernible deflection.

Requirement: If micromhos meter reading exceeds 1-1/2 small scale divisions (about five microamperes), the tube shall be rejected. This general maximum grid current limit applies only in lieu of other requirements specified on the roll chart or in sections of Bell System Practices which cover the maintenance of the particular tube in the particular equipment involved. A momentary initial deflection of the meter pointer in either direction should be ignored. The direction of such deflections also has no significance. It is the steady state reading which should be observed.

Cathode (or Filament) Activity Test

3.12 This test is performed in conjunction with the transconductance test described in Paragraph 3.07.

3.13 Procedure:

(1) With the tube under test in operation (Gm push switch P4 LOCK operated) and CATH. ACT. switch NORMAL, when a steady deflection of the micromhos meter on the 3000 micromhos range is obtained note the reading. (This may not be the proper scale to read true indicated transconductance, but this test is simplified by using the 3000-micromho scale only.) It is not necessary to observe the true indicated transconductance per the MICROMHOS switch setting.

(2) Operate the CATH. ACT. switch to TEST.

(3) Wait a minimum of 1-1/2 minutes for heater type or 1/2 minute for filamentary type tubes (see Paragraph 3.03) and note the micromhos meter reading again on the 3000-micromho scale.

(4) The nearest percentage cathode activity is obtained from Table II using the meter readings observed in Items (1) and (3).

Requirement: See Paragraphs 3.14 and 3.16.

3.14 Cathode Activity Test Requirements, Western Electric Tubes: For Western Electric tubes the percentage cathode activity as determined in Paragraph 3.13, Item (4) should be not greater than the limits given in Section 100-635-501 under NOTATIONS as "@X%." The symbol "@" has been used to mean cathode activity limit, in order to save space. For this purpose Table II can be used to determine whether the required per cent activity rejection limit has been exceeded, for the particular micromhos reading of the tube under test. For a given percentage, if the observed reading exceeds or equals the value in the proper percentage TEST column on line with its observed reading in the NORMAL column, the tube meets the requirements. Tubes which fall below this TEST column value should be rejected.

3.15 Cathode Activity Test Requirements, Non-Western Electric Tubes: Tubes of other than Western Electric manufacture usually are rejected on the basis of the micromhos meter reading using the MIN. TRANSCOND. column value only. No activity test limits ordinarily are specified for them. If, however, it is desired to apply a cathode (or filament) activity test, a limit of 25 per cent maximum change in micromhos may be assumed in the absence of other specified values. Table II may be used for determining whether the observed percentage exceeds 25 per cent or for determining the minimum TEST value corresponding to the observed NORMAL value.

3.16 The MIN. TRANSCOND. limits for micromhos meter reading (Paragraph 3.08) and the cathode activity limits given in Section 100-635-501 are for general use and correspond approximately to the requirements generally employed for corresponding tests made by other standard testing methods. For tubes in certain services, other limits may be specified, of course, and when so specified should be followed in place of these limits. In general, emphasis is directed toward the primary

use of the Hickok tester as a maintenance tool, and in many cases its purpose is to restore to service equipment suspected of having tube trouble. Intensive testing of tubes in equipment which is satisfactorily working, unless specified by definite Practices or working routines, is not recommended. In such cases unnecessary replacement of tubes not actually below minimum transconductance values may serve no useful purpose and sometimes lead to unsatisfactory operation of equipment.

(C) Rectifier and Diode Tests

3.17 Procedure for Full-wave or Half-wave High Vacuum Rectifiers:

(1) Set up tube for test per Paragraph 3.02, with the CATH. ACT. switch NORMAL and the SHORTS selector at TUBE TEST.

(2) Set the MICROMHOS switch at SHUNT.

(3) Adjust the SHUNT potentiometer to the required value.

(4) Depress the P3 (RECT.) pushbutton and observe the micromhos meter reading.

Requirement: Rectified plate current is satisfactory if the micromhos meter deflection reaches or exceeds the RECTIFIERS & DIODES OK index mark. Reject the tube for readings below this index mark.

(5) In case of twin plate rectifiers, proceed with test of the second section as listed in the data sections or on the roll chart by setting up the new SELECTORS combination and repeating Items (1) through (4).

3.18 Diode Tests: Diode plate current tests require a procedure similar to that of rectifiers as outlined in Paragraph 3.15. Each diode element or section of a multipurpose tube is tested separately, and each test preferably should be of short duration to avoid possible damage to the tube.

3.19 Procedure:

(1) Set up the tube for test per Paragraph 3.02, with the CATH. ACT. switch NORMAL and the SHORTS selector at TUBE TEST.

(2) Set the MICROMHOS switch at SHUNT.

(3) Adjust the SHUNT potentiometer to the required value shown on the roll chart or in the tube data section.

(4) Depress the P1 (DIODE) pushbutton and observe micromhos meter reading.

Requirements: The diode plate current is satisfactory if the micromhos meter deflection reaches or exceeds the RECTIFIERS & DIODES OK index mark. Reject tube for readings below this index mark.

(5) For twin diode or diode sections of multipurpose tubes, proceed with the test of other sections as listed in the data sections or on the roll chart by setting up the new SELECTORS combinations and repeating Items (1) through (4).

3.20 0Z4 Tests: 0Z4 gas filled rectifiers of the cold cathode and similar type are tested similarly to diodes or rectifiers.

3.21 Procedure:

(1) Set up the tube for test per Paragraph 3.02, with the CATH. ACT. switch NORMAL and the SHORTS selector at TUBE TEST.

(2) Set the MICROMHOS switch at SHUNT.

(3) Adjust the SHUNT potentiometer for the required value shown on the roll chart or in the tube data section.

(4) Depress the 0Z4 (P2) pushbutton and observe the micromhos meter reading.

Requirements: The rectified plate current is satisfactory if the micromhos meter deflection reaches or exceeds the RECTIFIERS & DIODES OK index mark. Reject the tube for readings below this index mark.

3.22 In testing the rectifier section of dual purpose tubes such as the 117N7GT, 117L7GT, or similar type tubes, the METER switch is first operated to REVERSE and then the RECT. (P3) pushbutton is depressed. The micromhos meter reading is observed as usual. The use of the REVERSE METER switch, whenever required, is always indicated on the roll chart under NOTATIONS.

(D) Special Tests

3.23 The set is arranged to provide rough tests on cold cathode tubes, electron ray (magic eye) indicator tubes, and ballast resistor tubes, all of other than Western Electric manufacture. Settings for tests of these types of tubes (except ballast and voltage regulator tubes) are contained on the roll chart. Methods of making any of the special tests not covered in this section are described in the instruction booklet furnished by the manufacturer of the test set or briefly on the roll chart. These tests for ballast tubes check only the continuity of the resistance elements. Tests of voltage regulator tubes are not recommended as they show only that the tube is capable of ionizing (firing) and has a sufficient emission. Thus, the test is incapable of measuring the true voltage-current characteristics of the tube.

3.24 Plate current in the case of triode type tubes, and total space current (plate plus screen current) in the case of tetrodes or pentodes, can be measured if desired, by the use of a suitable external dc milliammeter. This meter may be connected in the cathode return circuit of a tube under test by wiring it, properly poled, to the SELF BIAS binding post pair, with the normal connecting strap of the binding posts removed.

4. MAINTENANCE

4.01 Rectifier Tubes in Set: Ordinarily the set comes equipped with rectifier tubes. These tubes are a No. 83 full wave mercury-vapor rectifier tube (the high vacuum No. 83V-type rectifier tube is not suitable), and a No. 5Y3GT full wave high vacuum type rectifier tube. A 5W4 or 5W4GT tube may be used as a satisfactory substitution for the 5Y3GT in this tester.

4.02 If it is necessary to install new tubes, the following applies.

Installation Procedure:

(1) Remove the screws holding the control panel, also remove one holding screw located on the bottom of the set. Then lift the panel from the cabinet (use the lift rings on the L2 set).

(2) Insert a 5Y3GT tube in the 8-pin octal socket on the subpanel inside the set, and lock its base in place with the screw clamp.

(3) Insert a No. 83 tube in the 4-pin socket on the subpanel inside the set, and lock its base in place with the screw clamp.

(4) Plug the power supply cord into a source of 60-cycle 105-to 125-volt ac power, operate the POWER switch to ON and depress the Gm (P4) pushbutton. If the micromhos meter needle vibrates and the fuse lamp lights up brilliantly, an unsatisfactory 83-type tube is indicated. This condition seldom obtains with a new tube of reliable manufacture and is caused by an excess of metallic mercury within the bulb. Replace the tube with an 83-type which does not produce this effect, if it occurs.

(5) Remount the panel and reinsert the screws. The set is ready for use.

4.03 The following data apply to the lamps used in this set:

Fuse Lamp	No. 81 Mazda, 6-8 volts
Pilot Lamp	No. 40 Mazda, 6-8 volts
Shorts Test Lamp	Neon, Type NE, 1/4 watt, 115 volts

4.04 The care ordinarily accorded any piece of calibrated testing apparatus should be given to the test set to ensure satisfactory operation. The top cover should be in place at all times when the set is not in use, to prevent dust or dirt from entering any of the moving parts, particularly the sliding potentiometer contacts. These contacts should be inspected periodically and cleaned if necessary by the standard methods for such apparatus. Key contacts and the contact prongs of the vacuum tube sockets also should be kept free from corrosion and dirt, and should be burnished as required.

4.05 Tube test sockets sometimes become defective due to contact prong spring pressure variation or misalignment. This trouble usually shows up by intermittent operation of the tube under test in a questionable socket. In such cases replacement with a new socket is desirable. To obtain proper replacements for test sockets or any other defective components, reference should be made to the complete parts list appearing at the end of the Operating Instructions booklet supplied by the manufacturer for each new tester. Both the Hickok Company's part number and the original parts maker's part number are listed.

4.06 The meters of this set should be stable if the set is not subjected to serious mechanical shocks or electrical abuse. Factory meter calibrations are within 1.5 per cent at full scale deflection. The set is calibrated to be used in a normal horizontal position. Zero settings of the meters should be checked on installation, each time the set is carried to a new location, and from time to time as required.

4.07 Once a year the 5Y3GT (or 5W4) and 83-type rectifier tubes, used in the power supply of the tester, should be replaced by new tubes temporarily and should be tested in the set. They should be rejected for further use if test requirements are not met.

