

US Internal
c/o Fluke Biomedical
6045 Cochran Rd

Order Number: 756200
Print date: 2/13/2019

44139 SOLON, OH
United States

Service Activity:

Description

Serial#

SERVICE PROGRAM - ANNUAL CALIBRATION	133904
RaySafe Xi Base unit w/ mAs	133904
RaySafe Xi R/F & MAM detector	133957
RaySafe Xi CT detector	164572
RaySafe Xi Light detector	160504
RaySafe Xi Survey detector	163193
RaySafe Xi Transparent detector	191441
RaySafe DXR+	195536

----- service and new parts -----

Internal Service Program Xi

RaySafe Xi mammo M-Pro 2.0 Plus calibration

Certificate of Calibration

US Internal
c/o Fluke Biomedical
6045 Cochran Rd
44139 SOLON, OH
United States

Product:	RaySafe Xi
Model:	mAs
Serial Number:	133904
Arrival Check	Date: 02/13/19
Calibration Certificate	Date: 02/13/19
Calibration Equipment List	

Your instrument has passed several strict tests and has been approved for delivery.
Enclosed you will find detailed documents for your instrument.



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Certificate of Calibration

Date of Calibration:	02/13/19	Product:	RaySafe XI
Serial Number:	133904	Model:	mAs

Current, As Found			
Nominal Settings	Measured Data		
Current (mA)	Reference Current (mA)	XI Current (mA)	Current Deviation
1	0.99992	0.995	-0.48%
10	10.0001	10.000	0.00%
100	99.996	99.96	-0.03%

Charge, As Found			
Nominal Settings	Measured Data		
Charge (mAs)	Reference Charge (mAs)	XI Charge (mAs)	Charge Deviation
100	99.995	100.00	0.00%
1000	1000.02	999.6	-0.04%

Current, As Left			
Nominal Settings	Measured Data		
Current (mA)	Reference Current (mA)	XI Current (mA)	Current Deviation
1	0.99992	0.994	-0.54%
10	10.0001	9.998	-0.02%
100	99.996	99.99	-0.01%

Charge, As Left			
Nominal Settings	Measured Data		
Charge (mAs)	Reference Charge (mAs)	XI Charge (mAs)	Charge Deviation
100	99.995	99.99	-0.01%
1000	1000.02	999.9	-0.01%

mA/mAs Specification:
mA: $\pm 1\%$ or 0.02 mA
mAs: $\pm 1\%$ or 0.02 mAs

For further specification details, please refer to your RaySafe XI Manual.

Calibration Equipment

Date of Calibration:	02/13/19	Product:	RaySafe Xi
Serial Number:	133904	Model:	mAs

The listed equipment below was used as a main reference for the calibration

	As Found	CALIBRATION DATE	As Left	CALIBRATION DATE
REFERENCE SYSTEM Current / Charge	Keithley 2601B S/N: 4008620	07/11/18	Keithley 2601B S/N: 4008620	07/11/18

The reference system is calibrated once a year by SP Technical Research Institute of Sweden.

The expanded uncertainties of measurement for the RaySafe Xi Base Unit w/ mAs are:

0,24% for Current

0,25% for Charge

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%. (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))

Unfors RaySafe calibration method: "Calibration method for Electrical Current ACCR-1385" and "Calibration method for Electrical Charge ACCR-1386".

Calibration Condition:

Ambient Temperature: 59-86°F

Relative Humidity: <60%

Tested by: Juan Long

Approved by:


Stacey Torres
Finalization Clerk

RaySafe Inc.

a Fluke Biomedical Company
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CALIBRATION CERTIFICATE *Issued by an Accredited Calibration Laboratory*

US Internal
c/o Fluke Biomedical
6045 Cochran Rd
44139 SOLON, OH
United States

Product:	Xi
Model:	R/F & Mammo
Serial Number:	133957
R/F Arrival Check:	Date: 02/07/19
Mammo Arrival Check:	Date: 02/07/19
R/F Calibration Certificate:	Date: 02/13/19
Mammo Calibration Certificate:	Date: 02/13/19
Calibration Equipment List	

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Arrival Check

Xi R/F

Date of Arrival Check:	02/07/19	Product:	Xi
Serial Number:	133957	Model:	R/F & Mammo

Measurement details, as found:

kVp Total Filtration = 2.5 mm Al

R/F Low				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. kVp	Xi kV	Tolerance *) 3,1%
50	32	50.60	50.64	0.1%
70	16	70.67	72.08	2.0%
100	8	100.8	102.5	1.7%
150	5	150.8	152.7	1.3%

Total Filtration = 2.5 mm Al

R/F High				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. kVp	Xi kVp	Tolerance *) 3,1%
50	51	50.60	50.99	0.8%
70	26	70.67	71.99	1.9%
100	10	100.8	102.6	1.8%
150	5	150.8	152.4	1.1%

Dose Total Filtration = 2.5 mm Al

R/F Low				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. Dose μGy	Xi dose μGy	Tolerance *) 6,5%
50	32	371.1	368.7	-0.6%
70	16	239.7	241.2	0.6%
100	8	228.5	230.9	1.1%
150	5	281.8	282.0	0.1%

Total Filtration = 2.5 mm Al

R/F High				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. Dose μGy	Xi dose μGy	Tolerance *) 6,5%
50	51	5899	5824	-1.3%
70	26	2990	2984	-0.2%
100	10	2201	2209	0.3%
150	5	3413	3393	-0.6%

Time (Non-Accredited) Total Filtration = 2.5 mm Al

R/F High				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. Time ms	Xi Time ms	Tolerance *) 0,5%
70	320	319.9	320.6	0.2%

*) The tolerance is calculated as the manufacture specification plus the expanded uncertainty. 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%. (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)). For further details regarding the arrival check tolerances, please refer to enclosed "Information on Assessment of Compliance with Specification".

