PLANMECA

Planmeca ProX™

EN

technical manual

10029965_12

Table of contents

The manufacturer, assembler and importer are responsible for the safety, reliability and performance of the unit only if:

- installation, calibration, modification and repairs are carried out by qualified authorised personnel
- electrical installations are carried out according to the appropriate requirements such as IEC 60364
- equipment is used according to the operating instructions.

Planmeca pursues a policy of continual product development. Although every effort is made to produce up-to-date product documentation this publication should not be regarded as an infallible guide to current specifications. We reserve the right to make changes without prior notice.

Publication number 10029965 Revision 12
Released 28 November 2016

1 GENERAL & TECHNICAL DATA

1.1 Introduction

The Planmeca ProX X-ray unit produces intraoral X-ray images for the diagnosis of teeth and adjacent structures. The unit is allowed to be used only under supervision of a dental/ health care professional.

NOTE

This manual is valid for software revision 4.11.R or later.

NOTE

The Planmeca ProX intraoral X-ray unit is allowed to be used only under supervision of a dental/health care professional.

CE 0598

The Planmeca ProX intraoral X-ray unit fulfils the requirements of Directive 93/42/EEC.

1.2 Warnings and cautions

WARNING

THE FOLLOWING WARNINGS, CAUTIONS AND NOTES MUST ALWAYS BE CONSIDERED WHILE SERVICING THE UNIT, IN ORDER TO AVOID EITHER PERSONAL INJURY OR DAMAGE TO THE UNIT.

WARNING

Do not connect a multiple portable socket outlet (MPSO) or extension cord to the system.

WARNING

To avoid risk of electric shock, this equipment must only be connected to a supply mains with protective earth.

WARNING

No modification of this equipment is allowed.

Do not modify this equipment without authorisation of the manufacturer.

If this equipment is modified, appropriate inspection and testing must be conducted to ensure continued safe use of equipment.

CAUTION

RADIATION SAFETY RULES
Some procedures described in this manual produces X-ray radiation. Always follow the rules for radiation protection.
Never attempt to open the tube head. It does not contain any serviceable parts, and radiation safety could not be guaranteed any more.

CAUTION

ELECTRICAL SAFETY RULES

The unit contains hazardous voltages. While servicing internal parts, always turn off externally the power to the unit, and wait for 2 minutes before touching any electrical parts.
Always replace the fuses with ones of the same type and rating. Otherwise patient, operator or equipment safety cannot be guaranteed.
The circuit boards can be damaged due to static discharges and require careful handling.

CAUTION

GENERAL SAFETY RULES

The unit must be serviced only by qualified personnel, trained by PLANMECA.
Repairs and parts replaced by unqualified personnel carry no warranty.
Periodical maintenance as described in this manual must be performed on a regular basis, to ensure the safety and image quality of the unit.
Some procedures described in the unit could be dangerous, if not followed as stated.

CAUTION

Check that the X-ray unit is installed properly and no mechanical play caused by wear, corrosion, metal fatigue or ageing can be found between the wall bracket and horizontal arm.

1.3 Symbols

Type B equipment (Standard IEC 601-1).

Alternating current (Standard IEC-417).

General warning (Standard ISO 7010).

Warning, electricity (Standard ISO 7010-W012).

Attention, consult accompanying documents
(Standard IEC 601-1).

Intermediate focal spot (Standard IEC-417).

Separate collection for electrical and electronic equipment according to Directive 2002/96/EC (WEEE).