4.08 With the 60-cycle ac power voltage at any value between 105 and 125 volts the set is designed to permit the 83-tube rectifier circuit to supply an adequate value of dc operating plate potential (max. approx. 154 volts), and the 5Y3GT rectifier circuit to provide approximately 130 to 135 volts screen grid supply. A special circuit feature in this set provides a lower screen voltage (65 volts) when the P1 push switch is operated. The grid signal voltage supply calibration also should be satisfactory over this 60-cycle voltage range. Should inadequate operating potentials be encountered, the ac line voltage should be verified first, using the ac line volts check circuit. The rectifier tubes 83, and 5Y3GT or 5W4 should be checked and replaced if necessary in case of inadequate operating conditions. Further and more detailed test information may be found under Part 5, CALIBRATION DATA.

4.09 In case the set fails to operate when testing a tube, i.e., no pilot lamp illumination, no dc voltage, or no grid signal supply (or as indicated by the absence of an ac voltmeter reading with the POWER switch turned to ON), the small fuse lamp should be inspected first before removing the front panel for further investigation. Except in the case of tubes having very high heater wattage consumption (e.g., 421A), burning out or extreme brilliancy of this fuse lamp, which is located in the main primary transformer circuits, usually is an indication of overload or circuit trouble. If a trouble condition exists, it should be cleared before continuing the operation of the set.

4.10 Reference may be made to the attached schematics (Pages 102, 103, 104, and 105) or to the manufacturer's drawings which are part of the booklet delivered with the tester, in case it is desired to check its wiring. These drawings are schematic wiring diagrams showing essential circuit details. In the event of serious physical or electrical injury to the test set it should be returned for repair to the Western Electric Company, or to the manufacturer's factory or service stations. A parts list for this tester is included in the manufacturer's instruction booklet.

4.11 If a false shorts indication is observed with no tube in any of the test sockets (particularly noticeable for position 3 or 5 of the SHORTS switch), the first suspicion is that a neon tube with an usually low firing voltage is in the set and a change of lamps may clear the trouble. However, it would be well under such conditions to inspect the resistors R11 and R24 located on the SHORTS switch, particularly the former, to make sure that they are the required values. R11 should be green, brown, orange and R24 should be blue, red, orange.

4.12 With the SHORTS switch at either 3 or 5 and with no tube in any of the test sockets but with a test setting for a 6SJ7 tube increase the LINE ADJUST rheostat to obtain an A.C. VOLTS meter reading of 108 to 110 volts. If any glow is obtained on the neon lamp under this condition, it indicates that the firing point of the neon lamp is not satisfactory for the particular set. This test assumes that the resistor and shorts test circuit have been checked.

5. CALIBRATION DATA

5.01 General: Under normal usage of this tester, doubtful transconductance measurements involving marginal or suspect tubes can usually be checked by comparison with test results of a new or good sample of a tube type in question. However, whenever the Gm measurement accuracy of the set is suspected it may first be checked by testing certain operational standard tubes described in Paragraph 5.07, in accordance with the procedures and requirements outlined in Paragraphs 5.08 through 5.12.

5.02 The use of operational standard tubes for checking set calibration should suffice in most cases to indicate whether the set is satisfactory and further tests should be unnecessary. For those cases where difficulties persist, supplementary testing information is outlined in Paragraphs 5.13 through 5.18 for further checks on the set. These supplementary tests are principally ac and dc voltmeter

measurements readily made if suitable meters are available. These check tests are not especially recommended as being fully indicative unless the accuracy requirements of the necessary meter equipment can be fulfilled. If a tester can not meet all of the test requirements set forth in Part 5 and if corrective measures can not be taken, it should be returned to the Western Electric Company or to the manufacturer for service.

Test Instruments and Operational Standard Tubes

5.03 For rough voltage checks, in lieu of better instruments, an analyzer type ac/dc voltohmmeter similar to the KS-14510, or the M9B-type could be used (this meter also is designated as meter D in Paragraph 5.14), although meters equivalent to the following are to be preferred for most satisfactory calibration results.

5.04 Meter A: Weston Model 433 iron vane type ac voltmeter with full scale range of 150 volts (rms), of one per cent accuracy and with a minimum internal resistance of 5000 ohms. This meter is to be used to check the A.C. VOLTS meter per Paragraph 5.13 and can also be used to check the higher filament tap voltages (25 to 117).

5.05 Meter B: Weston Model 1 or 45 dc voltmeter of 1000 ohms per volt sensitivity with full scale 15 and 150-volt ranges, and full scale accuracy at least as good as one-half per cent. This meter is used to check the plate and screen grid voltage supplies per Paragraph 5.15, and the GRID BIAS dc voltage, per Paragraphs 5.18 and 5.19.

5.06 Meter C: An electronic ac voltmeter similar to the Ballantine 300-type or equivalent with ranges of 1 and 10 volts to read rms values with an accuracy in the order of two per cent; with inherent power supply stability. This meter is necessary for measuring the various grid signal voltage values accurately as given in Paragraph 5.17.

5.07 Operational standard tubes of Western Electric Company manufacture, which have been preaged for stable operation and are individually identified with their true calibration Gm values, are available for set calibration tests as follows:

Tube Type	Test	BIAS
KS-4732 (272A)	5-volt high signal - 3000 micromhos	Voltage
KS-4733 (2C51/396A)	1-volt low signal - 6000 or 15,000 micromhos 0.5-volt low signal - 30,000 micromhos	Voltage
KS-4757 (404A)	0.5-volt low signal - 30,000 micromhos	Self
KS-4758 (417A)	0.25-volt low signal - 60,000 micromhos	Self

5.08 Tube Measurement Test: Calibration checks of the set can be made by the use of four types of operational standard tubes of Western Electric Company manufacture, as indicated in Paragraph 5.07. These tubes have been preaged by the manufacturer for stable operation and are individually identified with their true Gm values as originally measured in a suitable precision tube test set under standard test conditions. In order to meet the requirements given in Paragraphs 5.11 and 5.12, it will be necessary to derive a Hickok Gm calibration value from the true Gm value as marked on the operational standard tube. The 272A and 2C51/396A operational standard tubes do not need such correlation standard charts. For best calibration tube test results, the use of two samples of the desired KS tube type is recommended.

5.09 HIGH SIGNAL 3000 (5 Volts) Grid Signal Test - Voltage Bias: An operating test is made using a Western Electric Company operational standard 272A tube per KS-4732 and the micromho meter transconductance reading is compared with the caliorated value for this tube. All tests should be made with the CATH. ACT. switch at NORMAL and the MICROMHOS switch at HIGH SIGNAL 3000.

KS-15560 Tube Tester Settings

Tube Type	Selectors	Fil.	Bias Volts	MIC-SW SHUNT
272A	JR-3204-0	10	15	HIGH 3000

Requirement: The measured Gm should be within ±5 per cent of the value marked on the operational standard tube.

5.10 LOW SIGNAL 6000 (1 volt), 15,000 (1 volt) and 30,000 (0.5 volt) Grid Signal Test - Voltage Bias: An operating test is made using a Western Electric Company operational standard 2C51/396A tube per KS-4733, testing both triode sections of the tube. The micromhos meter transconductance readings are compared with the calibrated values for this tube. Tests should be made with the CATH. ACT. switch at NORMAL and with the MICROMHOS switch at LOW 6000 (1.0 volt) or 15,000 (1.0 volt), and LOW 30,000 (0.50 volt).

KS-15560 Tube Tester Settings

Tube Type	Selectors	Fil.	Bias Volts	MIC-SW SHUNT
2C51/396A Sect. 1	KR-7608-2	6.3	2.0 (5-volt range)	(LOW 6000 or 15,000 (LOW 30,000
Sect. 2	KR-3402-8	6.3	2.0 (5-volt range)	(LOW 6000 or 15,000 (LOW 30,000

Requirement: The measured Gm reading obtained for the required micromhos scale on the KS-15560 tester should be within ±8 per cent of the calibrated Gm value of the operational standard Western Electric Company tube for each respective section.

5.11 LOW SIGNAL 30,000 (1/2 volt) Grid Signal Test - Self-bias Operation: An operating test is made using a Western Electric Company operational standard 404A tube per KS-4757. The calibration chart (Fig. 8) for this tube is used to establish the Hickok Gm micromhos reading as described on this chart. This Hickok Gm value will be used as the standard value with which the measured Gm is compared. This operating test is made in accordance with the tube tester settings noted on the calibration chart (repeated here) with CATH. ACT. switch at NORMAL and the proper self-bias resistor connected across the unstrapped SELF BIAS binding posts. The micromhos meter reading is compared with the derived calibrated value for this tube.

KS-15560 Tube Tester Settings

Tube Type	Selectors	Fil.	Bias Volts	MIC-SW SHUNT	Self-bias Resistance
404A	DZ-1684-0	6.3	0	LOW 30,000	110 ohms ±5 ohms

Requirement: The measured Gm should be within ±6 per cent of the value derived from Fig. 8 for the true Gm marked on the operational standard tube.

5.12 LOW SIGNAL 60,000 (1/4 volt) Grid Signal Test - Self-bias Operation: An operating test is made using a Western Electric Company operational standard 417A tube per KS-4758. The calibration chart (Fig. 9) for this tube is used to establish the Hickok Gm micromhos reading as described on this chart. This Hickok Gm value will be used as the standard value with which the measured Gm is compared. This operating test is made in accordance with the tube tester settings noted on the calibration chart (repeated here) with CATH. ACT. switch at NORMAL and the proper self-bias resistor connected across the unstrapped SELF BIAS binding posts. The micromhos meter reading is compared with the derived calibrated value for this tube.

KS-15560 Tube Tester Settings

Tube Type	Selectors	Fil.	Bias Volts	MIC-SW SHUNT	Self-bias Resistance
417A	DZ-5106-0	6.3	0	LOW 60,000	62 ohms ±1/2 ohm

Requirement: The measured Gm should be within ±6 per cent of the value derived from Fig. 9 for the true Gm marked on the operational standard tube.

5.13 Check of A.C. VOLTS Meter: Using test clips, connect meter A in parallel with terminal studs of the A.C. VOLTS meter. Operate the POWER switch to ON and check the scale accuracy at the 90, TEST (100-volt), and 120-volt points.

Requirement: The TEST (100-volt) point should be accurate within ±1 volt. The 90-volt and 120-volt points should be accurate within ±2 volts at 90V and ±2.5 volts at 120V.

5.14 Check of Filament Supply Circuit: In lieu of a low range Model 433 Weston iron vane ac voltmeter or equivalent, filament voltage supply taps between 0.6 and 12.6 volts, inclusive, may be checked with a suitable analyzer type ac rectifier voltmeter such as the KS-14510, the M9B or, the Weston Model 772 or equivalent type. This meter will be designated as meter D.

5.15 Procedure:

(1) Connect the test prods from meter A or D as required to the filament terminals of any tube socket. Set the filament selector switches to the J and R positions.

