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Radiation Kilovoltmeter for X-Ray Diagnostic Equipment

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Abstract: The paper considers the calibration of the X-ray machine 12L7UR, which shows that to perform the calibration, the minimum step of changing the additional filters and the step of the anode voltage are selected and a correspondence is established between the readings of the verified Piranha instrument and the measured values of the reduced scattering coefficient.

Key words: kilovoltmeter, radiation, anode voltage, phantom, X-ray tester, control panel, sensor.

X-ray spectral high voltage meter of X-ray diagnostic devices, provides measurement of anode voltages in the range from 40 kV to 125 kV with a basic relative error of less than 0.1%. However, for economic reasons, the scope of this device is limited to the tasks of verification of X-ray radiation testers with a higher measurement error. Universal X-ray tester UXRT (device for monitoring radiation and electrical characteristics) three detection channels, provides non-invasive measurement of the anode voltage in the range of 40 - 125 kV with a relative error of up to 5%.

Fig. 1 Device for monitoring radiation and electrical characteristics.

However, there are a number of limitations when working with the UXRT X-ray tester. For example, it was experimentally shown in [1] that with the introduction of additional filtering of radiation, the readings of the kilovoltmeter increase at a constant value of the anode voltage "setpoint". The control of radiation parameters of X-ray diagnostic devices involves the use of non-invasive measurement methods. An analysis of the instrumentation park shows that modern kilovoltmeters implement a dual-energy measurement technique based on the use of spectral shifting filters [2].
The operation of a radiation kilovoltmeter is based on the idea of simultaneous registration of attenuated and scattered radiation arising during the passage of bremsstrahlung through a solid-state phantom of a given shape [3-4]. As criterion for evaluating the conditions for excitation of radiation and measuring the anode voltage, it was proposed to use the coefficient of reduced scattering coefficient (RSC), which is determined by the ratio of the signals of the detectors of the direct and scattered beams. It is obvious that

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the RSC value is affected by both the spectral composition of the incident radiation and the parameters of the phantom itself: its material, density, and geometric dimensions.

Fig. 2 - X-ray equipment 12L7UR

The appearance of the push-button console (with the results displayed) and the appearance of the touch screen console are shown in Figures 3 and 4.

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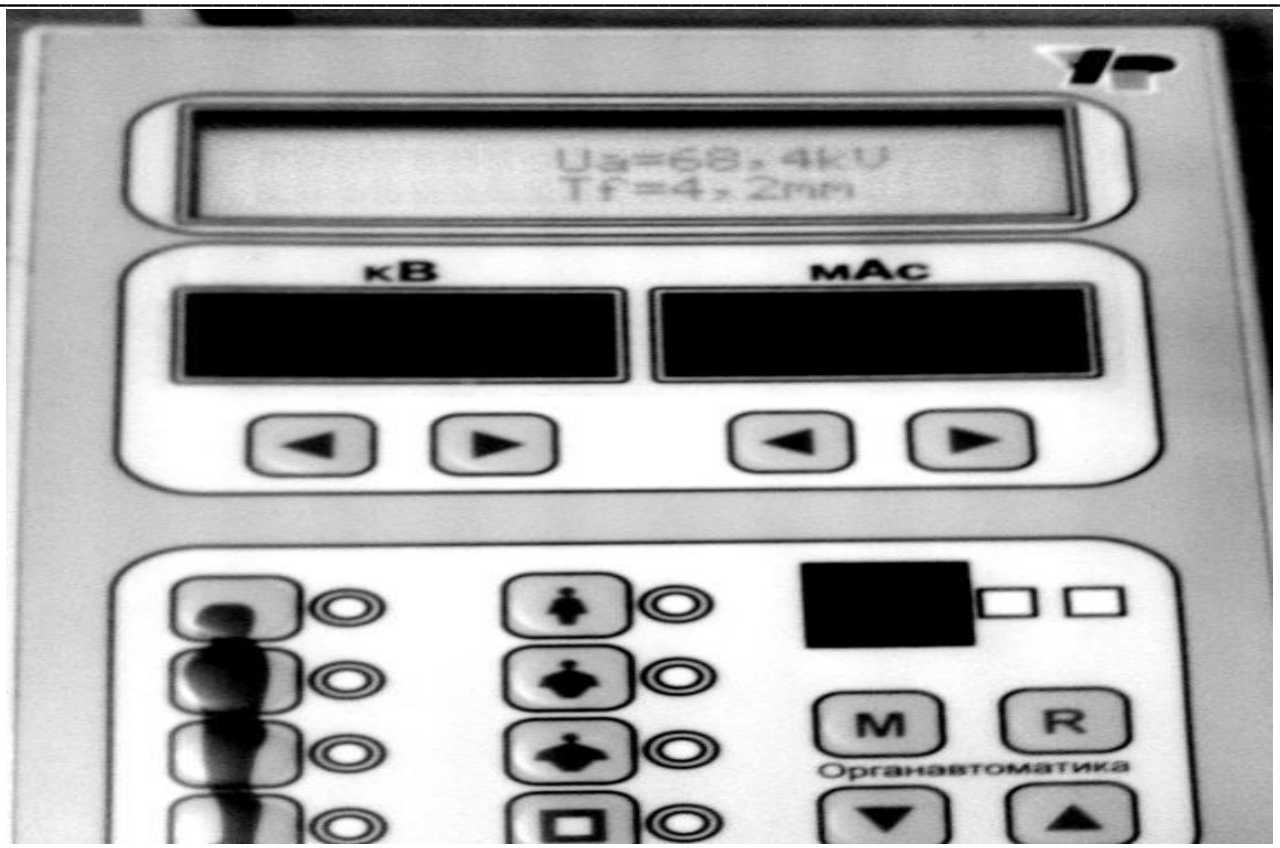

