
APPLICATION NOTE

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Measurements on a Siemens Mammomat 3000 Mammography Unit Using the R100 Dose Detector

This application note describes how to use the R100 solid state detector to measure the dose on a Siemens Mammomat 3000 mammography unit. It also describes how to use the PMX-III to measure the kVp.

The M3000 is equipped with a new type of tube with a dual-track anode made from two different metals, tungsten and molybdenum. Three different tube/filter combinations are available, Mo/Mo, Mo/Rh, and W/Rh. One of these, Mo/Mo, can be measured with the R100 without any corrections. To measure the other tube/filter combinations it is necessary to make corrections to the measured values.

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Introduction and Background

The mammography unit Mammomat 3000 from Siemens is equipped with a new type of X-ray tube. This tube has a dual-track anode made from two different metals, a tungsten (W) track for imaging of dense breasts and a molybdenum (Mo) track for imaging average and low density breasts. This new anode material was selected to be able to maintain low glandular dose levels even for large and dense breasts. The tungsten (W) anode with the rhodium (Rh) filtration gives a higher mean energy X-ray spectra. According to Siemens results in less glandular dose with maintained image quality for dense breasts compared to the Mo/Mo and Mo/Rh combinations.

Three different tube/filter combinations are possible to use:

Mo/30 μm Mo	kVp and dose can be measured directly
Mo/25 μm Rh	kVp can be measured directly dose readings must be corrected
W/50 μm Rh	dose readings must be corrected

With the R100 (type 8/D) dose detector, dose and dose rate can be measured when the Mo/Mo tube filter combination is used. This application note describes how to use the R100 detector to measure dose and dose rate when the combination Mo/Rh or W/Rh is used.

The PMX-III can directly measure kVp when the first two combinations are used, the other combination does not need to be measured. For a detailed description of how to measure with the PMX-III read the User's Manual and the instructions on top of the instrument.

Measurement of Dose with the R100 Using PMX-III or the Solidose 300

This application note gives the correction factors for Mo/Rh and W/Rh.

The correction graphs for dose and dose readings are valid for manual measurements with the PMX-III. If you use oRTIgo, you must make sure that the automatic energy compensation is disabled in the template you use. To do this you must create a template without the ADI and enter the conversion factor on the "Re-configure" menu.

To measure the output from a Mammomat 3000 unit using the PMX-III:

1. Place the R100 detector in the X-ray beam.
2. Connect the R100 detector to the input on the rear panel of your PMX-III.
3. Connect the ADI module for Mo/Mo (8/D) to the connector on the rear panel.
4. Power on your PMX-III and enable the DOSIMETER mode.
5. Select desired exposure mode and exposure values on the operator console of the Mammomat 3000 and make an exposure.
6. Read the correction factor for the set peak voltage (kVp) in the appropriate graph (1 or 2). Multiply this read value with the value shown on the PMX-III display to get the measured dose.

To measure the output from a Mammomat 3000 unit using the Solidose 300:

1. Place the R100 detector in the X-ray beam.
2. Connect the R100 detector and the ADI module for Mo/Mo (8/D) to their respective connectors on the left side of the Solidose.
3. Power on your Solidose 300.
4. Select desired exposure mode and exposure values on the operator console of the Mammomat 3000. Make an exposure and read the value on the display.

¹ "The effect of different anode/filter combinations on image quality and glandular dose and OPDOSE" by Stefan J. Thunberg, Siemens-Elema, SRX-MS, Sweden

² With PMX-III version 5.0 or newer

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5. Read the correction factor for the set peak voltage (kVp) in the appropriate graph (1 or 2). Multiply this read value with the value shown on the display to get the measured dose.

Example 1:

kV is set to 24 kV, charge to 20 mAs and the tube/filter combination is Mo/Rh.

Display reading is 340 mR.

Correction factor from Graph 1 is $0,99$

Measured dose = $340 \times 0,99 = 337$ mR

Example 2:

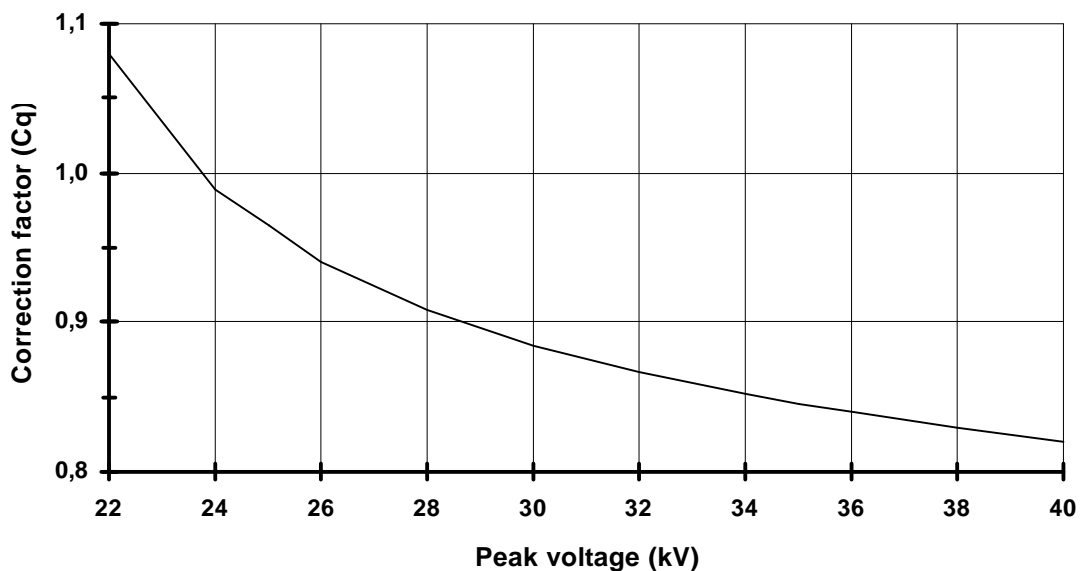
kV is set to 30 kV, charge to 20 mAs and the tube/filter combination is W/Rh.

