COLD CATHODE TUBES
USING TEST SET SD-96464-01 (J94731A)
REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers the conditions under which the electrical requirements of cold cathode tubes shall be applied, using the cold cathode tube test set SD-96464-01.

Caution: Before handling any tubes marked with a purple-red, 3-bladed, propeller-shaped symbol on the tube envelope, take precautions which are specified in Section 024-700-801 covering method of handling specially marked cold cathode electron tubes containing radium bromide.

1.02 This section is reissued to add the 430C electron tube to Table A.

1.03 Reference shall be made to Section 024-722-101 for interpretation of marking showing the date of manufacture of tubes.

1.04 The following applies when making voltage or current measurements with the M2 meter:

VM POSITION	μAMP POSITION	MULTIPLY READING BY
0-100	0-100	1
0-200		2
0-300		3
	0-500	5

1.05 Terminal numbering on tubes having soldering terminals is as follows:

(a) Tubes having tubular soldering terminals:

ELECTRODE	TERMINAL NO.
Anode	1
Starter anode	2
Starter anode through resistance	3
Cathode	4

(b) Tubes having flat-type soldering terminals:

ELECTRODE	TERMINAL NO. 3-ELEMENT	TERMINAL NO. 2-ELEMENT
Anode	2	5
Starter anode	4	—
Starter anode through resistance	5	—
Cathode	7	2

2. APPARATUS

2.01 One cold cathode tube test set, J94731A (SD-96464-01).

2.02 Pratt and Lambert "Dulux" black enamel, 83-005 or 93-005.

2.03 "Dulux" olive green enamel, RP88033.

Tubes Wired in Circuit

2.04 One W2W cord, 6 feet long, equipped with one 310 plug, one 360B tool, one 360C tool (2W17A cord), and two KS-6278 connecting clips.

Tubes Having Lead-In Wires—Not in Circuit

2.05 One 893 cord, 6 feet long, equipped with two 360A tools (1W13B cord), one KS-6278 connecting clip, and one 364 spade terminal.

Tubes Having Soldering Terminals—Not in Circuit

2.06 One W2W cord, 6 feet long, equipped with one 310 plug, one 360B tool, one 360C tool (2W17A cord), and two KS-6278 connecting clips.

2.07 One 893 cord, 6 feet long, equipped with two 360A tools (1W13B cord), one KS-6278 connecting clip, and one 364 spade terminal.

3. PREPARATION

3.01 Restore all test set keys to normal.

3.02 Turn all variable controls to the MIN position.

Caution: At all times before operating the M key to the INC I position, make sure that the CATH I control is at the MIN position. Also, always turn the FINE TR I control to the MIN position before operating the COARSE TR I control each step toward the MAX position.

3.03 Connect the S3A cord of the test set to a +130 volt battery supply jack.

3.04 Connect the S3B cord of the test set to a −48 volt battery supply jack. In cases where a greater negative voltage is required, connect the S3B cord to a −130 volt battery supply jack if one is available.

3.05 Connect the tube to be tested to the test set as specified in Tables A and B. If a socket mounting is specified, insert the tube in the proper socket of the test set. Other methods of connection referred to are covered in the paragraphs which follow. After connecting the tube to the test set, operate the BAT key to ON.

Tubes Wired in Circuit

3.06 Insert the 310 plug of the W2W cord in the TST jack of the test set. If anode potential is not permanently connected to the tube under test, connect the 364 spade terminal on the 893 cord to the A binding post of the test set. Then with the associated circuit removed from service, connect the KS-6278 connecting clips, inserted in the 360-type tools, to the tube terminals in accordance with the test clip data in the circuit requirements table.