1.4 Technical specifications

Generator	Constant potential, microprocessor controlled, operating frequency 66 kHz
X-ray tube	Toshiba D-041SB
Focal spot size	0.4 mm according to IEC 60336
Cone diameter	60 mm (2.36 in.) Rectangular 33 x 43 mm (1.30 x 1.69 in.)
Max. symmetrical radiation field	ø 60 mm at SSD 200 mm ø 60 mm at SSD 300 mm according to IEC 806
Total filtration	min. 2.5 mm Al equivalent at 70 kV according to IEC 60522
Inherent filtration	1 mm Al equivalent at 70 kV according to IEC 60522
Anode voltage	2-8 mA: 60, 63, 66, 70 kV, ±2 kV
Anode current	8, 7, 6, 5, 4, 3, 2 mA ±(5% + 0.2 mA)
Target material	Tungsten
Target angle	12.5°
Exposure times	0.01- 2 sec. ±(5% + 0.001 sec.), 24 steps
Reference current time product	8 mAs at 70 kV, 8 mA, 1 sec.
Lowest current time product	0.02 mAs at 2 mA, 0.01 sec.
Max. nominal anode voltage	70 kV
Power input	1000 VA (220-240 V) 890 VA (100-115 V)
Max. electrical output	560 W at 70 kV, 8 mA
Electrical output at 0.1 sec.	560 W at 70 kV, 8 mA
Max. loading energy	1987 mAs/h at 70 kV
SID (SID = source - image receptor distance)	min. 200 mm (8 in.)
SSD (Source-Skin Distance) Standard/Long Long with rectangular collimator	 200 mm (8 in.)/300 mm (12 in.) 306 mm (12.04 in.)
Mains voltage	100 V~/110-115 V~/220-240 V~
Apparent resistance	0.3 ohms 100-115 V~ /0.8 ohms 220-240 V~
Mains frequency	50/60 Hz
Fusing	units with 100V~ or 110-115V~ voltage setting: 15AT, 250V, slow blow (6.3x32mm) (special fuse, manufacturer Bussmann, type MDA) units with 220-240V~ voltage setting: 8AT, 250V, slow blow (6.3x32mm) (special fuse, manufacturer Bussmann, type MDA)
Duty cycle	1:13,5, at least 6s. automatic control
Electrical classification	Class I Type B

Mechanical data

Weight	total 33 kg (73 lbs)
	tube head
	4.2 kg (9.3 lbs) with standard cone
	4.5 kg (10 lbs) with long cone
Color	RAL 9016

Environmental requirements

Ambient temperature	operating +5°C - +40°C storage -10°C - +50°C transport -10°C - +50°C
Humidity	25% - 75%
Atmospheric pressure range	700 hPa - 1060 hPa

External mains fuse recommendation

The recommendation for the external mains fuses are:

- units with 100V~ or 115V~ voltage setting: 16A, time lag
- units with 220-240V~ voltage setting: 10A, time lag

No other equipment should be connected to the same fused mains line as the x-ray unit. In some countries an additional external fault current guard is also required.

Original manufacturer

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phone: +358-20-7795 500

1.5 User's statement for Planmeca ProX intraoral X-ray unit

Radiation leakage technique factors

The maximum rated peak tube potential is 70 kV and the maximum rated continuous tube current is 0.14 mA for the maximum rated peak tube potential.

Minimum filtration

The radiation port contains an added 1.5 mm aluminium filtration. The measured half-value is 0.50 - 0.55 at 70 kV. The measured value corresponds to an aluminium equivalent of 2.5 mm.

Rated line voltage

100, 110-117, 220-240 V~ ±10%. Line voltage regulation 10%.

Maximum line current

5.0 A at 230 V~, 7.4 A at 115 V~

Technique factors that constitute the maximum line current condition

70 kV, 8 mA

Generator rating and duty cycle

0,8 kW, duty cycle 1:13,5. The wait period is controlled automatically by calculating it according to the formula tw = n.13,5x, min. 6s

Maximum deviation of peak tube potential from indicated value

± 2.0 kV

Maximum deviation of tube current from indicated value

±(5% + 0.2mA)

Maximum deviation of exposure time from indicated value

±(5% + 0.001 sec.)

DEFINITION OF MEASUREMENT CRITERIA

Exposure time

The beginning and end points of the exposure time are defined at 70% of the peak radiation waveform measured with a calibrated x-ray monitor.

Peak tube potential

Is defined as the high voltage mean value measured with a calibrated non-invasive kVp meter.

Tube current

Is defined using the voltage over the feedback resistor measured with a calibrated multimeter. The mA value is calculated by dividing the voltage by the resistance value.

The nominal x-ray voltage together with the highest x-ray tube current obtainable from the high-voltage generator when operated at it's highest x-ray tube voltage

