SEPTEMBER 1967

RECOMMENDED PRACTICE

FOR

MEASUREMENT OF X-RADIATION

FROM

DISPLAY CATHODE RAY-TUBES

FORMULATED BY

JEDEC ELECTRON TUBE COUNCIL

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RECOMMENDED PRACTICE FOR MEASUREMENT OF X-RADIATION FROM DISPLAY CATHODE-RAY TUBES

1. Purpose and Scope

1.1 Purpose - To obtain the x-radiation characteristics of display cathode-ray tubes in order to predict the levels emitted by the tube when it is used in applications of known electrical characteristics.

1.2 Scope - This test method applies to the measurement of x-radiation emitted from direct-view television or other display cathode-ray tubes.

2. Apparatus

2.1 Ionization Chamber - 15 cm. diameter by 10 cm: length cylindrical ionization chamber (Riverdale Precision TV-150, or equivalent), used in combination with an electrometer.

Note 1: This chamber is recommended for tubes having a diagonal screen dimension of ten inches or larger. Chambers having smaller effective apertures shall be used for smaller tubes.

2.2 Electrometer - A device for charging the ionization chamber and reading the residual charge after exposure (Victoreen II model 687C, or equivalent).

2.3 Survey Meter - A dose-rate meter (electrostatically shielded) for probing or rapid surveying of a radiation field (Victoreen Model 440 RF, or equivalent).

Note 2: Other detectors of low energy x-radiation may also be used such as Geiger-Mueller counters, proportinnal counters, scintillation counters, or solid-state counters.

2.4 Timer - A stop-watch or equivalent device for measuring or controlling exposure time to an accuracy of at least ± 1.0%.

2.5 Test Equipment - To provide stable electronic conditions for operation of the display tube under test and to measure anode voltage and current.

2.5.1 Anode Voltage Meter - A meter for measurement of the anode voltage during test, with an accuracy of at least ± 0.5%. (Hewlett-Packard model 3439A digital voltmeter or equivalent with Hewlett-Packard model 3441A range selector or equivalent with suitable voltage divider such as a pair of X2177 resistors, Resistor Products Co., or equivalent. Calibrate using John Fluke Differential DC voltmeter model 825A/AG, or equivalent with John Fluke High Voltage Divider Model 80D or equivalent).

2.5.2 Anode Current Meter - A meter for measurement of the anode current during test, with an accuracy of at least ± 2.0%.

2.6 Ionization Chamber Support - A holder for supporting the ionization chamber during exposure in the recommended positions. It shall be constructed of wood or plastic and shall not lie between the chamber and the tube.

3. Calibration

3.1 The ionization chamber and electrometer combination shall be calibrated by exposure to a known filtered x-ray field, generated at 25 to 35 kilovolts, using the three-reading technique of Section 5.4. The calibration standard should be traceable to the National Bureau of Standards.

Note 3: If two or more individual laboratories require comparative radiation measurements, it is suggested that all chambers and electrometers be calibrated by using a common standard and by one standards laboratory (Riverdale Precision Instruments, Inc., 6044 Tyndale Ave., Bronx, New York 10471, or equivalent).

3.2 Any survey meter used for purposes other than probing or rapid surveying shall be calibrated similarly to Section 3.1.

3.3 Stability of the calibration may be checked periodically by using an appropriate radio-active source.

4. Test Conditions

4.1 The tube under test shall be positioned relative to the test equipment so that measurements may be made at recommended or representative positions (see Figure 1).

4.2 The tube under test shall be operated at the required anode voltage and current, which shall not vary or drift more than ± 0.5% during the entire test period.

4.3 A d-c signal voltage shall be applied to one electron gun of the tube under test.

4.4 Scanning controls shall be adjusted so that the raster edges are visible and positioned within a distance from the edge of the screen equivalent to 1% of the published horizontal and vertical screen dimensions. The linearity of scan shall be adjusted to at least 10% using a suitable pattern.

4.5 A warm-up period shall be provided for both the tube and test equipment in order to obtain stable operating conditions before proceeding with measurements.