3.07 Where test clip data is not given in the circuit requirements table, analyze the circuit in order that the proper connections may be made. In such cases, insulate contacts at the nearest electrical points to the starter anode and the cathode of the tube to be tested. Connect the KS-6278 connecting clip associated with the 360C tool (white) to the starter anode (through control resistance where used) and connect the KS-6278 connecting clip associated with the 360B tool (black) to the cathode. If anode potential is not permanently connected to the tube under test, insulate contacts at the nearest electrical point to the anode and connect the KS-6278 connecting clip associated with the 360A tool (red) to the anode. For 2-element tubes, disregard above connecting information pertaining to the starter anode.

Tubes Having Lead-In Wires—Not in Circuit

3.08 Connect the wires or terminals of the tube to the binding posts of the test set as follows:

(a) Yellow wire (cathode) to the K binding post

(b) Black wire (main anode) to the A binding post

(c) Red wire (starter anode) to the SA binding post.

3.09 Connect the wires or terminals of the tube to the binding posts of the test set as follows:

(a) Yellow wire (cathode) to the K binding post

(b) Black wire (main anode) to the A binding post

(c) Terminal 2 (starter anode) to the SA binding post by means of the 893 cord with the 364 spade terminal on the cord connected to the binding post of the test set and the KS-6278 connecting clip to the terminal of the tube.

Tubes Having Soldering Terminals—Not in Circuit (See 1.05.)

3.10 Insert the 310 plug of the W2W cord into the TST jack of the test circuit. Connect the 364 spade terminal on the 893 cord to the A binding post of the test set. Connect the KS-6278

TABLE A

2-ELEMENT TUBES

TUBE	WIRING CONNECTIONS	IONIZE VOLTAGE TEST PROCEDURE 5.25-5.30		ANODE DROP TEST PROCEDURE 5.37-5.42		
		MIN	MAX	MIN	MAX	CURRENT (MA)
413A and B	(a), (d)	180	255	55	75	30

3-ELEMENT TUBES

TUBE	TEST SET SOCKET OR WIRING CONNECTIONS	STARTER GAP VOLTAGE					ANODE GAP VOLTAGE				TRANSFER CURRENT (μA) TEST PROCEDURE 5.19-5.24
		IONIZE TEST PROCEDURE 5.01-5.06		DROP TEST PROCEDURE 5.07-5.10 [See Note (e)]			FORWARD VOLTAGE TEST PROCEDURE 5.11-5.13	DROP TEST PROCEDURE 5.14-5.18			
		MIN	MAX	MIN	MAX	CURRENT (MA)	MAX	MIN	MAX	CURRENT (MA)	MAX
313C	V2	62	89	52	74	20	185(f)	68	90	20	—
313CA	V2	66	78	52	74	20	200	68	88	20	—
313CB	V2	62	89	52	74	20	170	71	81	20	—
313CC	V2	66	78	52	74	20	150	68	88	20	—
313CD	V2	64	78	52	74	20	—	—	—	—	—
333A	(a),(c)	62	89	52	74	20	150	68	90	20	—
346B and C	(a),(d)	65	89	52	74	20	225	72	90	20	110
353A	(a),(d)	62	89	52	74	20	150	68	90	20	—
359A	(a),(b)	67	89	52	74	10	165	66	90	10	50
372A	(a),(c)	62	89	52	74	20	150	68	90	20	—
376B and C	V1	67	85	52	74	20	275	60	80	30	150
395A	(a),(b)	71	84	52	74	10	140	68	85	10	—
405A	(a),(b)	67	89	52	74	10	165	66	90	10	50
426A	(a),(b)	65	85	53	72	3	180	63	75	10	70
430A and B	V2	65	85	52	74	20	185	68	85	20	—
430C	**V2**	**65**	**89**	**52**	**74**	**20**	**185**	**68**	**85**	**20**	**—**

Notes:

(a) Tube wired in circuit — preparation as in 3.06 and 3.07.

(b) Tube out of circuit — preparation as in 3.08.

(c) Tube out of circuit — preparation as in 3.09.

(d) Tube out of circuit — preparation as in 3.10.

(e) Not applicable to tubes wired in circuit.