70 kV, 8 mA

The nominal x-ray tube current when operated at the highest x-ray tube voltage

8 mA, 70 kV

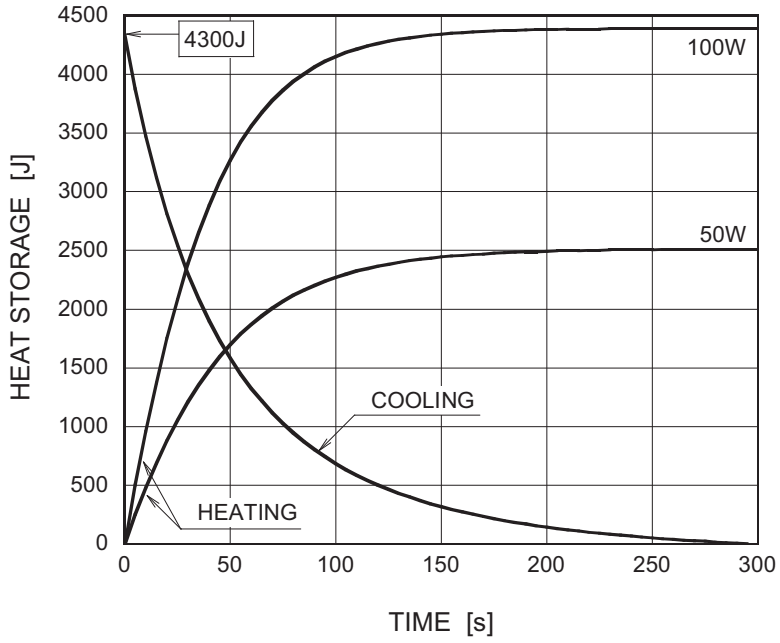
The x-ray tube voltage and tube current which result in the highest electric output power

70 kV, 8 mA

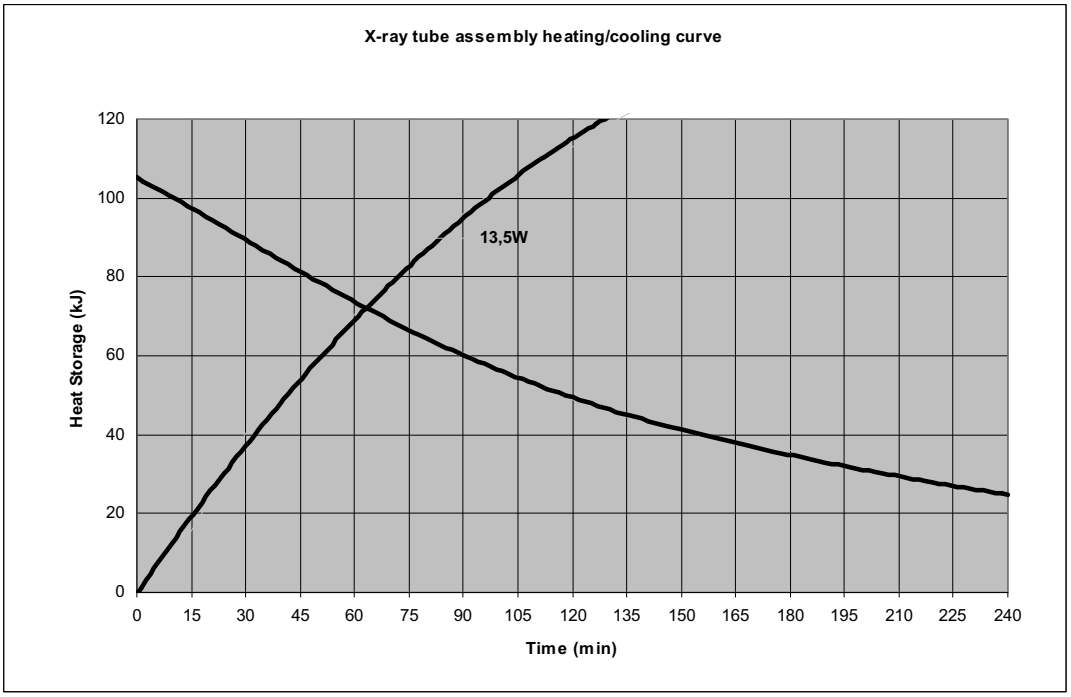
The nominal electric power for a load time of 0.1 sec and at the nominal x-ray tube voltage

1.4 kW at 70 kV, 8 mA

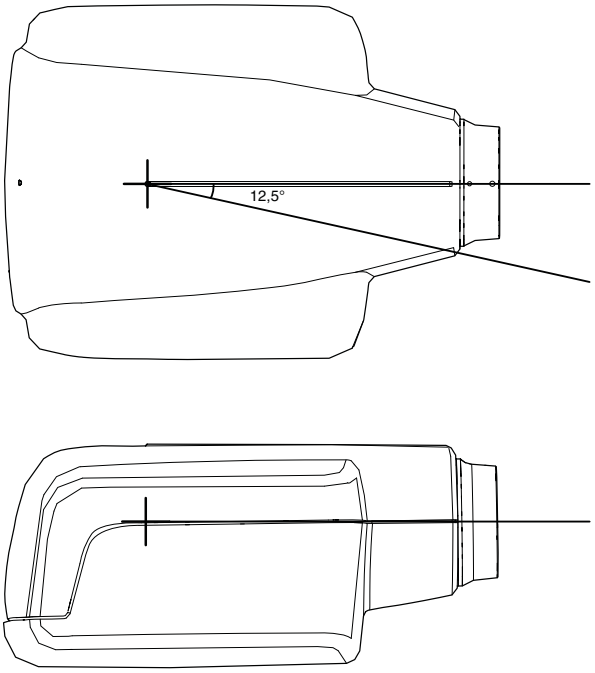
Anode heating/cooling curve of the X-ray tube