Arrival Check

Xi Mammography

Date of Arrival Check:	02/07/19	Product:	Xi
Serial Number:	133957	Model:	R/F & Mammo

Measurement details, as found:

kVp

Mo / 30µm Mo

Mo/Mo No Paddle				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. kVp	Xi kV	Tolerance *) 2,7% or 0,8 kV
23	50	23.01	23.08	0.3%
25	50	25.02	25.04	0.0%
28	50	28.02	28.03	0.0%
32	50	32.05	32.12	0.2%
35	50	35.06	35.06	0.0%

Mo / 30µm Mo + 0,1mm Al

Mo/Mo Paddle				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. kVp	Xi kVp	Tolerance *) 2,7% or 1,0 kV
23	50	23.01	23.04	0.1%
25	50	25.02	24.96	-0.3%
28	50	28.02	28.02	0.0%
32	50	32.05	32.21	0.5%
35	50	35.06	34.99	-0.2%

Dose

Mo / 30µm Mo

0mm Al Added Filtration				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. Dose µGy	Xi dose µGy	Tolerance *) 7,2%
23	50	3393	3385	-0.2%
25	50	4531	4508	-0.5%
28	50	6475	6484	0.1%
32	50	9549	9563	0.2%
35	50	12147	12062	-0.7%

Mo / 30µm Mo + 0,1mm Al

0,1mm Al Added Filtration				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. Dose µGy	Xi dose µGy	Tolerance *) 7,2%
23	50	2551	2560	0.4%
25	50	3480	3485	0.1%
28	50	5115	5115	0.0%
32	50	7703	7712	0.1%
35	50	9897	9912	0.1%

*) The tolerance is calculated as the manufacture specification plus the expanded uncertainty. 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%. (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)). For further details regarding the arrival check tolerances, please refer to enclosed "Information on Assessment of Compliance with Specification".

Certificate of Calibration

Xi R/F

Date of Calibration:	02/13/19	Product:	Xi
Serial Number:	133957	Model:	R/F & Mammo

Measurement details, as left:

kVp

Total Filtration = 2.5 mm Al

R/F Low				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. kVp	Xi kV	Deviation
50	32	50.33	50.47	0.3%
70	16	70.37	70.98	0.9%
100	8	100.4	100.9	0.5%
150	5	150.3	150.8	0.3%
Active Compensation		Total Filtration = 2.5 + 10 mm Al		
100	16	100.4	100.7	0.3%

Total Filtration = 2.5 mm Al

R/F High				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. kVp	Xi kVp	Deviation
50	51	50.33	50.35	0.0%
70	26	70.37	70.69	0.5%
100	10	100.4	100.2	-0.3%
150	5	150.3	150.9	0.4%
Active Compensation		Total Filtration = 2.5 + 10 mm Al		
100	16	100.4	100.7	0.2%

Dose

Total Filtration = 2.5 mm Al

R/F Low				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. Dose μ Gy	Xi dose μ Gy	Deviation
50	32	412.0	414.1	0.5%
70	16	269.8	272.8	1.1%
100	8	259.1	263.0	1.5%
150	5	350.3	349.7	-0.2%
Active Compensation		Total Filtration = 2.5 mm Al + 26 mm Al		
80	64	153.8	156.3	1.6%

Total Filtration = 2.5 mm Al

R/F High				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. Dose μ Gy	Xi dose μ Gy	Deviation
50	51	6482	6482	0.0%
70	26	3355	3392	1.1%
100	10	2439	2468	1.2%
150	5	4269	4266	-0.1%
Active Compensation		Total Filtration = 2.5 + 26 mm Al		
80	102	1078	1091	1.2%

HVL

(Non-Accredited)

Total Filtration = 2.5 mm Al

R/F Low				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. HVL mm Al	Xi HVL mm Al	Deviation
70	16	2.74	2.78	1.3%

Total Filtration = 2.5 mm Al

R/F High				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. HVL mm Al	Xi HVL mm Al	Deviation
70	26	2.74	2.75	0.2%

Time

(Non-Accredited)

Total Filtration = 2.5 mm Al

R/F High				
Generator settings		Measurements		
Set kVp	Set ms	Ref. Time ms	Xi Time ms	Deviation
70	320	320.4	320.7	0.1%

RF Low Specification:

kV/kVp for <0.5mm Cu \pm 2%, for >0.5mm Cu \pm 3%, Dose \pm 5%,
HVL \pm 10% or \pm 0.2 mm Al, Time \pm 0.5% or \pm 0.2 ms,
Total Filtration \pm 10% or 0.2mm Al

RF High Specification:

kV/kVp for <0.5mm Cu \pm 2%, for >0.5mm Cu \pm 3%, Dose \pm 5%,
HVL \pm 10% or \pm 0.2 mm Al, Time \pm 0.5% or \pm 0.2 ms,
Total Filtration \pm 10% or 0.2mm Al

For further specification details, please refer to your Xi Manual.

Certificate of Calibration

Xi Mammography

Date of Calibration:	02/13/19	Product:	Xi
Serial Number:	133957	Model:	R/F & Mammo

Measurement details, as left:

kVp

Mo / 30µm Mo

Mo/Mo No Paddle				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. kVp	Xi kV	Deviation
20	50	19.74	19.72	-0.1%
23	50	23.01	23.04	0.1%
25	50	25.02	24.97	-0.2%
28	50	28.02	27.99	-0.1%
32	50	32.05	32.04	0.0%
35	50	35.06	35.01	-0.2%
39	50	39.03	39.02	0.0%

Mo / 30µm Mo + 0,1mm Al

Mo/Mo Paddle				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. kVp	Xi kVp	Deviation
20	50	19.74	19.75	0.1%
23	50	23.01	23.03	0.1%
25	50	25.02	24.94	-0.3%
28	50	28.02	27.98	-0.2%
32	50	32.05	32.18	0.4%
35	50	35.06	34.96	-0.3%
39	50	39.03	38.94	-0.2%

Dose

Mo / 30µm Mo

0mm Al Added Filtration				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. Dose µGy	Xi dose µGy	Deviation
23	50	3400	3378	-0.7%
25	50	4518	4498	-0.4%
28	50	6468	6484	0.2%
32	50	9543	9629	0.9%
35	50	12158	12145	-0.1%

Mo / 30µm Mo + 0,1mm Al

0,1mm Al Added Filtration				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. Dose µGy	Xi dose µGy	Deviation
23	50	2553	2571	0.7%
25	50	3484	3501	0.5%
28	50	5092	5149	1.1%
32	50	7683	7799	1.5%
35	50	9896	10007	1.1%

Mo / 30µm Mo + 2mm Al

2mm Al Added Filtration				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. Dose µGy	Xi dose µGy	Deviation
23	100	191.8	195.9	2.1%
25	50	160.2	160.7	0.3%
28	50	287.0	290.9	1.4%
32	50	522.0	526.1	0.8%
35	50	747.8	741.3	-0.9%

HVL

(Non-Accredited)

Mo / 30µm Mo

Mo/Mo No Paddle				
Generator settings		Measurements		
Set kVp	Set mAs	Ref. HVL mm Al	Xi HVL mm Al	Deviation
28	50	0.324	0.328	1.4%

Mo/Mo No Paddle Specification:
kV $\pm 2\%$ or ± 0.5 kV, Dose $\pm 5\%$ and \pm HVL 5%

Mo/Mo Paddle Specification:
kV $\pm 2\%$ or ± 0.7 kV, Dose $\pm 5\%$ and \pm HVL 5%

For further specification details, please refer to your Xi Manual.

