

RESTRICTED

MODEL OQ-2
VACUUM TUBE TESTING EQUIPMENT

INSTRUCTIONS

Manufactured for
NAVY DEPARTMENT BUREAU OF SHIPS
by
WESTON ELECTRICAL INSTRUMENT CORP.
Newark, N.J.

Contract NXss/a-13581

Contract Dated September 30, 1942

GUARANTEE

ON

MODEL OQ VACUUM TUBE TESTING EQUIPMENT

This Model OQ Vacuum Tube Testing Set is guaranteed to be free from defects in workmanship and material for a period of one year of service, this period to be considered as actual service covering the time the device is installed and in use. In the event that the device has not seen a full year's service at the end of a two year period from the date of this contract, this guarantee shall be considered as terminated. This guarantee does not cover vacuum tubes as used in the device itself, lights, or fuses, all of which are purchased on the open market from one or more commercial companies, and carry the usual guarantee of the manufacturer.

In the event that defects are found, other than the parts mentioned in the previous paragraph, this guarantee shall cover the satisfactory repair or replacement of the defective part, at the contractor's plant, Newark, N. J., within the two year period mentioned above. Should such defects occur, report of failure of any part of this equipment during its service life, shall be made to the Bureau of Ships in accordance with current instructions. The report shall cover all details of the failure and give the date of installation of the equipment. Refer to latest revision of Bureau of Engineering Circular Letter No. 40 for instructions concerning Reports of Failures, etc.

Contract NXss/a-13581

Contract Dated September 30, 1942

Serial number of equipment.....

Date of acceptance by the Navy.....

Date of delivery to contract destination.....

Date of completion of installation.....

Date placed in service.....

WESTON ELECTRICAL INSTRUMENT CORPORATION

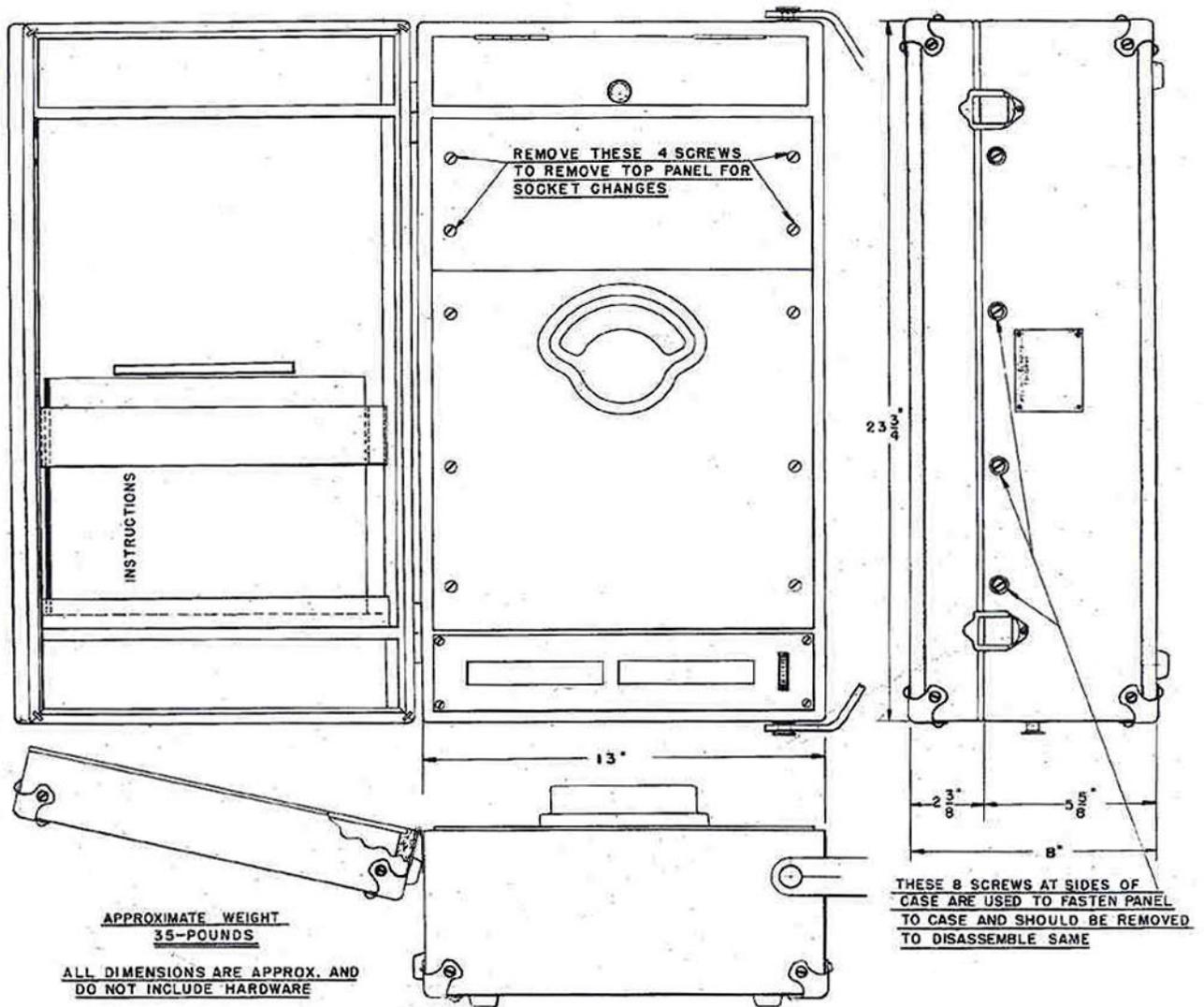
Newark, N. J., U. S. A.

RESTRICTED

INSTRUCTIONS
on
THEORY AND USE
of
MODEL OQ
VACUUM TUBE TESTING EQUIPMENT

Supply: 115 Volts—60 Cycles
35 Watts

This instruction book is furnished for the information of commissioned, warrant, enlisted and civilian personnel of the Navy whose duties involve design, instruction, operation and installation of radio and sound equipment. The word "RESTRICTED" as applied to this instruction book signifies that this instruction book is to be read only by the above personnel, and that the contents of it should not be made known to persons not connected with the Navy.



Dimensional Diagram of OQ Equipment
Approximate Weight: 35 Lbs.

TABLE OF CONTENTS

	PAGE
I. INTRODUCTION	
A. Testing Vacuum Tubes.....	2
B. Apparatus & Data.....	2
C. The Method	3
II. DETAILED DESCRIPTION OF THE EQUIPMENT	
A. General	4
B. Short Test System.....	4
C. Heater Voltage Supply.....	4
D. Element Voltage Circuit.....	5
E. Proportional Mutual Conductance Readings.....	5
F. The Controls	5
III. OPERATION—THE TESTING OF VACUUM TUBES	
A. Unpacking and Setting Up.....	8
B. Testing an Amplifier Tube.....	8
C. Testing Rectifiers and Diodes.....	9
D. Explanation of Tube Data Charts and Tables.....	10
E. Condensed Step by Step Procedure.....	10
LIST OF ILLUSTRATIONS	
Block Diagram	3
Wiring Diagram	7
Tube Base Diagrams.....	21, 22, 23, 24
LIST OF TABLES	
Complete Tube Data	11, 12, 13, 14, 15, 16, 17
Table of Abbreviations.....	10
Tube Base List.....	18, 19
Parts List	25, 26
Cross Index of old and new Navy Type Numbers.....	20

I.**INTRODUCTION****A. TESTING VACUUM TUBES**

Each vacuum tube purchased by the Navy is subjected to more than fifteen electrical and mechanical tests which are designed to insure that vacuum tubes supplied to the Service are satisfactory in every respect.

It is seldom that tubes, during shipment or handling, are subjected to mechanical shocks of sufficient magnitude to dislocate or dismember the electrodes; however, it is desirable to have available a means for quickly and easily testing vacuum tubes prior to placing them in service.

The end of useful life of vacuum tubes is usually occasioned by a reduction of electron emissivity of the cathode which reduces the amplifying ability or conductivity of the tube. In receiving equipment this decadence of a tube results in loss of sensitivity and, in the case of rectifier tubes, with a reduction of the rectified output voltage. Whenever receiving equipment operates subnormally, it is desirable to have available a means for testing each vacuum tube so that the defective one may be replaced, if the fault lies in the tubes, and so that the remainder may be retained to deliver additional useful life.

To fulfill the need for a portable tube testing device, the Service has been provided with the Model OQ Vacuum Tube Testing Equipment.

This tube tester was designed to provide a portable device, with the best possible accuracy, consistent with size and weight. With the large number of tubes in use by the Service and available on the commercial market, flexibility was also an important object so that facilities would be available in all types of emergencies for obtaining reasonably accurate measurements on vacuum tubes in all types of communication receiving equipment. The accuracy of measurement obtainable is partly a function of the skill of the operator in adjusting the applied voltages and instruments to the correct values and in reading the instrument indications. The indications of the potential and current instruments used with this equipment are guaranteed to be accurate to only 2% of their full scale read-

ings. Should all instrument errors happen to be cumulative, errors of 6 to 8% or even 10% are possible. Care should therefore be exercised in setting the instruments correctly for best accuracy.

B. APPARATUS AND DATA

The Model OQ equipment includes the following apparatus:

A group of vacuum tube sockets engraved with the R.M.A. standard pin numbering, consisting of a 4 pin, 5 pin, 6 pin, combination large and small 7 pin, an 8 pin loktal, an 8 pin octal, a miniature, an acorn socket and a separate socket for testing the Western Electric 215A peanut tubes; a transformer supplying suitable heater voltage in accord with a selector switch setting, to any of the above mentioned sockets; patch cords for making connections to any of the socket pins; a second and separately controlled power transformer for supplying potentials for all other electrodes including plate, grid, screen and suppressor voltages; individual $3\frac{1}{2}$ " a.c. instruments for indicating the correct transformer potentials; a plurality of controls for selecting the correct proportional voltages to be supplied to the patch cord jacks; a self-contained d.c. supply including a rectifier tube and suitable transformer windings for supplying the energy for short testing; a neon lamp operating with a short test switch for indicating short circuited tube elements and a large fan shaped meter with 4" scale length for reading the proportional mutual conductance and emission readings on the various vacuum tubes. A block diagram of the equipment is shown on page 3.

The four master controls are lettered A through D, and are in line on the bottom of the panel. Settings for controls "A", "C", and "D" for each tube, and the cut-off or end point reading on the main indicating instrument, are tabulated on a roller type indexing chart mounted in the oak case, directly below the panel. This roller chart provides all the data necessary for tube testing, providing the operator is familiar with the tube base connections for the tube to be tested. A complete

set of tube base charts is available elsewhere in this book for locating the pin numbers for each tube electrode. In addition, complete data including all pin numbers, voltages required and end point readings are listed in a large table in this book. If the tube to be tested is listed on the roller chart, but the base data is not known, this table will be far more rapid in use for making the various patch cord connections and setting the controls, than the tube base charts.

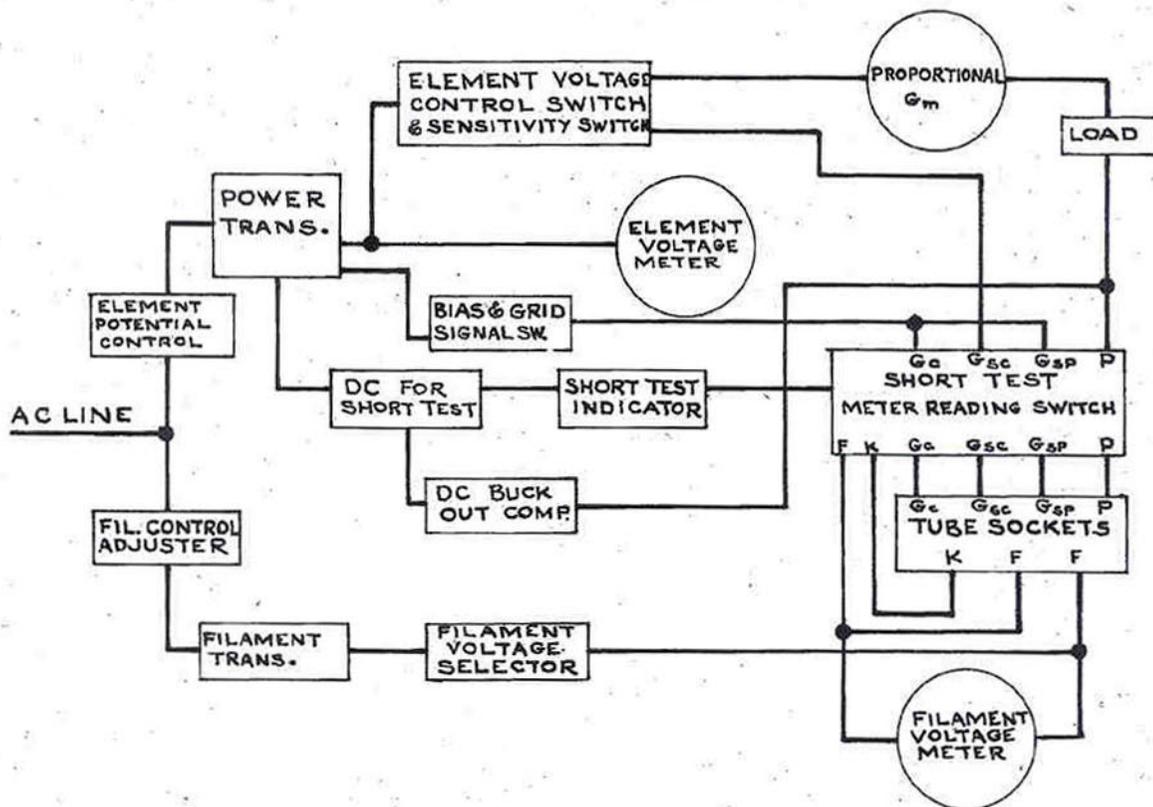
C. THE METHOD

Of the many measurable characteristics of a vacuum tube, the transconductance is the one most closely associated with operating performance. For this reason, the factor which determines the end of useful life of vacuum tubes is generally taken to be the transconductance except in the case of diodes which have no grids and except in the case of certain other tubes, the transconductance of which is not conveniently measured. The factor which determines the end of useful life of these last mentioned tubes is generally taken

to be the cathode emission current measured under specified conditions.

