INSTRUCTION MANUAL

for

Taylor

Windsor Model 45C VALVE TESTER

TAYLOR ELECTRICAL INSTRUMENTS LTD

MONTROSE AVENUE · SLOUGH · BUCKS · ENGLAND

Telephone: SLOUGH 21381 Telegrams: TAYLINS, SLOUGH

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FOR

WINDSOR MODEL 45C

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1. DESCRIPTION

This Manual is for use in conjunction with the Valve Chart published separately.

1/1 GENERAL

The Model 45C Valve Tester caters for practically every known type of electronic valve except the larger transmitting types. Any normal fault can be quickly detected and the general condition of a valve is precisely measured by the Mutual Conductance Test. The instrument is self-contained and A.C. operated.

1/2 MAINS ADJUSTMENT

A 3-pin plug should be fitted to suit the sockets available.

Red — Line
Black — Neutral
Green— Earth

If a 2-pin plug is used the green wire is preferably connected to a separate earth.

The instrument is designed to operate from supplies of 105-125 or 200-250 volts 40-100 cycles. The voltage adjustment panel will be found on the left hand side of the instrument; the bakelite-headed plug should be plugged firmly into the socket most nearly corresponding to the actual voltage, i.e.:—

For 105–125 volts use the 115V. socket
,, 200–224 ,, ,, ,, 210V. ,,
,, 225–250 ,, ,, ,, 240V. ,,

The consumption is approximately 30 watts.

1/3 CONTROLS

The Main Selector at top right-hand side of panel enables the required type of test to be selected.

Below this is the Grid Volts control, calibrated in volts 0–15.

On the left-hand side are the selectors for Anode and Screen voltages, and for filament voltage.

Below the meter are the ABC selectors by means of which the correct pin connections are made.

The right-hand push button and the knobs marked A and B are used on Mutual Conductance Tests.

Tests for Gas are made with the left-hand push button.

The fuse (mains circuit) is fitted inside the instrument immediately above the mains adjust panel. The mains ON/OFF switch is at the front of the instrument.

1/4 METER SCALES

The outer scale is calibrated direct in mA/V, the two sets of figures referring to the two ranges available on the Main Selector.

The arc marked "Replace—?—Good" is used on Rectifier and Diode Tests only.

VALVE BASES

CIRCUIT	UX6 6 PIN AMERICAN	UX5 5 PIN AMERICAN	UX4 4 PIN AMERICAN	BR5 5 PIN ENGLISH	BR7. 7 PIN ENGLISH	MO8 8 PIN MAZDA OCTAL	B9G. 9 PIN ENGLISH GLASS	UX7 7 PIN AMERICAN	TEL. TELEFUNKEN	SC8 8 PIN SIDE CONTACT	SC5 5 PIN SIDE CONTACT	IO8/1 8 PIN AMERICAN OCTAL Nº1	IO8/2 8 PIN AMERICAN OCTAL Nº2	B8B B8G LOKTAL	B7G/1 7 PIN MINIATURE	B7G/2 7 PIN MINIATURE	B9A. 9 PIN MINIATURE GLASS	B8A. 8 PIN LOCK-IN MINIATURE GLASS	B8A/2 8 PIN LOCK-IN MINIATURE GLASS	B3G. 3 PIN MINIATURE GLASS
1	4	–	–	–	2	5	2	5	7	6	1	5	3	6	6	1	2	3	3	–
2	2	2	2	1	3	3	7	3	8	8	–	4	4	3	–	2	6	5	5	–
3	5	–	3	2	1	6	8	6	2	1	4	1	1	4	4	6	9	4	4	–
4	–	4	–	–	7	7	3	2	4	5	–	3	6	2	–	5	1	2	2	–
5	3	3	–	5	–	–	6	4	1	7	5	6	2	5	3	–	8	–	1	–
6	–	–	–	–	6	4	4	–	–	–	–	8	5	7	5	7	7	6	6	–
7	–	–	–	–	–	2	5	–	3	4	–	–	–	–	–	–	3	7	7	2
8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–
9	6	5	4	3	4	1	1	7	6	3	2	7	7	8	1	4	4	1	–	1.
10	1	1	1	4	5	8	9	1	5	2	3	2	8	1	7	3	5	8	8	3

CIRCUIT SELECTOR SWITCH POSITIONS.