X-ray tube assembly heating/cooling curve



Reference axis to which the target angle and the focal spot characteristics of the tube head assembly refer



Target angle with respect to the reference axis

12.5°

Dimensions of the tube head assembly

(WxHxD) 175mm x 105mm x 165mm

Weight of the tube head assembly

3.1 kg

Values of loading factors concerning leakage radiation

70 kV, 8 mA

Tolerances of the focal spot on the reference axis

X= ±0.5 mm (sideways)
Y= ±0.5 mm (in depth)
Z= ±0.5 mm (in height)

1.6 Stray radiation measurements for Planmeca ProX intraoral X-ray unit

The measurements are given for loading factors which result in the maximum local dose per current time product. The loading factors include the highest selectable X-ray tube voltage.

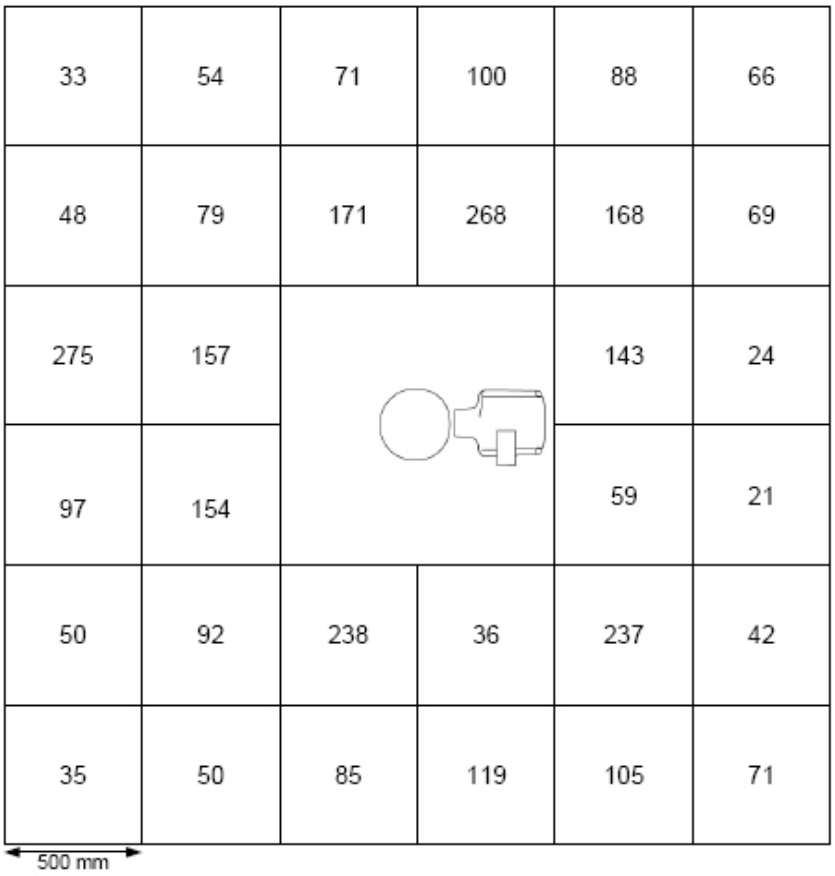
PMMA phantom with a diameter of 160 mm and a height of 160 mm has been used for the measurements. The phantom is compatible with the specification in international standard IEC 60601-1-3.

The values were measured in the horizontal plane which was at the height of the centre of the phantom and the X-ray source. The unit of measurement was air kerma per mAs applied to the X-ray tube during normal use.

Exposure values:

70 kV / 8 mA / 0.5 s

Dose values are presented in nGy/mAs.