The Model OQ equipment measures proportional mutual conductance in terms of percent above or below the normal listed or so-called bogie value, as specified by the various tube manufacturers. This measurement is made by reading the change in plate current with simultaneous change in grid voltage. Various grid signal values are used in accord with the type tube under measurement, and suitable potentials are applied to the various electrodes through the switching controls A through D. A.C. potentials are used in all cases, the tube under test acting as its own rectifier and the main indicating instrument showing the rectified current in the plate circuit. Under controlled conditions a change in the grid voltage will cause a proportionate change in the plate current, and this reading if taken on the proper section of the tube characteristic, will be proportional to the mutual conductance of the vacuum tube as measured under standard conditions, such as those used in the Model OD equipments.

BLOCK DIAGRAM



II.

DETAILED DESCRIPTION OF THE EQUIPMENT

A. GENERAL

The complete tube checker is housed in a heavy quartered oak case supplied with suitable protective corners and a full length carrying strap. The tube testing panel in itself consists of two sections. The first, or lower section, containing all of the instruments, controls, short test lamp, pilot light and the energized patch cord jacks, and the upper or smaller section containing only the tube sockets and connections to the corresponding set of patch cord jacks numbered in accord with the R.M.A. basing system. The two panels are held together by heavy brass angle pieces, and this whole section of the tester may be removed in one unit by taking out the four large oval head screws in line on the handle and hinged sides of the oak case. The panel screws only mount the two panel sections together on the brass angle pieces, and these should not be disturbed when removing the equipment from the case. The large screws that go through the oak case into the angle brackets, are the ones that should be removed when it is necessary to take the test set out of the case. The socket panel is kept separate and this CAN BE removed separately by taking out the four corner screws holding this section to the brass angle pieces. However, this should only be necessary for actual socket replacement or repair as required. This panel has been manufactured as an individual section so that should tube bases change radically, requiring new socket designs, this section could be replaced at a relatively small cost.

The tube indexer of the roller chart type, mounts in a separate section at the bottom of the case, and this can be taken out by removing the four corner wood screws. This indexer is equipped with a printed chart approximately three feet long, which can be removed and replaced if necessary. Three metal clamps of the snap-on type hold the paper in position on each end of the rollers, and a new chart may be set in position by removing these clamps and snapping them on individually over the new paper chart on the roller. Space is available at the lower section

of the roller chart for adding extra tubes. This can be done by removing the indexer and writing in pencil or ink on the line near the bottom of the page.

A lead compartment is available at the top section of the case and this houses the twelve individual patch cords and a ten foot line cord equipped with a fuse plug. A hinge cover is provided so that the cords can be kept in this compartment when not in use. The cover has a notch in one corner for the line cord so that the set can be operated with this compartment door closed. Spare fuses are provided in a small envelope which should be kept in this compartment, and should the device fail to function, the fuses in the plug itself can be examined and replacements made if necessary. Note that each side of the line is fused and that both fuses should be tested if failure occurs.

B. SHORT TEST SYSTEM

The short testing circuit of this device has been worked out so that the tube is tested for all inter-electrode shorts after it has been brought up to temperature, for mutual conductance or emission testing. This circuit operates through the master control switch B and a six position short testing switch. A single neon lamp is used, this lamp being connected into each of the electrode circuits consecutively by operation of the six position switch. This short testing is done after the patch cords are in position, but just before the emission or mutual conductance readings are taken. Energy for the short test is supplied through one of the two internal transformers and a rectifier tube. The voltage of this circuit is automatically adjusted when the right hand or element voltage instrument is set to the correct reading. No other rectifier tubes are used in this device.

C. HEATER VOLTAGE SUPPLY

Heater voltages are available in steps all the way from 1 volt to 120 volts. These potentials are selected by the rotary switch control marked A and are available in values used on the greater proportion of receiver vacuum

tubes. The switch selects the approximate voltage and final adjustment of the potential is made by using the HEATER VOLTAGE ADJUSTER and setting the reading to the correct value on the heater voltage instrument directly above this control. An interlocking circuit is used on the heater voltage switch marked A, to automatically select the correct potential range on the heater voltage instrument. This avoids damage to the meter from overloading when rotating the switch rapidly from one potential to another. A separate transformer is used for all heater potentials and, therefore, adjustments of this voltage do not in any way affect the potentials used on the other electrodes. The readings on the heater voltage instrument should always be checked after the tube is placed in the socket to be sure to correct for any drop in potential caused by loading the filament transformer.

D. ELEMENT VOLTAGE CIRCUIT

All other electrode potentials as differentiated from heater potentials are supplied by a second, separately controlled transformer. The actual values of these potentials are selected by a 22 position control marked D. These voltages are then supplied to the patch cord jacks on the top of the panel in accord with the heading on the marked plate directly above the jacks. An element voltage instrument is mounted above this control D and is used for setting the line potential on this transformer to the correct value. A control directly below the instrument marked PLATE VOLTAGE ADJUSTER is used to set the instrument pointer to the 100 volt mark as indicated by an arrow on the scale of this instrument.

Control C is used for setting up the proper values of shunt resistance network for the instrument and meter reset circuits. All the controls, A through D, should be set to the proper positions before placing the tube in the socket. Switch B should always be in the left hand or SHORT TEST position, until the tube has come up to temperature and a short test made by operating the six position switch marked ROTATE WATCHING NEON LAMP. Any flash or indication on the neon lamp will show a short between two or more of the electrodes, and the tube should be rejected as unfit for service at this point. Further testing of the tube under severe

shorted conditions may cause damage to the test set.

E. PROPORTIONAL MUTUAL CONDUCTANCE READINGS

The fan shaped instrument in the center of the panel is equipped with a scale marked 0 to 130. This instrument will indicate readings in percent of normal mutual conductance or emission on all tubes except in a few cases where the tubes are listed with a notation in the remark column to the effect that the normal reading is less than 100. The test set is calibrated on each tube type so that where the tube is normal with a manufacturer's rated mutual conductance, it will read 100 on this instrument. If the tube happens to have a mutual conductance higher than the rated value, it will show indications above the 100 value up to 130%. If the tubes read higher or show an indication off scale on the instrument, it is doubtful if they should be used for normal service. End point values are listed in the book and examples will be given on subsequent pages showing the minimum readings acceptable for Naval service.

When testing each amplifier tube, that is, all tubes calling for mutual conductance readings, the normal plate current of the tube must be cancelled out or bucked out on the large fan shaped instrument. When a tube has been brought up to temperature and control B set in the METER READINGS position, this meter will indicate normal plate current. The control to the lower right of the fan shaped instrument should be rotated in a clock-wise direction INCREASING THE REVERSE OR BUCK-OUT CURRENT THROUGH THE METER bringing the pointer back to the zero value. The mutual conductance test switch marked G_m TEST should then be depressed and the percent indication noted. If this reading is above the rejection point as listed on the roller chart or in the instruction book tables, the tube can be used for further service.

F. THE CONTROLS

Heater Volts—A. This is the selector switch for the approximate filament voltage. It should be set first of all to the correct reading as listed on the roller chart for Control A.

Switch B. This is the master control switch to separate short test and mutual conductance

or emission readings. It should always be set first to the SHORT TEST position until this part of the test is completed.

Control C. This is a double potentiometer controlling two separate instrument circuits and should be set to the correct value as noted on the roller chart under the column headed Control C.

Control D. This is the master control for selecting the series of electrode potentials required for proper testing of the particular vacuum tube in question. This should be set in accord with column D on the roller chart.

Heater Voltage Adjuster. This is the vernier control for accurately setting the heater voltage to the correct value as read on the HEATER VOLTAGE instrument. It is used after Control A is set to the correct position.

Short Test Switch Marked "Rotate Watching Neon Lamp". This is a six position switch connecting all electrode circuits in turn into the short test circuit and should be rotated while watching the neon lamp.

Meter Reset. This is a potentiometer controlling the reverse current through the proportional mutual conductance indicating instrument. It is only used for measuring G_m percentage values and is not required and can be ignored when testing rectifiers and diodes for emission values. It is automatically disconnected from the circuit when the four

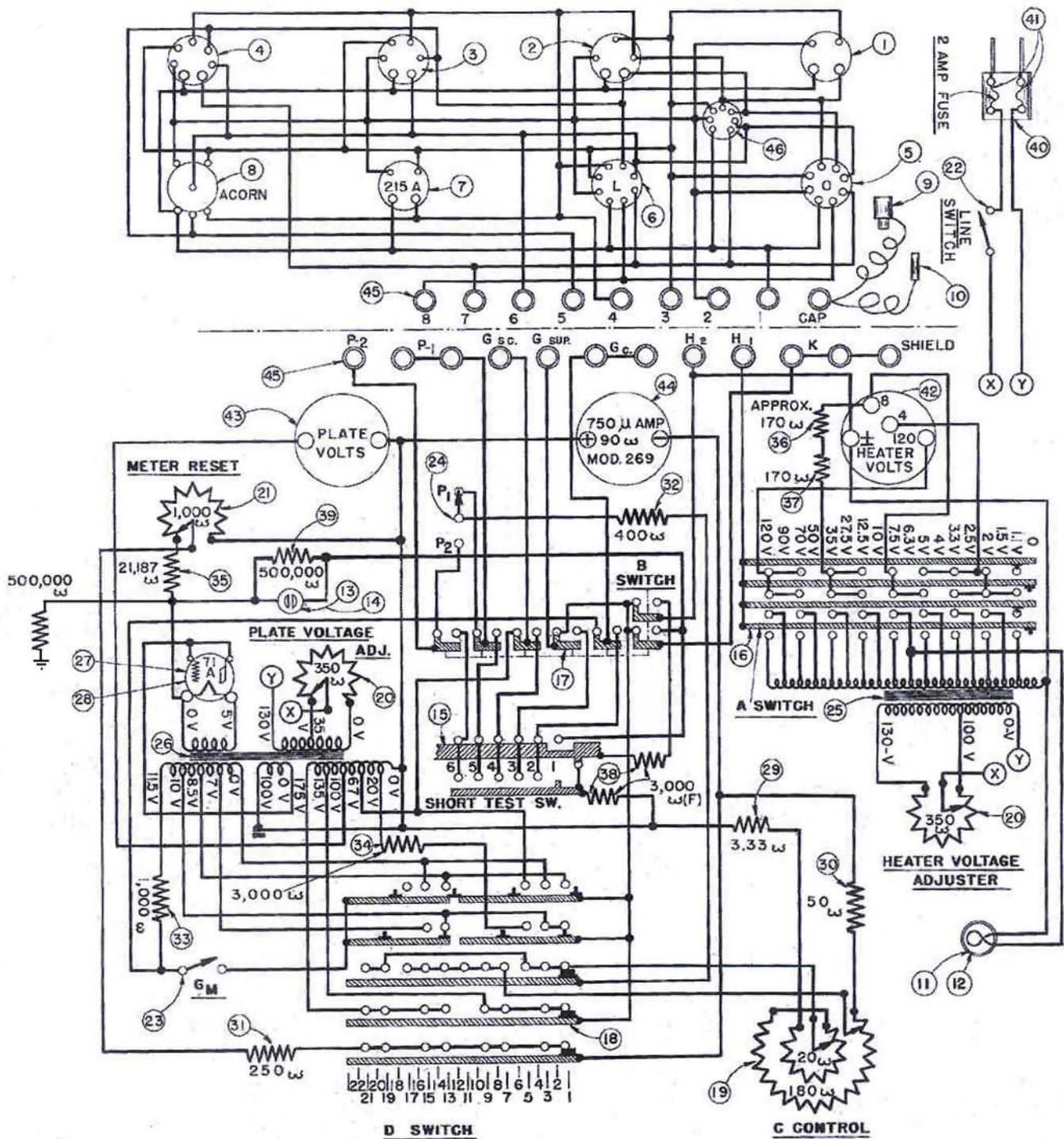
main controls A through D are properly set for emission readings.