Fig. 3 - External view of the control panel of the apparatus 12L7UR with push-button control

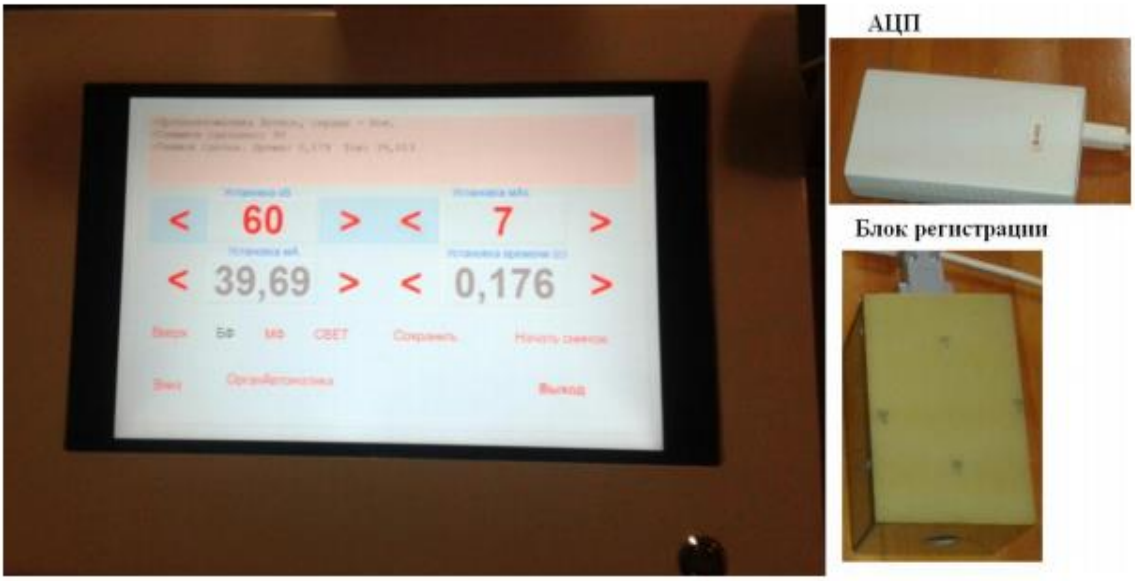

Fig. 4 - Touch control panel 12L7UR (left) with a registration unit (right) and an analog-to-digital converter

Calibration of the radiation kilovoltmeter (RK) as part of the built-in control system (BCS) is necessary condition for the normal functioning of the system.

To perform the calibration, the minimum step of changing the additional filters and the step of the anode voltage are selected, and a correspondence is established between the readings of the verified Piranha instrument and the measured RSC values.

It was proposed to form calibration table with a step of 5 kV for voltage in the range of 60 - 100 kV and 0.9 mm for additional filtering in the range of 0.9 - 7.2 mm aluminum. High-purity aluminum plates 85x85 mm2 in size and 0.9 mm thick were used as external additional filters, sequentially installed on the output window of the X-

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ray apparatus collimator. The focal length for calibration and control should be 80 cm.

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