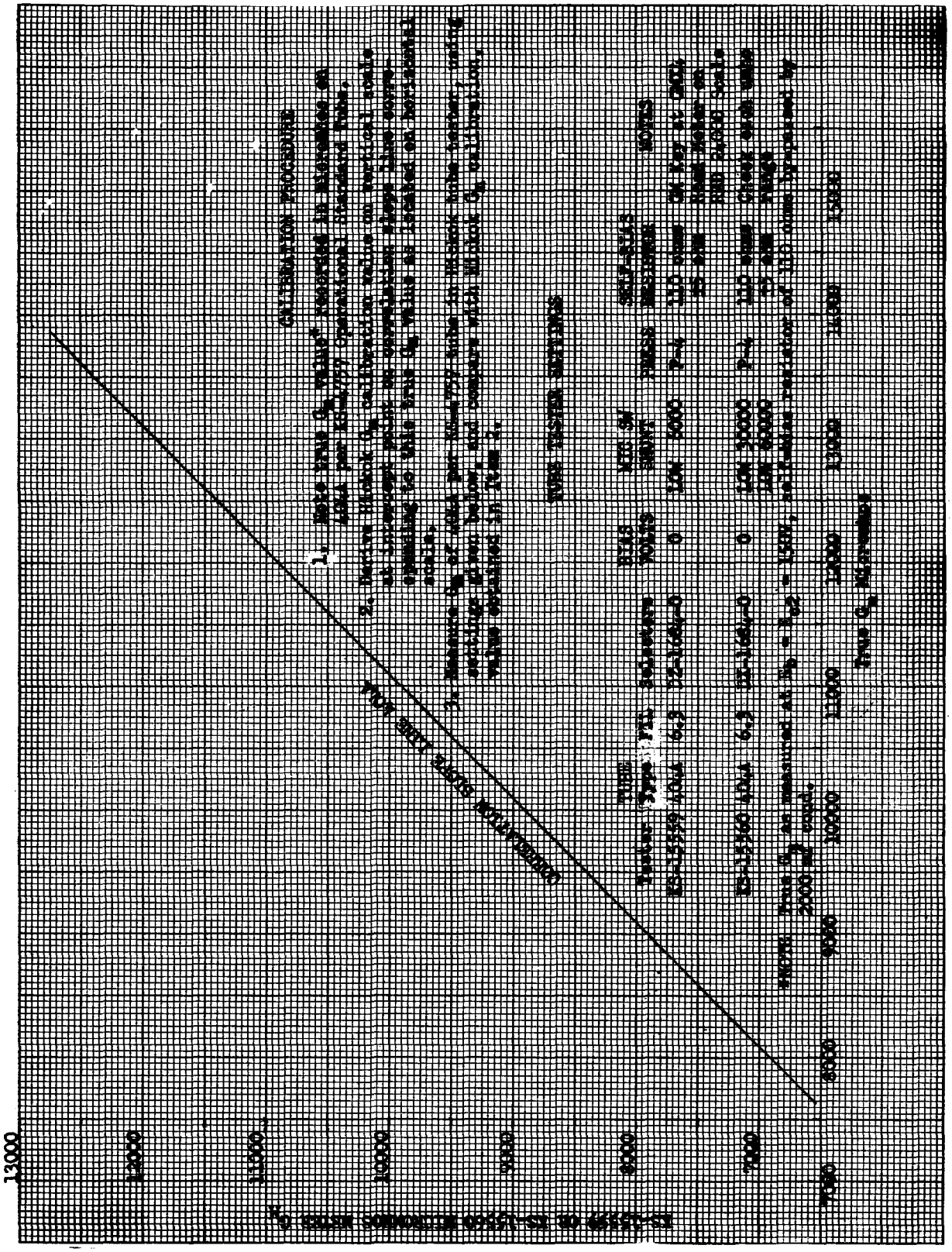


Fig. 8 - Calibration Data, 404A per KS-4757

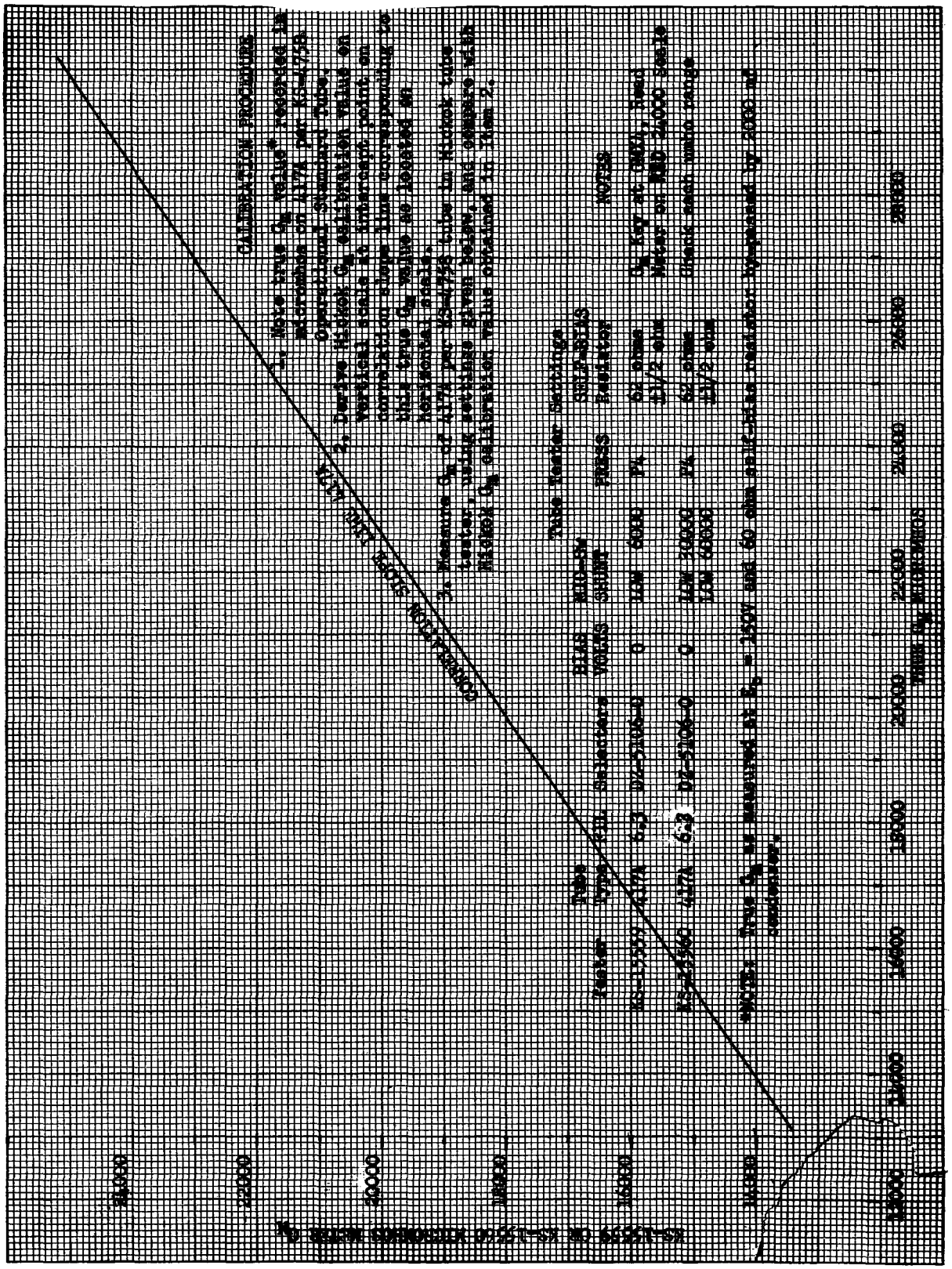


Fig. 9 - Calibration Data, 417A per KS-4758

(2) Operate the POWER switch to ON and adjust the LINE ADJUST rheostat knob until the A.C. VOLTS meter reads TEST (100 volts). Filament taps up through 12.6 should be tested with meter D. The remaining taps should be tested with meter A.

(3) Read the open-circuit voltage for each FIL. voltage tap at each one of the following positions of the FIL. selector switch using the lowest suitable meter range required for each measurement. Check the TEST (100 volts) reading on the A.C. VOLTS meter for each voltage tap reading. This test should be made with CATH. ACT. switch at NORMAL.

Nominal Tap Value	Max.	Min.	Nominal Tap Value	Max.	Min.
0.6*	0.65	0.55	7.5	8.35	7.60
1.1	1.25	1.05	10.	11.00	10.05
1.5	1.60	1.40	12.6	13.50	12.30
2.0	2.15	2.00	20.	22.00	20.00
2.5	2.95	2.70	25.	28.20	25.50
3.0	3.40	3.00	35.	39.80	36.50
4.3	4.90	4.30	50.	57.00	52.00
5.0	5.70	5.10	75.	86.00	78.00
6.3	6.90	6.3	117.	133.00	122.00

*L2 set only.

Note: The preceding ac voltage tap requirements are wider than the factory requirements in order to take into account the accuracy of meters normally available in the plant. Significant departures from limits usually will indicate definite filament transformer trouble.

5.16 Check of Test Operating Voltages: For these and all other tests following, the LINE ADJUST setting always should be maintained at a point which will cause the A.C. VOLTS meter to read at the 100-volt red mark designated TEST, unless otherwise noted. Set up the JR-0036-0 combination on the selector switches. Operate the POWER switch to ON, and depress and lock the P4 LOCK button. Using the voltmeter B on the 150-volt range, measure the following voltages on the octal socket pin terminals indicated.

5.17 Procedure:

(1) Plate Voltage: Measure the plate voltage between pin 6 (cathode) of the octal socket and the PLATE jack (positive).

Requirements:

Minimum - 148 volts
Maximum - 154 volts

(2) Screen Voltage: Measure the screen grid voltage between pins 6 (cathode) and 3 (positive) of the octal socket with the BIAS ADJUST turned to 0.

Requirements:

Minimum - 127 volts
Maximum - 132 volts

(3) Reduced Screen Voltage: Repeat Item (2) with the P1 push switch operated.

Requirements:

Minimum - 64 volts
Maximum - 66 volts

5.18 Grid Bias Voltage: Observe the dc control grid bias voltage on the BIAS VOLTS meter directly, for maximum potentiometer settings on both 5 and 50-volt scale ranges.

Requirement:

	Minimum Volts on Range	
	5 Volts	50 Volts
At maximum BIAS ADJUST setting	5	49

5.19 GRID BIAS Voltmeter Check: Using the 5-volt range position observe the voltmeter B reading on the 15-volt scale at five cardinal points 1, 2, 3, 4, and 5 volts. Calibration voltmeter B should be connected directly across the GRID BIAS voltmeter 5-volt range terminals for this test. For the 50-volt range test, connect voltmeter B, set on the 150-volt range, between pin 6 (cathode) of the octal socket and the GRID (negative) jack.

