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## OPERATING INSTRUCTIONS

# MODEL 10-40

## CONDENSED INSTRUCTIONS

### TUBE QUALITY AND GAS TEST

1. Connect line plug to 50-60 cycle 110-125V AC source.

2. Return all levers to "NORMAL" position by means of the "LEVER RETURN" Button.

3. Locate tube on Roller Chart or in the Supplement.

4. Set Controls "A", "B", "C", "D", and "E".

5. Press "Tube Quality" Button Momentarily to turn instrument on.

6. Insert tube, allow to heat, and rotate the "LINE AND VR ADJUST" Control to bring the Pointer to the "ADJUST LINE" mark on the Meter Face.

7. Push "SHORT CHECK" Buttons in sequence (1 to 12). Neon "TUBE SHORTS-FIL. CONT." should NOT glow on any buttons other than those listed under "FIL. CONT." unless otherwise noted on the data chart. If any other buttons cause a glow, the tube should be rejected.

8. After Short Check, throw levers listed under "W-X-Y-Z" to the positions listed on the chart. All other levers REMAIN IN "NORMAL" POSITION.

9. Depress "TUBE QUALITY" Button and read Quality on the "REPLACE-WEAK-GOOD" scale of the Meter.

10. Proceed to "GAS" Test if desired. Check for presence of GAS as follows:

    a. Leave all controls as set for Quality Test.

    b. Set "F" Switch as indicated and push Button or Buttons listed under "Depress" on Roller Chart.

    c. Rotate "A" Switch to "Gas Test" position, (Zero Adjust the Meter If Necessary,) and allow approximately 2 minutes warm-up time to elapse before continuing to next step.

    d. Depress "TUBE-GAS / PIX TUBE" Button and note reading on the 0-20 "Gas" scale. If reading is above 2 μa. for Voltage Amplifiers, or above 5 μa. for Power Amplifiers, reject the tube as gassy.

## MODEL 10-40

### CONDENSED INSTRUCTIONS

### VOLTAGE REGULATORS

1. Set "A" Switch to "VR-VOLTAGE, 250V" position.

2. Set "F" Switch to position indicated in the Test Data.

3. Set "LINE AND VR ADJUST" Control to extreme counter-clockwise position.

4. Set levers as indicated in Test Data.

5. Insert tube in socket.

6. Rotate "LINE AND VR ADJUST" Control until tube fires. (If tube fires upon insertion, turn "F" Switch to next lower number.)

7. Make note of firing voltage (the highest voltage obtained just before the tube fired) and check that the tube is within limits listed for this tube type.

8. Set "A" Switch to "VR-CURRENT, 50 MA" and read current on the "50 MA" scale of meter.

9. Rotate "LINE AND VR ADJUST" Control until the lower current indicated under "CURRENT RANGE" for this tube type is reached.

10. Reset "A" Switch to "VR-VOLTAGE, 250V" and note the voltage reading.

11. Reset "A" Switch to "VR-CURRENT, 50 MA" and rotate "LINE AND VR ADJUST" for the upper current limit of the tube.

12. Reset "A" Switch to "VR-VOLTAGE, 250V" and read voltage obtained.

13. The difference between voltage readings obtained in Steps 10 and 12 is the regulation of the tube over its operating range and should be less than the maximum specified in the Test Data.

14. The voltage readings obtained in Steps 10 and 12 are actual operating voltages and should be within the extremes specified in the Test Data.

## MODEL 10-40

## CONDENSED INSTRUCTIONS

PICTURE TUBES

1. Return all levers to "NORMAL" position, using "Lever Return" button.

2. Set "A" to 8, "B" to 1, "C" to 25, "E" to 9 and "F" to 6.

3. Connect the Duodecal end of the PTA Cable to the picture tube base and plug the other end of the PTA Cable into the octal socket of the 10-40. Connect the alligator clip of the PTA to the HV anode of the Picture Tube. Make sure that there is no High Voltage on the Picture Tube HV anode before touching the tube.

4. Release "OFF"/"ON" Button of the 10-40, set the "LINE AND VR ADJUST" Control to bring pointer of meter to the "Line" indication on the meter scale.

5. Check Filament Continuity by depressing buttons 1 and 8 INDIVIDUALLY.

6. Perform "SHORT" Test by pressing buttons 2, 4, 5, 6 and 7, INDIVIDUALLY.

7. LEAVE BUTTON #7 depressed.

8. Rotate "A" to "PIX TUBE" position and set the Meter to Zero, using the "Gas & Pix Tubes Zero Adjust" Control.

9. If the Picture Tube passes the "SHORT" Test, throw Lever 6 to "Y" position, press the "Tube-Gas"/"Pix Tubes" Button and read Quality on the special "Pix Tube" Scale.

## INTRODUCTION

The Model 10-40 Electronamic Tube Tester has been designed to provide the Service Lab with complete facilities for the following tests:-

*1. Complete Tube Tests:- *Electronamic Quality, Shorts and Leakage, and Gas Content.
  *SEE "PRINCIPLES OF ELECTRONAMIC TUBE TESTING" at the rear of this manual.

2. Picture Tube Beam Current Tests.

3. Voltage Regulator Tube Tests:- Direct Voltage and Current readings under variable load conditions.

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The three major Test Functions of the Model 10-40 are supplemented by a carefully designed variety of functional facilities specifically aimed at simplification of Test operations:-

## BASIC TUBE TEST FEATURES

1. ACCOMMODATES ALL MODERN TUBE TYPES AND FILAMENT VOLTAGES from .75 to 117 volts. Tests noval button 9 pin tubes, 7 and 8 pin sub-miniature types, hearing aid and pocket radio tubes, double-cap U.H.F. types, loctals, single-ended (TV and FM amplifiers), regular Octals (MG, G and metals), spray-shield and glass types, and miniature 7 pin types.

2. BUILT-IN MINIATURE 7 and 9 pin Straighteners:- Rustproof, long-lived, stainless steel pin straighteners provide means for convenient and rapid adjustment of bent base pins. Assures longer trouble-free life from tube sockets and better contact when tubes are returned to original apparatus sockets.

3. QUALITATIVE TUBE MERIT readings directly indicated on a single three colored TUBE QUALITY SCALE supplemented by a linear scale for tube matching and qualitative comparison purposes.

4. DUAL FREE-POINT FILAMENT TERMINAL SELECTION locates terminals of ALL filaments (single, double, center-tapped) regardless of rotating pin positions.

5. VISIBLE FILAMENT CONTINUITY TESTS:- Rapidly performed by the PRECISION NUMBERED PUSH BUTTON SYSTEM; shows up open filaments for all types of tubes regardless of filament base connections. In addition, this PRECISION feature immediately reveals the open section of tapped filaments.

6. MASTER ELEMENT LEVER-OPERATED SELECTOR SYSTEM: This highly important PRECISION feature COMPLETELY ELIMINATES ALL POSSIBILITIES OF INFLEXIBILITY due to unusual multiple tube basing terminations of new tubes and tubes yet to be developed. Maximum speed in the use of the lever system is accomplished by the unique fool-proof MASTER LEVER RETURN MECHANISM which allows for instantaneous return of ALL levers to "Normal" position before testing a tube. Individual time-consuming return of each lever is thereby completely eliminated. In addition, simplified tube analysis is made possible by the Standard element numbering system employed.

7. SPECIFIC INDIVIDUAL LOADS AND VOLTAGES (control grid, screen, plate, etc.) applied to each respective element of tube under test.

8. METER READS IN PLATE CIRCUIT ONLY. Indications, therefore, are entirely dependent upon control action and condition of ALL intervening elements.

9. OPEN ELEMENTS: Shows up tubes with open elements. The exclusive "ELECTRONAMIC" TUBE TEST NECESSITATES ALL ELEMENTS INTACT FOR PROPER reading.

10. TESTS diodes, triodes, rectifiers, tetrodes, pentodes, multi-purpose tubes, gaseous types such as OY4, OZ3 and OZ4 and remote control gaseous types such as OA4 and 2A4, regardless of varying filaments or other element positions.

11. MULTI-SECTION TUBES: Individual tests for each section of multi-section tubes including visible tests of the fluorescent screen, winking effect on cathode ray indicator tubes and FM/AM alignment ray indicator tubes. No shifting of tubes is necessary to obtain all tests.

12. HOT CATHODE LEAKAGE TEST: Sensitive neon method quickly shows up poor cathode structure in accord with leakage specifications of leading tube manufacturers.

13. DUAL SENSITIVITY HOT INTER-ELEMENT SHORT TESTS made ingeniously simple through the use of PRECISION Automatic Interlocking Push-Buttons, and lens-protected magnified neon lamp. Double sensitivity is made available through the flip of a switch to permit special application tube selection to more rigid standards.


## GAS TEST FEATURES


1. Gas measurement is taken Directly in the grid circuit of the tube to be checked. Meter reads Direct Gas on a special 0-20 Microamperes scale.

2. Distinctly separate panel controls provide for a Direct Gas test on all tubes where tube gas content is a factor in circuit operation.

3. A selected variety of plate potentials are available which are pre-calculated in conjunction with applied bias to insure a sufficient power development for reliable Gas detection.

4. As soon as "A" Switch is set to Gas Test, selected potentials are applied to the tube under test to provide for gas-development time, required in some cases for true build-up of gas.

5. All Gas Test meter readings are made through the use of a built-in Vacuum Tube Voltmeter circuit. This VTVM circuit provides the required high sensitivity for Gas readings and also provides automatic meter protection inherent in VTVM circuits of this type.

6. Auto-radio tubes designed to work on 12 volts plate and screen can be tested for both gas, and contact potential. See Page 8 for procedure.


## VOLTAGE REGULATOR TEST FEATURES


1. The basic Lab-type Voltage Regulator Tests included in Model 10-40 permit direct comparison of test results with published data for VR tubes:-

    (a) The load on VR tubes can be directly varied from minimum to maximum, directly monitored current-wise on the 10-40 Meter.

    (b) Voltage regulation at any load point between Maximum and Minimum is read directly on the 10-40 Meter.

2. Firing and Extinction potentials can be checked and read directly on the Meter.

3. Facilities provide for test of all types of VR tubes from below 65 volts to above 150 volts.

## PICTURE TUBE BEAM-CURRENT TEST FEATURES

1. The VTVM Indicating Circuit of the 10-40 permits BEAM CURRENT Measurement of Picture Tubes (current measurement from Cathode through $G_1$ to $G_2$) through use of Accessory Cable, Model PTA.

   Beam Current bears direct relationship to Picture Brightness inasmuch as current collected on $G_2$ emanates from the small picture producing area of the Cathode. This type of test is preferred by picture-tube manufacturers as compared to a standard Emission test (Cathode to $G_1$) because of Beam Current's direct relationship to Picture Brightness.

## MISCELLANEOUS FEATURES

1. THREE WINDOW, HIGH SPEED ROLLER CHART SYSTEM. Provides complete listings of up-to-date tubes. Provides "years" of space for new tube releases.