1.7 DAP values

DAP[µGy*cm²] = S*T*I*A1*(A2/A1)*(D1²/D2²)

S = radiation/mAs (as a function of kV) [µGy]
T = exposure time [s]
I = exposure current [mA]
A1 = radiation sensor area [cm²]
A2 = exposure field area [cm²]
D1 = radiation source to radiation dose meter distance [cm]
D2 = radiation source to skin distance, SSD [cm]

D1²/D2² = scaling from radiation measurement distance to skin distance
A2/A1 = ratio of areas

PLANMECA ProX **[DAP] = mGy*cm²**

No cone, SSD 20cm ± 20% ± 0,5mGy

		0,010 s	0,012 s	0,016 s	0,020 s	0,025 s	0,032 s	0,040 s	0,050 s	0,064 s	0,080 s	0,100 s	0,125 s	0,160 s	0,200 s	0,250 s	0,320 s	0,400 s	0,500 s	0,640 s	0,800 s	1,000 s	1,250 s	1,600 s	2,000 s
2 mA	60 kV	0,6	0,7	0,9	1,1	1,4	1,8	2,2	2,8	3,5	4,5	5,6	7	8,9	11	14	18	22	28	35	45	56	70	89	111
2 mA	63 kV	0,6	0,7	1	1,2	1,6	2	2,5	3,1	3,9	5	6,2	7,8	10	12	16	20	25	31	39	50	62	78	99	124
2 mA	66 kV	0,7	0,8	1,1	1,4	1,7	2,2	2,7	3,4	4,3	5,4	6,8	8,5	11	14	17	22	27	34	43	54	68	85	109	136
2 mA	70 kV	0,8	0,9	1,2	1,5	1,9	2,4	3,1	3,8	4,8	6,1	7,6	10	12	15	19	24	31	38	48	61	76	95	122	153
3 mA	60 kV	0,8	1	1,3	1,7	2,1	2,7	3,4	4,2	5,3	6,7	8,4	11	13	17	21	27	34	42	53	67	84	105	134	168
3 mA	63 kV	0,9	1,1	1,5	1,9	2,3	3	3,7	4,7	5,9	7,4	9,3	12	15	19	23	30	37	47	59	74	93	116	149	186
3 mA	66 kV	1	1,2	1,6	2	2,6	3,3	4,1	5,1	6,4	8,2	10	13	16	20	26	33	41	51	64	82	102	128	163	204
3 mA	70 kV	1,2	1,4	1,8	2,3	2,9	3,7	4,6	5,8	7,2	9,2	12	15	18	23	29	37	46	58	72	92	115	144	184	230
4 mA	60 kV	1,1	1,3	1,8	2,2	2,8	3,6	4,4	5,6	7	8,9	11	14	18	22	28	36	44	56	70	89	111	139	178	222
4 mA	63 kV	1,2	1,5	2	2,5	3,1	4	5	6,2	7,8	10	13	16	20	25	31	40	50	62	78	99	124	155	198	248
4 mA	66 kV	1,4	1,6	2,2	2,7	3,4	4,4	5,4	6,8	8,6	11	14	17	22	27	34	44	54	68	86	109	136	170	218	272
4 mA	70 kV	1,5	1,8	2,4	3,1	3,8	4,9	6,1	7,7	10	12	16	19	24	31	38	49	61	77	96	122	153	191	245	306
5 mA	60 kV	1,4	1,7	2,2	2,8	3,5	4,4	5,6	7	8,8	11	14	18	22	28	35	44	56	70	88	111	139	174	222	278
5 mA	63 kV	1,6	1,9	2,5	3,1	3,9	5	6,2	7,8	10	13	16	20	25	31	39	50	62	78	98	124	155	194	248	310
5 mA	66 kV	1,7	2	2,7	3,4	4,3	5,4	6,8	8,5	11	14	17	21	27	34	43	54	68	85	107	136	170	213	272	340
5 mA	70 kV	1,9	2,3	3,1	3,8	4,8	6,1	7,6	10	12	16	19	24	31	38	48	61	76	96	120	153	191	239	306	382
6 mA	60 kV	1,7	2	2,7	3,3	4,2	5,3	6,7	8,4	11	14	17	21	27	33	42	53	67	84	105	134	167	209	267	334
6 mA	63 kV	1,9	2,2	3	3,7	4,7	6	7,4	9,3	12	15	19	23	30	37	47	60	74	93	117	149	186	233	298	372
6 mA	66 kV	2	2,4	3,3	4,1	5,1	6,5	8,2	10	13	17	20	26	33	41	51	65	82	102	129	163	204	255	326	408
6 mA	70 kV	2,3	2,7	3,7	4,6	5,7	7,3	9,2	12	15	19	23	29	37	46	57	73	92	115	144	183	229	286	366	458
7 mA	60 kV	2	2,3	3,1	3,9	4,9	6,2	7,8	10	13	16	20	24	31	39	49	62	78	98	123	156	195	244	312	390
7 mA	63 kV	2,2	2,6	3,5	4,3	5,4	6,9	8,7	11	14	18	22	27	35	43	54	69	87	109	137	174	217	271	347	434
7 mA	66 kV	2,4	2,9	3,8	4,8	6	7,6	10	12	15	19	24	30	38	48	60	76	95	119	150	190	238	298	381	476
7 mA	70 kV	2,7	3,2	4,3	5,3	6,7	8,5	11	14	17	21	27	33	43	53	67	85	107	134	168	214	267	334	427	534
8 mA	60 kV	2,2	2,7	3,6	4,5	5,6	7,1	8,9	11	14	18	22	28	36	45	56	71	89	112	140	178	223	279	357	446
8 mA	63 kV	2,5	3	4	5	6,2	7,9	10	13	16	20	25	31	40	50	62	79	99	124	156	198	248	310	397	496
8 mA	66 kV	2,7	3,3	4,4	5,4	6,8	8,7	11	14	17	22	27	34	44	54	68	87	109	136	171	218	272	340	435	544
8 mA	70 kV	3,1	3,7	4,9	6,1	7,6	10	12	16	19	24	31	38	49	61	76	98	122	153	192	244	305	381	488	610