Plate Voltage Adjuster. This is used to set all other voltages other than the heater voltage to the correct values. This should be used to set the ELEMENT VOLTAGE instrument to the 100 volt position as indicated by the arrow.

On-Off Switch. This is mounted on the left hand side of the panel below the heater voltage instrument. This controls energy flow to all circuits. The red jewel light indicates at all times whether or not this switch is turned on.

Normal Plate—Second Plate Switch. This is used when testing double plate rectifiers, diodes and two section triodes and pentodes, etc. It actually connects the two patch cord jacks marked Plate No. 1 into the circuit when the switch is in the NORMAL PLATE position, and the patch cord jack marked Plate No. 2 when this switch is in the SECOND PLATE position. This control should always be kept in the NORMAL PLATE position except when taking actual readings on the second sections of double tubes.

G_m Test Switch. This is a spring return switch and should only be depressed for proportional mutual conductance readings on the large fan shaped instrument, after the pointer has been set to the zero position by means of the meter reset control.



Wiring Diagram

III.

OPERATION

THE TESTING OF VACUUM TUBES

A. UNPACKING AND SETTING UP

Remove the Model OQ equipment from the shipping carton by means of the leather carrying strap, and set the device in the horizontal position on the table or bench for operation. Open the cover by releasing the two snap catches on the handle side and, if desirable, remove the cover entirely by means of the slip hinges. The instruction book is held in the cover of the set, and may be removed by sliding it towards the top of the cover.

Open the hinged compartment at the top of the instrument, and unpack the twelve patch cords, and line cord assembly. The patch cords can be left temporarily in the compartment and the line cord inserted in a 60 cycle, 115 volt outlet.

Turn on the test set by means of the left hand toggle switch. The pilot light and right hand instrument should indicate immediately. The left hand instrument will also show a reading if the A control is indexed to one of the voltage positions. Index switch B to the SHORT TEST position and connect a patch cord from one of the jacks marked CATHODE to one of the jacks marked CONTROL GRID. With the short test switch marked ROTATE WATCHING NEON LAMP in either the 1 or 2 position, the neon lamp should indicate.

If no meter or pilot light indications are obtained at first, check the fuses in the plug making sure these are not open circuited, and also be sure that there is energy at the a.c. outlet. If the neon lamp shows no indication, be sure this is indexed correctly in the socket. This is a bayonet type of socket and the lamp must be pushed down and rotated to remove it or insert it in the socket.

Remove the patch cord used for checking the short test lamp and replace this in the top compartment.

B. TESTING AN AMPLIFIER TUBE

Select a tube to be tested. It is recommended that one of the simpler types be tried first, such as the type 01A, the first tube listed

on the roller chart. Set controls A, C and D to the 5.0, 10 and 10 positions respectively. Set control B to the SHORT TEST position. This tube has a conventional four prong base, and therefore, patch cords should be connected from the two heater jacks to socket panel jacks 1 and 4 respectively. The control grid is on No. 3 and therefore, this jack should be connected with one of the control grid jacks. The plate is on pin No. 2 and this should be connected to one of the two jacks marked PLATE 1. *The "PLATE 1" jacks should always be used on tubes having a single plate electrode.* The "PLATE 2" jack is only used on double tubes.

Be sure that the test set is turned on. The heater voltmeter should read approximately 5 volts and the PLATE VOLTAGE ADJUSTER should be rotated to bring the element voltmeter to the 100 mark. Place the tube in the four prong socket and correct the heater voltage reading if necessary, by means of the HEATER VOLTAGE ADJUSTER. Rotate the short test switch from positions 1 through 6 watching the neon lamp. If the tube is free from shorts; index the B control to the METER READINGS position. A plate current indication should be noted on the large fan shaped meter. Be sure that the NORMAL PLATE-SECOND PLATE switch is in the NORMAL PLATE position. Starting from the counter-clockwise extreme position, rotate the METER RESET control until the pointer of the large fan shaped meter reads zero. This control covers a wide range of reverse currents, and some care may be required in accurately setting the pointer to the zero mark. After this is done, depress the G_m TEST switch. The condition of the tube in terms of percent normal mutual conductance will be noted on the large fan shaped meter. Refer to the roller chart, and this will show that this tube has a rejection point (Rej. Pt.) value of 65. If the reading is above 65 on this instrument, the tube should be retained as having sufficient mutual conductance for normal purposes. After completion

of the test, it is advisable to reset Control B to the short test position before proceeding with the testing of another tube. If other tubes of this type are to be checked, they should all be done at once to avoid having to reconnect the patch cord jacks.

Other amplifier tubes are tested in similar fashion. In each case set the controls A through D to the correct positions as listed, always starting with the B control in the SHORT TEST position. Keep the NORMAL PLATE-SECOND PLATE switch in the NORMAL PLATE position and always start with the METER RESET control in the extreme counter-clockwise position. If desirable, the heater connections can be made first using the patch cords, and the tube placed in its socket and allowed to come up to temperature while the balance of the patch cords are being connected. *This should only be done with the B control in the SHORT TEST position so as to avoid any damage to the tube or test set during the patching process.*

If the tube base connections are known, all information necessary for testing the tube is listed on the roller chart. There are a few tubes such as converters wherein special patch cord instructions are necessary, and on these tubes the roller chart lists a notation "See Instruction Book". On tubes of this type there are several ways of measuring the mutual conductance, and to obtain correct test readings the patching instructions in the tube data tables listed further on in this book, should be referred to. On twin triodes, twin tetrodes, and pentodes as well as double plate rectifiers and diodes, a single patching operation can be used for testing both sections of the tube. If mutual conductance readings are desired, the two grid circuits can be patched simultaneously to the grid jacks, with one plate circuit connected to one of the jacks marked "PLATE 1", and the second plate connected to the separate jack marked "PLATE 2". In this case the normal procedure for testing a single amplifier tube should be followed and after this is complete, the NORMAL PLATE-SECOND PLATE switch should be changed to the SECOND PLATE position, the large fan shaped instrument again balanced to the zero value, and the proportional G_m reading taken on the second section of the tube.

Where a glass tube (G or GT) has equivalent characteristics to the metal tube, only

one type is listed and values given apply to all.

C. TESTING RECTIFIERS AND DIODES

On rectifier tubes and diodes, emission readings are used to measure the condition of the tube. This means that the meter reset control and the G_m test switch are not used for any measurements on either rectifier or diodes types. The first indication on the large fan shaped meter is, therefore, the measurement of the tube condition.

To test a rectifier tube, proceed in the same way in setting up the correct switch positions A through D. Make the patch cord connections as listed under the complete tube data in the instruction book, or, in accord with the tube base diagram. If the tube is a double plate rectifier, connect one plate to the "PLATE 1" jack and the second plate to the jack marked "PLATE 2".

Test the tube for shorts and then change the control B to the METER READINGS position. Note the large fan shaped instrument reading in percent of normal and compare this with the cut-off value on the chart in the book. If the tube is a double plate rectifier type, shift the NORMAL PLATE-SECOND PLATE switch to the SECOND PLATE position and note the condition of the second section of the tube. If the tube has only one plate, use the jacks marked P1 and leave this switch in the NORMAL PLATE position. It is only necessary to use this switch when double section tubes are involved.

In testing diodes such as the 6H6 or other equivalent types, proceed exactly as in the case of rectifier tubes. Note when testing all diodes, that the meter indications of normal tubes are considerably below the 100 value on the instrument scale. This is due to the limited current in tubes of this type, where the cathode and plate areas are quite small. Normal readings for these tubes, as well as some other types, are listed separately preceding the rejection point value. Diode currents in these tubes may vary considerably; and in some cases may be 2 or 3 times the minimum deflection or rejection point value listed in the chart. Such tubes are perfectly all right so long as they will show emission readings above the rejection point value.

Where diode plates are encountered in tubes with other sections, such as duo-diode-pentodes, and diode-triode combinations, the

amplifier section should first be tested in accord with instructions under amplifier tubes, and then each diode plate checked afterwards to be sure that the diode sections of these tubes are in good condition.

D. EXPLANATION OF TUBE DATA CHARTS AND TABLES

Roller Chart. This lists all of the tubes encountered in normal Navy service work and also a very large group of commercial types. This roller chart is divided into two sections or columns, one for each rectangular window. The tubes are listed in the left hand column of each window section in numerical order, all types in the number series from 0 to 6 inclusive appear in the left hand section as the indexer is rotated. All other types with numbers starting with the digit 7 up through the 117 volt types and letter types such as the Western Electric tubes, appear in the right hand section. No patch cord connections or tube base data are given on this roller chart, as such information would require entirely too much space to include in a roller chart design. If the tube base is known, all other information necessary is listed on the roller chart. The settings for Controls A, C and D are shown opposite each tube type, and in addition, any notes that are required, as well as the rejection point values are listed. Where glass tube (G or GT) has equivalent characteristics to the metal tube, only one type is listed and values given apply to all. If data on the tube basing are required, the complete tube data listings can be referred to, wherein this same list of tubes is repeated with the settings for the various controls, and also the patch cord connections for each electrode.

Tube Base Charts. Complete tube base charts are given in this book for general information only. These charts include all of the R.M.A. tube base assignments, as well as some additional base diagrams required for special types.

Navy Type Numbers. Where the old Navy type numbers are encountered the cross-index of old and new type numbers for vacuum tubes, listed on page 18, may be referred to.

Table of Abbreviations. Certain abbreviations have been used in listing the tube data to conserve on space, especially on the roller chart. These are given below and the operator should become familiar with these in

order to make the best use of the tables and roller chart listing:

Cap	This refers to the tube top cap.
Di.	Diode.
G_m	Mutual conductance.
Hex. Conv.	Hexode converter.
Norm.	Normal. This is the normal value for good tubes. Where this value is other than 100, the normal value is listed.
Pe.	Pentode.
Pent. Conv.	Pentagrid converter.
Rect.	Rectifier.
Rej. Pt.	Rejection point, or cut-off point. Tubes showing readings below this value should be rejected as unfit for service.
Tr.	Triode.
Tw. Pe.	Twin pentode.
Tw. Tr.	Twin triode.

E. CONDENSED STEP BY STEP PROCEDURE

This condensed procedure is listed for rapid reference whereby the operator can check quickly to be sure that he is going through the proper sequence in completely testing a vacuum tube.

1. Locate the tube type number on the roller chart or in the complete tube data tables in the book.
2. Set the panel controls A, C and D to the listed values, and set Control B to the SHORT TEST position.
3. Make the patch cord connections for each of the tube electrodes, referring to the complete tube data in the book if the base connections are not known.
4. Turn on the tube tester and set the heater voltmeter to the correct reading and the element voltmeter to the indicating arrow.
5. Place the tube in the socket and allow it to come up to normal operating temperature. If the tube has a top cap connection, be sure to connect the grid lead.
6. Rotate the SHORT TEST switch through the 6 indicated positions watching the neon lamp. It is often advisable to tap

the tube with a pencil when looking for intermittent shorts. If the lamp indicates on any of the 6 positions, the tube should be rejected as shorted.

7. Be sure the NORMAL PLATE-SECOND PLATE switch is in the NORMAL PLATE position and the METER RESET control in the extreme counter-clockwise position.
8. Index B control to the METER READINGS position. On most tubes a plate current indication will be noted on the mutual conductance meter. On all tubes such as rectifiers and diodes, where emission readings are used, this will show the tube condition.
9. On amplifier types, rotate the METER RESET control in a clockwise direction, resetting the instrument pointer to the zero position.
10. Depress the G_m TEST switch and note the proportional mutual conductance reading. Compare this reading with the rejection point value on the roller chart.
11. If the tube has two identical sections, and the patch cords have been set up for the testing of both sections at once, manipulate the NORMAL PLATE-SECOND PLATE switch, set the pointer again to the zero position value and depress the G_m TEST switch for the reading on the second section of the tube.