Requirement: At full scale 5 volts and at the 1, 2, 3, and 4-volt points the observed value shall not vary more than ±0.1 volt from the calibration voltmeter B value. For the 50-volt range, the full scale reading shall not vary more than ±1.0 volt from the calibration voltmeter B value.

5.20 Procedure for AC Grid Signal:

(1) Five-volt (High) Signal: Operate the MICROMHOS range switch to a HIGH SIGNAL 3000 position.

(2) Turn the BIAS ADJUST potentiometer to 0 and have both P4 buttons in the normal (nonoperated) position.

(3) Using the 10-volt range of meter C, measure the grid signal between pin 6 (cathode) of the octal socket and the GRID pin jack.

Requirement:

5 volts ±0.2 volt.

(4) One-volt, 1/2-volt and 1/4-volt (Low) Signals: Operate the MICROMHOS meter switch successively through the various LOW signal positions, beginning with the 15,000 (1-volt), continuing with the 30,000 (0.5-volt) and 60,000 (0.25-volt) switch points.

(5) Measure the signal voltages with meter C in the one-volt range between pin 6 (cathode) of the octal socket and the GRID pin jack.

Requirements: 1 ±0.05 volt, 0.5 ±0.015 volt, and 0.25 ±0.015 volt, respectively.

21 Procedure for Ratio Check of Micromhos Scale Ranges:

(1) High Signal Test Condition: Any suitable tube giving a Gm reading of less than 3000 micromhos using the high signal shall be employed for the test. It is preferable to choose a tube with a value somewhere near 3000, e.g., a 27SA or a 25L6 tube so as to get a good deflection on the higher scales. In this test the bias voltage may be adjusted to obtain an exact full scale reading to simplify reading meter deflections.

Requirement: Gm readings obtained on the 6000 and 15,000 high signal Gm ranges shall be within ±5 per cent of the value read on the 3000 Gm high signal range.

(2) Low Signal Test Condition: Any suitable tube giving a Gm reading of less than 6000 micromhos using the one-volt low signal shall be employed in this test. It is preferable to choose a tube with a value somewhere near 6000, e.g., a 2C51/396A or a 6AK5/403A so as to get a good deflection on the high scale.

Requirement: Gm readings obtained on the 15,000 low signal Gm range shall be within ±5 per cent of the value read on the 6000 Gm low signal range.

6. TUBE BASING CODES AND SELECTOR SETTING DATA

6.01 For commercial electron tubes it may sometimes be desirable either to verify the SELECTORS setting code or in certain cases to base a new type for which no roll chart setting is available, and the new type is an equivalent electronically to a listed tube. The test sockets in this tester are number coded for basing purposes as shown in Fig. 10. From the socket numbering arrangement and Table A of this figure, the correct filament or heater pin basing may be determined. The numbers appearing on each type socket, i.e., 4-pin, 5-pin, etc, represent the selector code setting number to be used in basing the various elements of any particular tube as related to their function, such as filament, grid, plate, etc. The latter functions all appear as separate SELECTOR dials, and are so designated on the main panel of the tester.

6.02 In particular, attention is directed to the code numbers 1 and 8 appearing on every socket in Fig. 10. These represent the most common filament (or heater) terminal assignments for most tube types. Code pin 1 corresponds to the actual pin 1 assignment in all sockets except the octal and the 7-pin miniature. This arrangement has been used to minimize the over-all variation required in the two FILAMENT SELECTOR settings, and is evident from

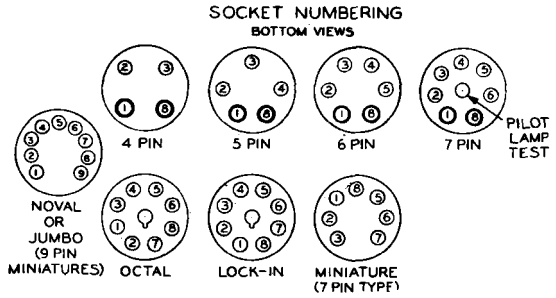


TABLE A
SOCKET CODING
FOR FILAMENT SELECTORS

0 (FIL OFF)	A	P
1	B	R
2	C	S
3	D	T
4	E	U
5	F	V
6	G	W
7	H	X
8	J	Y
9	K	Z

Fig. 10 - Tube Basing Selector Code Arrangements

the frequency of appearance of the code JR on the roll chart, as derived from Table A of Fig. 10. This usually necessitates the recording of other pin assignments. The majority of variations in FILAMENT SELECTOR settings appear more often in 7 and 9-pin miniatures (Noval and Jumbo), and occasionally in the octal socket, as for example, where the actual heater pins 7 and 8 of certain tube types result in JX filament selector code setting. Another example is found in 7-pin miniature tubes where pins 1 and 7 of this tube are sometimes assigned as filament. These are selector codes numbered 3 and 7 and result in a filament setting code of DX from Table A of Fig. 10. In any case the opposite code could also be used for filament pin basing, for example, HT instead of DX in the example just given.

6.03 The remaining basing for the GRID, PLATE, SCREEN, CATHODE and SUPPRESSOR switches is accomplished by viewing the desired coded number socket to be used in Fig. 10 and associating the grid, heater, screen, cathode positions or whatever elements are found on the new tube to be based, and using the code numbers found on the required Fig. 10 socket, as selector settings for each function (grid, plate, etc). For example, in the 6AK5 or Western Electric 403B, using tube base data for element pins as found in any handbook, and referring to the miniature 7-pin socket in Fig. 10, this type is based for SELECTOR settings as follows:

Actual Pin Basing		FUNCTION	Code Fig. 10	SEL. SWITCH Sequence Setting	
1		Grid	3	FIL.	J
2		Cathode & Suppr.Grid	2	FIL.	R
3	From	(Heater	1	GRID	3
4	Table A	(Heater	8	PLATE	5
5		Plate	5	SCREEN	6
6		Screen Grid	6	CATHODE	2
7		Cathode & Suppr.Grid	7	SUPPRES-SOR	0

6.04 In this example, tube pins 2 and 7 are the same, so it is only necessary to connect cathode and internally connected suppressor grid once at code pin 2, and pin 7 is assigned 0 (no external connection). If this tube example were the 415A (6AS6) type the final SELECTOR switch setting would be JR-3562-7 in order to tie the separate G3 suppressor grid element to the cathode pin 2 externally to the tube.

When an external cap grid or plate is used, the grid or plate selector, respectively, is set at 0. In the case of diode or rectifier plate element pins, the diode or rectifier plate elements are always associated with the PLATE selector switch. (In this case a separate setting is required to test each diode or rectifier plate section.) The two 9-pin types (Noval and Jumbo) and the lock-in pin codes are straightforward (see Fig. 10) and require no code interpretation except for FILAMENT pin assignments.

7. TEST DATA

7.01 Test data for Western Electric tubes are given in Section 100-635-501 and supplemental or corrective data for tubes of other than Western Electric Company manufacture are given in Section 100-635-502.

7.02 Roll Chart Details: As indicated in Paragraphs 3.08 and 3.09, most Western Electric Company tubes and commercial types are set up for test and evaluated for acceptance or rejection on a basis of a minimum indicated transconductance reading. In the case of diodes, rectifiers, and a few other types, the test is in terms of the RECTIFIER & DIODES OK rejection index mark on the micromhos meter scale. The tube test data as set up in Section 100-635-501 and in Section 100-635-502 for each tube type conforms to the commercial tube roll chart headings and columnar spacing engraved on the designation panel of the set. This has been done so that the test data may be inserted at the end of the roll chart, if desired. If this is done, it should be fastened securely to the roll chart strip with scotch tape or other suitable means. The principal settings necessary for an indicated transconductance measurement are given in the following order: FIL. for the FILAMENT voltage selector, complete SELECTORS letter and number code in proper sequence (for basing a tube correctly for test) and the BIAS VOLTS for the required grid bias voltmeter reading, and the MIC-SW SHUNT requirements. This last column heading provides the proper MICROMHOS switch range choice for any indicated transconductance measurement, or if a number is given it denotes a SHUNT setting of the MICROMHOS switch and the number given is the required SHUNT potentiometer setting.

7.03 Two special symbols are sometimes found under the BIAS VOLTS column. Where the symbol, ϕ, is found next to a 0, self-bias is

indicated, and a resistor value, as given under NOTATIONS for the tube type being tested, is required. This resistor must be strapped in place of the short-circuit link across the SELF BIAS binding post pair for a self-biased Gm test. The symbol, ‡ indicates that the BIAS VOLTS is to be reduced gradually, using the BIAS ADJUST control, until the tube strikes. This is manifested by a sudden micromhos meter reading. This test, principally for small commercial gas triodes or thyratrons, considers a tube to be satisfactory if the meter reading passes the RECTIFIERS & DIODES OK index at a BIAS VOLTS striking point value as specified under NOTATIONS.

7.04 The final operation is listed under the column heading PRESS, designating the particular pushbutton switch to be depressed by number code (P4, etc). The principal exception appearing in the PRESS column is the symbol, #. This means that a regular Gm test is made except that the P1 push switch should be depressed first, and held depressed while the P4 (Gm) switch is operated. This is done to make this test at reduced screen voltage.

7.05 The column heading MIN. TRANSCOND. lists the minimum value of indicated transconductance for each tube type. A tube should be rejected for micromhos meter readings only if less than such listed reject or minimum values, as previously discussed in Paragraphs 3.08 and 3.09. A star or asterisk, *, symbol appearing in the MIN. TRANSCOND. column denotes a micromhos meter reading to be observed with respect to the RECTIFIERS & DIODES OK index mark, with the MICROMHOS switch set at SHUNT and the SHUNT potentiometer at the required setting as given in the MIC-SW SHUNT column. A few rectifier types (e.g., 1B3) do not have the star or asterisk designation but are tested with the MICROMHOS switch set at 3000 and a criterion based on the RECTIFIERS & DIODES OK index mark. Such tube tests are covered in the NOTATIONS column.

7.06 The BIAS VOLTS meter settings have been selected to approximate normal plate and screen grid current operation as well as to obtain micromhos meter readings as near as possible to nominal values for both Western Electric and commercial electron tubes, within the limitations imposed by the set. Nominal values of indicated transconductance have been purposely omitted from Sections 100-635-501 and 100-635-502, and the roll chart for both Western Electric Company and non-Western Electric Company electron tubes to avoid confusion in rating or classifying new and unused tubes by comparison with the nominal transconductance values given for other tube testers. Although in many cases tubes might be so rated in this tester, the variables as to the permissible Gm range in a new tube product for many tube types are sufficiently great that such use of the set is impracticable except in a laboratory where correlative check testing facilities are available.