Calibration Equipment

Date of Calibration(s):	02/13/19	Product:	Xi
Serial Number:	133957	Model:	R/F & Mammo

The listed equipment below were used as main references for the calibration

	R/F Arrival Check	R/F Calibration	Mammo Arrival Check	Mammo Calibration
GENERATOR	CPI INDICO 100	CPI Indico 100	Siemens Mammomat 3000	Siemens Mammomat 3000
WAVEFORM TYPE	HF	HF	HF	HF
ANODE/FILTER	W / 2.5 mm Al	W / 2.5 mm Al	Mo / 30µm Mo	Mo / 30µm Mo
FIELD SIZE	10 x 10 cm	10 x10 cm	18x23 cm	18x23 cm
FDD	R/F Low: 200/100 cm R/F High: 50 cm	R/F Low: 200/100 cm R/F High: 50 cm	63cm	63cm

	R/F Arrival Check	Calibration Date	R/F Calibration	Calibration Date	Mammo Arrival Check	Calibration Date	Mammo Calibration	Calibration Date
REFERENCE SYSTEM DOSE	RaySafe X2 S/N: 251789	04/30/18	RaySafe Xi S/N: 251807	03/18/18	RaySafe X2 S/N: 202378	04/30/18	RaySafe X2 S/N: 202378	04/30/18
REFERENCE SYSTEM kV	CPI Indico 100 S/N: AM8497E07 Varian A-196 S/N: 19995-N8	04/25/18	CPI Indico 100 S/N: AM14819G11 Varian A196 S/N: 98755-R1	03/24/18	Siemens Mammomat 3000 S/N: 3671 Siemens P40 Mo W S/N: 532921	05/02/18	Siemens Mammomat 3000 S/N: 3671 Siemens P40 Mo W S/N: 532921	05/02/18
REFERENCE SYSTEM TIME	RaySafe X2 S/N: 251789	04/27/18	RaySafe Xi S/N: 251807	03/24/18	RaySafe X2 S/N: 202378	05/02/18	RaySafe X2 S/N: 202378	05/02/18

The expanded uncertainties for the presented deviations are:

R/F: kVp: 1,1% Dose: 1,5% (without added filtration), 1,5% (with added filtration)
Mammo: kVp: 1,5% Dose: 2,2 % (< 1 mm added Al-filtration), 2,6 % (> 1 mm added Al-filtration)

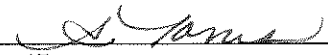
The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, which for a normal distribution provides a level of confidence of approximately 95%. (EA-4/02 (Expression of the Uncertainty of Measurement in Calibration) and ISO/IEC Guide 98-3:2008, Guide to the Expression of Uncertainty in Measurement (GUM))

All reference systems are calibrated once a year. kV systems are calibrated by the Swedish National Testing and Research Institute and are traceable to PTB. All dose systems are calibrated by PTB and are traceable to NIST on available beam qualities. NIST does not currently have traceable dose standards for the W/Rh, Mo/Rh (2 mmAl), Rh/Al and Mo/Al 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 Xi, to be accurate within its published specifications.

Xi is calibrated according to FDA MQSA requirements.

Unfors RaySafe calibration method: "Calibration method for kV meters.ACCR-0454 ver. 3" and/or "Calibration method for Air Kerma.ACCR-0453 ver. 3".

Tested by: Robin Fisk, Adam Denney

Approved by: 
Stacey Torres
Finalization Clerk

RaySafe Inc.

a Fluke Biomedical Company
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Phone: 800.850.4609 FAX: 440.349.2307
customerservice.us@raysafe.com www.RaySafe.com

Calibration condition:

Ambient Temperature: 59-86°F
Relative Humidity: <80%

CALIBRATION CERTIFICATE *issued by an Accredited Calibration Laboratory*

US Internal
c/o Fluke Biomedical
6045 Cochran Rd
44139 SOLON, OH
United States

Product:	Xi
Model:	Mammo Pro
Serial Number:	133957
Mo/Rh Arrival Check:	Date: 02/07/19
W/Ag Arrival Check:	Date: 02/07/19
W/Rh Arrival Check:	Date: 02/07/19
Mo/Rh Calibration Certificate:	Date: 02/13/19
W/Ag Calibration Certificate:	Date: 02/13/19
W/Rh Calibration Certificate:	Date: 02/13/19
Calibration Equipment List	

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Arrival Check

Xi Mammography Mo/Rh

Date of Arrival Check:	02/07/19	Product:	Xi
Serial Number:	133957	Model:	Mammo Pro

Measurement Details, As Found:

kVp

Mo / 25µm Rh + 2 mm Al

Mo/Rh 2mm Al Added Filtration					
Generator Settings		Measurements			
Set kVp	Set mAs	Ref. kVp	Xi kV	Deviation	Tolerance *)
32	50	32.05	32.16	0.4%	2.8% or 0.92 kV
35	50	35.06	35.09	0.1%	2.8% or 0.92 kV
38	50	38.02	38.02	0.0%	2.8% or 0.92 kV

Dose

Mo / 25µm Rh

Mo/Rh 0mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose µGy	Xi Dose µGy	Tolerance *)
23	50	2267	2273	0.2%
25	50	3204	3185	-0.6%
28	50	4768	4776	0.2%
32	50	7238	7249	0.2%
35	50	9292	9304	0.1%

Mo / 25µm Rh + 0.1mm Al

Mo/Rh 0.1mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose µGy	Xi Dose µGy	Tolerance *)
23	50	1790	1785	-0.3%
25	50	2581	2594	0.5%
28	50	3928	3937	0.2%
32	50	6058	6055	-0.1%
35	50	7834	7859	0.3%

*) The tolerance is calculated as the manufacture specification plus the expanded uncertainty. 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%. (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)). For further details regarding the arrival check tolerances, please refer to enclosed "Information on Assessment of Compliance with Specification".

