

# Calibration Certificate



## Customer

Konex Industria e Comercio  
Ltda.  
Rua Joao Mafra, 424 jd da  
Saude  
CNPJ: 48.203.210/0001-03  
04288-000 Sao Paulo, SP  
Brazil

## Laboratory

Unfors RaySafe AB  
Uggledalsvägen 29, SE-427 40 Billdal, Sweden  
+46 31 719 97 10 (phone), +46 31 910 950 (fax)  
customerservice.se@raysafe.com

## Customer Instrument

Product X2 MAM  
Serial Number 222263  
Manufacturer RaySafe

## Calibration Information

As Found Not performed  
As Left 2016-08-03  
Adjustment Done Yes  
Tested by Jonatan Landin  
Approved by   
Örjan Arnström  
Certificate Date 2016-08-11

This laboratory is accredited by the "Swedish Board for Accreditation and Conformity Assessment" (SWEDAC) and the results shown in this certificate have been determined within the scope of accreditation unless stated otherwise in this certificate.



# Laboratory Information

## ENVIRONMENTAL CONDITIONS

Ambient temperature: 15 – 30 °C

Relative humidity: < 80 %

## CALIBRATION METHODS

RaySafe calibration methods used are "Calibration method for Air Kerma.ACCR-0453" and "Calibration method for Voltage.ACCR-0454".

## LABORATORY CALIBRATION

All standards are calibrated once a year. Voltage standards are calibrated by SP Technical Research Institute of Sweden. All air kerma standards are calibrated by PTB, and are traceable to NIST on available beam qualities. Unfors RaySafe certifies the W/Rh, Mo/Rh, Rh/Al, Rh/Rh and Mo/Al (if applicable) beam quality measurements, made with this instrument, to be accurate within its published specifications. This instrument is calibrated according to FDA MQSA requirements.

# Calibration As Left

## REFERENCE EQUIPMENT

INSTRUMENT	VALID UNTIL DATE
RaySafe Xi MAM Serial number: 186377	2017-06-29
Siemens Mammomat 3000 Serial number: 07878	2017-06-30
Siemens P40 Mo W Serial number: 500350	

## MEASUREMENTS

### Air Kerma

Set Voltage	Anode Target	Nominal tube filtration	Added filtration	Air Kerma Rate $\mu\text{Gy/s}$	Instrument setting	Standard $\mu\text{Gy}$	Deviation from standard	Deviation limit	Uncertainty
23 kV	Mo	25 $\mu\text{m Rh}$	0.1 mm Al	5001	kVp off	1677	-0.1%	2.6%	2.5%
28 kV	Mo	25 $\mu\text{m Rh}$	0.1 mm Al	9993	kVp off	3733	-1.1%	2.5%	2.6%
35 kV	Mo	25 $\mu\text{m Rh}$	0.1 mm Al	15807	kVp off	7438	-0.5%	2.7%	2.3%
23 kV	Mo	30 $\mu\text{m Mo}$	0.1 mm Al	7782	Mo/Mo paddle	2616	0.0%	2.4%	2.6%
28 kV	Mo	30 $\mu\text{m Mo}$	0.1 mm Al	13963	Mo/Mo paddle	5220	-1.5%	2.7%	2.3%
35 kV	Mo	30 $\mu\text{m Mo}$	0.1 mm Al	21359	Mo/Mo paddle	10048	-0.7%	2.6%	2.4%
23 kV	W	50 $\mu\text{m Ag}$	0.1 mm Al	3372	W/Ag paddle	905.7	-0.4%	3.1%	1.9%
28 kV	W	50 $\mu\text{m Ag}$	0.1 mm Al	6774	W/Ag paddle	2022	0.6%	3.1%	1.9%
35 kV	W	50 $\mu\text{m Ag}$	0.1 mm Al	9423	W/Ag paddle	3538	1.2%	3.1%	1.9%
23 kV	W	500 $\mu\text{m Al}$	0.1 mm Al	9438	W/Al	2545	-1.8%	2.5%	2.6%
28 kV	W	500 $\mu\text{m Al}$	0.1 mm Al	16224	W/Al	4855	-1.5%	2.9%	2.1%
35 kV	W	500 $\mu\text{m Al}$	0.1 mm Al	23112	W/Al	8669	-1.6%	3.0%	2.1%
23 kV	W	50 $\mu\text{m Rh}$	0.1 mm Al	2987	W/Rh Siemens paddle	802.5	-1.6%	2.6%	2.4%
28 kV	W	50 $\mu\text{m Rh}$	0.1 mm Al	5482	W/Rh Siemens paddle	1636	-1.7%	2.8%	2.2%
35 kV	W	50 $\mu\text{m Rh}$	0.1 mm Al	7290	W/Rh Siemens paddle	2736	-1.0%	2.8%	2.2%