7.07 The column heading labeled NOTATIONS shows test operations as required for certain tubes by reference to the particular pushbutton. Multipurpose tubes and the separate anode circuits of diodes and full-wave rectifier types require more than one series of test settings. The column headed NOTATIONS includes all special test information as may be required for each tube type. In the Western Electric Company list of Section 100-635-501 the principal item first listed for each tube is the maximum allowable per cent cathode (or filament) activity, which appears as @X%. The symbol, @, is used here to designate "cathode activity" and is used to conserve space. This percentage is the limit to be observed in conjunction with the procedure indicated in Paragraphs 3.12 through 3.16. For commercial tubes of other than Western Electric Company manufacture a broad minimum limit for cathode activity of 25 per cent may be assumed, as discussed in Paragraph 3.15.

7.08 Other test information supplied in the NOTATIONS column include GRID or PLATE cap connection if required, identification of sections of multipurpose tubes, SHORTS switch neon lamp glow positions to be ignored, self-bias resistor values, adapter codes when necessary, and in a few cases special references or unusual operating test instructions.

7.09 The L2 set has a blank space on the panel below the left-hand roll chart window. This area is designated "LAST TUBE." The last tube type appearing in the first column of the particular chart issue in the tester should be entered in pencil in this space to serve as convenient subsequent reference information.

8. IMPROVED OSCILLATION SUPPRESSION MODIFICATION (EARLY L1 SETS)

(A) General

8.01 The purpose of this modification is to improve anti-sing arrangements by substituting a minimum of suppressor elements, thus

replacing the oscillation suppressors originally provided. The original suppressors consisted of pyramid or star connected capacitor combinations on both 9-pin sockets, and series suppressor units on the octal socket. The modification enables all earlier production testers to conform to the new improvements, which have been incorporated in L1 sets manufactured since November, 1951 (after about serial number 335).

8.02 A further need for the elimination of series suppressor elements previously used with the octal socket was a heavy current burnout hazard. This could occur when unusual heater or filament terminal assignments on particular tubes would coincide with test socket terminals which used a series Jeffers choke for an oscillation suppressor.

(B) Description

8.03 Modification consists of removal of all oscillation suppressor capacitors and series elements associated with the Noval and Jumbo 9-pin and octal test sockets. Certain socket interconnections are rewired, drainage capacitors are provided for the signal winding on the power transformer, and a new resistor choke is provided in series with pin 1 of the Noval socket. Another special choke is used to replace resistor R22 at the plate jack. All these changes are shown in the schematic circuit shown on Page 104.

8.04 This modification will apply to all KS-15560, L1 sets up to serial number 335. The need for making the modification on sets having serial numbers just above or below number 335 may be verified by inspection of chassis wiring. Any set with series suppressors on the octal test socket or with star connected 1500-mmf capacitors associated with both 9-pin test sockets does not have this modification.

(C) Parts and Drawing Information

8.05 Parts:

1 - 470-ohm resistor, 1/2-watt type, 10% tolerance (Hickok part number 18411-472)

2 - Special resistor chokes (Hickok part number 3250-44)

2 - 1500-mmf capacitors (Hickok part number 3095-50)*

1 - Single lug terminal strip (Hickok part number 20350-23)

* These items could be recovered from 1500-mmf capacitor "pyramids" associated with 9-pin sockets.

These parts may be obtained as a kit under the ordering code #100-520 Parts Kit directly from the Hickok Electrical Instrument Company, 10514 Dupont Avenue, Cleveland 8, Ohio.

8.06 The wiring changes should be made with bare, 20-gauge, tinned copper wire. Where insulated sleeving ("spaghetti tubing") is specified this may be any suitable size, varnish impregnated braided tubing being slightly preferable to the plastic types. Color code is not important.

8.07 Drawings: The details of the modifications are covered in Figs. 11 and 12. A new schematic circuit is attached (Page 104). The new schematic applies only to List 1 sets which have serial numbers greater than about 335 and to sets of earlier manufacture which have been modified according to Part 8 of this section. If these earlier sets are not modified the previous issue of the schematic as covered on Page 103 applies.

(D) Installation Procedure

8.08 Procedure:

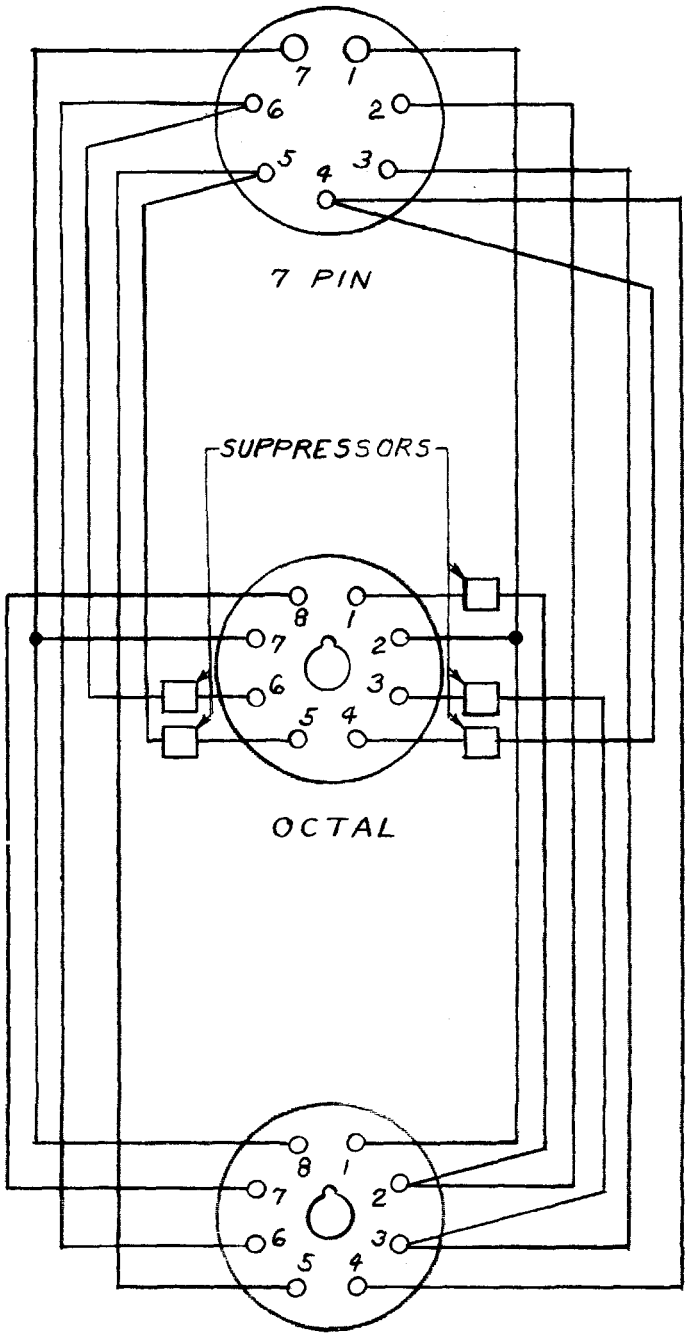
(1) Remove all Phillips mounting screws around the rim of the panel and also remove the holding screw at bottom of the case, and lift the chassis and panel out.

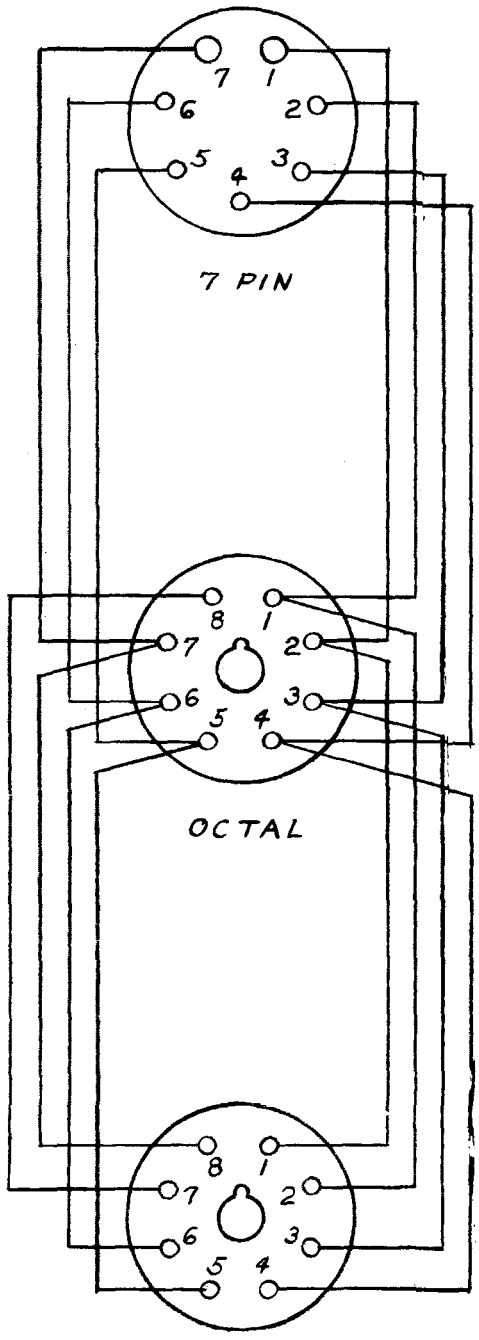
(2) Remove the 83 and 5Y3 rectifier tubes from their sockets, after unscrewing individual holding clamps.

(3) Remove all the oscillator suppressor capacitors (1500 mmf) which are pyramid-connected to the Noval and Jumbo 9-pin sockets.

(4) Observing Fig. 11 (A) remove all series suppressor elements associated with the octal socket. Remove these elements one at a time, in each case restoring the lead to the corresponding socket terminal as indicated in Fig. 11 (B).

Note: Sets up to serial number 254 should have four octal socket suppressors and above serial number 255, five suppressors.