CIRCUIT	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	CIRCUIT SWITCH
1	C	G	C	A	G	G	C	A	C	S	G	–	–	–	A				A
2	C	A	A	S	S	C	S	C	G	G	–	S	–	G	–				
3	C	A	G	C	S	C	A	G	–	–	C	S	–	C	G				B
4	C	S	A	A	A	S	–	C	C	A	–	–	S	G	S				
5	C	A	S	C	C	G	S	A	G	–	S	–	–	A	C	–	–		C
6	C	S	A	G	A	C	C	C	–	C	–	A	–	G	–	–	C		
7	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	A	S		
8	PERMANENTLY CONNECTED TO ANODE.																		
9	" " " F1 (CATHODE SIDE)																		
10	" " " F2																		

VALVE BASES WIRING CHART

The inner arc is calibrated in Megohms and is used on Cathode Leakage Test only.

1/5 VALVE HOLDERS

There are 20 valve holders and three sockets on the top of the instrument. The valve holder nomenclature and numbering system are given in the Valve Chart. The Red, Black and Green sockets are used to connect the valve top cap, if any, to the Anode, Cathode or Grid circuits respectively as required by the nature of the test and specified in the Valve Chart. A clip lead is supplied with the instrument for this purpose.

2. OPERATION

2/1 APPLICATION OF TESTS

The seven different tests available are briefly described in the seven following paragraphs and are considered in more detail in Section 3.

Which tests should be applied, and the order in which they should be carried out, depends on the type of valve and what is known about its condition.

The following table lists the recommended sequence of tests on valves of six general categories.

Main Selector	VALVES						Remarks
	Rectifier	Diodes	Triode or screen grid	Gas rectifier	Gas triode & tetrode	Magic eye	
Rectifiers	3	—	—	3	4	—	
Diodes	—	3	—	—	—	—	
Filament Continuity	1	1	1	1	1	1	Unless cold cathode
Element Shorts	—	—	2	—	2	2	
Cathode Leakage	2	2	3	2	3	3	Unless directly heated
Mutual Conductance	—	—	4	—	—	4	
Gas button	—	—	5	—	—	5	

The full sequence of tests is suitable for testing valves of unknown condition. Under these circumstances it is advisable not to omit the Element Shorts test otherwise the fuse may trip on switching to Mutual Conductance. Discretion can often be used and if, for example, a valve, working in an amplifier, is suspected of low gain it can be tested for Mutual Conductance only.

Multiple valves, such as double triodes, or diode triodes, are treated as several separate valves, the proper test conditions for each section being listed in the valve chart. This applies also to frequency changers (mixers) which have separate tests for the oscillator and mixer sections.

Tuning indicators ("magic eye" valves) are also tested in sections, first normal tests on the amplifier section, then a test on the shadow section. For the latter, moving the Anode and Screen volts selector from the position given opposite "Shadow" in the valve chart, to that opposite "Test" should cause a distinct change in shadow angle.

In the case of gas-filled valves, particularly mercury vapour types, it is important to wait for one minute on the "Cathode Leakage" position before switching to "Rect" or to "Mutual Conductance." This is to ensure that the cathode is at operating temperature before anode voltage is applied.

Mercury vapour and gas-filled triodes (thyratrons) are tested with the voltage settings given but on "Rectifier" position. The grid volts should be reduced slowly from 15 and at some lower value the valve should start to conduct, as shown by movement of the meter pointer to the "Good" sector. The value obtained varies considerably with the type of valve, and its rated "control ratio," i.e., anode voltage/grid voltage at start of conduction.

NOTE: In the following six sections the setting of switches not mentioned is immaterial.