2. ROLLER CHART ASSEMBLY COMPLETELY DETACHED FROM THE INSTRUMENT ITSELF.

3. MASTER LEVER ELEMENT SELECTOR-DISTRIBUTION SYSTEM:- This important PRECISION feature ELIMINATES INFLEXIBILITY OR OBSOLESCENCE due to multiple and changing basing terminations of new tubes.

4. LARGE, EASY-TO-READ, rugged, double-jeweled "PACE" Meter, accurately balanced and factory-calibrated to within 2%.

5. FACTORY-CALIBRATED ACCURACY of the tube test circuit is closely maintained by the use of individual calibrating controls, adjusted and sealed at the factory against laboratory standards, and through use of individual, 1% bridge-calibrated wire wound shunts.

6. TELEPHONE-CABLED PLASTIC INSULATED WIRING EMPLOYED THROUGHOUT, is highly resistant to moisture. Assures reliable performance even under highly humid conditions.

7. TEST CIRCUITS ARE COMPLETELY TRANSFORMER ISOLATED FROM POWER LINE.

8. MICRO-LINE ADJUSTMENT, read directly on meter, provided by use of continuously variable, heavy-duty line voltage control.

9. DEEP-ETCHED ENAMEL-FILLED SATIN ALUMINUM INSTRUMENT AND ROLLER CHART PANELS:

*     *     *     *     *     *     *

## FUNCTIONS OF PANEL COMPONENTS

### (As they relate to TUBE TEST)

1. SWITCH "A":- Load and Voltage Selector - This switch (in positions 1 through 8) selects the load and plate potential applicable to the particular tube under test. In addition, Switch "A" provides for variation of the basic meter sensitivity, allowing for standardized testing of diodes, low current types, and other special vacuum tubes.

2. SWITCH "B":- Filament Return Selector - Control "B" provides free-point filament terminal selection for all type tubes, regardless of filament base termination arrangement.

3. CONTROL "C":- Control-grid Voltage Potentiometer - Provides selected test input circuit potentials which are automatically applied to the control grid selected by the MASTER LEVER SYSTEM.

4. CONTROL "D":- Meter Sensitivity Potentiometer - A special-tolerance, tapered potentiometer enabling the setting of calibration limits for all tubes as noted on the tube test roller chart.

5. CONTROL "E":- Filament Voltage Selector - Provides a complete range of 22 filament operating potentials from .75 through 117 volts.

6. MASTER LEVER SWITCH (Master Element Selector) - This MASTER switch consists of 12 individual 5 position switches. Each switch is individually numbered from 1 through 12. Each number represents a tube element number as listed by Tube Manufacturers and the Electronic Industries Association. For example, consider the case of a screen grid tube type 6SJ7. The tube element numbering, as listed in standard tube manuals, is as follows:

        Pin 1 - Envelope
        Pin 2 - Heater
        Pin 3 - Suppressor
        Pin 4 - Control grid
        Pin 5 - Cathode
        Pin 6 - Screen grid
        Pin 7 - Heater
        Pin 8 - Plate

When, for example, a type 6SJ7 tube is inserted into its socket, pin 1 of the tube is automatically connected to Master lever 1; pin 2 to Master lever 2; pin 3 to Master lever 3; etc. (Each numbered lever, therefore, controls the application of its corresponding tube element into the appropriate tube test circuit.) It will be noted that each Master lever can be thrown into any one of 5 positions, indicated as: W, X, Y, Z and "Normal". Circuit identification of these positions are listed as follows:

Position "W" - Open position. Any lever thrown to the "W" position open-circuits its corresponding tube element.

Position "X" - Screen Grid position. In the case of the 6SJ7 example, element 6 is Screen Grid. Lever 6, therefore, becomes the Screen lever, and this lever is thrown to position "X".

Position "Y" - Plate circuit position. Element 8 of type 6SJ7 is a Plate. Lever 8, therefore, becomes the Plate lever, and this lever is thrown to "Y" position.

Position "Z" - Grid circuit position. Element 4 of 6SJ7 is Control Grid. Lever 4, therefore, becomes the Grid lever, and this lever is thrown to "Z" position.

Position "Normal" - Common termination to cathode and/or reference potential. All elements requiring a "normal" or cathode potential lever such as Suppressor grids, cathode, etc., are accordingly accommodated by leaving the corresponding levers in "Normal" position.

It is therefore seen that the complete lever setting for type 6SJ7 tube is simply set up as follows:

| W | X | Y | Z |
|---|---|---|---|
| - | 6 | 8 | 4 |

Only 3 levers in this example require actuation. All other levers are untouched and are left in the "NORMAL" position.

Although the connecting network of the MASTER LEVER SELECTOR appears complicated behind the instrument panel, its operation from the top of the panel is unusually simple and straightforward.

7. THE "LINE AND VR ADJUST" CONTROL - This control permits adjustment for the operating line voltage when the meter pointer is brought to the arrow-head center of the scale plate marked "LINE". This control is a heavy duty, continuously variable, wire-wound potentiometer, assuring step-free, positive, micro-voltage adjustment.

8. THE PUSH BUTTON SYSTEM - (Buttons 1 through 12) These buttons, in conjunction with the dual sensitivity neon test circuit, permit rapid short and leakage check of all tube elements, merely by consecutively depressing buttons 1 through 12 and observing the neon lamp indications. Visible filament continuity tests are also provided by the push button system in conjunction with data listed under "Fil. Cont." on the Roller Chart.

9. "TUBE QUALITY" BUTTON - This button (when held down) provides the meter reading for tube performance quality tests. When depressed, it also automatically releases any other buttons which may have previously been depressed.

10. "OFF" BUTTON - This button (when in the down or depressed position) shuts the instrument OFF. To turn the instrument ON, the "Tube Quality" button is depressed, releasing the OFF button.

11. SOCKETS - This instrument incorporates the 7 and 8 pin sub-miniatures. Noval Button 9 pin, loctal, combination 7 prong, Button 7 pin, 6 prong, 5 prong and 4 prong sockets, and also a special 12 prong socket which provides a centralized terminal for direct access to all 12 tube testing circuits.

    All tube analysis, ie: filament continuity, hot cathode leakage, hot neon short check, tube quality tests and ballast unit tests, are obtained from each of the test sockets, in accordance with the type of tube base involved.

12. "TUBE-GAS" PIX TUBES BUTTON - After making tube short and quality checks, if gas is suspected, the "F" Switch and the Push Button indicated on the Roller Chart are set. Then the Selector Switch "A" is set to Gas Test. The "Tube-Gas Pix Tubes" Button is depressed for a Gas reading on the Meter. (See instructions under "Gas Test" on Page 8 of this manual for discussion of "Gas Build-Up Time").

13. "GAS & PIX TUBES ZERO ADJUST" - This control is used to make an accurate Meter Zero Adjust before checking for tube Gas.


       *      *      *      *      *      *      *


## FUNCTIONS OF PANEL COMPONENTS

### (As they relate to PICTURE TUBE TEST)


1. "A" SWITCH - "Pix Tubes" position selects the proper circuit for Picture Tube tests.

2. "B" SWITCH selects the filament termination.

3. CONTROL "C" determines the range of Beam Current as indicated on the 10-40 Meter.

4. "E" SWITCH selects the filament voltage.

5. "F" SWITCH selects the "G2" voltage.

6. "GAS & PIX TUBES ZERO ADJUST" - This control is used to make an accurate Meter Zero Adjust before checking Beam Current.

7. MASTER LEVER SWITCH: Allows selection of proper CRT terminals for application of required voltages.

8. PUSH-BUTTONS 1 through 12: Checks for shorts, leakage and filament continuity, in conjunction with neon indicator and "High-Standard" leakage sensitivity switch.

9. PUSH-BUTTON #7 is depressed for tests of all types of Picture Tubes just before making the final Beam Current Test.

10. "TUBE-GAS PIX TUBES" BUTTON provides Picture Tube Beam Current Test when depressed.

## FUNCTIONS OF PANEL COMPONENTS

### (As they relate to VOLTAGE REGULATOR TUBE TESTS)

1. "A" SWITCH:- The two "VR" positions (marked "Voltage" and "Current") set up the proper test circuits and meter sensitivities for Voltage Regulator and Voltage Reference tubes.

2. "F" SWITCH:- Selects proper supply voltages.

3. "LINE AND VR ADJUST" CONTROL, in conjunction with "F" Switch, allows for variation of VR load current over its specified operating range.

4. "MASTER LEVER" SWITCH:- Allows selection of proper VR tube terminals for application of required voltages.

NOTE: It is not necessary to depress either the white or the red push button to make Voltage Regulator Test readings on the Meter. The Meter automatically indicates voltage or current dependent upon the setting of the "A" Switch. No short tests are necessary for VR tubes.

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## PICTURE TUBE TESTING

The Model 10-40 also includes complete facilities for BEAM CURRENT testing of PICTURE TUBES when used with PRECISION Picture Tube Adapter, Model "PTA", a separate accessory cable available from your favorite distributor or directly from the Service Department of PRECISION APPARATUS COMPANY, INC. Beam Current checking differs from the usual type of picture tube Emission testing, by revealing the true brightness capability of the picture tube. The intensity or magnitude of Beam Current directly determines the degree of screen brightness and is therefore the most significant factor in the determination of tube condition. The PICTURE-PRODUCING BEAM itself originates from a relatively small area in the center of the cathode disc: the remainder of cathode area has little or no effect upon the cathode beam. It is therefore most important that the Emission capabilities of this central area of the cathode be examined and that the remainder of the cathode area be eliminated from the actual brightness check. See Fig. 1 below.



Fig. 1
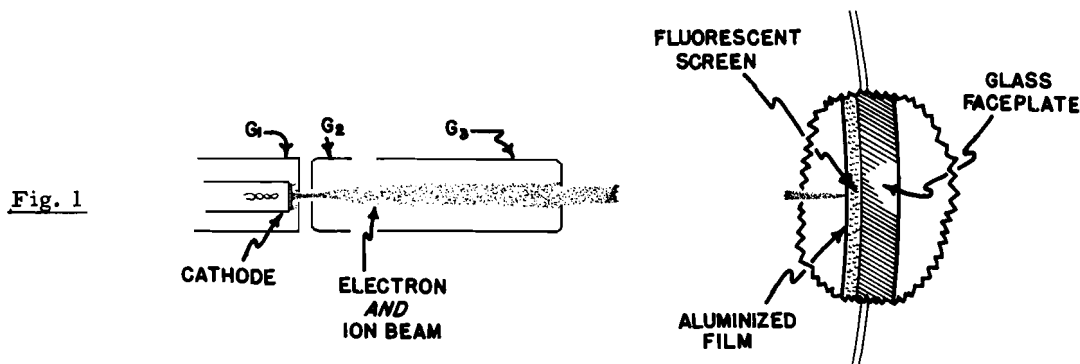
This most important condition is satisfied only by a set of test conditions which will measure the magnitude of the true Beam Current. The high sensitivity meter of the Model 10-40 reads only that current which passes through the small aperture in Grid #1 of the picture tube (true Beam Current) as can be seen from Fig. 1 . The emissive capabilities of the remainder of the cathode do not contribute to the picture-producing beam and are therefore not included in the Beam Current reading. It becomes obvious therefore that the usual type of Emission check which reads Total Emission from the complete cathode disc would reveal little or nothing as regards the condition of the small central area of the cathode.