COMPLETE TUBE DATA FOR MODEL OQ

Tube Type	Heater	Cathode	Control Grid	Normal Plate	Second Plate	Screen	Suppressor	Panel A	Panel C	Panel D	Rej. Point	Remarks	Tube Type
01A	1-4	---	3	2	---	---	---	5.0	10	10	65		01A
1A3	1-7	3	---	2	6	---	---	1.4	13	11	20	Diode	1A3
1A4	1-4	---	Cap	2	---	3	---	2.0	27	9	65		1A4
1A5-G	2-7	---	5	3	---	4	---	1.4	50	8	50		1A5-G
1A6	1-6	---	4 & Cap	2 & 3	---	5	---	2.0	46	8	50	Pent. Cover	1A6
1A7-G	2-7	---	5 & Cap	3 & 6	---	4	---	1.4	39	8	50	Pent. Cover	1A7-G
1B4-P	1-4	---	Cap	2	---	3	---	2.0	34	9	65		1B4-P
1B5/25S	1-6	---	5	2	---	---	---	2.0	50	8	52	Tr; Norm-79	1B5/25S
1B5/25S	1-6	---	---	3	4	---	---	2.0	13	11	25	Di.	1B5/25S
1C5-G	2-7	---	5	3	---	4	---	1.4	10	9	50		1C5-G
1C6	1-6	---	4 & Cap	2 & 3	---	5	---	2.0	28	8	50	Pent. Conv.	1C6
1C7-G	2-7	---	5 & Cap	3 & 6	---	4	---	2.0	28	8	50	Pent. Conv.	1C7-G
1D5-GP	2-7	---	Cap	3	---	4	---	2.0	33	9	65		1D5-GP
1D7-G	2-7	---	5 & Cap	3 & 6	---	4	---	2.0	46	8	50	Pent. Conv.	1D7-G
1D8-GT	2-7	---	5	3	---	4	---	1.4	33	8	50	Pe.	1D8-GT
1D8-GT	2-7	---	Cap	6	---	---	---	1.4	47	9	65	Tr.	1D8-GT
1D8-GT	2-7	---	---	8	---	---	---	1.4	13	11	20	Di.	1D8-GT
1E5-GP	2-7	---	Cap	3	---	4	---	2.0	35	9	65		1E5-GP
1E7-G	2-7	---	4 & 5	3	6	8	---	2.0	41	8	50	Tw. Pe.	1E7-G
1F4	1-5	---	3	2	---	4	---	2.0	32	8	50		1F4
1F5-G	2-7	---	5	3	---	4	---	2.0	32	8	50		1F5-G
1F6	1-6	---	Cap	2	---	3	---	2.0	41	9	65	Pe.	1F6
1F6	1-6	---	---	4	5	---	---	2.0	13	11	20	Di.	1F6
1F7-GV	2-7	---	Cap	3	---	6	---	2.0	41	9	65	Pe.	1F7-GV
1F7-GV	2-7	---	---	4	5	---	---	2.0	13	11	20	Di.	1F7-GV
1G4-G	2-7	---	5	3	---	---	---	1.4	5	10	65		1G4-G
1G5-G	2-7	---	5	3	---	4	---	2.0	21	8	50		1G5-G
1G6-G	2-7	---	4 & 5	3	6	---	---	1.4	27	9	50	Tw. Tr.	1G6-G
1H4-G	2-7	---	5	3	---	---	---	2.0	19	9	65		1H4-G
1H5-G	2-7	---	Cap	3	---	---	---	1.4	50	9	55	Tr; Norm-84	1H5-G
1H5-G	2-7	---	---	5	---	---	---	1.4	13	11	20	Di.	1H5-G
1H6-GT	2-7	---	6	3	---	---	---	2.0	50	8	52	Tr; Norm-80	1H6-GT
1H6-GT	2-7	---	---	4	5	---	---	2.0	13	11	20	Di.	1H6-GT
1J5	2-7	---	5	3	---	4	---	2.0	10	10	50		1J5
1J6-G	2-7	---	4 & 5	3	6	---	---	2.0	18	9	50	Tw. Tr.	1J6-G
1LA4	1-8	---	6	2	---	3	---	1.4	50	8	50		1LA4
1LA6	1-8	---	4 & 6	2 & 3	---	5	---	1.4	45	8	50	Pent. Conv.	1LA6
1LB4	1-8	---	6	2	---	3	---	1.4	33	8	50		1LB4
1LC6	1-8	---	4 & 6	2 & 3	---	5	---	1.4	40	8	50	Pent. Conv.	1LC6
1LH4	1-8	---	6	2	---	---	---	1.4	50	9	55	Tr; Norm-84	1LH4

COMPLETE TUBE DATA FOR MODEL OQ

Tube Type	Heater	Cathode	Control Grid	Normal Plate	Second Plate	Screen	Sup-pressor	Panel A	Controls C	D	Ref. Point	Remarks	Tube Type
1LH4	1-8	....	.....	.....	4	....	....	1.4	13	11	20	Di.	1LH4
1LN5	1-8	....	6	2	....	3	4	1.4	50	9	65		1LN5
1N5-G	2-7	....	Cap	3	....	4	....	1.4	50	9	62	Norm-95	1N5-G
1N6	2-7	....	5	3	....	4	....	1.4	50	8	50	Pe.	1N6
1N6	2-7	....	.....	6	....	....	....	1.4	13	11	20	Di.	1N6
1P5	2-7	....	Cap	3	....	4	....	1.4	47	9	65		1P5
1Q5-GT	2-7	....	5	3	....	4	....	1.4	15	8	50		1Q5-GT
1R5	1-7	....	4 & 6	2	....	3	....	1.4	25	9	50		1R5
1S4	1-7	....	3	2	....	4	....	1.4	50	4	38	Normal-76	1S4
1S5	1-7	....	6	5	....	4	....	1.4	46	9	50	Pe.	1S5
1S5	1-7	....	.....	3	....	....	....	1.4	13	11	20	Di.	1S5
1T4	1-7	....	6	2	....	3	....	1.4	24	9	65		1T4
1T5-G	2-7	....	5	3	....	4	....	1.4	31	8	50		1T5-G
1-V	1-4	3	....	2	....	....	....	6.3	1	6	60	Rect.	1-V
2A3	1-4	....	3	2	....	....	....	2.5	21	4	50		2A3
2A5	1-6	5	4	2	....	3	....	2.5	3	10	50		2A5
2A6	1-6	5	Cap	2	....	....	....	2.5	17	9	65	Tr.	2A6
2A6	1-6	5	....	3	4	....	....	2.5	13	11	25	Di.	2A6
2A7	1-7	6	5 & Cap	2 & 4	....	3	....	2.5	20	8	50	Pent. Conv.	2A7
2B7	1-7	6	Cap	2	....	3	....	2.5	24	9	65	Pe.	2B7
2B7	1-7	6	....	4	5	....	....	2.5	13	11	25	Di.	2B7
3A8-GT	2-7	....	Cap	3	....	4	....	2.8	50	9	38	Pe. Norm-59	3A8-GT
3A8-GT	2-7	....	5	6	....	....	....	2.8	50	9	56	Tr. Norm-86	3A8-GT
3A8-GT	2-7	....	....	8	....	....	....	2.8	13	11	20	Di.	3A8-GT
3Q4	1-7	....	3	2	....	4	....	2.8	17	8	50		3Q4
3Q5-GT	2-7	....	5	3	....	4	....	2.8	20	8	50		3Q5-GT
3S4	1-7	....	3	2	....	4	....	2.8	8	9	50		3S4
5T4	2-8	....	....	4	6	....	....	5.0	2	6	60	Rect.	5T4
5U4-G	2-8	....	....	4	6	....	....	5.0	3	6	60	Rect.	5U4-G
5V4-G	2-8	....	....	4	6	....	....	5.0	0	6	60	Rect.	5V4-G
5W4	2-8	....	....	4	6	....	....	5.0	8	6	60	Rect.	5W4
5X4-G	7-8	....	....	3	5	....	....	5.0	3	6	60	Rect.	5X4-G
5Y3-G	2-8	....	....	4	6	....	....	5.0	7	6	60	Rect.	5Y3-G
5Y4-G	7-8	....	....	3	5	....	....	5.0	7	6	60	Rect.	5Y4-G
5Z3	1-4	....	....	2	3	....	....	5.0	3	6	60	Rect.	5Z3
5Z4	2-8	....	....	4	6	....	....	5.0	0	6	60	Rect.	5Z4
6A3	1-4	....	3	2	....	....	....	6.3	21	4	50		6A3
6A4	1-5	....	3	2	....	4	....	6.3	23	8	50		6A4
6A6	1-7	4	3 & 5	2	6	....	....	6.3	25	8	50	Tw. Tr.	6A6
6A7	1-7	6	5 & Cap	2 & 4	....	3	....	6.3	20	8	50	Pent. Conv.	6A7
6A8	2-7	8	5 & Cap	3 & 6	....	4	....	6.3	18	8	50	Pent. Conv.	6A8
6AB5/6N5	1-6	5	3	2	4	....	....	6.3	29	15	65	Pull 2nd Plate Toggle Sw. & Visually Inspect Target.	6AB5/6N5
6AB6-G	2-7	8	5	3	....	4	....	6.3	45	8	50	Dir. Coup. Amp.	6AB6-G
6AB7/1853	2-7	5	4	3	....	6	3	6.3	25	7	65		6AB7/1853
6AC5-G	2-7	8	5	3	....	....	....	6.3	17	9	50		6AC5-G
6AC7/1852	2-7	5	4 & 6	3	....	....	....	6.3	10	15	65		6AC7/1852
6AD7-G	2-7	8	5	3	....	4	....	6.3	17	8	50	Pe.	6AD7-G
6AD7-G	2-7	8	1	6	....	....	....	6.3	28	10	65	Tr.	6AD7-G
6AE5-GT	2-7	8	5	3	....	....	....	6.3	40	4	65		6AE5-GT
6AE6-G	2-7	8	5	3	4	....	....	6.3	35	9	50	Tw. Plate Control Tube	6AE6-G
6AE7-GT	2-7	5 & 8	4 & 6	3	....	....	....	6.3	2	8	65		6AE7-GT
6AF6-G	2-7	8	....	3 & 5	....	4	....	6.3	27	16	60	Meter Reset Cont. to be set com- pletely counter- clockwise. No G _m measurements.	6AF6-G