PLANMECA ProX **[DAP] = mGy*cm^2**

Round cone, SSD 30cm ± 20% ± 0,5mGy

		0,010 s	0,012 s	0,016 s	0,020 s	0,025 s	0,032 s	0,040 s	0,050 s	0,064 s	0,080 s	0,100 s	0,125 s	0,160 s	0,200 s	0,250 s	0,320 s	0,400 s	0,500 s	0,640 s	0,800 s	1,000 s	1,250 s	1,600 s	2,000 s
2 mA	60 kV	0,2	0,3	0,4	0,5	0,6	0,8	1	1,2	1,6	2	2,5	3,1	4	4,9	6,2	7,9	10	12	16	20	25	31	40	49
2 mA	63 kV	0,3	0,3	0,4	0,5	0,7	0,9	1,1	1,4	1,7	2,2	2,7	3,4	4,4	5,5	6,8	8,8	11	14	17	22	27	34	44	55
2 mA	66 kV	0,3	0,4	0,5	0,6	0,8	1	1,2	1,5	1,9	2,4	3	3,8	4,8	6	7,5	10	12	15	19	24	30	38	48	60
2 mA	70 kV	0,3	0,4	0,5	0,7	0,8	1,1	1,3	1,7	2,1	2,7	3,4	4,2	5,4	6,7	8,4	11	14	17	21	27	34	42	54	67
3 mA	60 kV	0,4	0,4	0,6	0,7	0,9	1,2	1,5	1,9	2,3	3	3,7	4,6	5,9	7,4	9,3	12	15	19	23	30	37	46	59	74
3 mA	63 kV	0,4	0,5	0,7	0,8	1	1,3	1,6	2,1	2,6	3,3	4,1	5,1	6,6	8,2	10	13	16	21	26	33	41	51	66	82
3 mA	66 kV	0,5	0,5	0,7	0,9	1,1	1,4	1,8	2,3	2,8	3,6	4,5	5,6	7,2	9	11	14	18	23	28	36	45	56	72	90
3 mA	70 kV	0,5	0,6	0,8	1	1,3	1,6	2	2,5	3,2	4	5,1	6,3	8,1	10	13	16	20	25	32	40	51	63	81	101
4 mA	60 kV	0,5	0,6	0,8	1	1,2	1,6	2	2,5	3,1	3,9	4,9	6,2	7,9	10	12	16	20	25	31	39	49	62	79	99
4 mA	63 kV	0,5	0,7	0,9	1,1	1,4	1,7	2,2	2,7	3,4	4,4	5,5	6,8	8,8	11	14	18	22	27	34	44	55	68	88	109
4 mA	66 kV	0,6	0,7	1	1,2	1,5	1,9	2,4	3	3,8	4,8	6	7,5	10	12	15	19	24	30	38	48	60	75	96	120
4 mA	70 kV	0,7	0,8	1,1	1,3	1,7	2,2	2,7	3,4	4,2	5,4	6,7	8,4	11	14	17	22	27	34	42	54	67	84	108	135
5 mA	60 kV	0,6	0,7	1	1,2	1,5	2	2,5	3,1	3,9	4,9	6,2	7,7	10	12	15	20	25	31	39	49	62	77	99	123
5 mA	63 kV	0,7	0,8	1,1	1,4	1,7	2,2	2,7	3,4	4,3	5,5	6,8	8,5	11	14	17	22	27	34	43	55	68	85	109	137
5 mA	66 kV	0,8	0,9	1,2	1,5	1,9	2,4	3	3,8	4,7	6	7,5	9,4	12	15	19	24	30	38	47	60	75	94	120	150
5 mA	70 kV	0,8	1	1,3	1,7	2,1	2,7	3,4	4,2	5,3	6,7	8,4	11	13	17	21	27	34	42	53	67	84	105	134	168
6 mA	60 kV	0,7	0,9	1,2	1,5	1,9	2,4	3	3,7	4,7	5,9	7,4	9,3	12	15	19	24	30	37	47	59	74	93	118	148
6 mA	63 kV	0,8	1	1,3	1,6	2,1	2,6	3,3	4,1	5,2	6,6	8,2	10	13	16	21	26	33	41	52	66	82	103	131	164
6 mA	66 kV	0,9	1,1	1,4	1,8	2,3	2,9	3,6	4,5	5,7	7,2	9	12	14	18	23	29	36	45	57	72	90	113	144	180
6 mA	70 kV	1	1,2	1,6	2	2,5	3,2	4	5,1	6,4	8,1	10	13	16	20	25	32	40	51	64	81	101	126	162	202
7 mA	60 kV	0,9	1	1,4	1,7	2,2	2,8	3,4	4,3	5,4	6,9	8,6	11	14	17	22	28	34	43	54	69	86	108	138	172
7 mA	63 kV	1	1,2	1,5	1,9	2,4	3,1	3,8	4,8	6	7,7	10	12	15	19	24	31	38	48	60	77	96	120	154	192
7 mA	66 kV	1,1	1,3	1,7	2,1	2,6	3,4	4,2	5,3	6,6	8,4	11	13	17	21	26	34	42	53	66	84	105	131	168	210
7 mA	70 kV	1,2	1,4	1,9	2,4	3	3,8	4,7	5,9	7,4	10	12	15	19	24	30	38	47	59	74	94	118	148	189	236
8 mA	60 kV	1	1,2	1,6	2	2,5	3,2	4	5	6,2	7,9	10	13	16	20	25	32	40	50	62	79	99	124	158	198
8 mA	63 kV	1,1	1,3	1,7	2,2	2,7	3,5	4,4	5,5	6,9	8,7	11	14	17	22	27	35	44	55	69	87	109	136	174	218
8 mA	66 kV	1,2	1,4	1,9	2,4	3	3,8	4,8	6	7,6	10	12	15	19	24	30	38	48	60	76	96	120	150	192	240
8 mA	70 kV	1,4	1,6	2,2	2,7	3,4	4,3	5,4	6,8	8,5	11	14	17	22	27	34	43	54	68	85	108	135	169	216	270