(f) For tubes manufactured prior to the fourth quarter of 1948, the maximum for the anode gap forward voltage is 150 volts.

TABLE B

VOLTAGE REGULATOR TUBES – 2-ELEMENT

TUBE	TEST SET SOCKET	IONIZE VOLTAGE MIN	IONIZE VOLTAGE MAX	IONIZE VOLTAGE TEST PROCEDURE	ANODE DROP TEST PROCEDURE 5.37-5.42 MIN AT 5 MA	MAX AT 30 MA	REGULATION VOLTS
423A and B	VR3	—	160	5.25-5.30	99(b)	103(b)	0.75 (4-6 ma)
OA-2 (VR-150)	VR2	—	185	5.25-5.30	140	168	6.0
OA-3 (VR-75)	VR1	—	105	5.31-5.36	68	83	4.5
OB-2 (VR-105)	VR2	—	133	5.31-5.36	101	114	4.0
OC-3 (VR-105)	VR1	—	133	5.31-5.36	103	113	2.5
OD-3 (VR-150)	VR1	—	185	5.25-5.30	142	163	4.5
5651	VR2	—	115	5.31-5.36	82(c)	92(d)	3.0
447A	VR3	—	135	5.31-5.36	80(a)	85(a)	0.75 (2-4 ma)
453A	VR3	—	105	5.31-5.36	81	87	1.2 (4-6 ma)

Notes:

(a) Voltage drop at 4 ma.

(b) Voltage drop at 6 ma.

(c) Voltage drop at 1.5 ma.

(d) Voltage drop at 3.5 ma.

VOLTAGE REGULATOR TUBES – 3-ELEMENT

TUBE	TEST SET SOCKET	STARTER GAP VOLTAGE IONIZE TEST PROCEDURE 5.01-5.06 MIN	IONIZE MAX	DROP AT 5 MA TEST PROCEDURE 5.07-5.10 MIN	DROP MAX	ANODE GAP VOLTAGE FORWARD VOLTAGE TEST PROCEDURE 5.11-5.13 NOM	DROP AT 40 MA TEST PROCEDURE 5.14-5.18 MIN	MAX	REGULATION (VOLTS)	TRANSFER CURRENT (μA) TEST PROCEDURE 5.19-5.24 MAX
427A	V3	115	135	100	120	165	99	103	1.5 (5-40 ma)	80
446A	V3	90	115	80	90(a)	108	80	83	1.5 (5-40 ma)	100

Note:

(a) Voltage drop at 1 ma.

connecting clip inserted into the 360-type tools on these cords to the tube terminals in the following manner:

(a) 360A tool (red) to main anode

(b) 360B tool (black) to cathode

(c) 360C tool (white) to starter anode (not applicable for 2-element tubes).

4. REQUIREMENTS

4.01 Cold cathode tubes shall meet the electrical requirements specified in the circuit requirements table. Where the requirements are not given in the circuit requirements table, the values given in Tables A and B shall apply. The tables also refer to the test set socket to be used and the paragraph covering the test set preparation and test procedure for the various tubes.

4.02 Where the cold cathode tube is provided with a black or olive-drab, opaque, lacquer coating on the outside of the glass envelope, no glow shall be visible through the lacquer coating when the tube is in the ionized condition except that caused by defects in the coating. Where the cold cathode tube is provided with a red, translucent, lacquer coating on the outside of the glass envelope, glow shall be visible through the lacquer coating when the tube is in the ionized condition, regardless

of the presence or absence of defects in the coating. The following maximum defects in the coating are allowed.

(a) Thinness or absence of lacquer coating at the juncture between the base and glass envelope, extending not more than 1/32 inch from the base.

(b) For black or olive-drab lacquered tubes, a total area of all other defects not exceeding approximately 0.008 square inch; this is, for example, approximately equal to a single defect 1/16 inch by 1/8 inch or two defects 0.005 inch by 3/4 inch each. For red, translucent, lacquered tubes, a total area of all other defects not exceeding approximately 0.001 square inch; this is, for example, approximately equal to a single defect 1/32 inch by 1/32 inch or 0.005 inch by 1/4 inch.