2/2 RECTIFIERS

Set ABC selectors to positions specified in Valve Chart, Anode/Screen switch to 100/100 then turn main selector to "Rect" and read on coloured meter scale. Repeat for second anode if any.

TESTING COLD CATHODE RECTIFIERS

When testing cold cathode rectifiers e.g. OZ-4 the anode screen volt switch should be set to 250/200, which will cause the OZ-4 to strike. The anode screen volt switch should then be returned to the 100/100 position when the correct emission will be indicated on the meter. Failure of the OZ.4 to strike or the stopping of emission before the 100/100 switch position is reached indicates a faulty valve.

Care should be taken when testing other rectifiers that the anode screen volt switch be set to 100/100 as failure to do so will damage smaller types of rectifiers.

2/3 DIODES

Same as for rectifiers but main selector is at "Diodes."

2/4 FILAMENT CONTINUITY

Set main selector on "Fil. Cont." and if pointer moves to about half scale then the filament is intact.

2/5 ELEMENT SHORTS

Set main selector to "Element Shorts" and the top cap, if any, to green socket. Set ABC selectors initially to 000. Turn A selector slowly from 0 to 17 and back. If there is a definite meter reading on any switch position there is an internal short circuit in the valve. Repeat with B and C selectors. Also see Section 3/4.

2/6 CATHODE LEAKAGE

Set ABC selectors and filament volts as specified, then set main selector to "Cathode Leakage." The meter pointer will kick to the right, then fall back to some steady reading.

It is not possible to lay down a hard and fast rule as to the minimum acceptable resistance as so much depends on the type of valve and the circuit in which it is used. As a general guide, however, at least 2 megohms should normally be obtained and a reading of 1 megohm or less will usually indicate a faulty valve. Whether it need be rejected on this account depends entirely on the circuit in which it is used.

2/7 MUTUAL CONDUCTANCE

Set filament volts, anode/screen volts, grid volts and ABC selectors as specified and turn A and B knobs fully anti-clockwise then, and then only, set main selector to "Mutual

Conductance." (Two ranges are provided, the 15 mA/V or 3 mA/V positions being selected according to the anticipated result.)

Turn knob A clockwise until pointer reaches the XI mark. Turn knob B clockwise until pointer returns to zero. Press meter switch and read mA/V directly.

(Note a) : With a few valve types with low emission it may not be possible to reach the XI mark even with knob A fully clockwise. In these cases use the X2 mark and multiply the mA/V reading by 2.

(Note b) : If main selector is moved to Mutual Conductance position before ABC selectors are correctly set, voltage may be applied to the wrong electrodes. This may damage the valve or meter or blow the fuse. (See Section 1/3 for fuse replacement.) It is best to leave the main selector on Cathode Leakage whilst ABC selectors are altered, as this keeps the valve heater at operating temperature.

(Note c) : If the meter pointer is seen to be vibrating this is due to unrectified A.C. across the meter circuit and is probably caused by an internal short in the valve under test. The instrument should be switched off immediately to avoid damage to the meter, or the main selector can be turned back to Cathode Leakage.

2/8 GAS BUTTON

After the meter switch has been used for measuring Mutual Conductance as described in the last section, the valve can be tested for excessive grid current as follows, leaving selector switches, bias control and anode-screen volts control in the same positions.

Turn knob B in fully clockwise position. Turn knob A in clockwise position up to point when meter pointer reaches centre scale. Then press Gas Button. If meter pointer goes off scale in either direction the valve has excessive grid current. The pointer deflects to the right for positive grid current, to the left for negative grid current. The latter may be due to grid emission.

3. PRINCIPLES OF OPERATION

(See circuit diagrams, centre pages.)

3/1 RECTIFIERS

In this test 100 volts A.C. is applied to the anode circuit via a load resistor chosen so that the average good rectifier will pass a current sufficient to give a meter reading in the "Good" sector. The meter is shunted to about 22 mA. full scale. Screen voltage is not applied but Grid Volts are available for tests on grid controlled rectifiers.