Arrival Check

Mammography W/Ag

Date of Arrival Check:	02/07/19	Product:	Xi
Serial Number:	133957	Model:	Mammo Pro

Measurement Details, As Found:

Dose

W / 50µm Ag

W/Ag 0mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose µGy	Xi Dose µGy	Tolerance *) 7,5%
23	50	868.2	873.2	0.6%
25	50	1249	1266	1.4%
28	50	1870	1891	1.1%
32	50	2683	2689	0.2%
35	50	3286	3303	0.5%

W / 50µm Ag + 0,1mm Al

W/Ag 0,1mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose µGy	Xi Dose µGy	Tolerance *) 7,5%
23	50	717.8	728.1	1.4%
25	50	1057	1089	3.0%
28	50	1610	1644	2.1%
32	50	2320	2349	1.3%
35	50	2873	2911	1.3%

*) The tolerance is calculated as the manufacture specification plus the expanded uncertainty. 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%. (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)).
For further details regarding the arrival check tolerances, please refer to enclosed "Information on Assessment of Compliance with Specification".

Arrival Check

Mammography W/Rh

Date of Arrival Check:	02/07/19	Product:	Xi
Serial Number:	133957	Model:	Mammo Pro

Measurement Details, As Found:

kVp W / 50µm Rh

W/Rh No Paddle				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. kVp	Xi kV	Tolerance *) 2,8% or 0,7 kV
23	50	22.88	22.83	-0.2%
25	50	24.90	24.94	0.2%
28	50	27.87	28.09	0.8%
32	50	31.91	31.83	-0.3%
35	50	34.90	34.84	-0.2%

W / 50µm Rh + 0,1mm Al

W/Rh Paddle				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. kVp	Xi kVp	Tolerance *) 2,8% or 0,9 kV
23	50	22.88	22.78	-0.4%
25	50	24.90	24.92	0.1%
28	50	27.87	28.01	0.5%
32	50	31.91	31.66	-0.8%
35	50	34.90	34.89	0.0%

Dose W / 50µm Rh

0mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose µGy	Xi Dose µGy	Tolerance *) 7,0%
23	50	771.1	768.7	-0.3%
25	50	1092	1093	0.1%
28	50	1522	1536	0.9%
32	50	2107	2113	0.3%
35	50	2541	2556	0.6%

W / 50µm Rh + 0,1mm Al

0,1mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose µGy	Xi Dose µGy	Tolerance *) 7,0%
23	50	639.8	644.8	0.8%
25	50	921.9	932.3	1.1%
28	50	1301	1319	1.4%
32	50	1816	1840	1.3%
35	50	2212	2227	0.7%

*) The tolerance is calculated as the manufacture specification plus the expanded uncertainty. 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%. (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)).
For further details regarding the arrival check tolerances, please refer to enclosed "Information on Assessment of Compliance with Specification".

Certificate of Calibration

Xi Mammography Mo/Rh

Date of Calibration:	02/13/19	Product:	Xi
Serial Number:	133957	Model:	Mammo Pro

Measurement Details, As Left:

kVp		Mo /25µm Rh + 2 mm Al		
Mo/Rh 2mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. kVp	XI kV	Deviation
32	50	32.05	32.10	0.17%
35	50	35.06	34.99	-0.22%
38	50	38.02	37.95	-0.18%

Dose		Mo /25µm Rh		
Mo/Rh 0mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose µGy	Xi Dose µGy	Deviation
23	50	2264	2257	-0.33%
25	50	3186	3178	-0.26%
28	50	4740	4768	0.60%
32	50	7208	7261	0.73%
35	50	9271	9343	0.77%

Mo /25µm Rh + 0,1mm Al				
Mo/Rh 0,1mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose µGy	XI Dose µGy	Deviation
23	50	1785	1785	-0.04%
25	50	2579	2581	0.09%
28	50	3915	3946	0.80%
32	50	6028	6086	0.95%
35	50	7794	7895	1.30%

Mo /25µm Rh + 2 mm Al				
Mo/Rh 2mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose µGy	Xi Dose µGy	Deviation
23	100	188.11	190.99	1.53%
25	100	339.83	346.85	2.07%
28	100	608.94	612.79	0.63%
32	50	521.33	520.04	-0.25%
35	50	724.09	718.90	-0.72%

HVL (Non-Accredited)		Mo / 50µm Rh		
Mo/Rh 0mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. HVL mm Al	Xi HVL mm Al	Deviation
28	50	0.394	0.397	0.89%

Mo/Rh Specification:
kV $\pm 2\%$ or ± 0.5 kV, Dose $\pm 5\%$ and HVL $\pm 5\%$

For further specification details, please refer to your Xi Manual.

Certificate of Calibration

Mammography W/Ag

Date of Calibration:	02/13/19	Product:	Xi
Serial Number:	133957	Model:	Mammo Pro

Measurement Details, As Left:

Dose W / 50 μ m Ag

W/Ag 0mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose	Xi Dose	Deviation
23	50	872.7	871.3	-0.2%
25	50	1254	1263	0.7%
28	50	1871	1857	-0.7%
32	50	2674	2637	-1.4%
35	50	3269	3252	-0.5%

W / 50 μ m Ag + 0.1mm Al

W/Ag 0.1mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose	Xi Dose	Deviation
23	50	719.7	722.2	0.3%
25	50	1061	1077	1.6%
28	50	1608	1615	0.5%
32	50	2319	2316	-0.1%
35	50	2866	2865	-0.1%

W / 50 μ m Ag + 2mm Al

W/Ag 2mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose μ Gy	Xi Dose μ Gy	Deviation
23	100	120.8	122.5	1.4%
25	50	119.5	119.0	-0.4%
28	50	235.8	235.7	-0.1%
32	50	394.2	394.6	0.1%
35	50	521.8	523.7	0.4%

HVL (Non-Accredited) W / 50 μ m Ag

W/Ag 0mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. HVL mm Al	Xi HVL mm Al	Deviation
28	50	0.555	0.562	1.3%

W/Ag Specification:
Dose \pm 5% and HVL \pm 5%

For further specification details, please refer to your Xi Manual.