COMPLETE TUBE DATA FOR MODEL OQ

Tube Type	Heater	Cathode	Control Grid	Normal Plate	Second Plate	Screen	Sup-pressor	Panel A	Controls C	D	Rej. Point	Remarks	Tube Type
6AG7	2-7	5	4	8	.....	6	1	6.3	27	8	65		6AG7
6B4	2-7	.....	5	3	.....	.....	.....	6.3	21	4	50		6B4
6B5	1-6	5	4	2	.....	3	.....	6.3	34	8	50	Dir. Coup. Amp.	6B5
6B6-G	2-7	8	Cap	3	.....	.....	.....	6.3	24	9	65	Tr.	6B6-G
6B6-G	2-7	8	.....	4	5	.....	.....	6.3	13	11	25	Di.	6B6-G
6B7	1-7	6	Cap	2	.....	3	.....	6.3	24	9	65	Pe.	6B7
6B7	1-7	6	.....	4	5	.....	.....	6.3	13	11	25	Di.	6B7
6B8	2-7	8	Cap	3	.....	6	.....	6.3	24	9	65	Pe.	6B8
6B8	2-7	8	.....	4	5	.....	.....	6.3	13	11	25	Di.	6B8
6C5	2-7	8	5	3	.....	.....	.....	6.3	16	8	65		6C5
6C6	1-6	4 & 5	Cap	2	.....	3	.....	6.3	40	8	65		6C6
6C8-G	2-7	4-8	Cap & 5	3	6	.....	.....	6.3	29	8	65	Tw. Tr.	6C8-G
6D6	1-6	5	Cap	2	.....	3	4	6.3	28	8	65		6D6
6D8-G	2-7	8	5 & Cap	3 & 6	.....	4	.....	6.3	21	8	50	Pent. Conv.	6D8-G
6E5	1-6	5	3	2	4	.....	.....	6.3	24	15	65	Pull 2nd Pl. toggle switch & visually inspect target.	6E5
6E6	1-7	4	3 & 5	2	6	.....	.....	6.3	50	22	50		6E6
6F5	2-7	8	Cap	4	.....	.....	.....	6.3	9	9	65		6F5
6F6	2-7	8	5	3	.....	4	.....	6.3	3	10	50		6F6
6F7	1-7	6	Cap	2	.....	3	.....	6.3	47	8	65	Pe.	6F7
6F7	1-7	6	5	4	.....	.....	.....	6.3	20	10	65	Tr.	6F7
6F8-G	2-7	4-8	Cap & 5	3	6	.....	.....	6.3	10	8	65	Tw. Tr.	6F8-G
6G6-G	2-7	8	5	3	.....	4	.....	6.3	19	8	50		6G6-G
6H6	2-7	4-8	.....	3	5	.....	.....	6.3	13	11	40	Di.	6H6
6J5	2-7	8	5	3	.....	.....	.....	6.3	9	8	65		6J5
6J6	3-4	7	5 & 6	1	2	.....	.....	6.3	12	7	65		6J6
6J7	2-7	8	Cap	3	.....	4	5	6.3	40	8	65		6J7
6K5-G	2-7	8	Cap	3	.....	.....	.....	6.3	38	8	65		6K5-G
6K6-G	2-7	8	5	3	.....	4	.....	6.3	14	8	50		6K6-G
6K7	2-7	8	Cap	3	.....	4	5	6.3	33	8	65		6K7
6K8	2-7	8	5 & Cap	3 & 6	.....	4	.....	6.3	14	7	50	Hex. Conv.	6K8
6L5-G	2-7	8	5	3	.....	.....	.....	6.3	18	8	65		6L5-G
6L6	2-7	8	5	3	.....	4	.....	6.3	34	4	50		6L6
6L7	2-7	8	5 & Cap	3	.....	4	.....	6.3	29	8	50	Pent. Mixer	6L7
6N6	2-7	8	5	3	.....	4	.....	6.3	34	8	50	Dir. Coup. Amp.	6N6
6N7	2-7	8	4 & 5	3	6	.....	.....	6.3	25	8	50	Tw. Tr.	6N7
6P5-G	2-7	8	5	3	.....	.....	.....	6.3	19	8	65		6P5-G
6P7-G	2-3	8	Cap	4	.....	5	.....	6.3	47	8	65	Pe.	6P7-G
6P7-G	2-3	8	7	6	.....	.....	.....	6.3	20	10	65	Tr.	6P7-G
6Q7	2-7	8	Cap	3	.....	.....	.....	6.3	10	9	65	Tr.	6Q7
6Q7	2-7	8	.....	4	5	.....	.....	6.3	13	11	25	Di.	6Q7
6R7	2-7	8	Cap	3	.....	.....	.....	6.3	17	8	65	Tr.	6R7
6R7	2-7	8	.....	4	5	.....	.....	6.3	13	11	25	Di.	6R7
6S7	2-7	8	Cap	3	.....	4	5	6.3	27	8	65		6S7
6SA7	2-7	6	5 & 8	3	.....	4	1	6.3	25	8	50	Pent. Conv.	6SA7
6SC7	7-8	6	3 & 4	2	5	.....	.....	6.3	19	9	65	Tw. Tr.	6SC7
6SF5	7-8	2	3	5	.....	.....	.....	6.3	9	9	65		6SF5
6SG7	2-7	3	4	8	.....	6	.....	6.3	20	7	65		6SG7
6SH7	2-7	3	4	8	.....	6	.....	6.3	19	8	65		6SH7
6SJ7	2-7	5	4	8	.....	6	3	6.3	26	8	65		6SJ7
6SK7	2-7	5	4	8	.....	6	3	6.3	22	8	65		6SK7
6SL7	7-8	3 & 6	1 & 4	2	5	.....	.....	6.3	48	13	65	Tw. Tr.	6SL7
6SN7	7-8	3 & 6	1 & 4	2	5	.....	.....	6.3	9	8	65		6SN7
6SQ7	7-8	3	2	6	.....	.....	.....	6.3	20	9	65	Tr.	6SQ7
6SQ7	7-8	3	.....	4	5	.....	.....	6.3	13	11	25	Di.	6SQ7
6SR7	7-8	3	2	6	.....	.....	.....	6.3	17	8	65	Tr.	6SR7

COMPLETE TUBE DATA FOR MODEL OQ

Tube Type	Heater	Cathode	Control		Normal Plate	Second Plate	Screen	Sup-pressor	Panel Controls			Rej. Point	Remarks	Tube Type
			Grid	Plate					A	C	D			
6SR7	7-8	3	.....	4	5	.....	.....	6.3	13	11	25	Di.		6SR7
6SS7	2-7	5	4	8	.....	6	3	6.3	24	8	65			6SS7
6T7-G	2-7	8	Cap	3	.....	.....	.....	6.3	23	9	65	Tr.		6T7-G
6T7-G	2-7	8	.....	4	5	.....	.....	6.3	13	11	25	Di.		6T7-G
6U5/6G5	1-6	5	3	2	4	.....	.....	6.3	22	15	65	Pull 2nd plate toggle sw. & visually inspect target.		6U5/6G5
6U7-G	2-7	8	Cap	3	.....	4	5	6.3	28	8	65			6U7-G
6V6	2-7	8	5	3	.....	4	.....	6.3	8	8	50			6V6
6V7-G	2-7	8	Cap	3	.....	.....	.....	6.3	4	10	65	Tr.		6V7-G
6V7	2-7	8	.....	4	5	.....	.....	6.3	13	11	25	Di.		6V7
6W7-G	2-7	8	Cap	3	.....	4	5	6.3	39	8	65			6W7-G
6X5	2-7	8	.....	3	5	.....	.....	6.3	2	6	60	Rect.		6X5
6Y5	1-6	4	.....	3	5	.....	.....	6.3	1	6	60			6Y5
6Y6-G	2-7	8	5	3	.....	4	.....	6.3	13	4	50			6Y6-G
6Z7-G	2-7	8	4 & 5	3	6	.....	.....	6.3	14	9	50	Tw. Tr.		6Z7-G
6ZY5-G	2-7	8	.....	3	5	.....	.....	6.3	3	6	60	Rect.		6ZY5-G
7A4	1-8	7	6	2	.....	.....	.....	6.3	12	8	65			7A4
7A5	1-8	7	6	2	.....	3	.....	6.3	28	3	50			7A5
7A6	1-8	2-7	.....	3	6	.....	.....	6.3	13	11	40	Di.		7A6
7A7	1-8	7	6	2	.....	3	4	6.3	20	8	65			7A7
7A7-LM	1-8	7	6	2	.....	3	4	6.3	20	8	65			7A7-LM
7A8	1-8	7	4 & 6	2 & 3	.....	5	.....	6.3	22	8	50	Octode Conv.		7A8
7B4	1-8	7	6	2	.....	.....	.....	6.3	10	9	65			7B4
7B5	1-8	7	6	2	.....	3	.....	6.3	14	8	50			7B5
7B5-LT	1-8	7	6	2	.....	3	.....	6.3	14	8	50			7B5-LT
7B6	1-8	7	3	2	.....	.....	.....	6.3	20	9	65	Tr.		7B6
7B6	1-8	7	.....	5	6	.....	.....	6.3	13	11	25	Di.		7B6
7B6-LM	1-8	7	3	2	.....	.....	.....	6.3	20	9	65	Tr.		7B6-LM
7B6-LM	1-8	7	.....	5	6	.....	.....	6.3	13	11	25	Di.		7B6-LM
7B7	1-8	7	6	2	.....	3	4	6.3	27	8	65			7B7
7B8	1-8	7	4 & 6	2 & 3	.....	5	.....	6.3	19	8	50	Pent. Conv.		7B8
7B8-LM	1-8	7	4 & 6	2 & 3	.....	5	.....	6.3	19	8	50	Pent. Conv.		7B8-LM
7C5	1-8	7	6	2	.....	3	.....	6.3	6	8	50			7C5
7C5-LT	1-8	7	6	2	.....	3	.....	6.3	6	8	50			7C5-LT
7C6	1-8	7	3	2	.....	.....	.....	6.3	30	9	65	Tr.		7C6
7C6	1-8	7	.....	5	6	.....	.....	6.3	13	11	25	Di.		7C6
7C7	1-8	7	6	2	.....	3	4	6.3	15	9	65			7C7
7E6	1-8	7	3	2	.....	.....	.....	6.3	17	8	65	Tr.		7E6
7E6	1-8	7	.....	5	6	.....	.....	6.3	13	11	25	Di.		7E6
7E7	1-8	7	6	2	.....	5	.....	6.3	37	8	65	Pe.		7E7
7E7	1-8	7	.....	3	4	.....	.....	6.3	13	11	25	Di.		7E7
7F7	1-8	2-7	4 & 5	3	6	.....	.....	6.3	15	9	65	Tw. Tr.		7F7
7G7/1232	1-8	7	6	2	.....	3	4	6.3	9	8	65			7G7/1232
7H7	1-8	7	6	2	.....	3	4	6.3	15	8	65			7H7
7J7	1-8	7	4 & 6	2 & 3	.....	5	.....	6.3	11	8	50	Tr. Hex. Conv.		7J7
7L7	1-8	7	6	2	.....	3	4	6.3	28	7	65			7L7
7N7	1-8	2-7	4 & 5	3	6	.....	.....	6.3	10	8	65	Tw. Tr.		7N7
7Q7	1-8	7	4 & 6	2	.....	3	5	6.3	38	7	50	Pent. Conv.		7Q7
7Y4	1-8	7	.....	3	6	.....	.....	6.3	2	6	60	Rect.		7Y4
10	1-4	.....	3	2	.....	.....	.....	7.5	11	9	50			10
12A5	1-7	5	4	2	.....	3	.....	12.6	31	22	50			12A5
12A6	2-7	8	5	3	.....	4	.....	12.6	14	8	50			12A6
12A7	1-7	6	Cap	2	.....	3	.....	12.6	9	10	50	Pe.		12A7
12A7	1-7	4	.....	5	.....	.....	.....	12.6	1	6	60	Rect.		12A7
12A8-GT	2-7	8	5 & Cap	3 & 6	.....	4	.....	12.6	18	8	50	Pent. Conv.		12A8-GT
12B8	2-7	1	Cap	3	.....	4	.....	12.6	35	7	65	Pe.		12B8

COMPLETE TUBE DATA FOR MODEL OQ

Tube Type	Heater	Cathode	Control Grid	Normal Plate	Second Plate	Screen	Sup-pressor	Panel A	Controls C	D	Rej. Point	Remarks	Tube Type
12B8-GT	2-7	6	8	5	.....	.....	.....	12.6	35	7	65	Tr.	12B8-GT
12C8	2-7	8	Cap	3	.....	6	.....	12.6	24	9	65	Pe.	12C8
12C8	2-7	8	.....	4	5	.....	.....	12.6	18	11	25	Di.	12C8
12F5-GT	2-7	8	Cap	4	.....	.....	.....	12.6	9	9	65	.....	12F5-GT
12H6	2-7	4 & 8	.....	3	5	.....	.....	12.6	13	11	40	.....	12H6
12J5-GT	2-7	8	5	3	.....	.....	.....	12.6	12	8	65	.....	12J5-GT
12J7-GT	2-7	8	Cap	3	.....	4	5	12.6	40	8	65	.....	12J7-GT
12K7-GT	2-7	8	Cap	3	.....	4	5	12.6	33	8	65	.....	12K7-GT
12K8	2-7	8	5 & Cap	3 & 6	.....	4	.....	12.6	14	7	50	Hexode Conv.	12K8
12Q7	2-7	8	Cap	3	.....	.....	.....	12.6	10	9	65	Tr.	12Q7
12Q7	2-7	8	.....	4	5	.....	.....	12.6	13	11	25	Di.	12Q7
12SA7	2-7	6	5 & 8	3	.....	4	1	12.6	25	8	50	Pent. Conv.	12SA7
12SC7	7-8	6	3 & 4	2	5	.....	.....	12.6	19	9	65	Tw. Tr.	12SC7
12SF5	7-8	2	3	5	.....	.....	.....	12.6	9	9	65	.....	12SF5
12SF7	7-8	3	2	6	.....	4	.....	12.6	24	8	65	Pe.	12SF7
12SF7	7-8	3	.....	5	.....	.....	.....	12.6	13	11	25	Di.	12SF7
12SG7	2-7	3	4	8	.....	6	.....	12.6	20	7	65	.....	12SG7
12SH7	2-7	3	4	8	.....	6	.....	12.6	19	8	65	.....	12SH7
12SJ7	2-7	5	4	8	.....	6	3	12.6	26	8	65	.....	12SJ7
12SK7	2-7	5	4	8	.....	6	3	12.6	22	8	65	.....	12SK7
12SL7-GT	7-8	3 & 6	1 & 4	2	5	.....	.....	12.6	43	13	65	Tw. Tr.	12SL7-GT
12SN7-GT	7-8	3 & 6	1 & 4	2	5	.....	.....	12.6	9	8	65	.....	12SN7-GT
12SQ7	7-8	3	2	6	.....	.....	.....	12.6	20	9	65	Tr.	12SQ7
12SQ7	7-8	3	.....	4	5	.....	.....	12.6	13	11	25	Di.	12SQ7
12SR7	7-8	3	2	6	.....	.....	.....	12.6	17	8	65	Tr.	12SR7
12SR7	7-8	3	.....	4	5	.....	.....	12.6	13	11	25	Di.	12SR7
12Z3	1-4	3	.....	2	.....	.....	.....	12.6	0	6	60	Rect.	12Z3
14B6	1-8	7	3	2	.....	.....	.....	12.6	20	9	65	Tr.	14B6
14B6	1-8	7	.....	5	6	.....	.....	12.6	13	11	25	Di.	14B6
14H7	1-8	7	6	2	.....	3	4	12.6	15	8	65	.....	14H7
14J7	1-8	7	4 & 6	2 & 3	.....	5	.....	12.6	11	8	50	Tr. Hex. Conv.	14J7
14Q7	1-8	7	4 & 6	2	.....	3	5	12.6	38	7	50	Hept. Pent. Conv.	14Q7
15	1-5	4	Cap	2	.....	3	.....	2.0	32	9	65	.....	15
19	1-6	.....	3 & 4	2	5	.....	.....	2.0	18	9	50	.....	19
20	1-4	.....	3	2	.....	.....	.....	3.3	14	10	33	Norm-65	20
22	1-4	.....	Cap	2	.....	3	.....	3.3	50	9	52	Norm-80	22
24A	1-5	4	Cap	2	.....	3	.....	2.5	29	14	65	.....	24A
25A6	2-7	8	5	3	.....	4	.....	25	39	4	50	.....	25A6
25A7	2-7	8	5	3	.....	4	.....	25	50	4	50	Pe.	25A7
25A7	2-7	1	.....	6	.....	.....	.....	25	0	6	60	Rect.	25A7
25AC5-G	2-7	8	5	3	.....	.....	.....	25	10	9	50	.....	25AC5-G
25B5	1-6	5	4	2	3	.....	.....	25	43	22	50	Dir. Coup. Amp.	25B5
25B6-G	2-7	8	5	3	.....	4	.....	25	4	12	50	.....	25B6-G
25B8	2-7	1	Cap	3	.....	4	.....	25	30	7	65	Pe.	25B8
25B8	2-7	6	8	5	.....	.....	.....	25	35	7	65	Tr.	25B8
25C6	2-7	8	5	3	.....	4	.....	25	13	4	50	.....	25C6
25L6	2-7	8	5	3	.....	4	.....	25	38	2	50	.....	25L6
25N6	2-7	8	5	3	.....	4	.....	25	43	22	50	Dir. Coup. Amp.	25N6
25Z5	1-6	3-4	.....	2	5	.....	.....	25	0	6	60	Rect.	25Z5
25Z6	2-7	4-8	.....	3	5	.....	.....	25	0	6	60	Rect.	25Z6
26	1-4	.....	3	2	.....	.....	.....	1.5	4	10	65	.....	26
27	1-5	4	3	2	.....	.....	.....	2.5	4	10	65	.....	27
30	1-4	.....	3	2	.....	.....	.....	2.0	19	9	65	.....	30
31	1-4	.....	3	2	.....	.....	.....	2.0	3	10	50	.....	31
32	1-4	.....	Cap	2	.....	3	.....	2.0	36	9	65	.....	32
34	1-4	.....	Cap	2	.....	3	.....	2.0	41	9	65	.....	34
35	1-5	4	Cap	2	.....	3	.....	2.5	22	10	65	.....	35
35A5	1-8	7	6	2	.....	3	.....	35	24	4	50	.....	35A5
35L6-GT	2-7	8	5	3	.....	4	.....	35	24	4	50	.....	35L6-GT
35Z3	1-8	7	.....	2	.....	.....	.....	35	0	6	64	Rect. Norm-107	35Z3