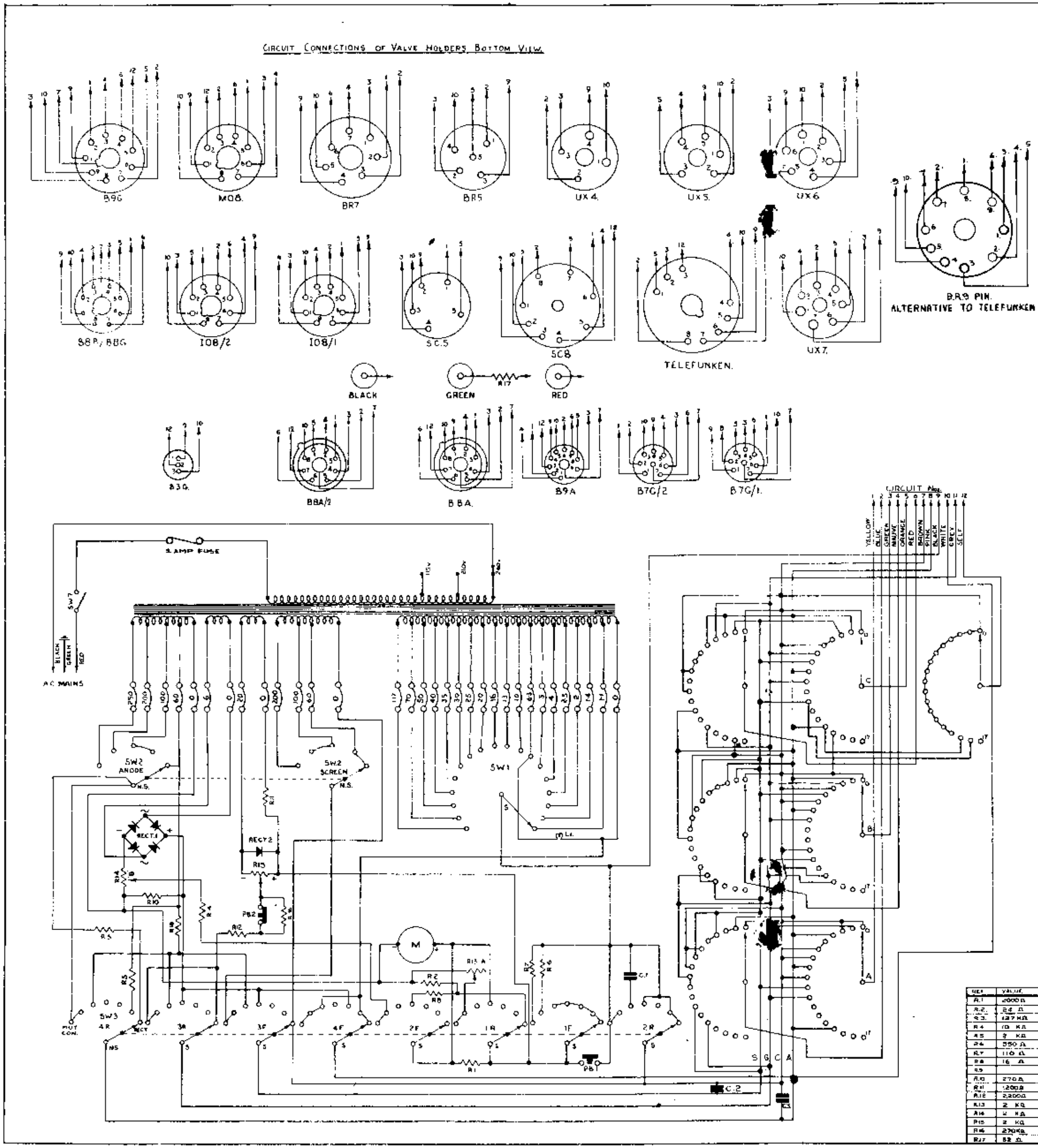
3/2 DIODES

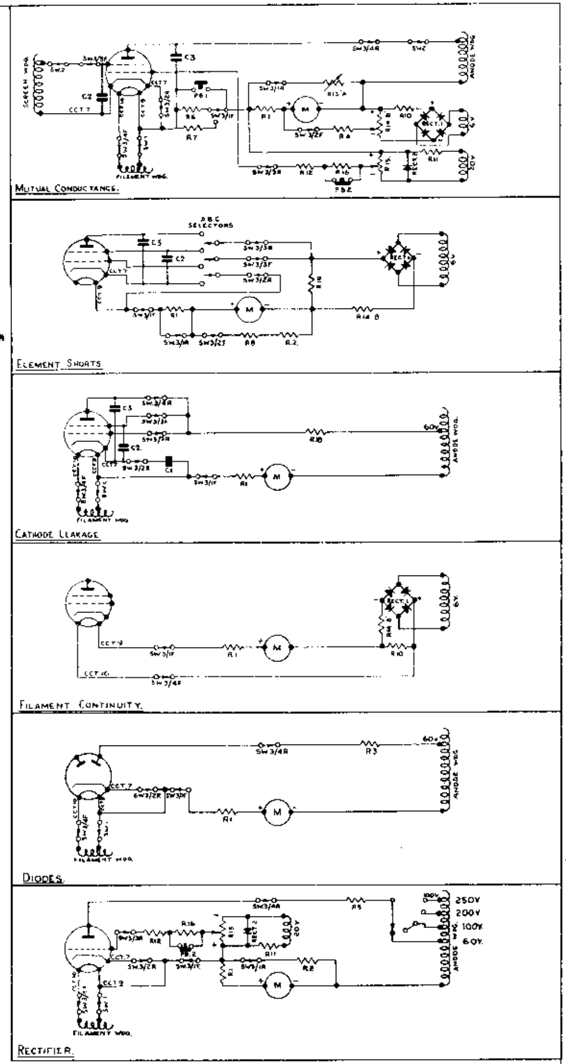
This test is similar to that for rectifiers except that the test voltage is reduced to 60 and the load resistor is much higher. The shunt is removed from the meter so that its full sensitivity of 250 μA. is available. Neither Screen nor Grid voltages are available.

3/3 FILAMENT CONTINUITY

Approximately ½ volt rectified A.C. is applied to the filament through the meter and a limiting resistor.

The maximum current is about 200 microamperes and is quite safe for all valves





REF	VALUE	RATING	TOL.	REF	VALUE TYPE	TOL
R.1	2000Ω	½ W.	5%	C.1	·1μF METAL CASE 300V	10%
R.2.	24 Ω	½ W	5%	C.2	·01μF CERAMICON	