### HVL (Non-Accredited)

Set Voltage	Anode Target	Nominal tube filtration	Added filtration	Air Kerma Rate $\mu\text{Gy/s}$	Instrument setting	Standard mmAl	Deviation from standard	Deviation limit
28 kV	Mo	25 $\mu\text{m Rh}$	0.1 mm Al	9993	kVp off	0.442	-0.7%	5.0%
28 kV	Mo	30 $\mu\text{m Mo}$	0.1 mm Al	13963	Mo/Mo paddle	0.365	-0.2%	5.0%
28 kV	W	50 $\mu\text{m Ag}$	0.1 mm Al	6774	W/Ag paddle	0.591	0.4%	5.0%
28 kV	W	50 $\mu\text{m Rh}$	0.1 mm Al	5482	W/Rh Siemens paddle	0.559	0.6%	5.0%



## Voltage

Set Voltage	Anode Target	Nominal tube filtration	Added filtration	Air Kerma Rate $\mu\text{Gy/s}$	Instrument setting	Standard kV	Deviation from standard	Deviation limit	Uncertainty
23 kV	Mo	30 $\mu\text{m}$ Mo	0.1 mm Al	7782	Mo/Mo paddle	23.02	0.3%	1.5%	0.5%
28 kV	Mo	30 $\mu\text{m}$ Mo	0.1 mm Al	13963	Mo/Mo paddle	28.05	0.2%	1.4%	0.6%
35 kV	Mo	30 $\mu\text{m}$ Mo	0.1 mm Al	21359	Mo/Mo paddle	35.09	0.0%	1.4%	0.6%
32 kV	Mo	25 $\mu\text{m}$ Rh	2 mm Al	16496	Mo/Rh 2 mm Al	32.09	0.3%	1.2%	0.8%
35 kV	Mo	25 $\mu\text{m}$ Rh	2 mm Al	19441	Mo/Rh 2 mm Al	35.09	0.0%	1.3%	0.7%
39 kV	Mo	25 $\mu\text{m}$ Rh	2 mm Al	21086	Mo/Rh 2 mm Al	38.98	-0.2%	1.3%	0.7%
23 kV	W	50 $\mu\text{m}$ Ag	0.1 mm Al	3372	W/Ag paddle	23.02	-0.1%	1.5%	0.6%
28 kV	W	50 $\mu\text{m}$ Ag	0.1 mm Al	6774	W/Ag paddle	28.05	0.5%	1.2%	0.8%
35 kV	W	50 $\mu\text{m}$ Ag	0.1 mm Al	9423	W/Ag paddle	35.09	0.6%	1.3%	0.7%
23 kV	W	500 $\mu\text{m}$ Al	0.1 mm Al	9438	W/Al	23.02	-0.5%	1.5%	0.5%
28 kV	W	500 $\mu\text{m}$ Al	0.1 mm Al	16224	W/Al	28.05	0.5%	1.5%	0.5%
35 kV	W	500 $\mu\text{m}$ Al	0.1 mm Al	23112	W/Al	35.09	0.3%	1.5%	0.5%
23 kV	W	50 $\mu\text{m}$ Rh	0.1 mm Al	2987	W/Rh Siemens paddle	23.02	-0.1%	1.4%	0.6%
28 kV	W	50 $\mu\text{m}$ Rh	0.1 mm Al	5482	W/Rh Siemens paddle	28.05	0.2%	1.4%	0.6%
35 kV	W	50 $\mu\text{m}$ Rh	0.1 mm Al	7290	W/Rh Siemens paddle	35.09	0.6%	1.5%	0.5%

## Appendix for Accredited Measurements

### INFORMATION ON ASSESSMENT OF COMPLIANCE WITH SPECIFICATION

#### UNCERTAINTY

All measurements are associated with some level of uncertainty. According to (EA-4/02 (Expression of the Uncertainty of Measurement in Calibration) and ISO/IEC Guide 98-3:2008, Guide to the Expression of Uncertainty in Measurement (GUM)), the uncertainty is stated as the probability that the measurement result is within a certain tolerance interval.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor  $k = 2$ , which for a normal distribution provides a level of confidence of approximately 95%.

#### TOLERANCE LIMIT FOR CALIBRATION AS FOUND

When an instrument arrives for service at Unfors RaySafe, a calibration is performed. The measurement results for the tested instrument are compared with a tolerance limit. Unfors RaySafe will indicate an instrument as Out of Tolerance if the measurement is outside the specification with a probability of at least 95%. The tolerance limit for calibration as found is the specification increased by the expanded uncertainty of measurement.

In the example below, only the measurement point marked with a star (\*) will be indicated as Out of Tolerance.