COMPLETE TUBE DATA FOR MODEL OQ

Tube Type	Heater	Cathode	Control Grid	Normal Plate	Second Plate	Screen	Sup-pressor	Panel A	Controls C	D	Ref. Point	Remarks	Tube Type
35Z3-LT	1-8	7	.....	2	.....	.....	.....	35	0	6	64	Rect. Norm-107	35Z3-LT
35Z5-GT	2-7	8	.....	5	.....	.....	.....	35	0	6	66	Rect. Norm-110	35Z5-GT
36	1-5	4	Cap	2	.....	3	.....	6.3	46	8	65		36
37	1-5	4	3	2	.....	.....	.....	6.3	3	10	65		37
38	1-5	4	Cap	2	.....	3	.....	6.3	10	10	50		38
39/44	1-5	4	Cap	2	.....	3	.....	6.3	41	8	65		39/44
40	1-4	.....	3	2	.....	.....	.....	5.0	41	9	65		40
41	1-6	5	4	2	.....	3	.....	6.3	14	8	50		41
42	1-6	5	4	2	.....	3	.....	6.3	3	10	50		42
43	1-6	5	4	2	.....	3	.....	25	39	4	50		43
45	1-4	.....	3	2	.....	.....	.....	2.5	40	4	50		45
45Z3	1-7	4	.....	2	.....	.....	.....	45	0	6	60	Rect.	45Z3
45Z5-GT	2-7	8	.....	5	.....	.....	.....	45	0	6	70	Rect. Norm-117	45Z5-GT
46	1-5	.....	3	2 & 4	.....	.....	.....	2.5	37	4	50		46
47	1-5	.....	3	2	.....	4	.....	2.5	18	8	50		47
48	1-6	5	4	2	.....	3	.....	30	18	4	50		48
49	1-5	.....	3	2 & 4	.....	.....	.....	2.0	0	10	55	Norm-110	49
50	1-4	.....	3	2	.....	.....	.....	7.5	48	22	50		50
50L6-GT	2-7	8	5	3	.....	4	.....	50	16	4	50		50L6-GT
50Y6-GT	2-7	4 & 8	.....	3	5	.....	.....	50	0	6	60		50Y6-GT
50Z7	2-7	4 & 8	.....	3	5	.....	.....	50	0	6	65		50Z7
53	1-7	4	3 & 5	2	6	.....	.....	2.5	25	8	50	Tw. Tr.	53
55	1-6	5	Cap	2	.....	.....	.....	2.5	4	10	65	Tr.	55
55	1-6	5	.....	3	4	.....	.....	2.5	13	11	25	Di.	55
56	1-5	4	3	2	.....	.....	.....	2.5	19	8	65		56
57	1-6	5	Cap	2	.....	3	4	2.5	40	8	65		57
58	1-6	5	Cap	2	.....	3	4	2.5	28	8	65		58
59	1-7	6	4	2	.....	3	5	2.5	18	8	50		59
70L7-GT	2-7	6	5	3	.....	4	.....	70	9	4	50	Beam Power	70L7-GT
70L7-GT	2-7	1	.....	8	.....	.....	.....	70	0	6	60	Rect.	70L7-GT
71A	1-4	.....	3	2	.....	.....	.....	5.0	47	4	50		71A
75	1-6	5	Cap	2	.....	.....	.....	6.3	20	9	65	Tr.	75
75	1-6	5	.....	3	4	.....	.....	6.3	13	11	25	Di.	75
76	1-7	4	3	2	.....	.....	.....	6.3	19	8	65		76
77	1-6	5	Cap	2	.....	3	4	6.3	40	8	65		77
78	1-6	5	Cap	2	.....	3	4	6.3	33	8	65		78
79	1-6	4	Cap & 3	5	2	.....	.....	6.3	14	9	65	Tw. Tr.	79
80	1-4	.....	.....	2	3	.....	.....	5.0	7	6	60	Rect.	80
81	1-4	.....	.....	2	.....	.....	.....	7.5	12	6	60	Rect.	81
82	1-4	.....	.....	2	3	.....	.....	2.5	0	6	60	Rect.	82
83	1-4	.....	.....	2	3	.....	.....	5.0	0	6	66	Rect. Norm-110	83
84/6Z4	1-5	4	.....	2	3	.....	.....	6.3	1	6	60	Rect.	84/6Z4
85	1-6	5	Cap	2	.....	.....	.....	6.3	4	10	65	Tr.	85
85	1-6	5	.....	3	4	.....	.....	6.3	13	11	25	Di.	85
89	1-6	5	Cap	2	.....	3	4	6.3	3	10	50		89
117L7-GT	2-7	8	4	3	.....	5	.....	117	0	8	50		117L7-GT
117L7-GT	2-7	1	.....	6	.....	.....	.....	117	15	11	60	Rect.	117L7-GT
117N7-GT	2-7	6	4	3	.....	5	.....	117	15	4	50		117N7-GT
117P7-GT	2-7	6	4	3	.....	5	.....	117	0	8	50		117P7-GT
117Z6-GT	2-7	4-8	.....	3	5	.....	.....	117	0	6	60	Rect.	117Z6-GT
801	1-4	.....	3	2	.....	.....	.....	7.5	3	10	65		801
807	1-5	4	3	Cap	.....	2	.....	6.3	42	4	50		807
837	1-7	6	4	Cap	.....	3	5	12.6	30	22	65		837
864	1-4	.....	3	2	.....	.....	.....	1.1	22	9	57	Norm-88	864
954	1-4	5	6	Cap	.....	2	3	6.3	26	8	65		954
955	1-4	5	3	2	.....	.....	.....	6.3	12	8	65		955
956	1-4	5	6	Cap	.....	2	3	6.3	23	8	65		956
957	1-4	.....	3	2	.....	.....	.....	1.25	50	8	61	Norm-93	957
958	1-4	.....	3	2	.....	.....	.....	1.25	23	8	65		958
959	1-4	.....	6	Cap	.....	2	3	1.25	50	8	42	Norm-65	959

COMPLETE TUBE DATA FOR MODEL OQ

Tube Type	Heater	Cathode	Control Grid	Normal Plate	Second Plate	Screen	Sup-pressor	Panel Controls			Rej. Point	Remarks	Tube Type
								A	C	D			
1201	2-8	4	1	3	-----	-----	-----	6.3	7	8	65		1201
HY-114	2-7	-----	Left	Right	-----	-----	-----	1.4	36	8	65		HY-114
HY-615	2-7	8	Left Cap	Right Cap	-----	-----	-----	6.3	17	8	65		HY-615
RK-33	1-7	6-2	4 & Cap	5	3	-----	-----	6.3	9	9	65		RK-33
WE-215A	1-4	-----	3	2	-----	-----	-----	1.1	14	10	65		WE-215A
WE-231D	1-4	-----	3	2	-----	-----	-----	3.1	38	9	65		WE-231D
WE-244A	1-5	4	3	2	-----	-----	-----	2	4	16	65		WE-244A
WE-257A	1-4	-----	Cap	2	-----	-----	-----	3.1	38	9	65		WE-257A
WE-262A	1-4	3	Cap	2	-----	-----	-----	10	35	8	65		WE-262A
WE-262B	1-4	3	Cap	2	-----	-----	-----	10	35	8	65		WE-262B
WE-271A	1-5	4	3	2	-----	-----	-----	5	46	4	50		WE-271A
WE-274A	1-4	-----	-----	2	3	-----	-----	5	5	6	80		WE-274A
WE-274B	2-8	-----	-----	3	6	-----	-----	5	5	6	60		WE-274B
WE-300A	1-4	-----	3	2	-----	-----	-----	5.0	22	4	50		WE-300A
WE-300B	1-4	-----	3	2	-----	-----	-----	5.0	22	4	50		WE-300B
WE-306A	1-5	-----	Cap	2	-----	3	-----	2.75	10	8	65		WE-306A
WE-307A	1-5	-----	3	Cap	-----	2	4	5.5	11	8	65		WE-307A
WE-339A	1-5	-----	3	Cap	-----	2	4	5	15	12	50		WE-339A
WE-350A	1-5	4	3	Cap	-----	2	-----	6.3	28	3	50		WE-350A
9001	3-4	2	1	5	-----	6	-----	6.3	20	14	65		9001
9002	3-4	2	6	5	-----	-----	-----	6.3	12	8	65		9002
9003	3-4	2	1	5	-----	6	-----	6.3	26	8	65		9003
9004	1-4	3	-----	2	-----	-----	-----	6.3	18	11	20	Diode	9004
2X2	1-4	-----	-----	Cap	-----	-----	-----	2.5	10	18	80		2X2