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## OPERATING INSTRUCTIONS
### TUBE TEST

1. With "OFF" button depressed, connect the line plug of the instrument to any 50-60 cycle 110-125 volt A. C. source.

2. By means of the "LEVER-RETURN" button on the right side of the MASTER LEVER DRUM, throw ALL levers to the "NORMAL" position.

3. Refer to the tube test roller chart windows for the tube type number to be tested and set CONTROLS "A", "B", "C", "D", "E" to positions designated for that tube.

    For simplicity in locating any tube type number, it will be helpful to note that all tubes are listed in strict numerical order beginning at the top of the left hand window opening, continuing downward to the end of the roller chart and thence to the top of the next window opening, etc.

4. PRESS (and then remove finger from) the "TUBE QUALITY" button to turn instrument "ON". (It will be noted that the "OFF" button is thereby released to the up or "ON" position.) Then rotate the "LINE AND VR ADJUST" control knob to bring pointer of meter to the "Line" indication on the meter scale.

5. Insert tube to be tested into its respective socket and allow the tube to heat. Use black overhead cap when necessary except where use of Red cap is specifically indicated on the roller chart. Any deviation of the meter pointer from the "LINE" position (after tube has heated) should be corrected by rotating the "LINE AND VR ADJUST" knob to bring the meter pointer back to "Line" indication.

    (DO NOT ATTEMPT TO OBTAIN TUBE QUALITY METER INDICATION UNTIL AFTER SHORT TESTS ARE MADE, ELSE SERIOUS DAMAGE MAY RESULT TO INSTRUMENT.)

6. Next, proceed to Short and Leakage Tests (WITH ALL LEVERS IN THE "NORMAL" POSITION) as follows:

7. Press the numbered push buttons 1 through 12, in consecutive order. Watch the neon lamp indicator for glow or continuous flicker. The tube under test should be LIGHTLY tapped during "Short" tests, to reveal loose elements which might become shorted under vibration.

    IMPORTANT: NEON LAMP SHOULD GLOW ONLY ON THOSE BUTTONS DESIGNATED ON TUBE CHART FOR FILAMENT CONTINUITY, ("FIL. CONT.") OR ON THOSE ADDITIONAL BUTTONS SPECIFICALLY NOTED ON THE ROLLER CHART.

    Inasmuch as the filament of the tube under test is disengaged when the "FIL. CONT." buttons (designated on the roller chart) are depressed, it is necessary that these buttons be immediately returned to normal "up" position (by depressing any other button) and thereby allowing the tube to remain in a heated condition for further test.

    THE TUBE UNDER TEST SHOULD BE REJECTED AS DEFECTIVE (OPEN FILAMENT) IF NEON LAMP FAILS TO GLOW WHEN THE DESIGNATED FILAMENT CONTINUITY BUTTONS ARE DEPRESSED.

    DISREGARD ANY MOMENTARY NEON LAMP FLASHES AS BUTTONS ARE DEPRESSED. These flashes are merely the discharge of the blocking condenser in the short check circuit.

    Inasmuch as the short check push button numbers directly coincide with socket prong numbers, it becomes apparent that the operator (for short check purposes) need only depress that quantity of buttons equal to the number of socket prongs involved. For example: If the tube under test inserts into the 4 prong socket, then only buttons 1 through 4 need be short-checked; if the tube inserts into the 5 prong socket, then buttons 1 through 5 are the only ones involved, etc. If a top grid cap is present, then add button #11 to the short check procedure.

8. A discernible neon lamp glow or continuous flicker, when any one of the numbered buttons "1 to 12" are depressed, (with the exception of the designated "FIL CONT" buttons) indicates an inter-electrode high resistance leakage or short and the tube should be rejected without further testing, (unless otherwise noted on the tube test roller chart). Inasmuch as these tests are made while the tube is in a heated condition, the tube should be allowed time to heat up sufficiently. In this manner, shorts or leakage that may occur due to expansion of internal elements can be more readily detected.

Because all tube elements connect to individually numbered push-buttons, there is no necessity to employ a separate cathode leakage button. Cathode leakage will be detected when the respective button (corresponding to a particular tube's cathode) is depressed.

Push-buttons 1 through 12 are numbered in accordance with standard tube basing sequence. Should short indications be obtained on any one or more buttons, (for example on buttons 5, 6 and 8), then the tube elements corresponding to tube pins #5, #6 and #8, are either internally shorted or are connected through low leakage paths to other elements of the tube.

The flexible element selection circuit of the Model 10-40 allows for either series or parallel connection of center-tapped filaments. In order to obtain uniformity of test settings and to minimize operating errors, all tubes with center-tapped filaments are tested in parallel connection. Should the neon lamp fail to glow when any one of the push buttons (listed on the roller chart under "Fil. Cont.") are depressed, (during filament continuity test), the tube should be discarded.

If, however, one section of a center-tapped filament be indicated to be open-circuited and, for some reason, the operator does perform a Quality test, it will be found in many cases that a reading in the upper section of the red "Replace" sector can be obtained. This is, of course, due to the parallel filament connection. The intact portion of the filament is still operating and causing a partial meter reading to be obtained. Such tubes should have been previously discarded as a result of the "Fil.Cont." test failure.

9. AFTER SHORT AND FILAMENT CONTINUITY CHECKS AND LINE ADJUSTMENTS HAVE BEEN ACCOMPLISHED, throw the levers indicated (on the roller chart) under "W-X-Y-Z" to the positions called for. All other levers MUST REMAIN IN "NORMAL" POSITION.

10. Then depress the "TUBE QUALITY" button and obtain the Quality Indication.

*        *        *        *        *        *        *

## GAS TEST

NOTE: As a standard operating procedure, it is not necessary to check all types of tubes for gas. The operator should choose to make a gas test only on those tubes where the operating circuit will be affected by excessive gas currents. Tubes used in Low Power circuits are seldom subject to gas current problems. Gas data is therefore not listed for Low Power tubes such as are used in portable battery receivers, etc., inasmuch as experience has proven that trouble-producing gas is not developed in these Low Power tubes.

After the Quality test has been completed, any tube (other than diodes or rectifier types) may be checked for excessive gas content as follows:

1. With all Controls, Switches and Levers set up for Quality Test, (unless otherwise instructed on Roller Chart), set "F" and the Push-Button as indicated.

2. Rotate "A" to "GAS TEST" position and set the Meter to Zero, using the "Gas & Pix Tubes Zero Adjust" Control.

3. Depress the "Tube-Gas" Pix Tube button and note the meter reading on the 0-20 "Gas" scale directly below the Black 0-120 meter arc. If the gas reading is above the limit listed (see NOTE 1 below), reject the tube without further testing. If the gas reading is BELOW the limit, wait at least two minutes (see NOTE 2 below) and then again note the meter reading. At the end of approximately two minutes, if there has been no change in the meter reading, the tube can be assumed to be free of gas. If the meter reading has changed, observe the meter pointer to see if the gas reading continues to climb.

NOTE 1. Gas Limits.

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Voltage Amplifier Tube Types:- 2 $\mu$a. Maximum

Power Amplifier Tube Types:- 5 $\mu$a. Maximum

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The above limits are based on informal Industry standards. However the technician should bear in mind that these limits are general and may not apply to all situations. For example, if an Output tube (Power Amplifier type) in a receiver produces obvious distortion after warm-up and the 10-40 detects 1 or 2 microamperes of gas, then the technician has obviously evolved a specific gas limit for that tube type when used in that particular type of circuit. The technician might further note, as a guide, that circuits involving high values of grid resistance will usually tolerate less gas current than will circuits where the grid resistance is low.

NOTE 2. Gas Build-Up.

The operator should note that troublesome gas will not be developed (and therefore not indicated on the meter) until at least a few minutes of gas bombardment has taken place within the tube. If a tube is suspected of being gassy, it is important that these few minutes be permitted for the Gas test inasmuch as this small expenditure of time may save considerable trouble-shooting time in the receiver or operating equipment itself.

It is of interest to note that the 10-40 Gas Test circuit will also detect two other possible sources of trouble at the same time:- grid emission and grid leakage. Grid emission is usually due to sputtering of cathode material onto the grid and may also take some time to build up. Grid leakage, on the other hand, will usually be indicated immediately by the Gas Test. Note that the same limits apply for the test regardless of the cause, since the effect will be the same.

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## CONTACT POTENTIAL TEST

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Tubes used in 12 volt auto-radio sets (wherein plate and screen voltage is obtained directly from the car battery) depend upon inherent contact potential for development of proper bias. Bias-producing current in the grid circuit of these tubes produced by contact potential is opposite in polarity as compared to grid current which might be produced by tube Gas. Therefore, the presence of gas in tubes of this type can upset the proper bias as produced by contact potential.

For example, a 12EK6 tube used as an I.F. amplifier in a typical car radio develops 0.5 volt of negative bias across its 2.2 megohm grid resistor. If this tube should develop gas, it would lose this negative bias and even develop a bias of opposite polarity. This could well result in detrimental operation of the car radio.

The 10-40 therefore tests these tubes under the simulated operating conditions to determine the presence of the necessary contact potential (or the absence of detrimental tube Gas). The procedure is as follows:

1. With all Controls, Switches and Levers set up for Quality Test, set "F" to the #1 position.

2. Rotate "A" to "Gas Test" position and set the Meter to Zero, using the "Gas & Pix Tubes Zero Adjust" Control.

3. Depress the "TUBE QUALITY" Button and note the reading on the 0-120 scale.

NOTE: A reading of 60 is approximately 1 volt; a reading of 30 is approximately 0.5 volt. Most good tubes should fall somewhere between these two settings. If a tube is gassy, the gas will either nullify the desired effect of the contact potential and read much lower than 30 or it may even reverse the polarity of the meter indication. Allow time for build-up of gas as in Note 2, Page 9.

*     *     *     *     *     *     *

## SPECIAL ROLLER CHART NOTATIONS FOR TUBE TESTS

By means of the flexible multi-channel circuit design of PRECISION "Electronamic" testers, three types of tests are performed upon standard and FM types of "eye" and alignment indicator tubes aside from the standard triode performance test.

Single Target Type: This type is typified by types 6E5 and 6G5: For example, a roller chart line for type 6E5 appears as follows:

|         |         |   |   |   |   |   |           | Lever |   |   |   |
| TUBE    | SECTION | A | B | C | D | E | Fil. Cont.| W | X | Y | Z |
|---------|---------|---|---|---|---|---|-----------|---|---|---|---|
| 6E5     | Eye     | 1 | 1 | 0 | 0 | 9 |           | - | - | 2-4 | - |

The following test procedure must be employed:

After performing the standard "short" test, set all Switches and Levers as indicated on the roller chart. Depress the "TUBE QUALITY" button and observe the circular fluorescent screen which should illuminate completely.