Certificate of Calibration

Mammography W/Rh

Date of Calibration:	02/13/19	Product:	Xi
Serial Number:	133957	Model:	Mammo Pro

Measurement Details, As Left:

kVpW / 50 μ m Rh

W/Rh No Paddle				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. kVp	Xi kV	Deviation
23	50	22.88	22.70	-0.8%
25	50	24.90	24.88	-0.1%
28	50	27.87	28.06	0.7%
32	50	31.91	31.67	-0.7%
35	50	34.90	34.87	-0.1%

W / 50 μ m Rh + 0,1mm Al

W/Rh Paddle				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. kVp	Xi kVp	Deviation
23	50	22.88	22.78	-0.4%
25	50	24.90	24.85	-0.2%
28	50	27.87	28.06	0.7%
32	50	31.91	31.76	-0.5%
35	50	34.90	34.88	-0.1%

DoseW / 50 μ m Rh

0mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose μ Gy	Xi Dose μ Gy	Deviation
23	50	769.9	756.1	-1.8%
25	50	1095	1076	-1.7%
28	50	1520	1509	-0.7%
32	50	2091	2082	-0.4%
35	50	2531	2515	-0.6%

W / 50 μ m Rh + 0,1mm Al

0,1mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose μ Gy	Xi Dose μ Gy	Deviation
23	50	638.0	636.5	-0.2%
25	50	923.8	918.2	-0.6%
28	50	1296	1297	0.1%
32	50	1809	1807	-0.1%
35	50	2196	2195	0.0%

W / 50 μ m Rh + 2mm Al

2mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose μ Gy	Xi Dose μ Gy	Deviation
23	100	113.8	112.6	-1.0%
25	100	206.3	206.3	0.0%
28	50	164.2	161.5	-1.6%
32	50	254.0	251.0	-1.2%
35	50	335.5	327.3	-2.5%

HVL

(Non-Accredited)

W / 50 μ m Rh

W/Rh No Paddle				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. HVL mm Al	Xi HVL mm Al	Deviation
28	50	0.533	0.538	0.9%

W/Rh No Paddle Specification:

kV $\pm 2\%$ or ± 0.5 kV, Dose $\pm 5\%$ and HVL $\pm 5\%$

W/Rh Paddle Specification:

kV $\pm 2\%$ or ± 0.7 kV, Dose $\pm 5\%$ and HVL $\pm 5\%$

For further specification details, please refer to your Xi Manual.

Calibration Equipment

Date of Calibration(s):	02/13/19	Product:	Xi
Serial Number:	133957	Model:	Mammo Pro

The listed equipment below were used as main references for the calibration

	Mammo Arrival Check	Mammo Calibration
GENERATOR	Siemens Mammomat 3000	Siemens Mammomat 3000
WAVEFORM TYPE	HF	HF
ANODE/FILTER	Mo / 25 µm Rh, W / 50 µm Rh, W / 50 µm Ag	Mo / 25 µm Rh, W / 50 µm Rh, W / 50 µm Ag
FIELD SIZE	18x23 cm	18x23 cm
FDD	63cm	63cm

	Mammo Arrival Check	Calibration Date	Mammo Calibration	Calibration Date
REFERENCE SYSTEM DOSE	Raysafe X2 S/N: 246643	11/01/18	Raysafe X2 S/N: 246643	11/01/18
REFERENCE SYSTEM kV	Siemens Mammomat 3000 S/N: 5853 Siemens P40 Mo W S/N: 533211	11/01/18	Siemens Mammomat 3000 S/N: 5853 Siemens P40 Mo W S/N: 533211	11/01/18
REFERENCE SYSTEM TIME	Raysafe X2 S/N: 246643	11/01/18	Raysafe X2 S/N: 246643	11/01/18

The expanded uncertainties for the presented deviations are:

MoRh: kVp: <27kV 1%, >27 0,8% Dose: 2% (< 1 mm added Al-filtration), 2,5% (> 1 mm added Al-filtration)
 W/Rh: kVp: 0,8% Dose: 2% (< 1 mm added Al-filtration), 2,2% (> 1 mm added Al-filtration)
 W/Ag: Dose: 2,5% (< 1 mm added Al-filtration), 2,7% (> 1 mm added Al-filtration)

Calibration Condition:

Ambient Temperature: 59-86°F
 Relative Humidity: <60%

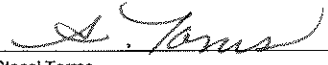
The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, which for a normal distribution provides a level of confidence of approximately 95%. (EA-4/02 (Expression of the Uncertainty of Measurement in Calibration) and ISO/IEC Guide 98-3:2008, Guide to the Expression of Uncertainty in Measurement (GUM))

All reference systems are calibrated once a year. kV systems are calibrated by the Swedish National Testing. All dose systems are calibrated by PTB and are traceable to NIST on available beam qualities. NIST does not currently have traceable dose standards for the W/Rh, Mo/Rh (2 mmAl), Rh/Al and Mo/Al beam qualities. Unless RaySafe certifies the W/Rh, Mo/Rh, Rh/Al, Rh/Rh and Mo/Al (if applicable) beam quality measurements, made with this Xi, to be accurate within its published specifications. Xi is calibrated according to FDA MQSA requirements.

Unless RaySafe calibration method: "Calibration method for kV meters ACCR-0454" and "Calibration method for Air Kerma ACCR-0453".

Tested by: Tanner Hogan, Adam Denney

Approved by:


 Staci Torres
 Finalization Clerk

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CALIBRATION CERTIFICATE *issued by an Accredited Calibration Laboratory*

US Internal
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6045 Cochran Rd
44139 SOLON, OH
United States

Product:	Xi
Model:	Mammo Pro Plus
Serial Number:	133957

Mammo W/AI Arrival Check: *Date: 02/07/19*
Mammo W/AI Calibration Certificate: *Date: 02/07/19*
Calibration Equipment List

*Your instrument has passed several strict tests and has been approved for delivery.
Enclosed you will find detailed documents for your instrument.*



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This certificate may not be reproduced other than in full, except with the prior written approval of Unfors RaySafe.