PLANMECA ProX **[DAP] = mGy*cm^2**

Rectangular cone, SSD 35,1 cm rad. area 45x36mm ± 20% ± 0,5mGy

		0,010 s	0,012 s	0,016 s	0,020 s	0,025 s	0,032 s	0,040 s	0,050 s	0,064 s	0,080 s	0,100 s	0,125 s	0,160 s	0,200 s	0,250 s	0,320 s	0,400 s	0,500 s	0,640 s	0,800 s	1,000 s	1,250 s	1,600 s	2,000 s
2 mA	60 kV	0,1	0,1	0,2	0,2	0,3	0,4	0,5	0,6	0,7	0,9	1,1	1,4	1,8	2,3	2,8	3,6	4,5	5,7	7,1	9,1	11	14	18	23
2 mA	63 kV	0,1	0,2	0,2	0,3	0,3	0,4	0,5	0,6	0,8	1	1,3	1,6	2	2,5	3,2	4,1	5,1	6,3	8	10	13	16	20	25
2 mA	66 kV	0,1	0,2	0,2	0,3	0,4	0,4	0,6	0,7	0,9	1,1	1,4	1,8	2,2	2,8	3,5	4,5	5,6	7	8,8	11	14	18	22	28
2 mA	70 kV	0,2	0,2	0,3	0,3	0,4	0,5	0,6	0,8	1	1,3	1,6	2	2,5	3,1	3,9	5	6,3	7,8	10	13	16	20	25	31
3 mA	60 kV	0,2	0,2	0,3	0,3	0,4	0,5	0,7	0,9	1,1	1,4	1,7	2,1	2,7	3,4	4,3	5,4	6,8	8,5	11	14	17	21	27	34
3 mA	63 kV	0,2	0,2	0,3	0,4	0,5	0,6	0,8	1	1,2	1,5	1,9	2,4	3	3,8	4,8	6,1	7,6	10	12	15	19	24	30	38
3 mA	66 kV	0,2	0,3	0,3	0,4	0,5	0,7	0,8	1,1	1,3	1,7	2,1	2,6	3,4	4,2	5,3	6,7	8,4	11	13	17	21	26	34	42
3 mA	70 kV	0,2	0,3	0,4	0,5	0,6	0,8	0,9	1,2	1,5	1,9	2,4	2,9	3,8	4,7	5,9	7,5	9,4	12	15	19	24	29	38	47
4 mA	60 kV	0,2	0,3	0,4	0,5	0,6	0,7	0,9	1,1	1,4	1,8	2,3	2,8	3,6	4,5	5,7	7,3	9,1	11	14	18	23	28	36	45
4 mA	63 kV	0,3	0,3	0,4	0,5	0,6	0,8	1	1,3	1,6	2	2,5	3,2	4,1	5,1	6,3	8,1	10	13	16	20	25	32	41	51
4 mA	66 kV	0,3	0,3	0,4	0,6	0,7	0,9	1,1	1,4	1,8	2,2	2,8	3,5	4,5	5,6	7	9	11	14	18	22	28	35	45	56
4 mA	70 kV	0,3	0,4	0,5	0,6	0,8	1	1,3	1,6	2	2,5	3,1	3,9	5	6,3	7,8	10	13	16	20	25	31	39	50	63