Next, throw the FIRST of the two levers indicated under the "Y" setting (in this example, lever 2) TO THE "Z" POSITION.

A good tube will now exhibit the typical angular shadow. Return the same first lever to its original "Y" position and note closure of the shadow angle. DISREGARD METER INDICATIONS.

Double Target Type. (Twin electron ray indicator tubes) This type is typified by type 6AF6 and 6AD6: For example, a typical roller chart line for type 6AD6 appears as follows:

|         |         |   |   |   |   |   |           | Lever |   |   |   |
| TUBE    | SECTION | A | B | C | D | E | Fil. Cont.| W | X | Y | Z |
|---------|---------|---|---|---|---|---|-----------|---|---|---|---|
| 6AD6    | Eye     | 1 | 2 | 0 | 0 | 9 | 2-7       | - | - | 3-4-5 | - |

The following test procedure must be employed:

After performing the standard "short" test, set all Switches and Levers as indicated on the roller chart.

Depress "TUBE QUALITY" button and observe the circular fluorescent screen which should illuminate completely.

Next, throw the FIRST of the three levers under the "Y" settings (in this example, lever 3) TO THE "Z" POSITION. A good tube will now exhibit a typical angular shadow.

Next, throw the SECOND of the three levers under the "Y" settings (in this example, lever 4) TO THE "Z" POSITION. The tube, if good, will exhibit another angular shadow opposite the position occupied by the first shadow.

**FM/AM Eye Tubes (Tuning indicator tubes).** This type of electron ray tube is typified by type 6AL7 and is tested simply and positively through virtue of the flexibility of the PRECISION ELECTRONAMIC MODEL 10-40.

Test procedure is as follows:

1. After performing the standard "short" test, set all Switches and Levers as indicated on the roller chart.

2. Depress the "TUBE QUALITY" button and observe the two rectangular fluorescent patterns on the screen of the tube.

3. With the "TUBE QUALITY" button depressed, throw the FIRST lever listed under the "Z" setting on the roller chart to "NORMAL" POSITION. One rectangular pattern should then become shorter in length; then return this lever back to its original "Z" position.

4. Next, throw the SECOND lever listed under the "Z" setting to "NORMAL" POSITION. The other rectangular pattern should then become shorter in length; then return this lever back to its original "Z" position.

5. Next, throw the THIRD lever listed under the "Z" setting to "NORMAL" POSITION. BOTH ends of the pattern (opposite to the ends noted in 3 and 4 above) should then slightly decrease in length. Observe these ends closely as the movement may be slight.


Special Rectifier Test (Types 7OA7 and 117N7)

Because of unusual internal connections (plate tied to one side of filament), the 7OA7 and 117N7 RECTIFIER sections require slightly special test procedures.

7OA7 - Rect. Section. Set all controls and levers in accordance with the Roller Chart. AFTER the tube has heated sufficiently, throw BOTH levers 2 and 7 rapidly to "W" position, then quickly depress the "TUBE QUALITY" button. The first meter deflection obtained is the significant reading inasmuch as the meter reading will quickly recede coincidental with cooling of the heater.

117N7 - Rect. Section. Set all controls in accordance with the Roller Chart. ALL levers including levers 2, 6 and 7 must FIRST be in the "NORMAL" position. AFTER the tube has heated SUF-FICIENTLY, throw lever 2 rapidly to "W" position AND lever 7 rapidly to "Y" position, then quickly depress the "TUBE QUALITY" button. The first meter deflection obtained is the significant reading inasmuch as the meter reading will quickly recede coincidental with cooling of the heater.

Special Short Indication Notes. Listings for several tubes on the Roller Chart bear notes indicating that certain tubes "Must show short" on one or more push button numbers in addition to the "Fil. Cont." buttons. For normal usage any tube which does NOT show short on the designated buttons should be considered a defective tube.

However, due to multiple terminations of elements in many modern tubes, certain of these tubes may be salvaged for specific applications wherein the exact circuit application is known. Two of these cases are noted below.

a) Tubes with the negative filament connection terminating in 2 base pins. Should one of the two base pin connections become open, the tube may be salvaged and the remaining pin may be used for negative filament termination only if the radio or electronic circuit will allow the use of that pin or BOTH.

b) Tubes with an element such as plate, grid, etc., terminating at two or more base pins. Again, if one terminating pin remains connected to the element, the tube may be salvaged if the electronic circuit will allow the use of that pin and does not require the use of the open-circuited base pin or BOTH.

Gas Type Rectifiers OY4, OZ3 and OZ4

When testing these gas rectifier types, it will be noted that the meter pointer will remain, for a short interval, in the REPLACE sector and then deflect rapidly into the GOOD sector. This condition is normal for a good gas rectifier. However, should the meter pointer remain constantly in the RE-PLACE sector (after the lapse of several seconds), then the gas rectifier should be rejected.

MULTI-SECTION TUBE TESTS

Full-wave rectifiers and other multi-section tubes such as double triodes, triode-diodes, pentode-diodes, duo-diodes, frequency converters, pentode-triodes and pentode-rectifiers, contain either a second plate, a second triode or other combination of sections. These tubes are designated on the tube chart wherein each of these sections is separately described and settings given.

Treat each of these sections as if testing individual tubes for the QUALITY test as outlined previously: Set controls and levers designated for each section. The circuit employed in this instrument permits testing of the individual sections of multi-section tubes and a complete test must be given these types, since any poor section will hinder proper operation.

SUB-MINIATURE TUBE TESTS

The sub-miniature type of vacuum tube (typified by types 1C8 and 2E31) employs closely-spaced flexible leads for element terminations in contrast to standard rigid pin basing. In addition, two bulb shapes are in production: The ROUND type with lead terminations arranged circularly and the FLAT type with lead terminations arranged in one linear plane. The two sub-miniature sockets in the upper left hand area of the 10-40 panel provide facilities for connecting both of these types of tubes to the 10-40. The small rectangular sub-miniature socket on the 10-40 is keyed only by a small molded "nib" in the corner of the socket. The Flat type of tube, which is to be plugged into this socket, includes a small red dot at the base of the glass bulb which identifies that end of the tube which should be adjacent to the above mentioned "nib". See Fig.2 below.

Many sub-miniature tubes are directly soldered into operating circuits with leads cut to varying lengths. When these tubes are removed from the circuit, it is usually difficult to insert their leads into the panel-mounted sockets of the 10-40. Considering this condition, PRECISION engineers offer a simple but FLEXIBLE and UNIVERSAL sub-miniature tube test adapter unit with flexible leads and positive contact clips. This adapter unit permits positive connection of sub-miniature tubes with maximum facility regardless of lead length variations and with a minimum possibility of inter-lead shorting. See Fig. 3.

This adapter, PRECISION NO. G-110, is available as an optional accessory and can be obtained directly from your distributor or the factory at nominal cost.

The Flat type of tube is keyed by a red dot at one corner. The leads read from the right to the left, with lead #1 nearest the red dot. The socket is keyed by a dot (or nib) on the top surface of the socket. The socket contact nearest this nib is Contact #1. See Fig. 2 below.
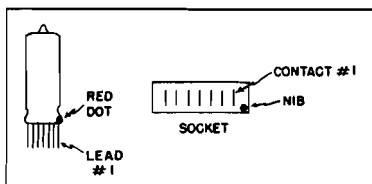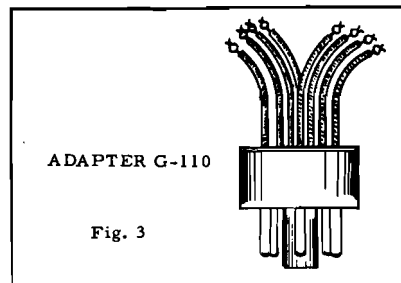


Fig. 2



ADAPTER G-110

Fig. 3

## TUBE BRAND VARIATIONS

In determining the tube test limits for this instrument, PRECISION engineers, in cooperation with the engineering divisions of leading tube manufacturers, have spent considerable time checking thousands of tubes from the production runs of leading tube manufacturers. From the information so gathered, the data on the Roller Chart, accompanying this instrument, has been compiled.

Inasmuch as extensive and intensive research is constantly being made in the radio tube industry to improve and stabilize the electrical and mechanical construction of tubes, it is not uncommon for a tube manufacturer to make a change in a particular tube's specifications. This change, though not necessarily readily noticeable in set performance, may nevertheless be made to improve tube stability and life. This change or variation may, however, indicate itself on the PRECISION ELECTRO-NAMIC Model 10-40 and necessitate a new test limit for that particular type number.

Therefore, should a particular type number be found to vary consistently from the assigned average roller chart limits, merely redetermine the new CONTROL "D" average setting required to pass these tubes at approximately 82 (on 120 scale) of the green GOOD sector and record same for future reference with respect to that manufacturer.

It can readily be seen that a consistently low or high reading for any particular tube type of a definite manufacturer is not to be taken as indicative of a poorer or better run of tubes, nor as a defect in the tube tester.

## PILOT LAMP TESTS

The miniature base socket, located in the center of the combination seven prong tube socket, accommodates all miniature screw and bayonet base type pilot lamps, Christmas tree bulbs, etc. Test procedure is as follows:

    a) Select proper filament voltage by setting CONTROL "E" to the applicable voltage:

| VOLTS | POS. | VOLTS | POS. | VOLTS | POS. |
|-------|------|-------|------|-------|------|
| .75 | 1 | 5.0 | 8 | 18.5 | 16 |
| 1.5 | 2 | 6.3 | 9 | 21 | 17 |
| 2.0 | 3 | 7.5 | 10 | 25 | 18 |
| 2.5 | 4 | 8.4 | 11 | 30 | 19 |
| 3.3 | 5 | 10 | 12 | 50 | 20 |
| 4.2 | 6 | 12.6 | 13 | 70 | 21 |
| 4.7 | 7 | 15.0 | 14 | 110 | 22 |
|  |  | 16.8 | 15 |  |  |

    b) Set CONTROL "B" to position 1; turn instrument "ON"; adjust for "LINE"; insert bulb.
        NOTE: ALL LEVER SWITCHES MUST BE IN "NORMAL" POSITION.

            *      *      *      *      *      *      *

## BALLAST TESTING

The neon short check circuit, in conjunction with the numbered Push-Button system, provides a simple and positive method for obtaining the following ballast tests:

    1. Point to point continuity test of each section of single unit as well as multiple section ballasts.

    2. Tests for loose elements.

    3. Tests for leakage between sections of multi-element ballasts.

NOTE: Frequently, one may encounter privately numbered ballast tubes, whose numbers have no relationship to the standard EIA Ballast Coding System. A uniform method of ballast resistor test can only be devised on the basis of some type of system. The PRECISION ballast test data, which follows, is related to the Standard EIA Code. Therefore, privately numbered ballasts should be referred to ballast manufacturer's replacement manuals for identification of this ballast in terms of the Standard EIA Code.

