

## New Devices

# Mammo-R Automatic Mammograph Produced by ROENTGENPROM JSC

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*This work describes specifications of a modern domestic film mammograph available from ROENTGENPROM JSC. Serial production of this mammograph began in 2008. This was the end of the first stage of development of a series of mammographs. The second stage included manufacture of the Mammo-RPTs digital scanning mammograph. This stage will be finished in late 2009. A biopsy unit compatible with this mammograph will be developed in 2010.*

The first stage of development of a series of mammographs was finished at ROENTGENPROM JSC in late 2008. These mammographs are designed to run all types of mammographic examinations. The serial production of these mammographs was started in 2008. This series includes the first modern domestic film mammograph Mammo-R (Fig. 1).

Experience of domestic physicians and foreign manufacturers was taken into account during development of this model. As a result, the Mammo-R mammograph meets the requirements for a modern mammographic system for both screening and diagnostic examination of women. The Mammo-R mammograph consists of 100% domestic components.

Therefore, the first stage of development of domestic mammographs is complete. The Mammo-R mammograph has been available to Russian medical organizations since late 2008. Digital mammographs and biopsy units for Mammo-R mammographs were developed at ROENTGENPROM JSC during the second and the third stages of the process of development of these domestic mammographs.

The second stage (late 2009) will bring either a digital unit to the film mammograph or a completely digital mammograph.

Advantages of a digital mammograph over a film mammograph include the ability to take higher quality photographs at lower radiation dose. The mammograph-



Fig. 1. General view of the Mammo-R mammograph.

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ic detector provides a scanning mode of examination. Advantages of the scanning mode of examination are well-known:

1) in contrast to other imaging modes, it removes radiation scattering. This increases imager contrast and spatial resolution, which is particularly important for mammography;

2) significant reduction of detector cost relative to solid-state panel mammographs;

3) CCD-detectors do not provide the necessary resolution.

Digital Mammo-RPTs mammograph is presently being certified. Serial production of this mammograph will start at the end of 2009.

The biopsy unit of the digital mammograph is of significant interest to physicians. This unit provides target-oriented digital photography of limited format ( $5 \times 5$  cm) and stereotaxic biopsy. This unit is compatible with the digital mammograph without additional accessories. The mammograph is equipped with a special interface in the photographic unit. The stereotaxic unit is positioned at the mammograph observing special orientation. The stereotaxic unit should be rotated at a specific angle so that the photographic unit takes the necessary position. The biopsy unit can rotate at angle  $\pm 90^\circ$  relative to the axis. To obtain stereoscopic images the device is rotated at angle  $\pm 15^\circ$ . When the images are taken, the position of device is not controlled.

The effective needle size is 60-120 mm. The effective needle length is set at the control panel. The needle positioning error along three coordinates is 0.5 mm. Needle position can be controlled from the control panel of the device. The coordinate change step is 0.1 mm along each coordinate.

This unit will be ready in 2010.

The presently available Mammo-R film mammograph is an optimal mammographic system providing both screening and diagnostic examination. This mammograph is characterized by:

- modern design;
- friendly use;
- automatic positioning control;
- comfortable control panel including computer control panel.

High imaging quality is provided by:

- double-focal X-ray tube;
- high-frequency X-ray image amplifier;
- raster X-ray screen synchronized with X-ray tube;
- modern exposure time control unit.

The Mammo-R mammograph is compatible with various accessories. The exposure time of the Mammo-R mammograph is automatically adapted to the accessory unit selected.

### Specifications of Mammo-R Mammograph

High-frequency generator (320 kHz)

High voltage control (20-35 kV; step 1 kV)

Exposure range (2-640 mAs)

Power (optional) (3.6 to 8 kW)

Double-focal X-ray tube (0.1/0.3 mm)

Rotating molybdenum anode (10000 rpm)

Beryllium window (0.5 mm Be)

Focal distance (65 cm)

*Filter:*

– molybdenum (0.03 mm Mo)

– rhodium (optional) (0.03 mm Rh)

*Automatic exposure time control:*

– semiconductor X-ray detector with eight independent measuring fields;

– fine tuning to necessary film darkening density;

– 15 X-ray film darkening degrees can be set;

– nine programs of film-screen combinations.

Additional combinations are optionally available.

*Separating raster grid:*

– mobile screening focused separating (ratio, 5:1; raster frequency, 31 line/cm);

– grid motion is synchronized with high voltage application;

– high voltage is blocked in case of grid immobility;

– table made of X-ray transparent carboplastic.