TUBE BASE LIST

Tube Type	Base	Tube Type	Base	Tube Type	Base	Tube Type	Base	Tube Type	Base
00	4D	1N6-G	7AM	6AC6-G	7W	6N7	8B	7N7	8AC
00A	4D	1P1	4T	6AC7/1852	8N	6P5-G	6Q	7Q7	8AL
0A4	4V	1P5-G	5Y	6AD5-G	6Q	6P7-G	7U	7R7	8AE
0Z3	5N	1Q1	4T	6AD6-G	7AG	6Q6-G	6Y	7S7	8BL
0Z4	4R	1Q5-GT	6AF	6AD7-G	8AY	6Q7	7V	7T7	X-29
01	4D	1R1-G	4T	6AE5-GT	6Q	6R6-G	6AW	7V7	8V
01A	4D	1R5	7AT	6AE6-G	7AH	6R7	7V	7W7	8BJ
01AA	4D	1S1-G	4T	6AE7-GT	7AX	6S6-GT	5AK	7Y4	5AB
01B	4D	1S4	7AV	6AF5-G	6Q	6S7-G	7R	7Z4	5AB
1	4G	1S5	6AU	6AF6-G	7AG	6SA7	8R	8	4A
1A1	4A	1T1-G	4T	6AF7	8AG	6SA7-GT	8AD	9	4A
1A3	5AP	1T4	6AR	6AG5	X-36	6SC7	8S	10	4D
1A4-P	4M	1T5-GT	6X	6AG7	8Y	6SD7-GT	8N	12A	4D
1A4-T	4K	1-V	4G	6AH5-G	6AP	6SE7-GT	8N	12A5	7F
1A5-G	6X	1V1	4A	6AH7-GT	8BE	6SF5	6AB	12A6	7AC
1A6-GT	6L	1Y1	4A	6AL6-G	6AM	6SF7	7AZ	12A7	7K
1A6S	6L	1Z1	4A	6A7	7C	6SG7	8BC	12A8-GT	8A
1A7-G	7Z	2	4A	6A7-M	8A	6SH7	8BK	12AH7-GT	8BE
1B1	4A	2A3	4D	6A7-S	7C	6SJ7	8N	12B7	8V
1B4	4K	2A3-H	4Q	6A8	8A	6SK7	8N	12B8-GT	8T
1B4-P	4M	2A4-G	5S	6B4-G	5S	6SL7-GT	8BD	12C8	8E
1B5/25S	6M	2A5	6B	6B5	6AS	6SN7-GT	8BD	12E5-GT	6Q
1B7-G	7Z	2A6	6G	6B6-G	7V	6SQ7	8Q	12F5-GT	5M
1C1	4A	2A7	7C	6B7	7D	6SR7	8Q	12G7	7V
1C5-G	6X	2B6	7J	6B8	8E	6SS7	8N	12H6	7Q
1C6	6L	2B7	7D	6C4	6BG	6ST7	8Q	12J5-GT	6Q
1C7-G	7Z	2E5	6R	6C5	6Q	6T5	6R	12J7-GT	7R
1D1	4A	2G5	6R	6C5-G	6Q	6T7-G	7V	12K7-GT	7R
1D5-GP	5Y	2S/4S	5D	6C6	6F	6U5/6G5	6R	12K8	8K
1D5-GT	5R	2V3-G	4Y	6C7	7G	6U6-GT	7AC	12Q7-GT	7V
1D7-G	7Z	2W3	4X	6C8-G	8G	6U7-G	7R	12SA7	8R
1D8-GT	8AJ	2X2/879	4AB	6D5	6Q	6V6	7AC	12SA7-GT	8AD
1E1	4A	2Y2	4AB	6D6	6F	6V7-G	7V	12SC7	8S
1E4-G	5S	2Y3	4C	6D7	7H	6W5-G	6S	12SF5	6AB
1E5-G	5R	2Y4	5D	6D8-G	8A	6W6-GT	7AC	12SF7	7AZ
1E5-GP	5Y	2Z2	4B	6E5	6R	6W7-G	7R	12SG7	8BC
1E7-G	8C	3	4A	6E6	7B	6X5	6S	12SH7	8BK
1F1	4A	3A4	7BB	6E7	7H	6Y3	4AC	12SJ7	8N
1F4	5K	3A5	7BC	6F5	5M	6Y5	6J	12SK7	8N
1F5-G	6X	3A8-GT	8AS	6F5-G	5M	6Y6-G	7AC	12SL7-GT	8BD
1F6	6W	3C5-GT	7AQ	6F6	7S	6Y7-G	8B	12SN7-GT	8BD
1F7-G	7AD	3LE4	X-14	6F7	7E	6Z3	4G	12SQ7	8Q
1F7-GH	7AD	3LF4	6BB	6F7-S	7E	6Z4	5D	12SR7	8Q
1F7-GV	7AD	3Q4	7BA	6F8-G	8G	6Z5	6K	12Z3	4Q
1G1	4A	3Q5-GT	7AP	6G5	6R	6Z6	7Q	12Z5	6K
1G4-G	5S	3S4	7BA	6G6-G	7S	6Z7-G	8B	14	5E
1G5-G	6X	4	4A	6G7	7N	6ZY5-G	6S	14A4	5AC
1G6-G	7AB	4A6-G	8L	6G7S	7N	7	4A	14A5	6AA
1H4-G	5S	4S	5D	6H4-GT	5AF	7A4	5AC	14A7	8V
1H5-G	5Z	5	4A	6H5	6R	7A5	6AA	14B6	8W
1H6-G	7AA	5T4	5T	6H6	7Q	7A6	7AJ	14B8	8X
1J1	4A	5U4-G	5T	6H7	7P	7A7-LM	8V	14C5	6AA
1J5-G	6X	5V4-G	5L	6H7-S	7P	7A8	8U	14C7	8V
1J6-G	7AB	5W4	5T	6H8	8E	7B4	5AC	14E6	8W
1K1	4A	5X3	4C	6J5	6Q	7B5	6AE	14F7	8AC
1L1	4T	5X4-G	5Q	6J6	7BF	7B6	8W	14H7	8V
1L4	X-39	5Y3-G	5T	6J7	7R	7B7	8V	14J7	8AR
1LA4	5AD	5Y4-G	5Q	6J7-G	7R	7B8	8X	14N7	8AC
1LA6	7AK	5Z3	4C	6J7-GT	7R	7C5	6AA	14Q7	8AL
1LB4	5AD	5Z4	5L	6J8-G	8H	7C6	8W	14R7	8AE
1LB6	8AX	6	4A	6K5-G	5U	7C7	8V	14S7	8BL
1LC5	7AO	6A3	4D	6K6-G	7S	7E6	8W	14W7	8BJ
1LC6	7AK	6A4/LA	5B	6K7	7R	7E7	8AE	14Y4	5AB
1LD5	6AX	6A5-G	6T	6K8	8K	7F7	8AC	14Z3	4G
1LE3	4AA	6A6	7B	6L5-G	6Q	7G7	8V	15	5F
1LH4	5AG	6AB5	6R	6L6	7AC	7H7	8V	17	5A
1LN5	7AO	6AB6	7AU	6L7	7T	7J7	8AR	18	6B
1N1	4T	6AB7/1853	8N	6N5	6R	7K7	8BF	19	6C
1N5-G	5Y	6AC5-G	6Q	6N6-G	7AU	7L7	8V	20	4D

TUBE BASE LIST

Tube Type	Base	Tube Type	Base	Tube Type	Base	Tube Type	Base	Tube Type	Base
22	4K	49	5-C	90	6N	958	X-8	D-1/2	4B
24A	5E	49A2	X-4	91	6N	959	X-7	D-1	4C
24S	5E	49B2	X-4	92	6N	985	5D	DE	4D
25	6M	50	4D	95	6B	986	4C	E	4D
25A6	7S	50A5	6AA	96	4G	1201	X-26	G	4D
25A7-G	8F	50C6-G	7AC	98	5D	1203	X-27	GA	5B
25AC5-GT	6Q	50L6-GT	7AC	112A	4D	1204	X-28	G-2	5D
25B5	6D	50Y6-GT	7Q	117L7-GT	8AO	1221	6F	G-2S	5D
25B6-G	7S	50Z6-G	7Q	117M7-GT	8AO	1223	7R	G-4	5D
25B8-GT	8T	50Z7-G	8AN	117N7-GT	8AV	1231	8V	G-4S	5D
25C6-G	7AC	51	5E	117P7-GT	8AV	1232	8V	G-84	5D
25D8-GT	8AF	52	5C	117Z6-GT	7Q	1284	X-29	H	4D
25L6	7AC	53	7B	165R	4A	1291	X-30	HY-114B	X-38
25N6-G	7W	55	6Q	165R4	X-3	1293	X-31	HY-615B	X-34
25S	6M	56	5A	165R8	X-3	1294	X-27	K-24	5E
25X6-GT	7Q	56AS	5A	181	4D	1299	6DB	K-27	5A
25Y4-GT	5AA	56S	5A	182A	4D	1602	4D	KR-1	4G
25Y5	6E	57	6F	182B	4D	1603	6F	KR-2	4G
25Z3	4G	57AS	6F	183/483	4D	1609	5K	KR-5	5B
25Z4	5AA	57S	6F	185R	4A	1612	7T	KR-20	6N
25Z5	6E	58	6F	185R4	X-3	1613	7S	KR-22	6N
25Z6	7Q	58AS	6F	185R8	X-3	1614	7AC	KR-25	6B
26	4D	58S	6F	210T	4D	1620	7R	KR-28	5D
27	5A	59	7A	213	4C	1621	7S	KR-31	4G
27HM	5A	59A	7A	213B	4C	1622	7AC	KR-98	5D
27S	5A	59S	7A	216	4B	1625	X-16	KR-7184	X-38
29	6N	64	5E	216B	4B	1626	6Q	LA	5B
30	4D	65	5E	257	5B	1629	X-13	P-361	5D
31	4D	67	5A	264	4D	1631	7AC	PZ	5B
32	4K	68	5E	291	5G	1632	7AC	PZH	5B
32L7-GT	8Z	69	5E	293	5G	1633	8BD	RA-1	4Q
33	5K	70	6N	295	5G	1634	8S	RE-1	4C
34	4M	70A7-GT	8AB	432A	4D	1635	X-22	RE-2	4B
35	5E	70L7-GT	8AA	432B	4D	1642	X-17	RK-19	X-1
35A5-LT	6AA	71A	4D	433	4D	1851	7R	RK-21	4AB
35L6-GT	7AC	75	6G	484	5A	1852	8N	RK-22	X-1
35Y4	5AL	75M	7V	485	5A	1853	8N	RK-24	4D
35Z3-LT	4Z	75S	6G	486	X-9	9001	X-18	RK-33	X-17
35Z4-GT	5AA	76	5A	585	4D	9002	X-19	RK-34	X-37
35Z5-GT	6AD	77	6F	586	4D	9003	X-18	RK-47	5J
35Z6-G	7Q	77M	7R	801	4D	9004	X-23	RK-62	4D
36	5E	78	6F	803	5J	9005	X-24	SO-1	4Q
37	5A	78S	6F	804	5J	A (5)	5H	SO-2	4D
38	5F	79	6H	807	X-11	A (6)	6N	V-99	4E
39/44	5F	80	4C	837	X-15	A-22	4D	VR-50	4W
40	4D	81	4B	840	5J	A-26	4D	VR-75-30	X-12
40Z5	6AD	82	4C	841	4D	A-28	4D	VR-90-30	4W
41	6B	82V	4L	842	4D	A-30	4Q	VR-105-30	X-12
41M	7S	83	4C	843	5A	A-32	4Q	VR-150-30	X-12
42	6B	83V	4L	864	4D	A-40	4Q	WE-215A	4D
42A2	X-4	84/6Z4	5D	865	X-2	A-48	4Q	WE-231D	4D
42B2	X-4	85	6G	874	4S	AC-22	5E	WE-257A	X-20
43	6B	85AS	6G	878	4P	AD	4G	WE-300A	4D
43-MG	7S	85L7	8AB	879	4AB	AF	4C	WE-300B	4D
44	5F	85M	7V	884	6Q	AG	4C	WE-306A	X-21
45	4D	85S	6G	885	5A	AX	4Q	WE-307A	5J
45Z3	5AM	86M	6Q	950	5K	B	4E	WE-350A	X-11
45Z5-GT	6AD	87S	6F	951	4K	BA	4J	WE-718A	8BK
46	5C	88	4C	954	X-5	BH	4J	WE-717A	X-35
46A1	X-10	88S	6F	955	X-6	BR	4H	X-99	4D
46B1	X-10	89	6F	956	X-5	BX	4D	XXD	8AC
47	5B	89RS	7N	957	X-8	CK-1005	X-32	XXL	5AC
48	6A								