NOTE: SUPPRESSOR ELEMENT TO PIN 5 OF OCTAL SOCKET NOT FOUND ON ALL SETS FIG. 11(A)

Fig. 11 - Changes at Sockets

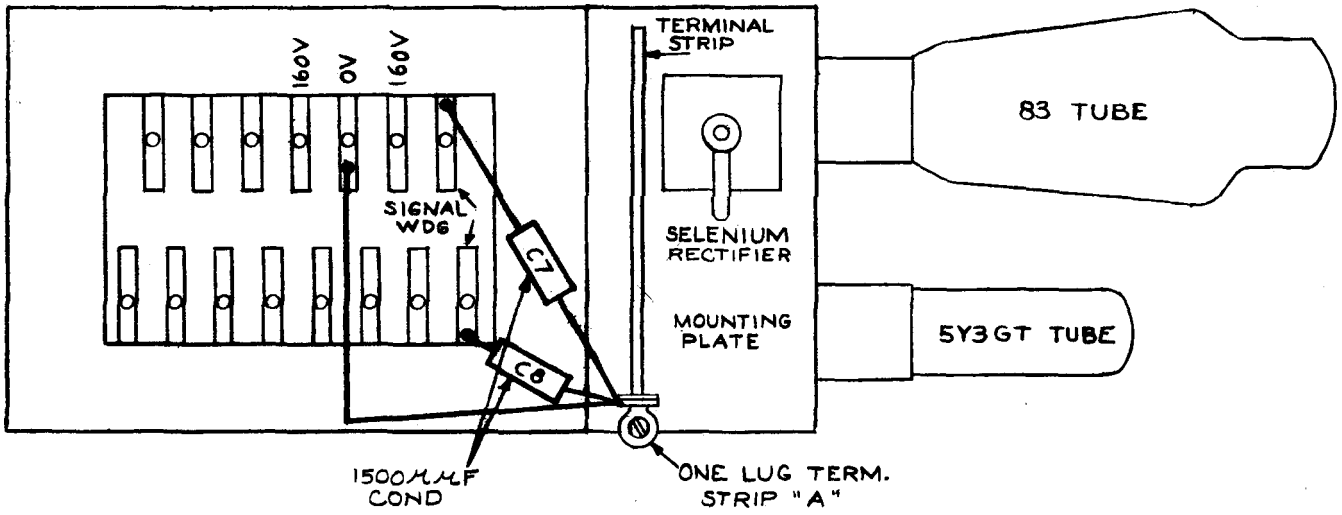


Fig. 12 - Changes at Location of Power Transformer

(5) All interconnections between the 7-pin octal and lock-in test sockets should be made to conform to Fig. 11 (B). The principal leads involved are those which previously contained a series suppressor. Each of these leads is rewired progressively from the 7-pin to the octal to the lock-in socket in that order as shown on Fig. 11 (B).

(6) Find the 47-ohm resistor (R22, color code: yellow, purple, black) wired in place on selector switch designated PLATE on the front panel. Note the position of any wiring which has to be disturbed to get at this resistor. Carefully unsolder and remove this resistor. Replace this with one of the special resistor chokes (designated RL1 in the schematic, Hickok part number 3250-44), and restore all associated wiring on this selector to its original position.

(7) Find the resistor (R21) associated with the GRID selector and make sure that it is a 470-ohm resistor (color code: yellow, purple, brown) and not a 47-ohm resistor (color code: yellow, purple, black). The kit contains the 470-ohm resistor for replacement, if necessary. This resistor is shown on the schematic circuit, attached, as a 500-ohm resistor.

(8) Unsolder the lead to the GRID jack at the jack, and pull this lead clear at its other end at the GRID selector switch. Resolder the lead to the GRID jack, keeping the lead above and away from the chassis. The purpose of this change is to minimize capacitance coupling of the grid jack lead with respect to the metal chassis.

(9) Disconnect and remove the lead between pin 1 of the Noval socket and pin 3 of the 7-pin miniature socket. Replace this lead with the second special resistor choke (designated RL2 in the schematic, Hickok part number 3250-44). Use insulated sleeving, and adjust the wiring to mount the resistor choke about 1/2 inch above the panel parallel to the chassis.

Attached:
Tables I and II
Pages 101 to 105, inclusive

TABLE I

SHORTS TEST LOCATION

BY NEON LAMP LIGHTING UNDER X

Hickok KS-15560 L1 and L2 Tube Testers

Kind of Short	Selector Switch Position 1	2	3	4	5
FIL -- CATHODE			X		
FIL -- GRID	X	X			X
FIL -- PLATE	X	X		X	X
FIL -- SCREEN	X		X	X	X
FIL -- SUP		X			
GRID -- CATHODE	X	X	X		X
GRID -- PLATE				X	
GRID -- SCREEN		X	X	X	
GRID -- SUP	X				X
PLATE -- SCREEN) CATHODE -- SUP)		X	X		
PLATE -- SUP) CATHODE -- SCREEN)	X			X	X
SCREEN -- SUP) CATHODE -- PLATE)	X	X	X	X	X

TABLE II

CATHODE ACTIVITY TEST GUIDE

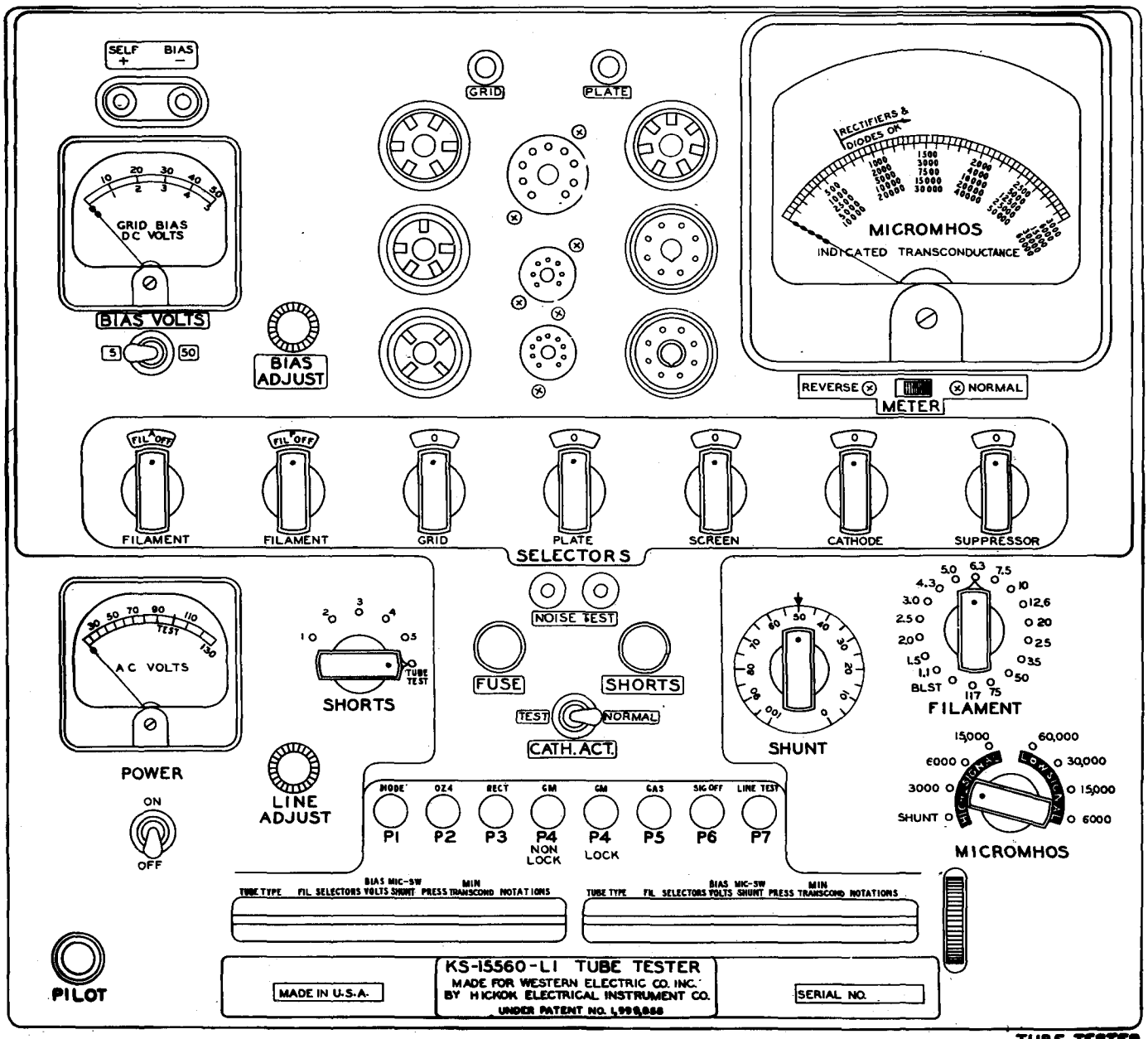
(Read on the 0-3000 Micromhos Scale only, irrespective of the Scale Range indicated by the MICROMHOS Switch.)

Micromhos Meter Rdg. CATH.ACT.NORMAL	Corresponding TEST Position Meter Reading for Activity Limits of: 15%	20%	25%	30%
200	170	160	150	140
240	205	190	180	170
280	240	225	210	195
320	270	255	240	225
360	305	290	270	250
400	340	320	300	280
440	375	350	330	310
480	410	385	360	335
520	440	415	390	365
560	475	450	420	390
600	510	480	450	420
640	540	510	480	450
680	580	540	510	475
720	610	575	540	505
760	645	610	570	530
800	680	640	600	560
840	715	670	630	590
880	750	705	660	615
920	780	735	690	645
960	815	770	720	670
1000	850	800	750	700
1040	885	830	780	730
1080	920	865	810	755
1120	950	900	840	785
1160	985	930	870	810
1200	1020	960	900	840
1240	1050	990	930	870
1280	1090	1020	960	900
1320	1120	1060	990	925
1360	1160	1090	1020	950
1400	1190	1120	1050	980
1440	1220	1150	1080	1010
1480	1260	1180	1110	1040
1520	1290	1220	1140	1060
1560	1325	1250	1170	1090

Micromhos Meter Rdg.CATH.ACT.NORMAL	Corresponding TEST Position Meter Reading for Activity Limits of: 15%	20%	25%	30%
1600	1360	1280	1200	1120
1640	1390	1310	1230	1150
1680	1430	1345	1260	1180
1720	1460	1380	1290	1200
1760	1500	1410	1320	1230
1800	1530	1440	1350	1260
1840	1565	1470	1380	1290
1880	1600	1500	1410	1320
1920	1630	1540	1440	1345
1960	1670	1570	1470	1370
2000	1700	1600	1500	1400
2040	1735	1630	1530	1430
2080	1770	1665	1560	1460
2120	1800	1700	1590	1485
2160	1840	1730	1620	1510
2200	1870	1760	1650	1540
2240	1900	1790	1680	1570
2280	1940	1825	1710	1600
2320	1970	1860	1740	1625
2360	2000	1890	1770	1650
2400	2040	1920	1800	1680
2440	2080	1950	1830	1710
2480	2110	1985	1860	1740
2520	2140	2020	1890	1765
2560	2180	2050	1920	1790
2600	2210	2080	1950	1820
2640	2245	2115	1980	1850
2680	2280	2140	2010	1880
2720	2315	2180	2040	1900
2760	2350	2210	2070	1930
2800	2380	2240	2100	1960
2840	2420	2275	2130	1990
2880	2450	2300	2160	2020
2920	2480	2340	2190	2040
2960	2520	2370	2220	2070
3000	2550	2400	2250	2100