The check of lacquered tubes shall be made under conditions of low intensity room illumination. For corrective action, see 6.01.

Note: Tubes with defects that approach the maximum stated above shall be located in equipment where they will not be exposed to direct sunlight.

5. TESTING PROCEDURES

A. Procedure for Checking Starter Gap Ionization Voltage—3-Element Tubes

5.01 Operate the VM (voltmeter) key to the 0-100 or 0-200 position, depending upon the value of the starter gap ionization voltage for the tube under test, and turn the SEL (selector) switch to the SG (start gap) position.

5.02 Turn the SG V (starter gap voltage) potentiometer slowly toward the MAX position, while watching the M1 milliammeter, until a sudden increase occurs in the milliammeter reading, indicating that the tube has ionized.

5.03 Operate the DEION (deionize) key, and note that the M2 voltmeter reading is within the specified limits. Release the DEION key.

5.04 Turn the SG V potentiometer to the MIN position. Then momentarily operate the DEION key. Observe that no reading is obtained on the milliammeter.

5.05 Repeat 5.02, 5.03, and 5.04 two or three times, and average all voltmeter readings except the first to determine the starter gap ionization voltage of the tube.

5.06 Restore the VM key to normal (0-300 position).

B. Procedure for Checking Starter Gap Voltage Drop—3-Element Tubes (Not to Be Used for Tubes Wired in Circuit Unless the Tube Is Used to Trip Ringing)

5.07 Operate the VM key to the 0-100 or 0-200 position, depending upon the specified starter gap voltage drop for the tube under test, and turn the SEL switch to the SG position.

5.08 Turn the SG V potentiometer slowly toward the MAX position, while watching the M1 milliammeter, until a sudden increase occurs in the milliammeter reading, indicating that the tube has ionized.

5.09 Turn the CATH I (cathode current) potentiometer and, if necessary, the SG V potentiometer toward the MAX position until a reading is obtained on the milliammeter corresponding to the specified starter gap current for the tube under test. If sufficient current cannot be obtained by this means, turn the CATH I potentiometer to the MIN position, hold the M key operated to the INC I (increase current) position, and turn the CATH I potentiometer again toward the MAX position until the specified current is obtained. Note that the M2 voltmeter reading is within the specified limits.

5.10 Restore the VM key to normal, and turn the SG V and CATH I potentiometers to the MIN positions.

C. Procedure for Checking Anode Gap Forward Voltage—3-Element Tubes

5.11 Allow 2 minutes to elapse after checking the starter gap voltage drop and before checking the anode gap forward voltage. Then operate the VM key to the 0-200 or 0-300 position, depending upon the specified anode gap forward voltage for the tube under test, and turn the SEL switch to the AG (anode gap) position.

5.12 Turn the AG V (anode gap voltage) potentiometer toward the MAX position until a reading is obtained on the M2 voltmeter, corresponding to the specified anode gap forward voltage for the tube under test or the greatest voltage obtainable if the specified voltage is greater than that obtainable on the test set. Observe that no reading is obtained on the M1 milliammeter, indicating that the tube has not ionized. Care should be taken that the hand or body is no closer than 2 inches to the tube under test to avoid false forward voltage readings.

> ***Note:*** This procedure does not provide an absolute test for tubes having specified forward voltages over 183 volts if the negative supply voltage is 48 volts, or over 268 volts if the negative supply voltage is 130 volts.

5.13 Restore the VM key to normal, and turn the AG V potentiometer to the MIN position.

D. Procedure for Checking Anode Gap Voltage Drop—3-Element Tubes

5.14 Turn the SEL switch to the AG position.

5.15 Turn the SG V potentiometer to the MAX position and momentarily operate the M key to the ION (ionize) position. Observe that a reading is obtained on the M1 milliammeter, indicating that the tube has ionized.