5. Procedure

5.1 The background radiation or leakage of the ionization chamber shall be verified at the test position for the test exposure period and corrections to observed data applied as required (see Appendix I).

5.2 Radiation measurements shall be taken at the center of the tube face at Position 1, Figure 1. (In this position, the axis of the cylindrical chamber and the tube axis coincide, with the center of one plane circular face of the chamber located 2.5 cm. from the outside surface of the tube).

Note 4: The chamber is located 2.5 cm. from the tube surface to avoid electrostatic effects. The exposure rate varies only slightly within this distance.

5.3 Radiation measurements for the tube funnel shall be taken with the plane circular face of the chamber on the surface of a hypothetical, non-absorbing rectangular cabinet, as indicated in Figure I. The side of such a cabinet shall be 2.5 cm. from the outside surface of the tube at the ends of the major and minor axes of the face. The back shall be 2.5 cm. behind the deflection yoke or other components mounted on the neck.

For convenience in locating the chamber on this surface, a box of the size specified may be used. It should be made of clear plastic no thicker than 1/16". Appropriate correction shall be made for the apsorption of this material, if it is used.

The measurements shall be made at the location on the "cabinet" of maximum intensity. The location of the maximum intensity may be determined with a survey meter.

Note 5: The 0.5 MR/hour limit recommended by the NCRP specifies measurements at 5 cm. from any accessible surface of the receiver. Based on this distance, the standard ion chamber was made 10 cm. high, and it is assumed that a measurement made with the plane circular face in contact with the receiver surface provides a reading equivalent to the radiation at 5 cm. distance from the surface.

5.4 Readings - At least three successive readings shall be taken for each ionization chamber position and each tube operating condition of anode voltage and current. The value reported shall be the average of at least three successive readings, no one of which shall differ from the average by more than 10%.

During any exposure period the voltage and current shall be constantly monitored to insure conformance with Section 4.2.

6. Report

The report shall contain the following:

6.1 Identification of the tube specimen.

6.2 Test date, laboratory, and other pertinent information on test equipment, including model and serial numbers of chambers, electrometers, and survey meters, and their calibration factors.

6.3 Exposure time, electrometer readings, average anode voltage and current, and any other test equipment data necessary to interpret results.