## BALLAST RESISTOR CODE

A sample and interpretation of the code appearing on standard octal type and replacement type ballasts are as follows:

(EIA STANDARD OCTAL TYPE) BK49AG
REPLACEMENT TYPE) BKX55AG

The first letter "B" on both types, if used, indicates ballast action.
The letter "K", "L" or "M" on both types, indicates type of pilot lamp.
The letter "X", "Y" or "Z", immediately following the pilot lamp designation, denotes a particular SERIES of base wiring and appears only on replacement type ballasts.
The numerals "49" or "55", appearing on the respective types, indicate the total voltage drop produced by the ballast resistor including the pilot lamp.
The letter "A" or B-C-D-E-F-G-H-J, appearing on both types (and immediately following the voltage drop numerals) designates the particular BASE WIRING circuit used.
The letter "G" following the base wiring circuit designation on both types, if used, merely indicates octal base glass unit and is of no importance as far as testing is concerned.
The letter "J", following the base wiring designation such as K55CJ, refers to an internal jumper between pins 3 and 4. (See TEST PROCEDURE).
Where the letter "P" or "PR" appears after the base wiring designation, such as K55CP or K55CPR, this indicates an additional resistor section is employed for the rectifier plate circuit. (See TEST PROCEDURE).

FOR STANDARD EIA OCTAL TYPE BALLASTS, THE BASE WIRING DESIGNATION (A-B-C-D-E-F-G-H-J) IS THE ONLY INFORMATION NECESSARY FOR TEST PURPOSES.

FOR REPLACEMENT TYPE BALLASTS, THE X, Y OR Z SERIES AND BASE WIRING DESIGNATION IS THE INFORMATION NECESSARY FOR THE TESTING OF THESE TYPES.

## BALLAST TEST PROCEDURE

The OCTAL SOCKET is used to accommodate all octal base type ballasts.

1. ALL CONTROLS AND LEVERS MUST BE IN THE FOLLOWING DESIGNATED POSITIONS BEFORE ANY ATTEMPT IS MADE TO TEST BALLAST UNITS:

Set CONTROL "A" to #1 position
Set CONTROL "B" to #12 position
Set CONTROL "C" to 0 position
Set CONTROL "D" to 0 position
Set CONTROL "E" to #24 position
Throw all levers to "NORMAL" position

2. Turn instrument "ON" and adjust for "LINE" indication on meter. Insert the Ballast.

3. Classify the ballast unit to be tested according to its EIA BASE WIRING. The push buttons then to be depressed (one at a time), will correspond with the numbers designated on the appropriate schematic in Fig. 4 on following page.

For example, Ballast type BK86A is an "A" type base wired unit. It is checked by referring to diagram "A" of Fig. 4 which reveals that button 3, then button 7, must be depressed. Neon lamp should glow as each of these 2 buttons is depressed. (Should the ballast incorporate a jumper (for example from pin 3 to pin 4 as for ballast designation BK86AJ), neon glow must also be obtained when button 4 is depressed.

CAUTION: NEVER DEPRESS "TUBE QUALITY" BUTTON DURING BALLAST TESTS.

4. A continuous neon lamp glow, after each numbered push-button (called for) is depressed, indicates that the section is not open-circuited. An open section (anywhere in the chain) will cause the neon lamp to extinguish when that section's numbered button is depressed.

It is advisable to tap the ballast units while each push-button (called for) is being depressed. In this manner, loose elements can be ascertained by noticing flickering instead of continuous glow of the neon lamp.

NOTE: Where letter "P" or "PR" follows the base wiring designation, such as BK86AP or BK86APR, then it is also necessary to depress button 5, in addition to the buttons required for the base wiring code "A".

## BALLAST LEAKAGE TESTS

Tests for leakage between sections of multi-section ballast units having BASE WIRING designations "F", "G", "H", or "I", are accomplished by depressing BOTH buttons 2 and 3 (simultaneously), with all other push-buttons remaining in the "UP" position. A neon lamp glow will indicate leakage or short between the two independent sections and the ballast should be rejected as defective.

If any special ballast resistors are encountered (which cannot be identified with any standard basing), then determine the internal wiring and proceed as outlined for all ballast continuity checks.

Fig. 4



STANDARD BALLAST TERMINATIONS

A    B    C    D    E    F    G    H    I

\* \* \* \* \* \* \*
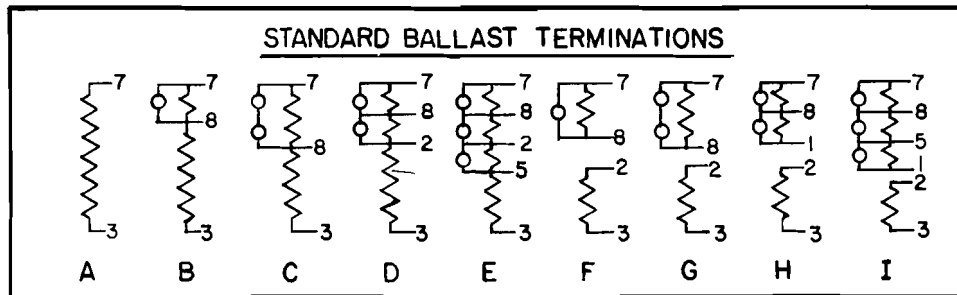
## OPERATING INSTRUCTIONS

### PICTURE TUBE BEAM CURRENT TESTS

Beam Current Tests using Model 10-40 require the use of an Adapter Cable to connect the Picture tube to the octal socket of the Tester. Use PRECISION Model PTA Adapter Cable. For 110° picture tubes, Model PAA Adapter Cable is required in addition to PTA Cable. Both are available at your favorite distributor.
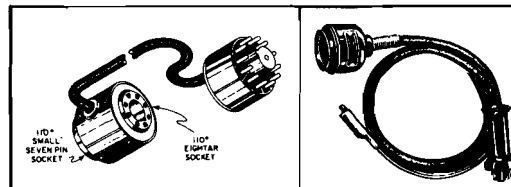
1. Set "A" to 8, "B" to 1, "C" to 25, "E" to 9 and "F" to 6.



2. Connect the Duodecal end of the PTA Cable to the picture tube base and plug the other end of the PTA Cable into the octal socket of the 10-40. Connect the alligator clip of the PTA to the HV anode of the Picture tube. Make sure that there is no High Voltage on the Picture Tube HV Anode before touching the tube.

3. Release "OFF" "ON" Button of the 10-40, set the "LINE AND VR ADJUST" Control to bring pointer of meter to the "Line" indication on the meter scale.

4. Check Filament Continuity by depressing buttons 1 and 8 INDIVIDUALLY. Neon SHOULD glow if filament is OK.

5. Perform "SHORT" Test by pressing buttons 2, 4, 5, 6, and 7 INDIVIDUALLY. Neon should NOT glow as each button is depressed.

6. LEAVE BUTTON #7 depressed.

7. Rotate "A" to "PIX TUBES" position and set the Meter to Zero, using the "Gas & Pix Tubes Zero Adjust" Control.

8. If the Picture Tube passes the "SHORT" Test, throw Lever 6 to "Y" position, press the "Tube-Gas" Pix Tubes Button and read Quality on the special "Pix Tube" Scale.

SEE NEXT PAGE FOR DESCRIPTION OF BEAM CURRENT LIMITS:-

USE THE FOLLOWING NOTES AS A GUIDE TO PICTURE-TUBE-TEST METER READINGS:-

NEW Magnetic CR tube production limits for Beam Current, as set up by CR tube manufacturers, are relatively wide range, and as a result, produce 10-40 readings between approximately 65 to 120 on the 0-120 meter scale. All NEW tubes which read above approximately 65 can be considered to be of equal merit irrespective of differences in numerical readings. High Beam Current tubes usually level off at lower values after a few hours of usage.

NEW, unused CR tubes which read below approximately 50 can be immediately suspected to be defective in manufacture and can be dealt with accordingly.

Most CR tubes which have been subjected to considerable use in the field, produce a Beam Current reading below approximately 65 on the meter scale as a result of gradual cathode deterioration.

It is important to note, however, that USED CR tubes which produce readings above approximately 95 up to higher than full scale can be suspected as gassy tubes.

USED tubes which read in the range from approximately 65 on the meter scale down to 25, can be considered quite satisfactory for continued use, with the following qualification: Within the range between approximately 45 down to 25, USED picture tubes will exhibit sufficient overall brilliance for general continued usage. However, the intensity of the peak whites (or bright scene highlights) begins to reduce in brightness below 45 on the scale. Whether or not this reduction of peak white intensity is to be of concern in any one particular case, depends wholly upon the reaction or degree of observation of any particular TV set owner. Experience indicates that the average TV set owner will, in many cases, find this degree of peak white intensity reduction quite tolerable should he even be aware of the condition, particularly when weighed against the alternative of replacing a tube which exhibits satisfactory overall brightness.

The next portion of the meter scale to be considered is yellow sector (15 to 25 on the 0-120 scale). As the meter reading progresses from 25 down to 15, it will be noticed that the meter pointer gradually passes from a predominantly Green area into a Yellow area. Analysis of USED tubes falling into this "Dim to Bright" sector will depend, in most instances, (in the case of picture tubes) upon the attitude of the particular TV set owner. In general, it may be stated that USED tubes falling into the upper half of the yellow sector can be considered "useable" tubes, in those cases where the set owner is not particularly discriminating and is willing to tolerate reduced overall brilliance and loss of highlights.

USED tubes falling into the lower half of the yellow sector can generally be classified as low limit tubes suitable for rejection except in those rare individual cases wherein set owners are willing to tolerate low brilliance and loss of highlights for an additional period of time.

IMPORTANT NOTE:   It should be remembered that there is no hard and fast all-inclusive rule for interpretation of the yellow sector readings: The above interpretation of this sector is offered only as a general guide in those cases wherein a definite opinion of the individual set owner is not forthcoming.

The RED sector is a definite reject area: USED or NEW Picture tubes which fall into this sector are definite rejects.

*      *      *      *      *      *      *

## OPERATING INSTRUCTIONS

## VOLTAGE REGULATOR TUBES

> NOTE: Test Data for Voltage Regulator Tubes is listed in the "TEST DATA" book supplied
> with your 10-40.

1. Set Switches "A" and "F" as indicated in the Test Data. (Set "A" Switch to "Voltage" position first.)

2. Set "LINE AND VR ADJUST" Control to extreme counter-clockwise position.

3. Set Levers as indicated under the listings in the Test Data book.

4. Insert tube in socket.

5. It is not necessary to depress either the white or the red push button for Voltage Regulator tests. Observe the tube to make sure that it has not yet fired. (A definite violet glow, due to ionization of gas, can be seen within tube when a VR tube fires.) If the VR tube has fired, set the "F" Switch to next lower number and observe the absence of the violet glow.