Display reading is 3,39 mGy.

Correction factor from Graph 2 is $0,76$

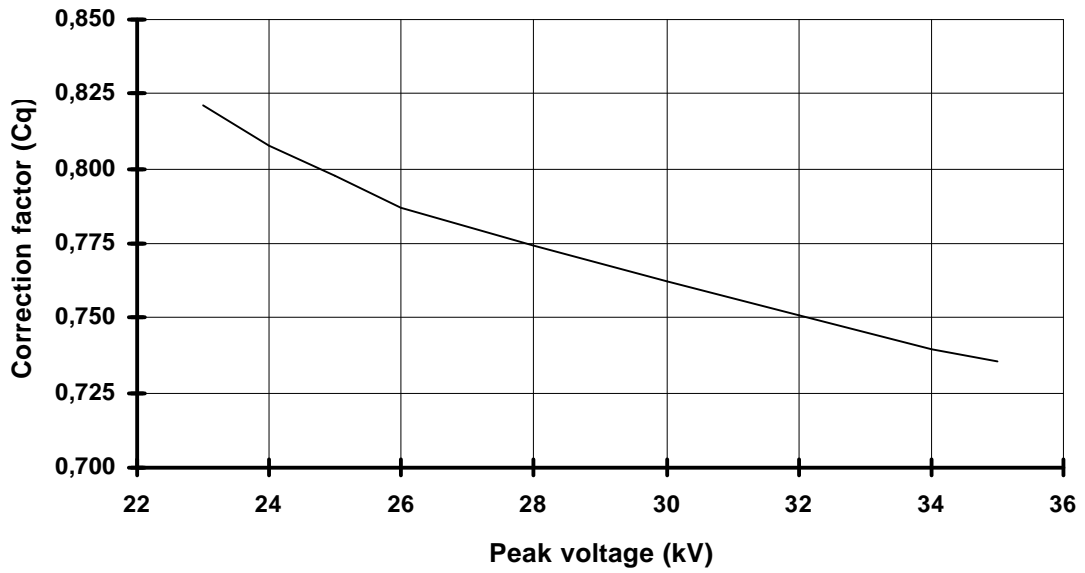
Measured dose = $3,39 \times 0,76 = 2,58$ mGy

**Correction factors for the R100 detector
Mo/25 μ m Rh**



Graph 1. Correction factor function for Mo anode with Rh filtration

Correction factors for the R100 detector
W/50 µm Rh



Graph 2. Correction factor function for W anode with Rh filtration

Measurement of kVp Using the PMX-III

To measure kVp of a Mammomat 3000 unit measure it with the Mo/Mo combination. **You do not need to measure the other tube/filter combinations as the applied voltage from the high voltage generator is the same and is the same regardless of which anode is in use. The choice of filter does likewise not affect this.**

Mo target and Mo filter

1. Power on your PMX-III and enable MULTIMETER mode.
2. Remove the compression device and centre the MAM sensor in the X-ray beam as close as possible to the edge of the patient support table (i.e. the chest wall edge).
3. Select manual mode on the operator console.
4. Press the TUBE/FILTER key and choose "CA 5".
5. Choose Mo target and Mo filter on the operator console. Set the generator to desired values, for example 25 kV and 40 mAs (large focal spot).
6. Make an exposure.
7. Read the kVp value on the display.

Other target/filter combinations

If you still want to measure the kVp with the Mo/Rh combination and have the PMX-III 5.0 or newer, you do just like for Mo/Mo but use CA 8 instead.

If you do not have version 5.0 then this is described in the Application Note 03-004/01 entitled "Measurement of kVp and Dose on a Senographe DMR Using PMX-III". If you use these corrections you will however get less accurate measurements than if you measure using the Mo/Mo combination.

• End •

³ These kind of tests are only meant to test the function of the high voltage generator, if you want to check the true energy of the output radiation you should use a spectrographic method, such as the Spectro-X spectrometer from RTI Electronics.