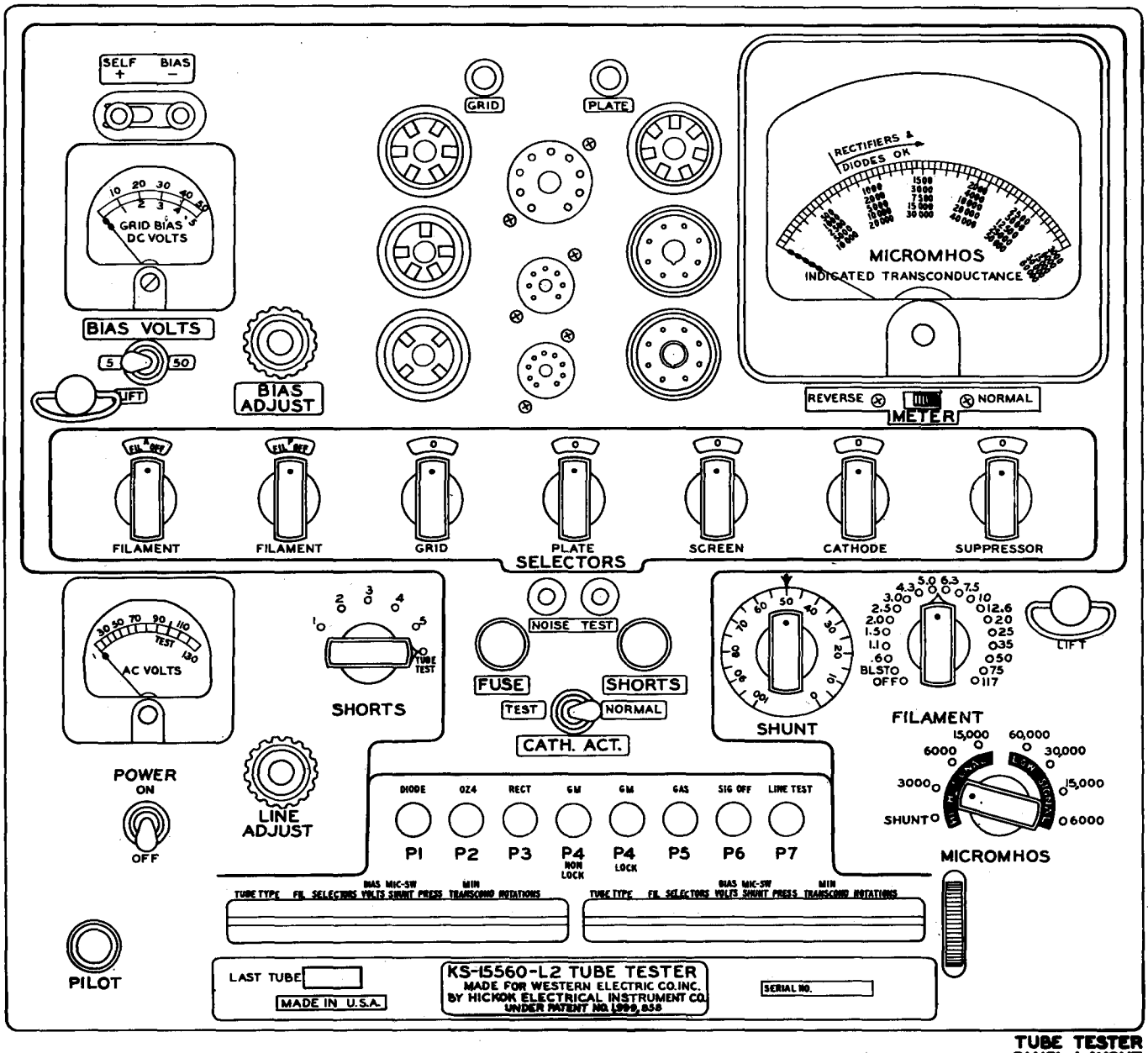
Per cent activity limits in this table computed to ±5 micromhos (approximately).

ISSUE	1	2	3	4	5
DATE	7-49	7-50	8-50	11-50	4-51



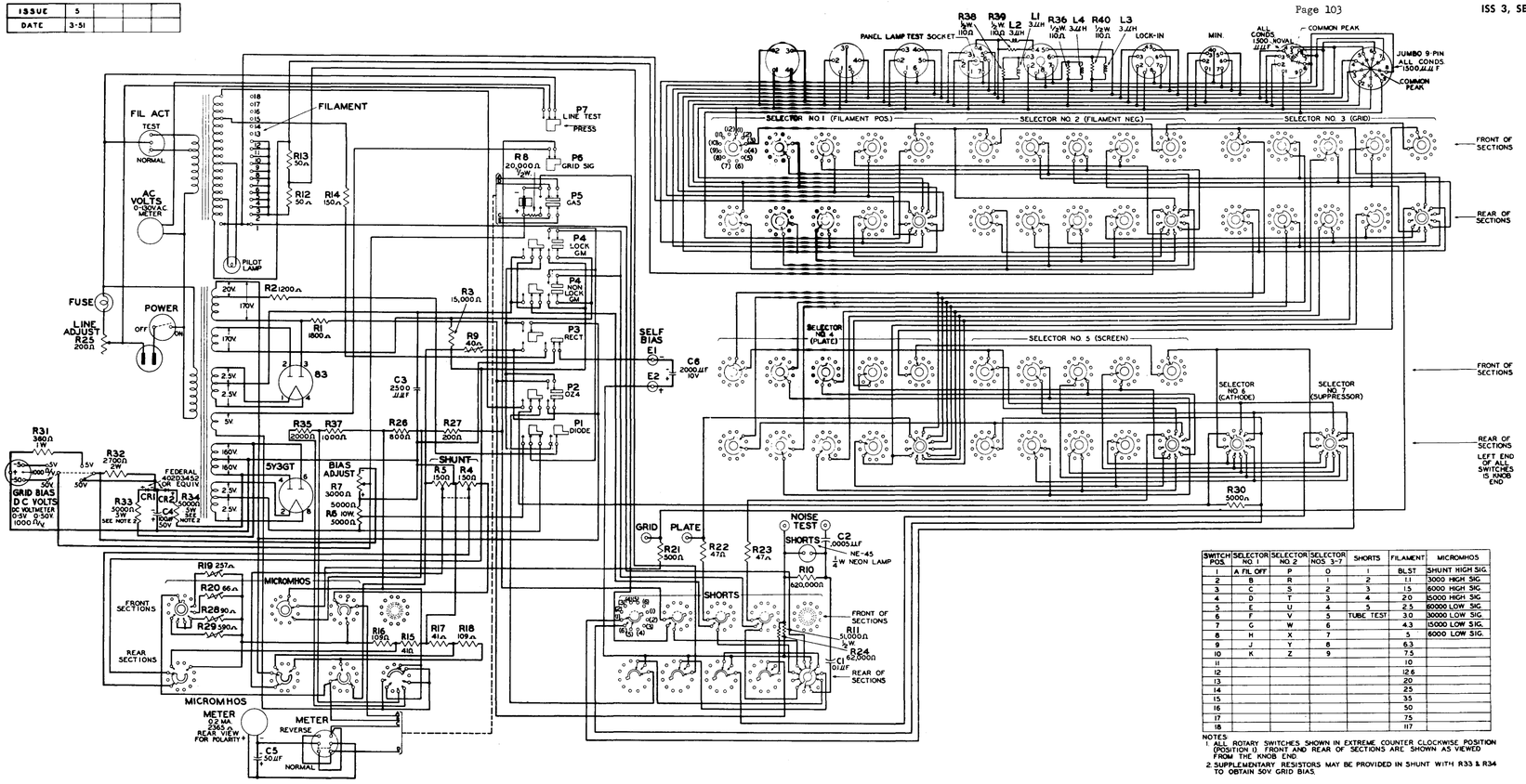
TUBE TESTER PANEL LAYOUT

ISSUE	1		
DATE	9-53		



TUBE TESTER PANEL LAYOUT

ISSUE	5			
DATE	3-51			



SWITCH POS.	SELECTOR NO. 1	SELECTOR NO. 2	SELECTOR NOS. 3-7	SHORTS	FILAMENT	MICROMHOS
1	A FIL OFF	P	0	1	BLST	SHUNT HIGH SIG.
2	B	R	1	2	1.1	3000 HIGH SIG.
3	C	S	2	3	1.5	6000 HIGH SIG.
4	D	T	3	4	2.0	35000 HIGH SIG.
5	E	U	4	5	2.5	60000 LOW SIG.
6	F	V	5	TUBE TEST	3.0	30000 LOW SIG.
7	G	W	6		4.3	15000 LOW SIG.
8	H	X	7		5	6000 LOW SIG.
9	J	Y	8		6.3	
10	K	Z	9		7.5	
11					10	
12					12.6	
13					20	
14					25	
15					35	
16					50	
17					75	
18					117	