6.4 The average of the three acceptable readings in milliroentgens/hr for each test condition.

6.5 Chamber locations.

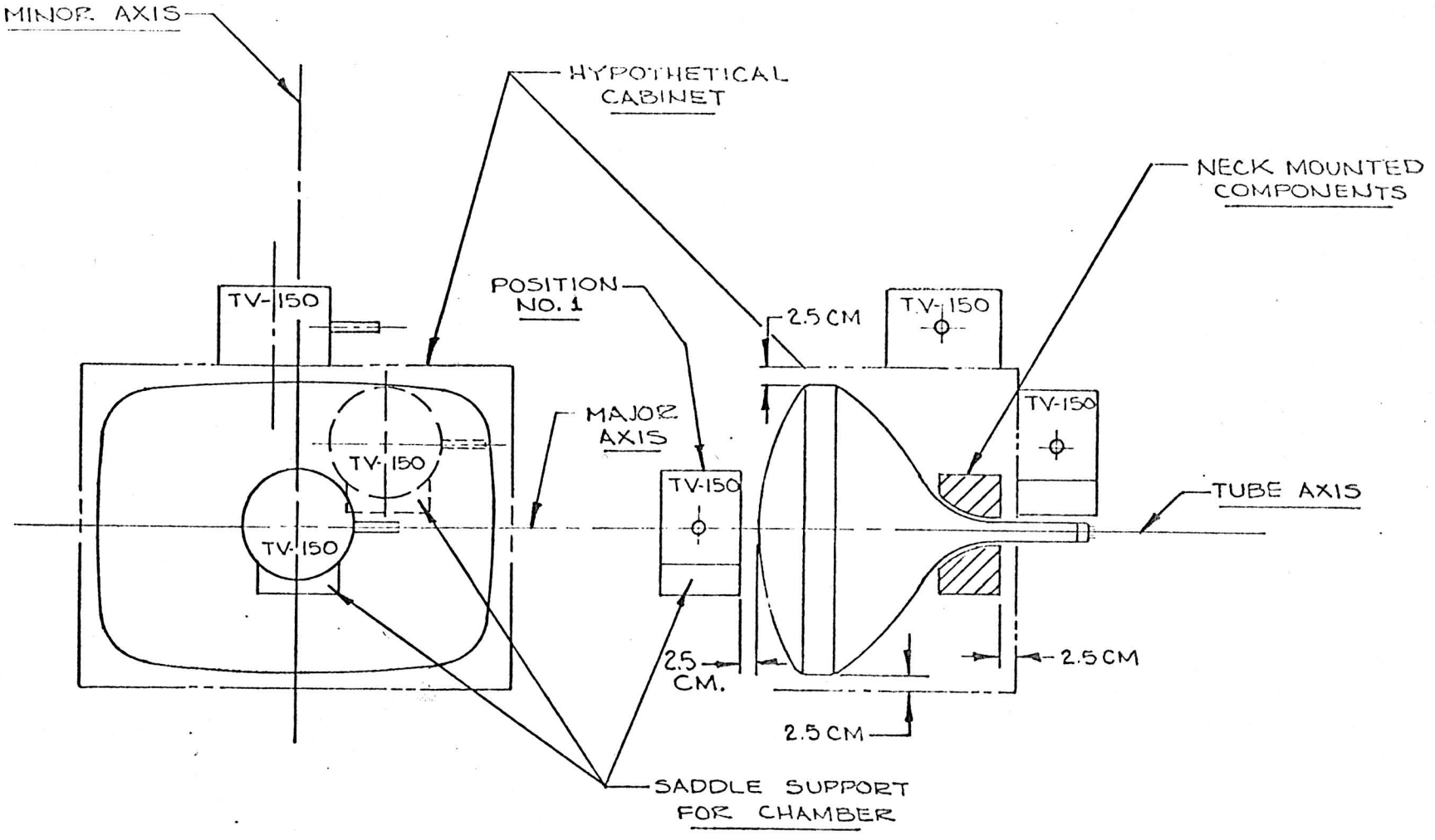
MINOR AXIS
HYPOTHETICAL CABINET
NECK MOUNTED COMPONENTS
POSITION NO. 1
TV-150
2.5 CM
TV-150
TV-150
MAJOR AXIS
TV-150
TV-150
TV-150
TUBE AXIS
2.5 CM.
2.5 CM
2.5 CM
SADDLE SUPPORT FOR CHAMBER
FRONT VIEW
SIDE VIEW

FIGURE 1.

APPENDIX I

Notes on Ionization Chambers, Electrometers & Survey Meters

1. It is desirable to keep chambers fully charged when not in use.

2. Chambers that have been fully discharged for an extended period may show an "insulation soakage" when recharged. This leads to a drift. It may be avoided by repeated recharging over a short period of 15 minutes or more.

3. It is desirable to keep a daily record of the spontaneous discharge rate of ionization chambers - due to natural radiation background of approximately 0.01 mR/hr. and to electrical leakage. If chambers are recharged each day before use (or during periods when not in use), the discharge rate can be determined. In this way any excessive leakage can be detected.

4. It is desirable to keep the protective cap on except when charging or reading to minimize the possibility of contaminating the end of the stem.

5. The exposed insulator at the end of the stem should not be contaminated by touching, since body fluids may cause electrical leakage.

6. If necessary, the end of the stem may be cleaned by wiping with a soft cloth saturated with pure alcohol.

7. The same surface of the chamber should always be towards the tube to be measured.

8. The chamber should be inserted in the electrometer well with the same rotational orientation each time.

9. Radiation bursts (probably cosmic rays) produce transient deflections of the survey meter needle. They occur randomly and vary in magnitude. Before recording a reading one should be sure the indication is a steady one due only to the tube being measured.