R.3.	127 KΩ	½ W	5%	C.3	·01μF CERAMICON	
R.4	10 KΩ	½ W.	10%	SW.1	FILAMENT VOLTS SW.	
R.5	3 KΩ	2 W.	5%	SW.2	ANODE & SCREEN VOLTS SW.	45c/17
R.6	550 Ω	6 W.	5%	SW.3	MAIN SELECTOR SW.	
R.7	110 Ω	6 W.	5%	SW.4	CIRCUIT SELECTOR SW 'A'	45c/14
R.8	16 Ω	½ W.	5%	SW.5	CIRCUIT SELECTOR SW. 'B'	45c/14
R.9				SW.6	CIRCUIT SELECTOR SW 'C'	45c/15
R.10	270Ω	½ W.	5%	SW.7	MAINS ON-OFF SW	
R.11	1200Ω	¼ OR ½ W.	10%	T.1	H.T TRANSFORMER ASSY.	
R.12	2,200Ω	½ W.	20%	T.2	FILAMENT TRANS. ASSY	
R.13	2 KΩ	A POT DRG. No. 45/27		PB.1	CLOSED CIRCUIT PB.	D18/1
R.14	2 KΩ	B POT.	5%	PB.2	OPEN CIRCUIT P.B.	G4/1
R.15	2 KΩ	Q.B. POT.	5%	RECT.1	BO123 OR GEX34 (4-OFF)	
R.16	270KΩ	½ W.	20%	RECT.2	SD3 OR GEX34	
R.17	82 Ω	½ W.	20%			