6. Observe the voltage reading on the 250 volt Voltage Regulator scale of the 10-40 Meter, then rotate the "LINE AND VR ADJUST" Control until the tube fires. As a rule, it is sufficient to watch the meter indication only. It will be observed that the voltage will keep increasing until the tube fires. Then the meter pointer will drop back down slightly. At this point, look carefully at the tube and the characteristic ionization glow should be seen although it may be fairly faint. Make a note of the firing voltage (highest voltage obtained just before the tube fires) to see that it corresponds with the limit indicated for this tube type.

7. Next, set the "A" Switch to the "Current" (50 Ma. VR Test) position and observe the current indication on the 50 Ma. VR Current Meter scale. Rotate the "LINE AND VR ADJUST" Control until the lower current operating range for the tube is reached.

8. Leave all settings unchanged except reset the "A" Switch back to the "Voltage" position and note the voltage reading.

9. Reset the "A" Switch back to the "Current" position. Rotate the "LINE AND VR ADJUST" Control clockwise until the upper current operating range for the tube is reached. In some cases, it may be necessary to reset the "F" Switch to the next higher position to reach the upper current range. In that case, first rotate the "LINE AND VR ADJUST" Control to the extreme counter-clockwise position before resetting the "F" Switch to the next higher position.

10. Next, leave all settings unchanged except reset the "A" Switch back to the VR "Voltage" position. Note the voltage reading on meter. The difference in voltage between Steps 8 and 9 indicates the voltage regulation of the tube over its current operating range. The regulation for the tube being measured should be equal to or less than the value indicated for that tube type for a good tube. The actual values of the voltages noted in Steps 8 and 9 are operating voltages. These actual voltages should be between the extremes of operating voltage indicated on the Test Data.

11. This completes the Voltage Regulator Test procedure.

*     *     *     *     *     *     *

## SERVICE NOTES

The PRECISION Model 10-40 has not only been designed as an accurate Test Instrument, but has also been constructed to withstand the abuses of general field use. All components have been exhaustively sample-tested by Precision's Test Engineering Laboratory and have been approved for general long-life usage. Generous mechanical design is a major Precision precept.

However . . . . . . . It is impossible to fully control the two major contributions to inoperative instruments, namely:

1) Failure of components after instruments have passed Precision's Performance Test Department and

2) Damage of components due to misoperation, accidental or otherwise, including failure to OBSERVE PRESCRIBED OPERATING PROCEDURES.

Therefore, in order to expedite rehabilitation of your instrument (should the need arise) the most commonly encountered possible failures and recommended remedial measures are listed as follows:-

IMPORTANT NOTE:    Your PRECISION Model 10-40 is a relatively complex instrument and has been carefully inspected and calibrated by Precision's Performance Test Department. - - DO NOT attempt repairs or modifications other than those listed below unless upon specific recommendation by Precision's SERVICE DEPARTMENT.

1. Instrument does not become energized upon application of line voltage.

   a) Remove the 2 ampere 3AG fuse. If blown, replace with same size and type fuse only if the cause for blowing of fuse is known and has been remedied.

   Reasons for fuse-blowing may be:

   Failure to short-check a tube before attempting Quality test.

   Shorted power transformer windings or other internal shorts.

2. Several type tubes with the same "A" Switch setting do not provide meter merit indications.

   a) The load resistor associated with the particular "A" Switch position may be open. Refer to the schematic, check the resistor with an ohmmeter. If open-circuited, contact Precision's Service Department for a replacement Resistor.

3. "LINE AND VR ADJUST" is erratic.

   a) Examine the "LINE AND VR ADJUST" potentiometer for shorted, open or worn turns. Unsolder the three leads and check for continuity with an ohmmeter. If defective, contact Precision's Service Department.

4. Erratic checks of several tubes with the same type base.

   a) Examine that particular socket and check for loose or broken contacts. If new sockets are required, contact Precision's Service Department or your parts distributor.

5. Tubes with overhead caps check improperly.

   a) Check cap leads for continuity especially at the cap end. Continuous use and attendant flexing of the wire occasionally cause breakage.

6. Apparent defective operation of the instrument meter.

   a) Repair and recalibration of the meter of a Model 10-40 is a delicate and highly specialized operation. DO NOT ATTEMPT TO REPAIR AN INOPERATIVE METER. Always contact Precision's Service Department should your meter appear defective or damaged.

## SPECIAL NOTES RE REPAIR SERVICE

When returning a PRECISION instrument for repair-recalibration service, ALWAYS pack carefully in a strong oversized corrugated shipping container, using a generous supply of padding such as excelsior, shredded paper or crumpled newspaper. The original container and filling pads (if available) are ideal for this purpose. Please ship via Railway Express PREPAID and mark for:

> PRECISION APPARATUS COMPANY, INC.
> 70-31 - 84th Street
> Glendale 27, L. I., N. Y.
>
> ATT: SERVICE DIVISION

FRAGILE label should appear on at least four sides of the carton. NEVER return an instrument unless it is accompanied by full explanation of difficulties encountered. The more explicit the details, the more rapidly your instrument can be handled and processed.

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### SPECIAL SUBSCRIPTION SERVICE

### NEW TEST DATA

IN LINE WITH "PRECISION'S" DESIRE TO EXTEND UTMOST SERVICE TO USERS OF "PRE-CISION" TEST EQUIPMENT, NEW TUBE TEST DATA IS NOW BEING MADE AVAILABLE ON A SPECIAL SUBSCRIPTION BASIS.

THIS PLAN ENTITLES THE SUBSCRIBER TO RECEIVE, AUTOMATICALLY, 2 UP-TO-DATE ROLL CHARTS AND A MINIMUM OF 2 ADDITIONAL SUPPLEMENTS DURING A ONE YEAR SUBSCRIPTION PERIOD.

NOTE FOR NEW OWNERS: THE FIRST YEAR'S SUBSCRIPTION IS ENTERED FREE OF CHARGE UPON OUR RECEIPT OF YOUR REGISTRATION-SUBSCRIPTION CARD COVERING THE PUR-CHASE OF A NEW "PRECISION" TUBE TESTER. IT IS IMPORTANT THAT THIS REGISTRATION-SUBSCRIPTION CARD BE COMPLETELY FILLED-IN AND RETURNED TO US IMMEDIATELY, IN ORDER THAT YOU MAY RECEIVE THE FULL BENEFITS OF THIS SPECIAL SERVICE.

PLEASE NOTE: UPON OUR RECEIPT OF YOUR REGISTRATION-SUBSCRIPTION CARD, WE WILL RESPOND WITH TWO SEPARATE CARDS:-

    a) ONE CARD ACKNOWLEDGES REGISTRATION OF YOUR NEW TUBE TESTER.

    b) THE OTHER CARD (WHICH WILL FOLLOW A FEW DAYS LATER) CONFIRMS YOUR
       ONE YEAR FREE TUBE TEST DATA SUBSCRIPTION.

UPON EXPIRATION OF THE FIRST ONE YEAR'S FREE SUBSCRIPTION, YOU WILL HAVE THE OPPORTUNITY TO RENEW THE SAME EFFICIENT SERVICE FOR THE NOMINAL CHARGE OF ONLY $2.50 PER YEAR. ADEQUATE ADVANCE NOTICE OF END OF SUB-SCRIPTION IS SENT TO ALL SUBSCRIBERS. FOR THOSE WHO MAY NOT WISH TO RENEW THIS AUTOMATIC SERVICE, CHARTS WILL BE AVAILABLE, UPON REQUEST, AT THE NOMINAL COST OF $1.25 EACH. IT IS VERY IMPORTANT THAT SUCH SEPARATE ROLL CHART REQUESTS LIST THE FOLLOWING INFORMATION:-

        A. MODEL NO. OF TUBE TESTER

        B. SERIAL NO. OF TUBE TESTER

        C. FORM NO. OF YOUR PRESENT CHART
          (PRINTED AT UPPER LEFT-HAND CORNER OF CHART)

THIS INFORMATION PERMITS OUR TUBE TEST DATA DEPARTMENT TO RESPOND WITH THE CORRECT CHARTS FOR YOUR PARTICULAR TUBE TESTER.

SPECIAL NOTE: PAID SUBSCRIPTION SERVICE APPLIES ONLY TO CONTINENTAL U. S. A., CANADA AND U. S. POSSESSIONS.

## ACCESSORY ADAPTERS AVAILABLE FOR YOUR TUBE TESTER

1. <u>Model G-118 Foreign Tube Adapter</u> for "Pico 8" basing. This Adapter plugs into the octal socket of your Model 10-40 and converts this socket for use with special European 8 pin miniature tubes.



G-118
"Pico 8"
Foreign Tube Adapter
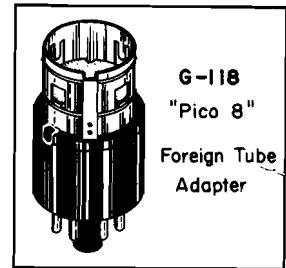
2. <u>Model G-110 Sub-miniature Flexible Lead Adapter.</u> In addition to the sub-miniature tubes with short straight pins (which can be inserted into the two sub-miniature sockets mounted in the upper left hand panel area of your Model 10-40, there are also special types with long flexible leads which are soldered directly into their respective operating circuits, with the leads cut to varying lengths. In the event a tube of this type has to be removed from its circuit for test, the operator may find it difficult to insert the tube leads into the 10-40 sockets. Because of this, PRECISION offers a simple universal sub-miniature tube test adapter with flexible leads and miniature contact clips. This special adapter permits test regardless of lead length variations.



G-110 SUBMIN. ADAPTER
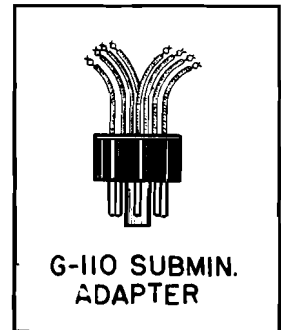
3. <u>Model PTA TV Picture Tube Adapter.</u> This Adapter, described in the section under "Picture Tube Tests", enables the operator to connect standard TV Picture Tubes to the Model 10-40 for test.