Fine tuning compression control. Digital indication of compression force and object thickness

Manual and automatic decompression after imaging

Manual compression with limited force and decompression are available

Automatic rotation of photographic unit ( $+135^\circ$  -  $-180^\circ$  with any step; automatic angle selection,  $0^\circ$ ,  $\pm 45^\circ$ ,  $\pm 90^\circ$ )

Automatic vertical motion of photographic unit, 500 mm

Dimensions (H, W, D, mm), 1580-2080, 1245, 700; or 1310, 1245, 700 for transportation

Floor-table distance, 760-1460 mm

Apparatus weight, 200 kg

Screen size (H, W, D, mm), 1905, 875, 661

Screen weight, 55 kg

The Mammo-R mammograph is equipped with a control unit (CU) installed at the protective shield. The CU of the Mammo-R mammograph is equipped with a large sensor screen (10"/25.4 cm). The sensor screen provides information input during mammographic examination.

The sensor panel provides control of the examination procedure using a special pen. The CU in medical

organizations is mainly used to provide visual monitoring of mammograph state or change of examination mode.

### Computer for Indication of Mammograph State

1. Large CU screen provides indication of all necessary parameters of the mammograph (Fig. 2).

2. Intuitive CU interface in combination with reference system provides easy training of device control. A reference system explains indicator functions and current status.

3. Any unexpected mammograph state is indicated as a flashing red alarm message "Not ready" on CU.

### Selection of Working Mode

1. The CU allows exposure mode to be selected: automatic, semiautomatic, and manual.

2. The CU stores a large number of screen/film programs. Each screen/film program is stored under a specific name: AGFA MR HD/HDR-C. This facilitates screen/film program selection. In addition, the CU contains additional programs.

3. The CU provides film darkening tuning within range  $\pm 70\%$ . On default, 15 degrees of film darkening are available. This range can be extended if necessary. Film darkening degree can be controlled at the next stage.

4. Automatic or manual decompression of the mammary gland after exposure is possible.

5. Serial imaging mode is available at given projection series; the next projection in the series is set after rack motion. The CU indicates projection and series names. The CU stores a large number of series. This function is useful for screening mammographic examination. Additional series are also available.

### Control of Apparatus Work

1. Control and troubleshooting or incorrect mammograph use with explanation of error.

2. Control of exposure time:

a) message "insufficient exposure" is set on if anode voltage is off before the calculated value (mAs) is reached or exnometer threshold value is reached before set time;

b) automatic anode current increase at large mAs to reduce exposure time.

3. Automatic resetting of working modes in case of appliance change.

4. Operator in automatic working mode cannot change exposure parameters.

5. Low-focus mode of X-ray tube is not available in case of automatic switching and imaging with magnification.

6. Exposure is not possible in the absence of a cassette (cassette-holder).

7. Control of cassette exposure: repeated exposure of cassette with film is not possible.

### Other Specific Features of the CU

1. Individual effective dose to the patient is calculated in accordance with MUK 2.6.1.1797-03.

2. Image counter of mammograph. Image counter can be zeroed.

3. The CU interface language can be changed. The presently available interface languages are Russian and English. The list of available languages can be extended if necessary.

4. The CU graphic interface can be extended if necessary. Four graphic interfaces are optionally available.

5. Current time and date are indicated.

In addition to the CU computer, the Mammo-R mammograph shipment kit includes:

- X-ray protective shield (0.5 mm Pb) with control panel;
- X-ray protective shield for face;
- compression plates;

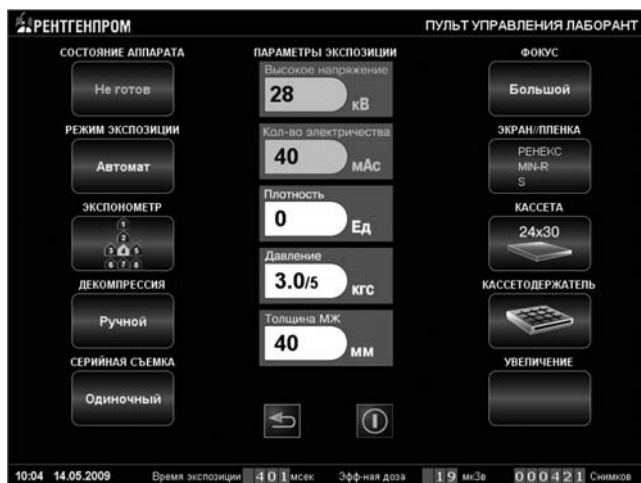


Fig. 2. Screen of computer control unit of the Mammo-R mammograph.

- magnification imaging kit;
- target-oriented imaging kit;
- film marking kit;
- cassette-holder with mobile separating grid  $18 \times 24$  cm;
- cassette-holder  $18 \times 24$  cm for imaging without raster (optional);
- cassette-holder with mobile separating grid  $24 \times 30$  cm (optional).

The apparatuses have been used in Russian Federation clinics since 2008. Results of experience of the

clinical use of the apparatuses for screening and diagnostic mammographic examination are positive.

The Mammo-R mammograph and its digital version and version with biopsy unit are convenient and friendly in use.

The electronic archive for facilitating X-ray mammographic examination is available from ROENTGEN-PROM JSC. This examination can be performed with domestic or imported X-ray mammographs. Both domestic and imported X-ray mammographs can be of film or digital types of DR and CR models.