REF	DESCRIPTION	DRG No.
L1	6·3V ·2A	

REF.	VALUE	RATING	TOL.
R18	75 KΩ	½ W.	20%

NOTES: 1. ALL SWITCHES SHOWN IN THE ANTI-CLOCKWISE POSITION.
2. FOR VALVE BASES WIRING CHART SEE DRG No. 45c/19

CIRCUIT DIAGRAM

3/4 ELEMENT SHORTS

The same arrangement is used as on Filament Continuity except that the test points are applied to all electrodes in turn by rotating the selectors. Should there be a short it must be shown on at least one position.

(With a few valves spurious results may be obtained. Such are those having heater centre taps or internal connections on pins which would otherwise be " blank.")

3/5 CATHODE LEAKAGE

In this test all the elements except cathode and heater are joined together and a condenser is connected between heater and cathode. An A.C. voltage is applied so that the valve acts as a rectifier and generates about 50 volts D.C. between heater and cathode. The meter then reads any leakage current and this can be interpreted in terms of megohms leakage on the lowest meter scale.

3/6 MUTUAL CONDUCTANCE

In this test a choice of anode, screen and grid voltages is provided. These are A.C. except that the grid voltage is prevented from going positive by a small rectifier. The transformer windings are phased so that the anode and screen voltages are in phase whilst the grid voltage is out of phase. When the anode and screen voltages are positive, therefore, the grid voltage is negative and meter current passes. When the anode and screen voltages are negative, the grid voltage is zero and no meter current passes. The inertia of the meter causes it to read steadily although the current through it is intermittent.

Knob A comprises an adjustable meter shunt. When it is fully anti-clockwise the meter is shorted and reads zero.

Knob B controls a bucking voltage derived from a separate transformer winding and small rectifier. When it is fully anti-clockwise the extra bucking voltage is zero.

On the Mutual Conductance test the screen voltage is applied between cathode and screen, the grid voltage between grid and the lower end of a cathode resistor, and the anode voltage between the anode and the lower end of the cathode resistor. The cathode resistor therefore carries anode current only. The meter reads anode current and is initially shunted to zero. As soon as the valve warms up pulsating anode current flows and the meter reads when knob A is turned clockwise. The X1 mark is at 3/5 of full scale. Next knob B is turned so that sufficient bucking voltage is applied to the meter to reduce its reading to zero. Pressing the meter switch then shorts out the cathode resistor and the resultant anode current increase is shown on the meter on the Mutual Conductance scale.

The cathode resistor has a value of 555 ohms on the 3 mA/V range and 111 ohms on the 15 mA/V range.

The theory of operation is as follows :—

Suppose the meter is shunted so that it reads x mA. full scale. Since the X1 mark is at 3/5 full scale the anode current is $3x/5$ mA. $= 3x/5000$ amps. On the 3 mA/V range the cathode resistor is 555 ohms so the cathode bias voltage $= 555 \times 3x/5000 = x/3$ volts. Suppose the valve on test has a mutual conductance of 3 mA/V under the specified test conditions. Then its anode current increase when the cathode resistor is shorted is $3 \times x/3 = x$ mA. The meter therefore reads full scale corresponding to 3 mA/V. Similarly for lower values of mutual conductance on this range.

Operation on the 15 mA/V range is the same except that the cathode resistor is 111 ohms and the meter is read on the 0–15 mA/V scale.

3/7 GAS. BUTTON

When knob A is fully clockwise the meter is shunted to approximately 500 μA. full scale.

The grid resistor is 270 kilohms, so with a low slope valve the usual grid current limit of 2 μA. produces a voltage change of 0·54 volts which is likely to cause an I_a change of about 0·54 mA. With a high slope valve the grid current is usually limited to 0·7 μA. which produces 0·19 volts which is likely to cause about the same I_a change.