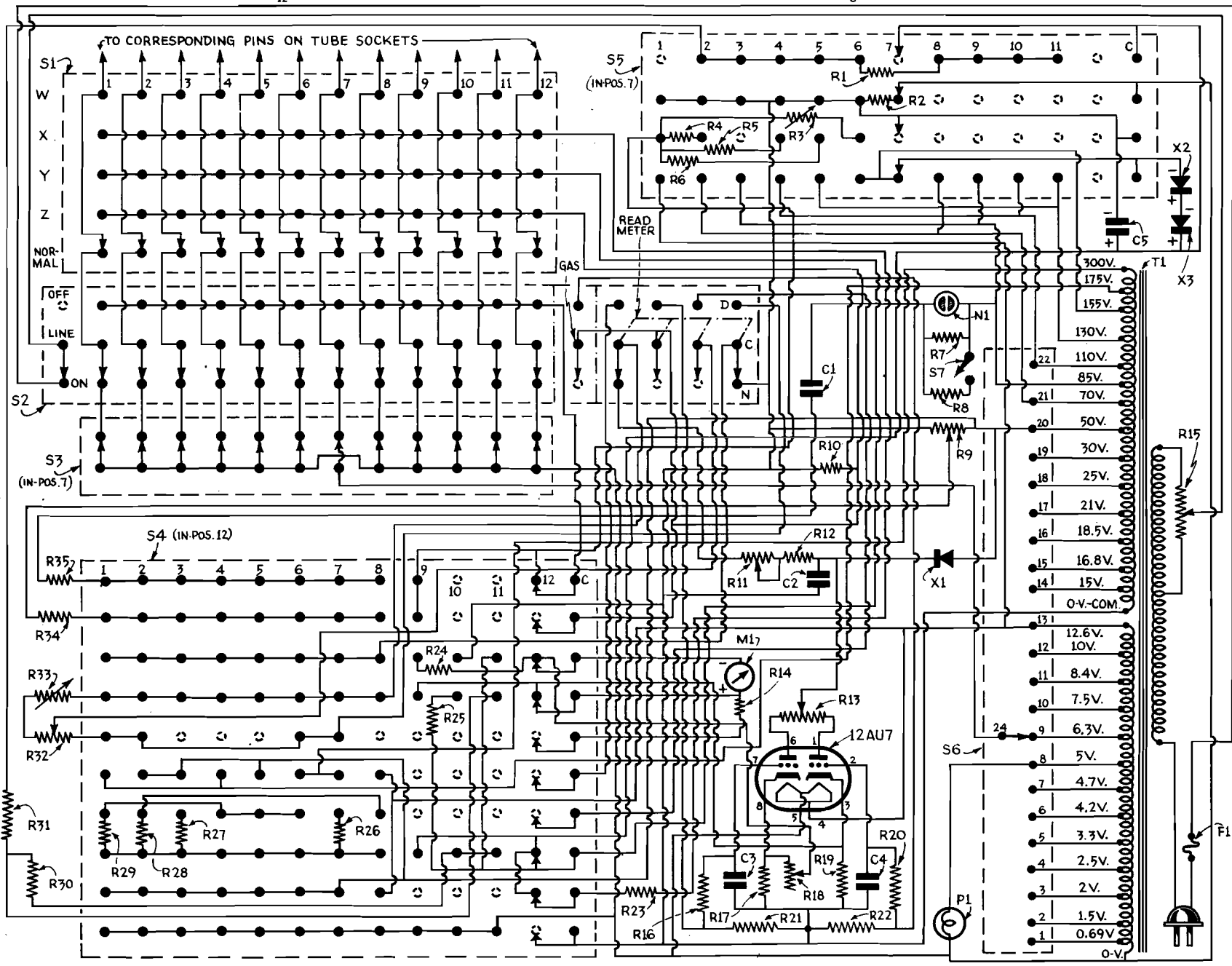"PTA" - STANDARD PICTURE TUBE ADAPTER
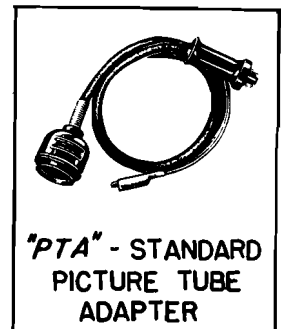
4. <u>Model PAA 110° Picture Tube Adapter.</u> Modern 110° Picture Tubes utilize two different types of special basings as compared to the standard duodecal basing of the older type of picture tubes. This special Adapter which is intended for use with the Model PTA Adapter listed above, adapts the duodecal socket of Model PTA to these two new types of 110° basings.



"PAA" - 110° PICTURE TUBE ADAPTER

\*        \*        \*        \*        \*
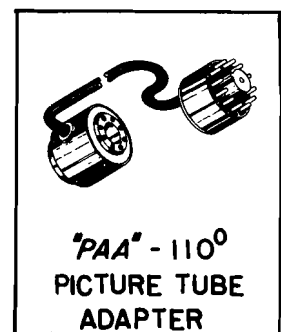
ALL THE ABOVE ADAPTERS ARE AVAILABLE EITHER FROM YOUR FAVORITE DISTRIBUTOR OR FROM THE FACTORY SERVICE DEPARTMENT.

PRECISION APPARATUS COMPANY, INC.
70-31 - 84th Street
Glendale 27, L. I., N. Y.

SUB-MIN 7 | SUB-MIN 8 | 12 PIN SOCKET | 4 PRONG SOCKET | 5 PRONG SOCKET | 6 PRONG SOCKET | COMBINATION 7 PRONG SOCKET | OCTAL SOCKET | LOCTAL SOCKET | BUTTON 7 PIN SOCKET (MINATURE) | BUTTON 9 PIN SOCKET (NOVAL)

PILOT LIGHT TEST

TO CORRESPONDING PINS ON TUBE SOCKETS

S1  W  X  Y  Z  NORMAL  OFF  LINE  ON  S2

S3 (IN-POS.7)

S4 (IN-POS.12)

S5 (IN-POS.7)

READ METER

GAS

R1 R2 R3 R4 R5 R6 R7 R8 R9 R10 R11 R12 R13 R14 R15 R16 R17 R18 R19 R20 R21 R22 R23 R24 R25 R26 R27 R28 R29 R30 R31 R32 R33 R34 R35

C1 C2 C3 C4 C5

D  C  N

X1 X2 X3

T1

M1  N1  P1  F1  S6  S7

12AU7

| Voltage Taps |
|---|
| 300V. |
| 175V. |
| 155V. |
| 130V. |
| 110V. |
| 85V. |
| 70V. |
| 50V. |
| 30V. |
| 25V. |
| 21V. |
| 18.5V. |
| 16.8V. |
| 15V. |
| 0-V.-COM. |
| 12.6V. |
| 10V. |
| 8.4V. |
| 7.5V. |
| 6.3V. |
| 5V. |
| 4.7V. |
| 4.2V. |
| 3.3V. |
| 2.5V. |
| 2V. |
| 1.5V. |
| 0.69V. |
| 0-V. |

| PART NO. | SPECIFICATION |
|---|---|
| R35 | 22KΩ |
| R34 | 500Ω |
| R33 | 0-40Ω INTERNAL CALIBRATION CONTROL |
| R32 | 300Ω CONTROL "D" |
| R31 | 1500Ω |
| R30 | 3.26Ω |
| R29 | 2KΩ |
| R28 | 295Ω |
| R27 | 5KΩ |
| R26 | 3KΩ |
| R25 | 250KΩ |
| R24 | 560Ω |
| R23 | 500Ω |
| R22 | 68KΩ |
| R21 | 10 MEG.Ω |
| R20 | 220KΩ |
| R19 | 1KΩ |
| R18 | 0-500 INTERNAL CALIBRATION CONTROL |
| R17 | 1KΩ |
| R16 | 220KΩ |
| R15 | 300Ω 25W. LINE ADJUST CONTROL |
| R14 | 53.33Ω |
| R13 | 5KΩ |
| R12 | 127.5Ω |
| R11 | 14KΩ |
| R10 | 2.279 MEG.Ω |
| R9 | 1KΩ FRONT SECTION CONTROL "C" |
| R8 | 1.8 MEG.Ω |
| R7 | 1.8 MEG.Ω |
| R6 | 1.2KΩ |
| R5 | 220Ω 2W. |
| R4 | 150Ω |
| R3 | 15KΩ REAR SECTION CONTROL "C" |
| R2 | 820Ω 2W. |
| R1 | 12KΩ |
| C5 | 100 MFD - 250V |
| C4 | .0047 MFD. |
| C3 | .0047 MFD. |
| C2 | 10 MFD. -75V. |
| C1 | 0.1-MFD. |
| F1 | 2 AMP. FUSE |
| M1 | 1MA -160 MV METER |
| N1 | NEON SHORT INDICATOR |
| P1 | №47 PILOT LAMP |
| S7 | SENSITIVITY SWITCH |
| S6 | SELECTOR SW. "E" (FILAMENT SWITCH) |
| S5 | SELECTOR SW. "F" |
| S4 | SELECTOR SW. "A" (LOAD SWITCH) |
| S3 | SELECTOR SW. "B" (FILAMENT RETURN) |
| S2 | PUSH-BUTTON SW. |
| S1 | 12 SECTION-5 POSITION MASTER LEVER SW. |
| T1 | POWER TRANSFORMER |
| X3 | SILICON RECTIFIER |
| X2 | " |
| X1 | " |

PRECISION APPARATUS Co. INC.
GLENDALE 27 L.I. N.Y.

TITLE: TUBE MASTER MODEL 10-40

DRAWN BY: W. Kadlick DATE: 8-4-58
CHECKED BY: J.F. DATE: 8-6-58

# PRINCIPLES OF

## *Electronamic* TUBE TESTING

The All-Inclusive, Single Operation
POSITIVE VACUUM TUBE PERFORMANCE TEST
that is Not Limited to Mutual Conductance Alone

☆ A most perplexing issue which confronts the electronics engineer and service technician is the choice of tube testing equipment that will solve tube test problems with **greatest possible accuracy and reliability**. With this thought foremost in mind, *PRECISION* engineers have devoted much time in extensive vacuum tube testing research and development.

All varieties of tests were conducted upon thousands of tubes, at our own fully equipped laboratories and at the plants of leading tube manufacturers. From this, a vital point stood out, above all others, which dictated that "**the resultant tube tester design cannot be based upon just one selected characteristic, such as just mutual conductance alone.**"

☆ A tube test based upon **just any one** characteristic does **not** fully vouchsafe the **over-all** performance capabilities of an amplifying tube.

When a vacuum tube is "receiver tested", the electronic circuits demand **performance** predicted upon the simultaneous presence and interaction of a multiplicity of tube characteristics including the following:

**Electron Emission**

**Amplification Factor**

**Plate Resistance**

**Mutual Conductance (Transconductance)**

**Plate Current**

**Power Output, etc.**

☆ To perform a whole series of such **individual** tests, in order to evaluate the overall merit of a tube, involves a collection of laboratory equipment hardly available to the general user of vacuum tubes. In addition, these characteristics are very closely knit to operating parameters. This means that these variable characteristic values are dependent upon the voltage, current and load conditions to which the tube, under consideration, may be subjected. This further means that for ANY GIVEN TUBE TYPE, **there is not** just one value of mutual conductance or power output, etc. characteristic of that tube.

For this very reason, tube characteristic manuals list CURVES (graphs) of operation to assist the design engineer in selecting tubes and circuit parameters which he **desires** to employ in the particular receiver or other electronic apparatus being developed.

The data listed in tube manufacturers' manuals are not fixed and inflexible ratings. Rather, such examples of operating conditions are given merely as guiding information. The tubes can be and are used under **any** suitable conditions within their maximum ratings. The **curves** provide the information to determine the proper operating points which will yield a required characteristic.