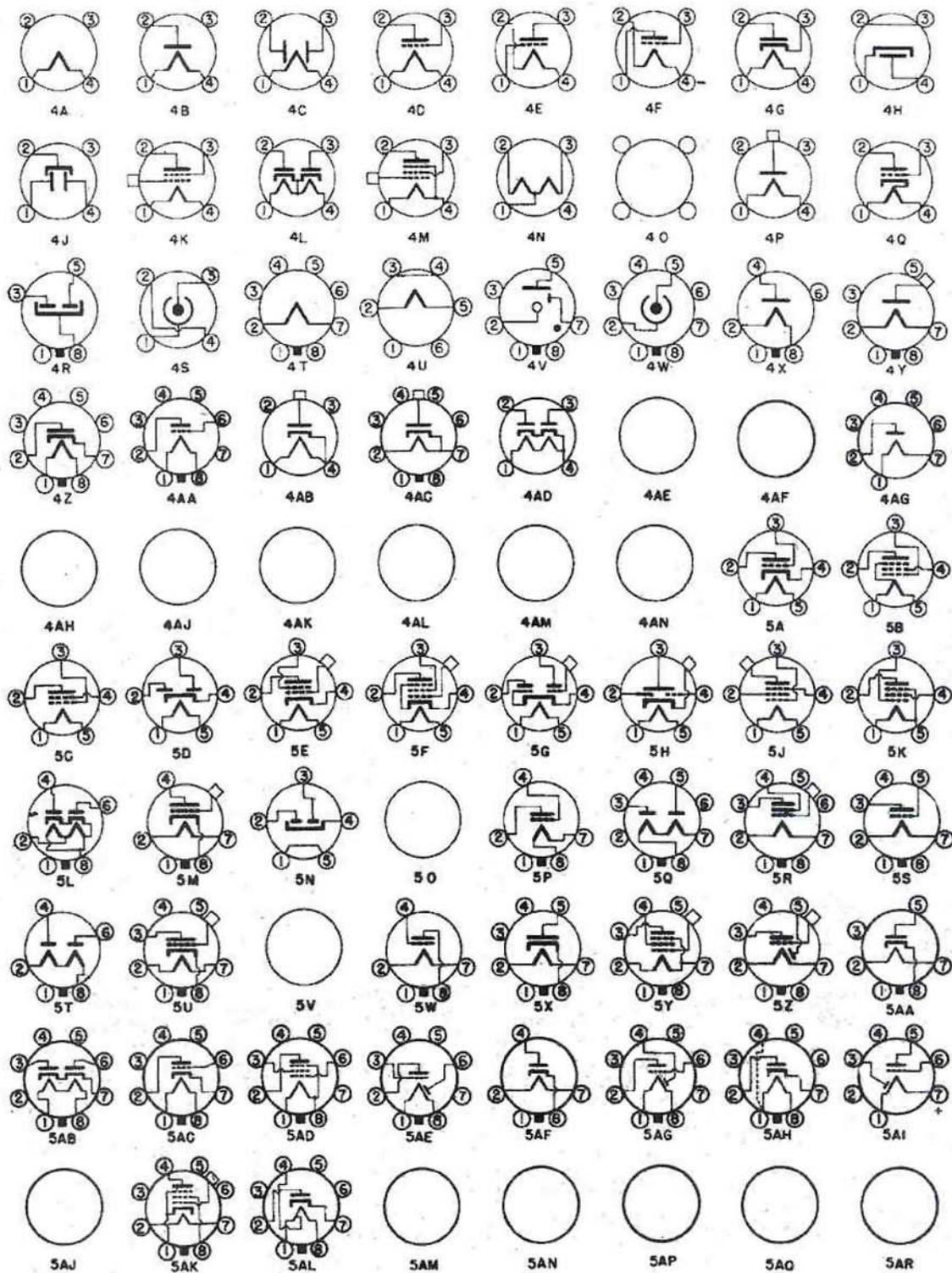
NAVY TYPE NUMBERS OF VACUUM TUBES

Cross Index of Old and New Type Numbers

Old	New	Old	New	Old	New
38001	01A	38114	214	38268	868
38012	112A	38116	38116	38274	874
38015	38015	38117	217C	38276	876
38019	19	38118	218	38278	38278
38022	22	38119	219	38282	38282
38024	24A	38120	38120	38286	886
38027	27	38138	838	38401	38401
38030	30	38142	38142	38402	38402
38031	31	38143	843	38403	38403
38032	32	38145	845	38412	38412
38032A	1B4P	38146	846	38565J	6J5
38033	33	38149	849	38566H	6H6
38034	34	38150	850	38567K	6K7
38035	35	38151	851	38567R	6R7
38036	36	38152	852	38568K	6K8
38037	37	38157B	857B	38593	5Z3
38038	38	38158	858	38616	6A6
38039	39	38160	860	38617	6A7
38040	40	38161	861	38627	6B7
38041	41	38162	862	38636	6C6
38042	42	38165	865	38646	6D6
38045	45	38166A	866A	38655	6E5
38047	47	38169A	869A	38667	6F7
38050	50	38170	870	38674	38674
38053	53	38171	871	38674A	38674A
38056	56	38172A	872A	38717E	1E7G
38057	57	38180	80	38765J	6J5G
38058	58	38181	81	38766Y	6Y6G
38059	59	38182	82	38768F	6F8G
38064	864	38183	83	38803	803
38071	71A	38184	84	38807	807
38075	75	38193	893	38808	808
38076	76	38205	38205	38814	814
38077	77	38211	211	38833	833
38078	78	38213	2A3	38837	837
38085	85	38215	2A5	38842	842
38089	89	38217	38217	38853	1853
38101	801	38222	38222	38884	884
38103	203A	38227	2B7	38897	38897
38104	204A	38233	38233	38954	954
38106	206	38236	1C6	38955	955
38107	207	38250	38250	38956	956
38110	10	38255	25Z5	38958	958
38111A	38111A	38266A	836	38959	959
38112	38112	38267	1616		

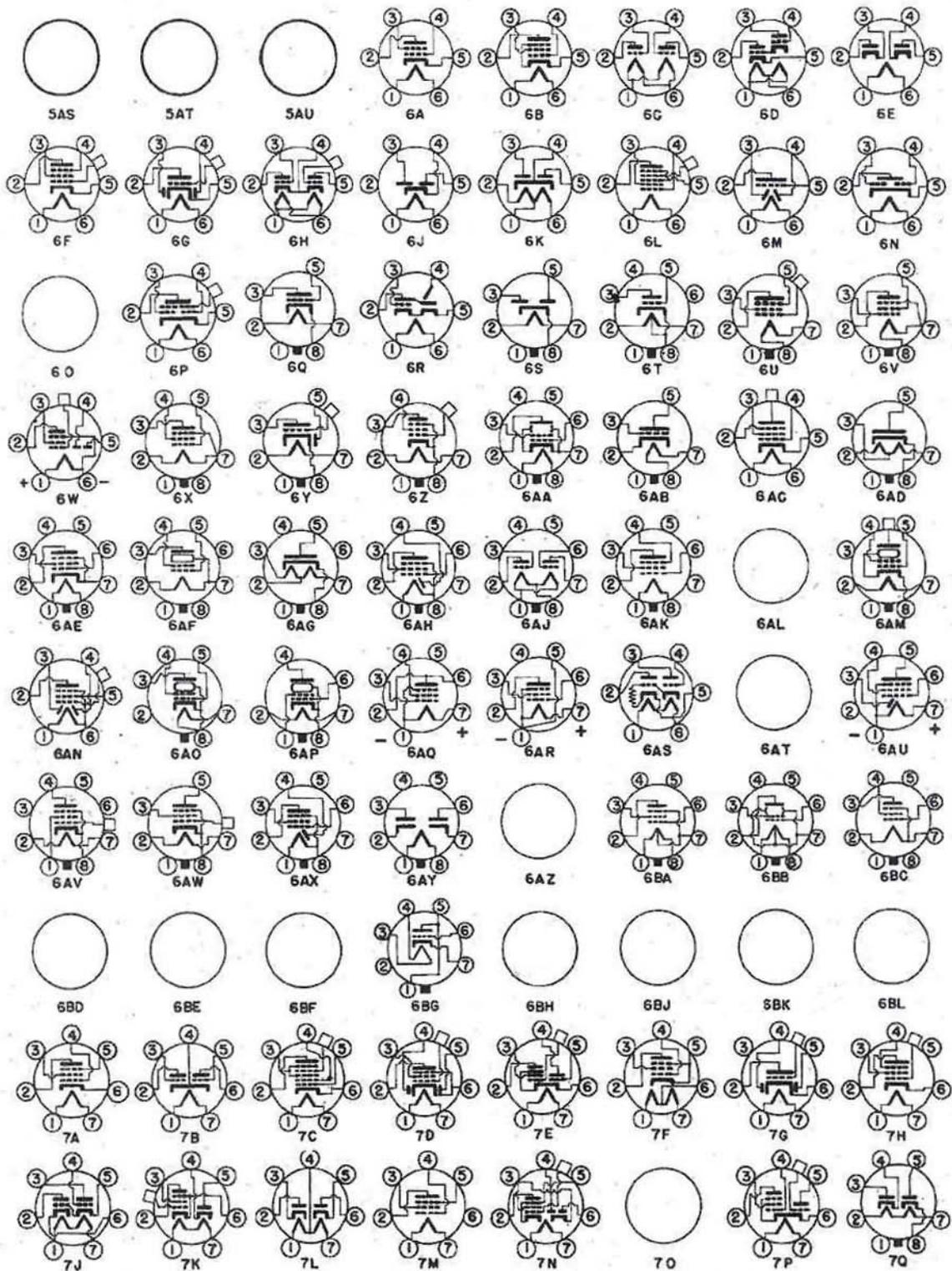
TUBE BASE CONNECTIONS

BOTTOM VIEW OF SOCKET OR BASE OF TUBE



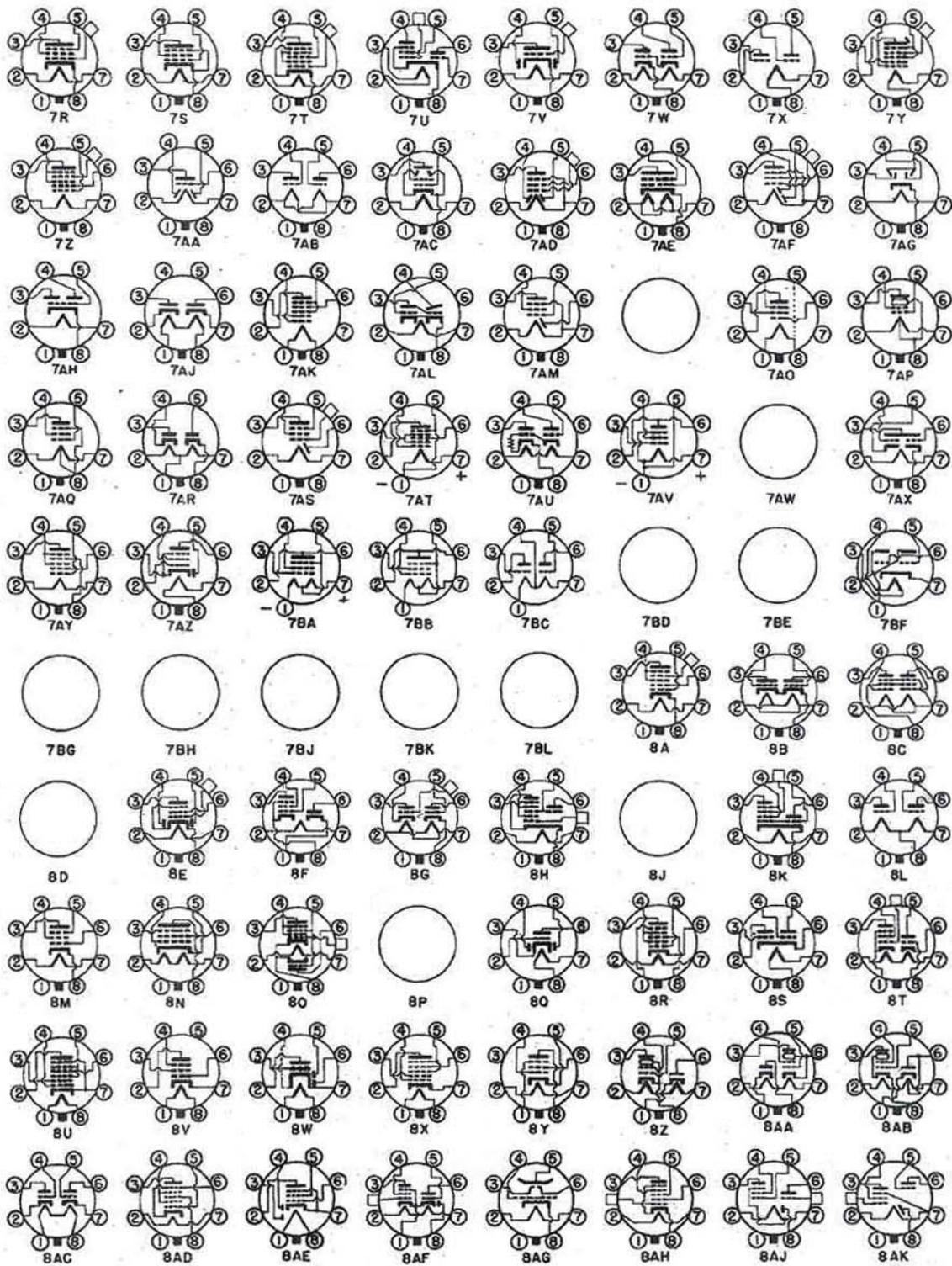
TUBE BASE CONNECTIONS

BOTTOM VIEW OF SOCKET OR BASE OF TUBE



TUBE BASE CONNECTIONS

BOTTOM VIEW OF SOCKET OR BASE OF TUBE



TUBE BASE CONNECTIONS

BOTTOM VIEW OF SOCKET OR BASE OF TUBE