4. VALVE DATA

4/1 METHOD OF WORKING OUT SETTINGS

The Valve Chart, published separately, gives data for nearly 3000 valves, but new types are constantly being added. Space is left for the user to fill in settings for new types as these are encountered. The settings are easily worked out as follows. It is assumed that manufacturers' data is available as to base connections and electrical characteristics.

Column 1 Valve Type
2 Manufacturer
3 Holder No.
4 Base Type
5 Heater Volts
6 Type
7 Voltages
8 Cap
9 ABC Selectors
10 Mutual Conductance

Columns 1, 2, 3, and 4 are filled by inspection. International Octal based valves with heaters to pins 2 and 7 are tested in No. 12 holder (I08/1) but those with heaters to pins 7 and 8 are tested in No. 13 holder (I08/2). Similarly miniature 7-pin based valves with heaters to pins 1 and 7 are tested in No. 15 holder (B7G/1) but those with heaters to pins 3 and 4 are tested in No. 16 holder (B7G/2).

Columns 5 and 6 are filled in from manufacturers data.

In Column 7 enter suitable test voltages as follows :—

60V. anode/60V. screen — small triodes and pentodes, high dissipation triodes and pentodes.

100V. anode/60V. screen — small triodes and pentodes, high dissipation triodes and pentodes and R.F. pentodes.

100V. anode/100V. screen — small triodes, high slope R.F. pentodes, most output pentodes.

200V. anode/100V. screen — high mu triodes, normal R.F. pentodes.

250V. anode/200V. screen — high mu triodes, R.F. pentodes with high rated screen voltage.

In general voltages nearest to normal operating conditions can be used, except for power valves taking over about 30 mA. anode current normally. For these, reduced voltages should be used to avoid testing them with an unnecessarily high anode current.

The grid voltage should be that recommended for normal operation (usually Class A amplifier conditions). If, however, lower anode and screen voltages are used, the grid bias voltage should be reduced in proportion to the reduction in anode voltage in the case of a triode, or the screen voltage of a tetrode or pentode.

Column 8 is blank unless there is a top cap. If this is a grid connection, enter G for green, if anode enter R for red. If the electrode is not used during tests of another section in the valve (e.g., the diode of a diode-triode) enter B for black.

To work out the ABC selector settings in Column 9, refer to the wiring chart (Page 4). There are 10 circuits to which the pins of all valve holders are connected in the manner shown by the chart, the right-hand side of which also lists the switch connections of the ABC selectors. The letters C, A, S, G, refer to cathode, anode, screen grid and control grid respectively. The top line on the chart shows that selector A connects circuit 1 to cathode in position 0, grid in position 1, cathode in position 2, anode in position 3 and so on. Only the first 7 circuits are controlled by the selectors. Circuit 8 is permanently connected to cathode and anode respectively, and circuits 9 and 10 carry the heater supply.

EXAMPLE 1. Triode type 30, having the following pin connections :—

(UX4 base) pin 1 filament
2 anode
3 grid
4 filament

The circuit connections for this base are given in the fourth column from the left. Selector A controls circuits 1 and 2, i.e., pin 2 on circuit 2, circuit 1 not being connected on this holder. Now pin 2 is anode, so the right-hand columns are scanned for a selector position giving anode on circuit 2. Positions 1 and 2 satisfy this requirement, no account being taken of the circuit 1 connections as these are immaterial in this instance. Selector A position 1 is therefore chosen. Similarly selector B controls pin 3 on circuit 3, circuit 4 not being connected. This pin is grid, so position 2 is chosen, although position 7 would do as well. Selector C controls no pins so it is left on position 0. The settings are therefore 120. The filament connections on pins 3 and 4 are made automatically as circuits 9 and 10 are permanently on the filament supply.