☆ Another aspect of the tube engineering problem is the question of rejection limits for any particular characteristic. This actually is a double-barrelled topic. New tube production is concerned with "**Production Tolerance Limits.**" The electronic design engineer, and of course the apparatus which uses the tubes, are further interested in "**Life Test End Limits.**"

Electronic apparatus, using vacuum tubes, must not only perform well with tubes which are within "Production Tolerance Limits," but should be able to perform until the tube has reached its "Life Test End Limit."

Detailed specifications of such "limits" are not generally available to the field and of course, specific **numerical** characteristics tests (such as micromhos) are inconclusive unless compared to a detailed table of limits paralleling actual test parameters or actual operating conditions.

Moreover, numerical characteristics readings (such as micromhos) are not fully meaningful unless the tester **duplicates** the exact voltages and loads under which the particular tube in question is actually operating in the specific circuit from which it has been removed. It would furthermore require reference to the tube's plate family and transfer characteristic curves in order to determine what the numerical characteristic SHOULD be under the particular conditions in which the receiver is using this tube.

☆ Therefore, since the numerical value (such as micromhos) of a tube characteristic varies so widely with the applied element potentials, it is necessary that TRUE vacuum tube characteristics **measuring** instruments provide:

1. Means for **metering** and reading each and every applied element potential.

2. Appropriate means for **metering** and reading each tube element current.

3. Suitable devices for **adjustment** and control of every element potential to duplicate operating conditions or to set up the specific operating point being investigated.

☆ It is obviously impractical to construct such a device, for general tube testing, as would permit the operator to do this; not only from the viewpoint of simplicity of operation, but also in consideration of the extremely high cost and physical size.

Accordingly, such equipment (for actual **numerical** characteristics investigation) is usually only found in research and production laboratories. These are the only places wherein such elaborate equipment might ever be required.

Needless to say, it would also not be practical for a tube tester's chart data to offer a multiplicity of alternative test settings for each and every tube.

☆ It has therefore been the constant purpose of *PRECISION* engineers to develop a tube tester circuit which would best meet the **realistic** needs of the electronic maintenance and Radio-TV service professions; to develop a basic test circuit affording the ultimate in correlation between test results and actual "in application" performance.

In the course of such investigations, it becomes conclusively apparent, that regardless of amplifier tube type number or variety of circuit applications, one phenomenon constantly manifests itself: **the tube output (voltage or power) is the result of a plate current caused by an applied control grid voltage, which current must be adequate even at full peak operating conditions.** This being a basic concept of amplifier tube operation (involving all operating characteristics), it led to the now famous time-proven and tried, *PRECISION Electronamic* tube tester. (Reg'd U. S. Patent Office)

☆ In offering the *Electronamic* tube tester, to the discriminating purchaser, *PRECISION* does so with a "performance checked" background. Such "performance" tests, heavily emphasized during World War II, were based upon the primary purpose of the instrument—TO FIND BAD TUBES!
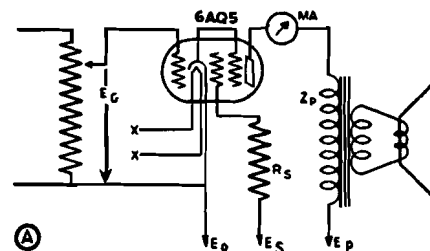
☆ To familiarize ourselves with the principles of the *PRECISION Electronamic* circuit, let us briefly observe the operation of a simple modern pentode such as the 6AQ5, in a standard power amplifier stage, shown in **Diagram A**, with the addition of a current indicating meter in the plate circuit.

The primary purpose of this tube is to deliver electrical output to the speaker through plate load Zp, in the following manner: with filament and plate supply operating and with zero signal applied to the input circuit, the plate milliammeter "MA" will indicate a steady current flow dependent upon cathode emissive power and the potentials of the interspaced elements. This zero signal meter reading is an indication of the tube's plate conductance. By applying an audio signal, Eg, to the input grid, THE PLATE CURRENT THROUGH Zp MUST VARY IN ACCORD WITH THE CHANGES IN GRID VOLTAGE. This is dependent upon the mutual conductance, plate resistance, amplification factor, load resistance, etc. The greater the grid voltage swing, the greater should be the plate current excursions, and accordingly, the louder the sound from the speaker.

Let us now assume that a high order of peak grid signal voltage is applied, (that is in keeping with the tube operating conditions), but severe distortion is nevertheless produced at the speaker, even though all circuit components, aside from the tube, are normal. This condition coincides with low peak plate current readings, and is usually caused by poor cathode structure and/or high plate resistance. In other words, an insufficient quantity of electrons is available to the plate circuit to handle peak power requirements.

Now let us suppose that with a normal signal applied to the input circuit, insufficient or no volume is obtained from the speaker, again assuming all circuit components, aside from the tube, are normal. This condition would indicate that the magnitude of plate current variations versus applied grid signal are not in keeping with the tube specifications and circuit requirements. This can be caused by a multiplicity of internal tube conditions, including reduced amplification factor, low mutual conductance, open, misplaced or shorted screen, control grid, suppressor, or plate, even though the tube's cathode structure may be absolutely normal.

In the case of resistance-coupled amplifiers, the change in plate current produces a change in voltage drop across the plate load resistor. This is then passed on through suitable coupling means to the succeeding stage.
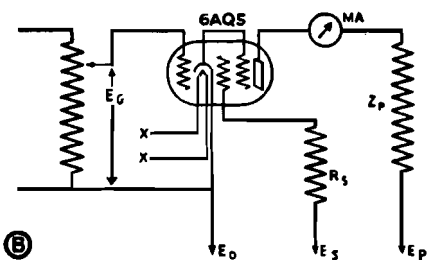
☆ It can therefore again be readily seen that the overall PERFORMANCE Merit of a tube is absolutely dependent on the ability of output plate current to respond to the applied grid voltage, over the full range of possible operating conditions, which involves **More than just Mutual Conductance.**

**Diagram B** shows the *PRECISION Electronamic* circuit set up to check the same type 6AQ5. Note that individual plate, screen and grid voltages and loads are applied to the respective elements of the tube under test and it is thereby being *Electronamically* tested as a pentode. Plate supply voltages from 12 to as high as 300 volts are applied to the tubes under test depending on the individual tube's requirements.

Appropriate treatment is accorded all amplifier tubes depending on whether they are triodes, tetrodes, etc. Multi-purpose tubes are treated and tested as two or more completely independent tubes, WITHOUT REMOVING THE TUBE FROM THE TEST SOCKET. All plate, screen, grid and filament test voltages and respective loads are factory calibrated (per the roller chart) to assure the high tube performance correlation for which the *Electronamic* tube testers are known to the field, both civilian and the military—a performance check based upon the **peak service** for which the tube was designed rather than just an arbitrarily chosen low or midpoint.

☆ As previously outlined, the overall quality or performance merit of a tube is dependent on how well control grid voltage "controls" plate current over a complete **range** of tube application.

For this reason, the *PRECISION Electronamic* circuit places the TUBE MERIT METER in the plate or output section of the tubes under test. Accordingly, the resultant quality or performance figure of merit involves a whole **series of** meaningful operational factors, not just one inconclusive characteristic. Such demanding test will reject all tubes which do not come up to the same standards from which the tube chart data is prepared.

☆ Much of the success of the *Electronamic* tube tester is attributable to the ELECTRO-DYNAMIC SWEEP nature of its circuit operation. Through application of appropriately phased individual element potentials, the tube under test is dynamically swept over a **Path of Operation**, on a sinusoidal time base, encompassing a wide range of plate family characteristics curves. In brief, the tube under test is made to **perform** on a basis which involves its ability to operate at a multiplicity of potential peak conditions rather than at just one arbitrarily chosen point.
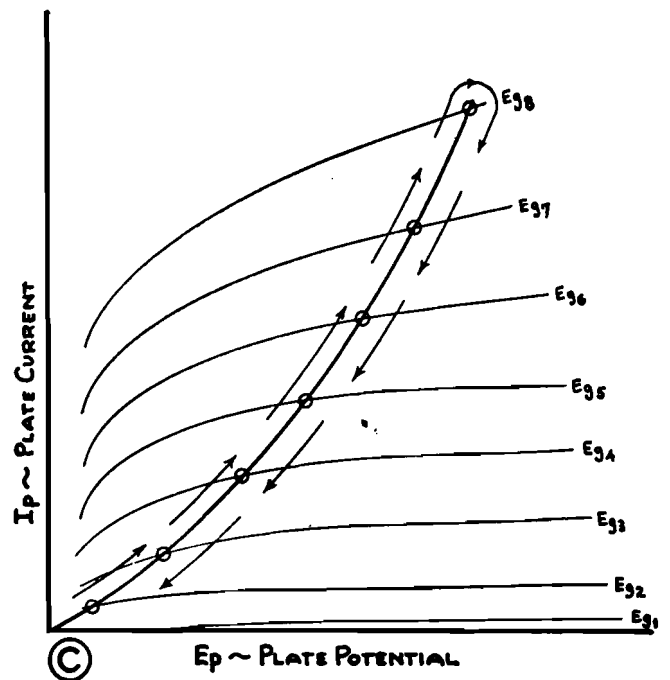
Reference to **Diagram C** graphically and directly illustrates this *Electronamic* picture. It is this encompassing **Path of Operation, involving More than just Mutual Conductance,** which is automatically integrated by the meter as the resultant figure of merit in the direct and non-confusing terms of REPLACE-WEAK-GOOD.

☆ The very nature of the *Electronamic* circuit necessitates and assures utmost instrument flexibility, to permit positive location and selection of all tube elements. This is accomplished in the "10-00" Model Tube Testers via design and use of a free-point LEVER TYPE master element selector system in combination with a multiple push-button short-check unit, PLUS specially engineered rotary, load and element potential selectors.

☆ Aside from the development of the complete *Electronamic* circuit, special consideration was given to the design of a reliable direct reading Gas Test, Hot Cathode Leakage Test, inter-element Short Check, and instantaneous Filament Continuity Test, to show up electrical and mechanical tube defects such as cathode to filament leakage, shorted, loose or open elements, open filaments, etc. THE CATHODE LEAKAGE CIRCUIT SENSITIVITY AND TEST VOLTAGE IS ADJUSTED TO COMPLY WITH THE APPROVED LEAKAGE SPECIFICATIONS OF LEADING TUBE MANUFACTURERS. Inter-element short-check **voltages have been critically selected to provide most effective test results without electrostatic damage to sensitive tube elements.** Additional independent circuit facilities appropriately accommodate diodes, rectifiers, tuning eyes, gas rectifiers, thyratrons, voltage regulators, etc.

☆ Modern methods of instrument construction, telephone cabled wiring and highest quality of materials afford maximum ruggedness for long-lasting satisfaction. INDIVIDUAL DUAL CALIBRATION against laboratory standards, insures maximum accuracy, and controlled, uniform *PRECISION* performance.



Ep ~ Plate Potential

Ip ~ Plate Current

Ec1, Ec2, Ec3, Ec4, Ec5, Ec6, Ec7, Ec8



6AQ5   MA   Eg   Zp   Rs   Eo   Es   Ep