Arrival Check

Xi Mammography W/AI

Date of Arrival Check:	02/07/19	Product:	Xi
Serial Number:	133957	Model:	Mammo Pro Plus

Measurement Details, As Found:

kVp W / 0,7mm Al

W/AI No Paddle				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. kVp	Xi kV	Tolerance *) 2,6% or 0,7 kV
20	50	19.97	19.90	-0.4%
25	50	24.96	24.94	-0.1%
30	50	29.94	29.90	-0.1%
35	50	34.92	35.15	0.7%

W / 0,7mm Al + 0,1mm Al

W/AI Paddle				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. kVp	Xi kVp	Tolerance *) 2,6% or 0,9 kV
20	50	19.97	19.95	-0.1%
25	50	24.96	24.96	0.0%
30	50	29.94	29.81	-0.4%
35	50	34.92	35.07	0.4%

Dose W / 0,7mm Al

W/AI 0mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose μGy	Xi Dose μGy	Tolerance *) 7,3%
20	50	1426	1422	-0.3%
25	50	3465	3499	1.0%
30	50	5928	6015	1.5%
35	50	8628	8841	2.5%
40	50	11450	11465	0.1%
45	50	14227	14181	-0.3%
49	50	16415	16362	-0.3%

W / 0,7mm Al + 0,1mm Al

W/AI 0,1mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose μGy	Xi Dose μGy	Tolerance *) 7,8%
20	50	1426	1422	-0.3%
25	50	3465	3499	1.0%
30	50	5928	6015	1.5%
35	50	8628	8841	2.5%
40	50	11450	11465	0.1%
45	50	14227	14181	-0.3%
49	50	16415	16362	-0.3%

*) The tolerance is calculated as the manufacture specification plus the expanded uncertainty. 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%. (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)). For further details regarding the arrival check tolerances, please refer to enclosed "Information on Assessment of Compliance with Specification".

Certificate of Calibration

Xi Mammography W/AI

Date of Calibration:	02/07/19	Product:	Xi
Serial Number:	133957	Model:	Mammo Pro Plus

Measurement Details, As Left:
kVp

W / 0,7mm Al

W/AI No Paddle				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. kVp	Xi kVp	Deviation
20	50	19.97	19.94	-0.2%
25	50	24.96	25.02	0.3%
30	50	29.94	29.82	-0.4%
35	50	34.92	35.06	0.4%

W / 0,7mm Al + 0,1mm Al

W/AI Paddle				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. kVp	Xi kVp	Deviation
20	50	19.97	19.86	-0.6%
25	50	24.96	24.97	0.1%
30	50	29.94	29.77	-0.6%
35	50	34.92	35.11	0.5%

Dose

W / 0,7mm Al

W/AI 0mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose μ Gy	Xi Dose μ Gy	Deviation
20	50	1902	1869	-1.7%
25	50	4295	4303	0.2%
30	50	7154	7139	-0.2%
35	50	10194	10297	1.0%
40	50	13284	13106	-1.3%
45	50	16384	16108	-1.7%
49	50	18795	18454	-1.8%

W / 0,7mm Al + 0,1mm Al

W/AI 0,1mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. Dose μ Gy	Xi Dose μ Gy	Deviation
20	50	1429	1423	-0.4%
25	50	3445	3474	0.9%
30	50	5913	5970	1.0%
35	50	8596	8772	2.0%
40	50	11365	11331	-0.3%
45	50	14142	14023	-0.8%
49	50	16341	16200	-0.9%

HVL (Non-Accredited)

W / 0,7mm Al

W/AI 0mm Al Added Filtration				
Generator Settings		Measurements		
Set kVp	Set mAs	Ref. HVL mm Al	Xi HVL mm Al	Deviation
30	50	0.454	0.452	-0.4%

W/AI No Paddle Specification:
KV \pm 2% or \pm 0.5 kV, Dose \pm 5% and HVL \pm 5%

W/AI Paddle Specification:
KV \pm 2% or \pm 0.7 kV, Dose \pm 5% and HVL \pm 5%

For further specification details, please refer to your Xi Manual.

Calibration Equipment

Date of Calibration:	02/07/19	Product:	Xi
Serial Number:	133957	Model:	Mammo Pro Plus

The listed equipment below were used as main references for the calibration

	Mammo Arrival Check	Mammo Calibration
GENERATOR	Hologic Selenia	Hologic Selenia
WAVEFORM TYPE	HF	HF
ANODE/FILTER	W/AI 0,7mm	W/AI 0,7mm
FIELD SIZE	24x29 cm	24x29 cm
FDD	70 cm	70 cm

	Mammo Arrival Check	Calibration Date	Mammo Calibration	Calibration Date
REFERENCE SYSTEM DOSE	RaySafe X2 S/N: 247597	4/25/2018	RaySafe X2 S/N: 247597	4/25/2018
REFERENCE SYSTEM kV	Hologic Selenia S/N: 28410072450RM Varian M-113T S/N: 82446-P7	5/28/2018	Hologic Selenia S/N: 28410072450RM Varian M-113T S/N: 82446-P7	5/28/2018
REFERENCE SYSTEM TIME	RaySafe X2 S/N: 247597	5/28/2018	RaySafe X2 S/N: 247597	5/28/2018

The expanded uncertainties for the presented deviations are:

W/AI: kVp: 0,6 % Dose: 2,3% (< 1 mm added Al-filtration) 2,8 % (> 1mm added Al-filtration)

Calibration Condition:

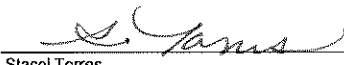
Ambient Temperature: 59-86°F
Relative Humidity: <80%

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%. (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))

All reference systems are calibrated once a year, kV systems are calibrated by the Swedish National Testing and Research Institute and are traceable to PTB. All dose systems are calibrated by PTB and are traceable to NIST on available beam qualities. NIST does not currently have traceable dose standards for the W/AI beam qualities. Unfors Instruments certifies the W/AI beam quality measurements, made with this Xi, to be accurate within its published specifications. Xi is calibrated according to FDA MQSA requirements.

Unfors RaySafe calibration method: "Calibration method for kV meters ACCR-0454" and/or "Calibration method for Air Kerma ACCR-0453".

Tested by: Justin Johns

Approved by: 
Stacey Torres
Finalization Clerk

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CALIBRATION CERTIFICATE issued by an Accredited Calibration Laboratory

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United States

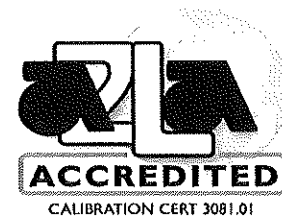
Product:	Xi
Model:	CT
Serial Number:	164572

CT Arrival Check: Date: 02/13/19

CT Calibration Certificate: Date: 02/13/19

Calibration Equipment List

*Your instrument has passed several strict test and has been approved for delivery.
Enclosed you will find detailed documents for your instrument.*



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Arrival check

Xi CT

Date of Arrival Check:	02/13/19	Product:	XI
Serial Number:	164572	Model:	CT

Measurement Details, As Found:

Dose

Generator settings				Measurements			
Set kVp	Set mA	Total Filtration mm Al	Total Filtration mm Cu	Ref. Dose μGy	Xi Dose μGy	Deviation	Tolerance *)
80	125	2.5	0	1511.4	1538.9	1.8%	10.7%
100	160	2,5+1,0	0.2	1107.7	1108.8	0.1%	10.7%
120	100	2,5+1,2	0.25	987.8	978.3	-1.0%	8.7%
150	80	2,5+2,0	0.3	1228.8	1202.3	-2.2%	10.7%

Calibration Condition:

Ambient Temperature (°F)	22,63 to 23,53
Atmospheric Pressure (kPa):	96,1 to 98,1
Relative Humidity:	<80 %RH

*) The tolerance is calculated as the manufacture specification plus the expanded uncertainty. 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%. (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)). For further details regarding the arrival check tolerances, please refer to enclosed "Information on Assessment of Compliance with Specification".