5.16 Turn the CATH I potentiometer and, if necessary, the AG V potentiometer toward the MAX position until a reading is obtained on the milliammeter corresponding to the specified anode gap current for the tube under test. If sufficient current cannot be obtained by this means, turn the CATH I potentiometer to the MIN position, hold the M key operated to the INC I position, and turn the CATH I potentiometer again toward the MAX position until the specified current is obtained. Operate the VM key to the 0-100 or 0-200 position depending upon the specified anode gap voltage for the tube under test, and note that the M2 voltmeter reading is within the specified limits.

5.17 If the tube being tested is a voltage regulator tube, readjust the CATH I potentiometer and, if necessary, the AG V potentiometer, until a reading is obtained on the milliammeter corresponding to the minimum anode gap current specified for the voltage regulation range. Observe the reading on the M2 voltmeter. Note that the difference between this voltmeter reading and the one obtained according to the procedure in 5.16 is within the specified voltage regulation limits.

5.18 Restore the VM key to normal, and turn the SG V, CATH I, and AG V potentiometers to the MIN positions.

E. Procedure for Checking Transfer Current—3-Element Tubes

5.19 Transfer current is the current flow required in the starter gap to produce anode gap ionization. To check the transfer current value of a tube, proceed as follows.

5.20 Operate the μAMP (microampere) key to the 0-100 or 0-500 position, depending upon the transfer current value in microamperes (μa) for the tube under test, and turn the SEL switch to the TR I (transfer current) position.

5.21 Turn the SG V potentiometer toward the MAX position, while watching the M2 microammeter, until an increase occurs in the microammeter reading, indicating that the starter gap has ionized.

> ***Note:*** If the reading is not stable, adjust the TR I potentiometers and readjust the SG V potentiometer until stability exists. To adjust the TR I potentiometers, turn the COARSE potentiometer one step at a time toward the MAX position and, after each step, turn the FINE potentiometer toward the MAX position. Before advancing the COARSE potentiometer each step, turn the FINE potentiometer back to the MIN position.

5.22 After the reading on the microammeter has been stabilized, adjust the TR I potentiometers in the manner described in the note under 5.21, while watching the M1 milliammeter, until a sudden increase occurs in the milliammeter reading, indicating that transfer has taken place. When checking tubes other than wired-in tubes, operate the READ TR I key as soon as transfer has taken place and observe the transfer current reading on the microammeter. Release the TR I key.

> ***Note:*** In cases where the transfer current value for the tube being tested is very slightly

greater than the starter gap ionization current value, transfer will occur almost simultaneously with starter gap ionization. Therefore, the potentiometers must be adjusted slowly so that the transfer current is not exceeded.

When checking wired-in tubes, watch the microammeter closely while adjusting the TR I potentiometers. In such cases, the transfer current is the maximum reading on the microammeter immediately before the sudden increase in the milliammeter reading.

5.23 Turn the SG V and TR I potentiometers to the MIN positions; then momentarily operate the DEION key. Observe that no reading is obtained on either of the meters.

5.24 Repeat 5.21, 5.22, and 5.23 two or three times, and average all microammeter readings except the first to determine the transfer current of the tube.

F. Procedure for Checking Ionization Voltage of 2-Element Tubes Having Ionization Voltage Above 135 Volts

5.25 Operate the VM key to the 0-200 or 0-300 position depending upon the specified ionization voltage for the tube under test, and turn the SEL switch to the AG position.

5.26 Turn the AG V potentiometer slowly toward the MAX position while watching the M1 milliammeter until a sudden increase occurs in the milliammeter reading, indicating that the tube has ionized. If the tube has not yet ionized with the AG V potentiometer at the MAX position, momentarily operate the M key to the ION position. Observe that the tube has ionized. Care should be taken that the hand or body is no closer than 2 inches to the tube under test to avoid false forward voltage readings.