EXAMPLE 2. Indirectly heated pentode type 6K7G having the following pin connections on an international octal base :—

pin 1 blank (or shell if metal type)
2 heater
3 anode
4 screen grid
5 suppressor grid
6 blank
7 heater
8 cathode
top cap—control grid

The I08/1 holder (No. 12) must be used, as the heaters are on pins 2 and 7. Selector A controls pins 5 and 4, i.e., suppressor and screen respectively. It should therefore be on position 6 (cathode, screen) since the suppressor grid is at cathode potential. Selector B controls pins 1 and 3, i.e., shell and anode. Its correct position is therefore No. 3 (cathode, anode) since the shell or metallizing if any should be connected to cathode. Selector controls pins 6 and 8, i.e., blank and cathode, and is therefore left on 0. The whole setting is thus 630, with top cap to Green socket.

EXAMPLE 3. Frequency changer type X61M Osram, having the following connections on on an international octal base :—

pin 1 metallizing
2 heater
3 anode
4 screen grid
5 oscillator grid
6 oscillator anode
7 heater
8 cathode
top cap—signal grid

The correct holder is I08/1, No. 12. Separate tests are made on triode and mixer sections. Triode setting 507 is worked out first, with mixer section electrodes such as those on pins 3 and 4 as well as the top cap to cathode. Next the mixer section is specified as 630, the triode connections on pins 5 and 6 being connected to cathode, and the top cap to the green socket.

EXAMPLE 4. Rectifier AZ31 Mullard, having the following connections on an international octal base :—

pin 1 blank
2 filament
3 blank
4 anode
5 blank
6 anode
7 blank
8 filament

The main selector is switched to "Rect." on which position the screen voltage is no longer applied. The grid voltage, however, is still available for testing thyratrons and grid-controlled rectifiers.

Pin 2 on filament is correct, but the other filament connection does not go to pin 7 but to pin 8. However, since circuit 9 is the cathode side of the filament, the filament circuit is completed by seeing that pin 8 is connected to cathode.

The two rectifier sections are tested separately, the anode voltage being connected to each anode in turn with all other electrodes to cathode. This gives settings of 100 and 007.

In column 10 is entered the manufacturers' figure for mutual conductance unless the anode or screen voltages used are different. In this case the figure should be reduced by the square root of the ratio between the test voltage and the normal voltages. The anode voltage of a triode is meant, or the screen voltage of a pentode. E.G., if a triode listed as having a slope of 4 mA/V at 200 volts on the anode, then if it is tested at 100 volts the slope to be expected would be—

$$4 \times \sqrt{(100/200)} = 2{\cdot}8 \text{ approximately.}$$

Similarly with a pentode the reduction of screen voltage is taken into account.

Very occasionally valves are encountered which cannot be tested owing to the base connections. Sometimes this is due to a heater centre tap being connected to a pin which cannot be isolated, and sometimes to internal connections being made on certain pins of glass-based valves.

Filament centre taps are taken if possible to a blank position on the selectors. E.G., type 3S4 has a filament centre tap on pin 5, and selector C is on position 8 which leaves circuit 6 disconnected.

We hereby guarantee each new instrument manufactured by us to be free from defective materials and workmanship and agree to rectify any such defects free of charge for a period of six months from date of registered purchase. This guarantee is subject to the following conditions :—

1. That the instrument has had, at all times, normal use and has not been tampered with.

2. That the registration card has been correctly completed and returned to us within seven days of purchase.

3. That in cases of complaint the instrument is returned to us securely packed and carriage paid.

4. That this guarantee is non-transferable and applies only to the registered user.

5. That any Valves, Rectifiers or Components not of our manufacture but incorporated in our instruments and subject to their Manufacturer's Guarantee are not covered by this guarantee.

6. In the event of repairs being carried out by the purchaser, the Company cannot be held liable for any expense incurred.

7. Under no circumstances can the Company be held responsible for indirect damage caused by any defect. Our liability in all cases is limited to making good any defective part.

8. In the event of any dispute arising as to the interpretation of this guarantee, the decision of the Company must be accepted as final.

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