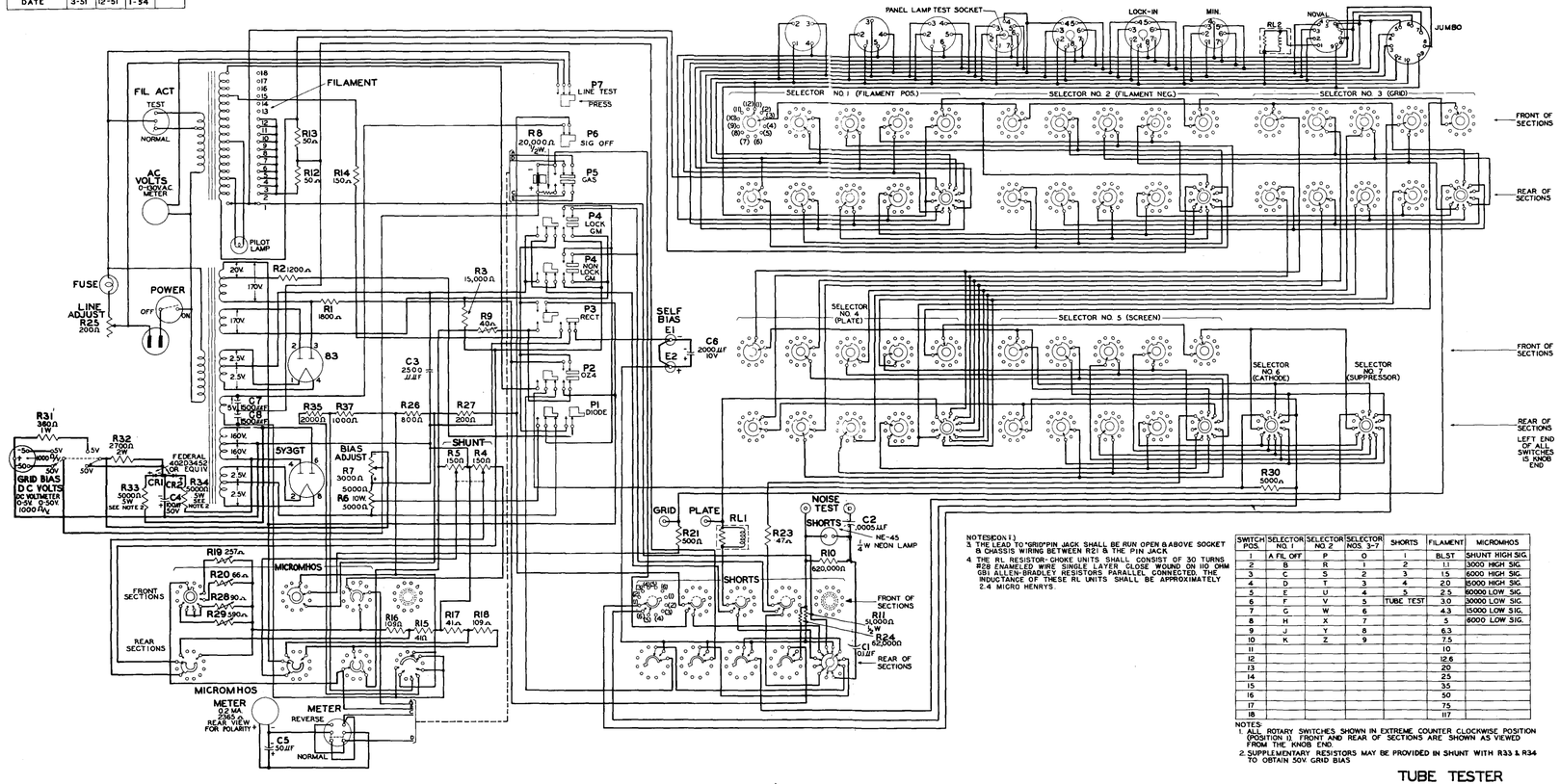
NOTES
1. ALL ROTARY SWITCHES SHOWN IN EXTREME COUNTER CLOCKWISE POSITION (POSITION 1) FRONT AND REAR OF SECTIONS ARE SHOWN AS VIEWED FROM THE KNOB END.
2. SUPPLEMENTARY RESISTORS MAY BE PROVIDED IN SHUNT WITH R33 & R34 TO OBTAIN 50V GRID BIAS.

LAST RESISTOR, COIL, & CONDENSER USED		
RES.	COIL	COND
R40	L4	C6

TUBE TESTER SCHEMATIC

EARLY L1 SETS

ISSUE	5	6	7	
DATE	3-51	12-51	1-54	



NOTES (CONT.)
3. THE LEAD TO "GRID" PIN JACK SHALL BE RUN OPEN & ABOVE SOCKET & CHASSIS WIRING BETWEEN R21 & THE PIN JACK.
4. THE RL RESISTOR-CHOKE UNITS SHALL CONSIST OF 30 TURNS #28 ENAMELED WIRE SINGLE LAYER CLOSE WOUND ON 110 OHM (BI) ALLEN-BRADLEY RESISTORS PARALLEL CONNECTED. THE INDUCTANCE OF THESE RL UNITS SHALL BE APPROXIMATELY 2.4 MICRO HENRYS

SWITCH POS.	SELECTOR NO. 1	SELECTOR NO. 2	SELECTOR NOS. 3-7	SHORTS	FILAMENT	MICROMHOS
1	A	P	O	1	BLST	SHUNT HIGH SIG.
2	B	R	I	2	1.1	3000 HIGH SIG.
3	C	S	2	3	1.5	6000 HIGH SIG.
4	D	T	3	4	2.0	15000 HIGH SIG.
5	E	U	4	5	2.5	60000 LOW SIG.
6	F	V	5	TUBE TEST	3.0	30000 LOW SIG.
7	G	W	6		4.3	15000 LOW SIG.
8	H	X	7		5	6000 LOW SIG.
9	J	Y	8		6.3	
10	K	Z	9		7.5	
11					10	
12					12.6	
13					20	
14					25	
15					35	
16					50	
17					75	
18					117	

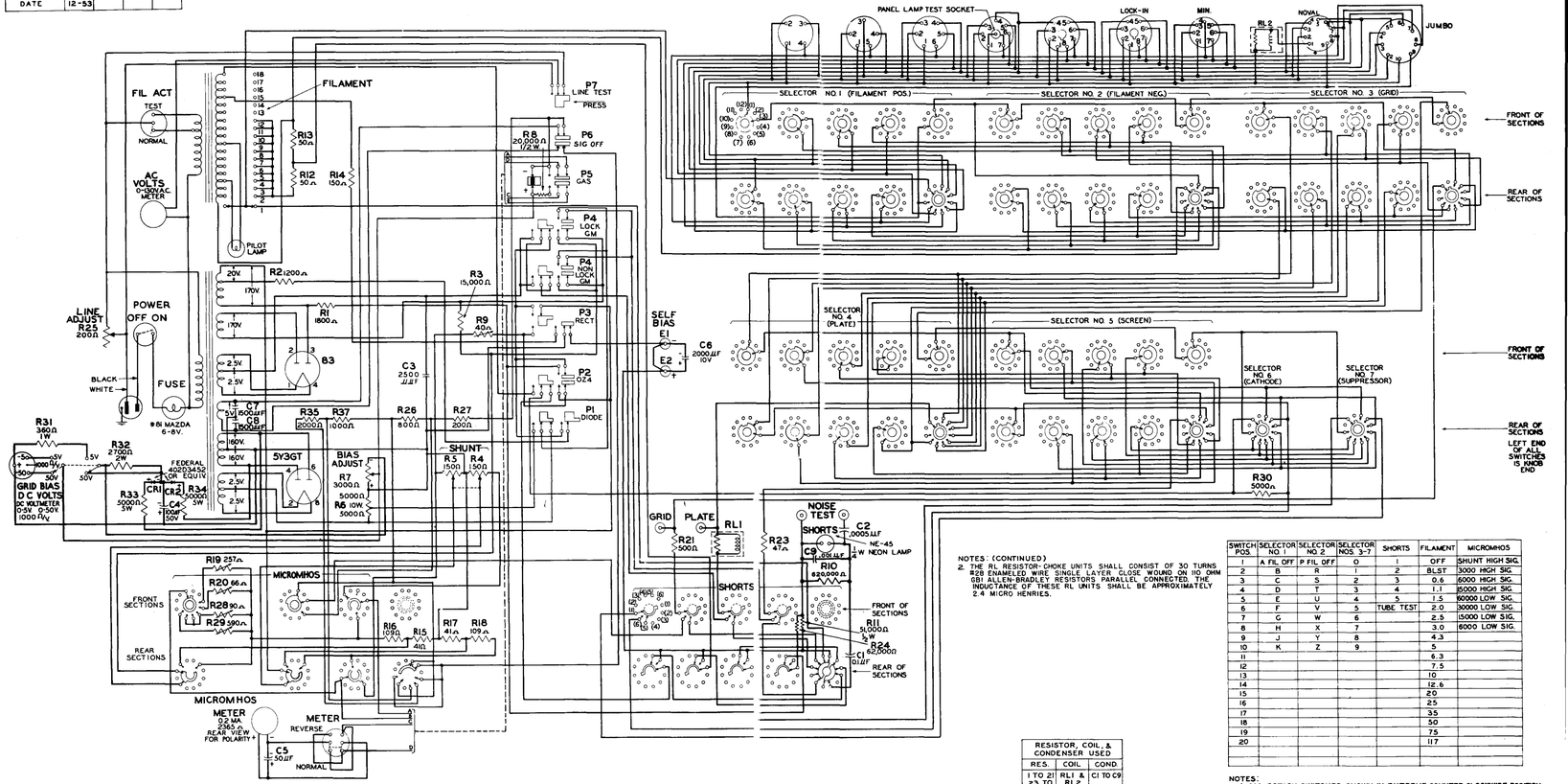
NOTES
1. ALL ROTARY SWITCHES SHOWN IN EXTREME COUNTER CLOCKWISE POSITION (POSITION 1). FRONT AND REAR OF SECTIONS ARE SHOWN AS VIEWED FROM THE KNOB END.
2. SUPPLEMENTARY RESISTORS MAY BE PROVIDED IN SHUNT WITH R33 & R34 TO OBTAIN 50V GRID BIAS

RESISTOR, COIL, & CONDENSER USED		
RES.	COIL	COND.
T931 thru T935	RL1&RL2	C1 TO C8

TUBE TESTER SCHEMATIC

FINAL L1 CIRCUIT

ISSUE	1			
DATE	12-53			



NOTES: (CONTINUED)
2. THE RL RESISTOR-CHOKE UNITS SHALL CONSIST OF 30 TURNS #28 ENAMELED WIRE SINGLE LAYER CLOSE WOUND ON 110 OHM GBI ALLEN-BRADLEY RESISTORS PARALLEL CONNECTED. THE INDUCTANCE OF THESE RL UNITS SHALL BE APPROXIMATELY 2.4 MICRO HENRIES.

SWITCH POS.	SELECTOR NO. 1	SELECTOR NO. 2	SELECTOR NOS. 3-7	SHORTS	FILAMENT	MICROMHOS
1	A	FIL OFF	P FIL OFF	O	OFF	SHUNT HIGH SIG.
2	B	R	I	2	BLST	3000 HIGH SIG.
3	C	S	2	3	0.6	6000 HIGH SIG.
4	D	T	3	4	1.1	15000 HIGH SIG.
5	E	U	4	5	1.5	60000 LOW SIG.
6	F	V	5	TUBE TEST	2.0	30000 LOW SIG.
7	G	W	6		2.5	15000 LOW SIG.
8	H	X	7		3.0	6000 LOW SIG.
9	J	Y	8		4.3	
10	K	Z	9		5	
11					6.3	
12					7.5	
13					10	
14					12.6	
15					20	
16					25	
17					35	
18					50	
19					75	
20					117	

RESISTOR, COIL, & CONDENSER USED		
RES.	COIL	COND.
1 TO 21 & 33 TO 35 & 37	RL1 & RL2	C1 TO C9

NOTES:
1. ALL ROTARY SWITCHES SHOWN IN EXTREME COUNTER CLOCKWISE POSITION (POSITION 1). FRONT AND REAR OF SECTIONS ARE SHOWN AS VIEWED FROM THE KNOB END.

TUBE TESTER SCHEMATIC L2 CIRCUIT