Certificate of Calibration

XI CT

Date of Calibration:	02/13/19	Product:	XI
Serial Number:	164572	Model:	CT

Measurement Details, As Left:

Dose

Generator Settings				Measurements		
Set kVp	Set mA	Total Filtration mm Al	Total Filtration mm Cu	Ref. Dose μGy	Xi Dose μGy	Deviation
80	125	2.5	0	1513.4	1542.5	1.9%
100	160	2,5+1,0	0.2	1107.7	1108.0	0.0%
120	100	2,5+1,2	0.25	987.4	974.5	-1.3%
150	80	2,5+2,0	0.3	1226.8	1198.8	-2.3%

Calibration Condition:

Ambient Temperature (°F)	22,84 to 23,74
Atmospheric Pressure (kPa):	98,1 to 98,1
Relative Humidity:	<80 %RH

CT Specification:

Uncertainty 5 %

(at reference point RQT9; 120 kV, 3.7 mm Al and 0.25 mm Cu)

Energy dependence < 5 % (at 80 kV to 150 kV; RQA, RQR and RQT qualities)

Radial uniformity ± 2 %

Axial uniformity ± 3 % within rated length

Influence of relative humidity < 0.3 % (for RH < 80 %)

Uncertainty in temp. and pressure correction 2 %

For further specification details, please refer to your CT Manual.

Calibration Equipment

Date of Calibration:	02/13/19	Product:	XI
Serial Number:	164572	Model:	CT

The listed equipment below was used as a main reference for the calibration

	Arrival Check	Calibration
GENERATOR	CPI Indico 100	CPI Indico 100
WAVEFORM TYPE	HF	HF
ANODE/FILTER	W / 2.5 mm Al	W / 2.5 mm Al
FIELD SIZE	12 x 12 cm	12 x 12 cm
FDD	85 cm	85 cm

Reference System		Calibration Date		Calibration Date
DOSE	X2 CT S/N: 248514	9/3/2018	X2 CT S/N: 248514	9/3/2018

The expanded uncertainties for the presented deviations are:

3,3 % for Dose

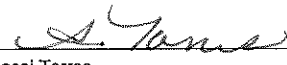
The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, which for a normal distribution provides a level of confidence of approximately 95%. (EA-4/02 (Expression of the Uncertainty of Measurement in Calibration) and ISO/IEC Guide 98-3:2008, Guide to the Expression of Uncertainty in Measurement (GUM))

Dose systems are calibrated by PTB.

All dose reference systems are traceable to NIST and PTB.

Unfors RaySafe calibration method: "Calibration method for kV meters.ACCR-0454 ver. 3" and/or "Calibration method for Air Kerma.ACCR-0453 ver. 3".

Tested by: Adam Denney

Approved by: 
 Stacey Torres
 Finalization Clerk

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Certificate of Calibration

US Internal
c/o Fluke Biomedical
6045 Cochran Rd
44139 SOLON, OH
United States

Product:	Xi
Model:	Light
Serial Number:	160504

Light Arrival Check: Date: 02/13/19

Light Calibration Certificate: Date: 02/13/19

Calibration Equipment List

*Your instrument has passed several strict tests and has been approved for delivery.
Enclosed you will find detailed documents for your instrument.*

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Certificate of Calibration

Xi Light Detector

Date of Calibration:	02/13/19	Product:	Xi
Serial Number:	160504	Model:	Light

Measurement Details, As Left:

Luminance

Measurements		
Ref. Value (cd/m ²)	Xi Value (cd/m ²)	Deviation
4.990	4.937	-1.1%
1000	994.9	-0.5%
3002	2968	-1.2%

Illuminance

Measurements		
Ref. Value (lux)	Xi Value (lux)	Deviation
200.3	199.9	-0.2%

Luminance measured with Xi setting at Luminance CRT

Unfors Xi Light Specification:
Luminance $\pm 3\%$ and Illuminance $\pm 3\%$

For further specification details, please refer to your Xi Light Manual.

Calibration Equipment

Date of Calibration:	02/13/19	Product:	Xi
Serial Number:	160504	Model:	Light

The listed equipment below was used as a main reference for the calibration

Reference System	Calibration Date
OL 462 Controller, S/N: 07407139 OL 462-8U Integrating Sphere Calibration Standard, S/N: 07202010 Opal Diffuser, S/N: 07202010-A	10/31/18

The expanded uncertainties for the presented deviations are:

Luminance: 1.8%

Illuminance: 2.0%

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%. (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 reference instruments are traceable to SP Technical Research Institute of Sweden providing traceability to international standards

Calibration condition:

Ambient Temperature: 15-30°C

Relative Humidity: <80%

Tested by: Adam Denney

Approved by: _____

Inel Arslanovic
Calibration Engineer

RaySafe Inc.

a Fluke Biomedical Company
6045 Cochran RD, Cleveland, OH 44139-3303
Phone: 800.850.4608 FAX: 440.349.2307
customerservice.us@raysafe.com www.RaySafe.com

CALIBRATION CERTIFICATE *issued by an Accredited Calibration Laboratory*

US Internal
c/o Fluke Biomedical
6045 Cochran Rd
44139 SOLON, OH
United States

Product:	Xi
Model:	Survey
Serial Number:	163193

Arrival check:
Calibration Certificate:
Calibration Equipment List

Date: 02/13/19
Date: 02/13/19

*Your instrument has passed several strict test and has been approved for delivery.
Enclosed you will find detailed documents for your instrument.*



This laboratory is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this certificate have been determined within the scope of accreditation unless stated otherwise in this certificate.

This certificate may not be reproduced other than in full, except with the prior written approval of RaySafe.

Certificate No.: 163193-20190213

Date of Calibration:	02/13/19	Product:	Xi
Serial No:	163193	Model:	Survey

Your instrument has passed several strict tests and has been approved for delivery.