5.27 Operate the DEION key, and note that the M2 voltmeter reading is less than the maximum ionization voltage specified and greater than the minimum ionization voltage, when specified. Release the DEION key.

5.28 Turn the AG V potentiometer to the MIN position; then momentarily operate the DEION key. Observe that no reading is obtained on the milliammeter.

5.29 Repeat 5.26, 5.27, and 5.28 two or three times, and average all voltmeter readings except the first to determine the ionization voltage of the tube.

5.30 Restore the VM key to normal.

G. Procedure for Checking Ionization Voltage of 2-Element Tubes Having Ionization Voltages Less Than 135 Volts

5.31 Operate the VM key to the 0-200 position, turn the SEL switch to the AG position, and operate the VR (voltage regulator) key. If the tube ionized when it was connected to the test set, momentarily operate the DEION key and observe that no reading is obtained on the M1 milliammeter.

5.32 Turn the SG V potentiometer slowly toward the MAX position, while watching the milliammeter, until a sudden increase occurs in the milliammeter reading indicating that the tube has ionized. Care should be taken that the hand or body is no closer than 2 inches to the tube under test to avoid false forward voltage readings.

5.33 Operate the DEION key, and note that the M2 voltmeter reading is less than the maximum ionization voltage specified. Release the DEION key.

5.34 Turn the SG V potentiometer to the MIN position; then momentarily operate the DEION key. Observe that no reading is obtained on the milliammeter.

5.35 Repeat 5.32, 5.33, and 5.34 two or three times, and average all voltmeter readings except the first to determine the ionization voltage of the tube.

5.36 Restore the VM and VR keys to normal.

H. Procedure for Checking Anode Voltage Drop—2-Element Tubes

5.37 Turn the SEL switch to the AG position.

5.38 If a reading is observed on the M1 milliammeter, the tube has ionized. If not, turn the AG V potentiometer slowly toward the MAX position while watching the milliammeter until a sudden increase occurs in the milliammeter

reading, indicating that the tube has ionized. If the tube has not yet ionized with the AG V potentiometer at the MAX position, momentarily operate the M key to the ION position. Observe that the tube has ionized.

5.39 Turn the CATH I potentiometer and, if necessary, the AG V potentiometer toward the MAX position until a reading is obtained on the milliammeter corresponding to the specified anode gap current for the minimum anode drop voltage of the tube under test. Operate the VM key to the 0-100 or 0-200 position depending upon the specified anode drop voltage for the tube under test, and note that the M2 voltmeter reading is not less than the specified minimum anode drop voltage of the tube under test.

> ***Note:*** If the tube under test is ***not*** a voltage regulator tube, as in the case of the 413A tube, the anode drop voltage is measured at only one specified current. In this case, adjust the controls to the specified current and note that the M2 voltmeter reading is within the specified limits. Then proceed as in 5.42, omitting 5.40 and 5.41.

5.40 Readjust the CATH I potentiometer and, if necessary, the AG V potentiometer until a reading is obtained on the milliammeter corresponding to the specified anode gap current for the maximum anode drop voltage of the tube under test. If sufficient current cannot be obtained by this means, turn the CATH I potentiometer to the MIN position, hold the M key operated to the INC I position, and turn the CATH I potentiometer again toward the MAX position until the specified current is obtained. Note that the M2 voltmeter reading is not more than the specified maximum anode drop voltage.

5.41 Note that the difference between the voltmeter readings in 5.39 and 5.40 is within the specified voltage regulation limit.

5.42 Restore the VM key to normal, and turn the CATH I and AG V potentiometers to the MIN positions.

6. CORRECTIVE ACTION

6.01 If defects in the lacquer coating exceed the area specified in 4.02, these defects shall be retouched as follows.

(a) On black opaque or red translucent finished tubes, defects shall be retouched with Pratt and Lambert "Dulux" black enamel 83-005 or 93-005.

(b) On olive-drab finished tubes, defects shall be retouched with "Dulux" olive green enamel RP 88033 or black enamels specified in (a).