Arrival check

Dose Xi Survey Detector

Measurement Details, As Found:

Generator Settings				Measurements			Tolerance *)	
kVp	mA	ms	Total Filtration	Reference μGy	Xi Survey μGy	Deviation	Min	Max
40	16	2000	4 mm Al + 0,2 mm Cu	15.4	15.1	-2.0%	-12.6%	12.6%
80	16	2000	4 mm Al + 2 mm Cu	17.6	17.6	0.2%	-12.6%	12.6%

Calibration

Dose Xi Survey Detector

Measurement Details, As Left:

Generator Settings				Measurements			Specification	
kVp	mA	ms	Total Filtration	Reference μGy	Xi Survey μGy	Deviation	Min	Max
40	16	2000	4 mm Al + 0,2 mm Cu	15.5	15.3	-1.1%	-10%	10%
80	16	2000	4 mm Al + 2 mm Cu	17.5	17.8	1.5%	-10%	10%

Xi Survey Specification: Dose $\pm 10\%$ (R/F & Mam) 20% (Nucl. Med.)
For further specification details, please refer to your Xi Survey Manual.

*) The tolerance is calculated as the manufacture specification plus the expanded uncertainty. 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%. (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)).

For further details regarding the arrival check tolerances, please refer to enclosed "Information on Assessment of Compliance with Specification".

Calibration Equipment

Date of Calibration:	02/13/19	Product:	Xi
Serial No:	163193	Model:	Survey

The listed equipment below was used as a main reference for the calibration

	Conventional and R/F Arrival Check	Conventional and R/F Calibration
GENERATOR	CPI Indico 100	CPI Indico 100
WAVEFORM TYPE	HF	HF
ANODE	W	W
FIELD SIZE	10 x 20 cm	10 x 20 cm
FDD	120 cm	120 cm

	Reference System	Calibration Date	Reference System	Calibration Date
DOSE	Unfors Xi S/N: 211690	2018/09/03	Unfors Xi S/N: 211690	9/3/2018

The expanded uncertainties for the presented deviations are:
2,6 % for Dose

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% (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))

All reference systems are calibrated once a year. Dose systems are calibrated by PTB.
All dose reference systems are traceable to NIST and PTB.

Calibration condition:
Ambient Temperature: 59-86°F
Relative Humidity: <80%

RaySafe calibration method: "Calibration method for Air Kerma.ACCR-0453 ver. 3".

Tested by: Adam Denney

Approved by:


 Stacey Torres
 Finalization Clerk

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CALIBRATION CERTIFICATE *Issued by an Accredited Calibration Laboratory*

US Internal
c/o Fluke Biomedical
6045 Cochran Rd
44139 SOLON, OH
United States

Product:	Xi
Model:	Transparent Detector
Serial Number:	191441

Arrival Check

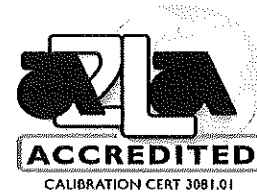
Date 02/13/19

Calibration Certificate:

Date 02/13/19

Calibration Equipment List

*Your instrument has passed several strict tests and has been approved for delivery.
Enclosed you will find detailed documents for your instrument.*



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Certificate No.: 191441-20190213

Date of Calibration:	02/13/19	Product:	Xi
Serial No:	191441	Model:	Transparent Detector

Your instrument has passed several strict tests and has been approved for delivery.

Arrival Check:

Dose, Xi Transparent Detector

Measurement Details, As Found:

Generator Settings				Measurements			Tolerance *):
kVp	mA	ms	Total Filtration	Reference μGy	Xi μGy	Deviation	
70	100	320	2,5 mm Al	855.32	857.16	0.22%	7.8%
100	80	320	2,5 mm Al	1362.00	1386.93	1.83%	7.8%
120	80	320	2,5 mm Al	1865.49	1916.46	2.73%	7.8%

Calibration

Dose, Unfors Xi Transparent Detector

Measurement Details, As Left:

Generator Settings				Measurements			Specification
kVp	mA	ms	Total Filtration	Reference μGy	Xi μGy	Deviation	
70	100	320	2,5 mm Al	841.5	833.1	-1.01%	5%
100	80	320	2,5 mm Al	1335.5	1341.4	0.45%	5%
120	80	320	2,5 mm Al	1829.9	1848.9	1.04%	5%

*) The tolerance is calculated as the manufacture specification plus the expanded uncertainty. 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%. (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)). For further details regarding the arrival check tolerances, please refer to enclosed "Information on Assessment of Compliance with Specification".

Arrival Check

Xi Light Detector

Date of Arrival Check:	02/13/19	Product:	Xi
Serial Number:	160504	Model:	Light

Measurement Details, As Found:

Luminance

Measurements		
Ref. Value (cd/m ²)	Xi Value (cd/m ²)	Tolerance *) 4,8%
4.990	5.127	2.7%
997.5	1027	3.0%

Illuminance

Measurements		
Ref. Value (lux)	Xi Value (lux)	Tolerance *) 5,0%
200.4	203.2	1.4%

Luminance measured with Xi setting at Luminance CRT

*) The tolerance is calculated as the manufacture specification plus the expanded uncertainty. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, which for a normal distribution, and a one-sided tolerance interval, provides a level of confidence of approximately 95%. (ISO/IEC Guide 98-3:2008, Guide to the Expression of Uncertainty in Measurement (GUM))

Calibration Equipment

Date of Calibration:	02/13/19	Product:	Xi
Serial No:	191441	Model:	Transparent Detector

The listed equipment below was used as a main reference for the calibration

	Arrival Check	Calibration
GENERATOR	CPI Indico 100	CPI Indico 100
WAVEFORM TYPE	HF	HF
ANODE	W	W
FIELD SIZE	10 x 10 cm	10 x 10 cm
FDD	130 cm	130 cm

DOSE	Reference System	Calibration Date	Reference System	Calibration Date
	Unfors Xi S/N: 206331	09/03/18	Unfors Xi S/N: 206331	09/03/18

The expanded uncertainties for the presented deviations are:
2,8 % for Dose

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%. (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))

All reference systems are calibrated once a year.
All dose reference systems are traceable to NIST and PTB.

Calibration Condition:

Ambient Temperature: 59-86°F
Relative Humidity: <80%

Unfors RaySafe calibration method: "Calibration method for Air Kerma ACCR-0453".

Tested by: Adam Denney

Approved by:


 Stacey Torres
 Finalization Clerk

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