5 mA	60 kV	0,3	0,3	0,5	0,6	0,7	0,9	1,1	1,4	1,8	2,3	2,8	3,5	4,5	5,7	7,1	9,1	11	14	18	23	28	35	45	57
5 mA	63 kV	0,3	0,4	0,5	0,6	0,8	1	1,3	1,6	2	2,5	3,2	4	5,1	6,3	7,9	10	13	16	20	25	32	40	51	63
5 mA	66 kV	0,4	0,4	0,6	0,7	0,9	1,1	1,4	1,8	2,2	2,8	3,5	4,4	5,6	7	8,8	11	14	18	22	28	35	44	56	70
5 mA	70 kV	0,4	0,5	0,6	0,8	1	1,3	1,6	2	2,5	3,1	3,9	4,9	6,3	7,8	10	13	16	20	25	31	39	49	63	78
6 mA	60 kV	0,3	0,4	0,5	0,7	0,9	1,1	1,4	1,7	2,1	2,7	3,4	4,3	5,4	6,8	8,5	11	14	17	21	27	34	43	54	68
6 mA	63 kV	0,4	0,5	0,6	0,8	1	1,2	1,5	1,9	2,4	3	3,8	4,8	6,1	7,6	10	12	15	19	24	30	38	48	61	76
6 mA	66 kV	0,4	0,5	0,7	0,8	1,1	1,3	1,7	2,1	2,6	3,4	4,2	5,3	6,7	8,4	11	13	17	21	26	34	42	53	67	84
6 mA	70 kV	0,5	0,6	0,8	0,9	1,2	1,5	1,9	2,4	3	3,8	4,7	5,9	7,5	9,4	12	15	19	24	30	38	47	59	75	94
7 mA	60 kV	0,4	0,5	0,6	0,8	1	1,3	1,6	2	2,5	3,2	4	5	6,4	7,9	10	13	16	20	25	32	40	50	71	79
7 mA	63 kV	0,4	0,5	0,7	0,9	1,1	1,4	1,8	2,2	2,8	3,5	4,4	5,5	7,1	9	11	14	18	22	28	35	44	55	71	89
7 mA	66 kV	0,5	0,6	0,8	1	1,2	1,6	2	2,5	3,1	3,9	4,9	6,1	7,8	10	12	16	20	25	31	39	49	61	78	98
7 mA	70 kV	0,5	0,7	0,9	1,1	1,4	1,8	2,2	2,7	3,5	4,4	5,5	6,9	8,8	11	14	18	22	27	35	44	55	69	88	110
8 mA	60 kV	0,5	0,5	0,7	0,9	1,1	1,5	1,8	2,3	2,9	3,6	4,5	5,7	7,3	9,1	11	15	18	23	29	36	45	57	73	91
8 mA	63 kV	0,5	0,6	0,8	1	1,3	1,6	2	2,5	3,2	4,1	5,1	6,3	8,1	10	13	16	20	25	32	41	51	63	81	101
8 mA	66 kV	0,6	0,7	0,9	1,1	1,4	1,8	2,2	2,8	3,5	4,5	5,6	7	9	11	14	18	22	28	35	45	56	70	90	112
8 mA	70 kV	0,6	0,8	1	1,3	1,6	2	2,5	3,1	3,9	5	6,3	7,8	10	13	16	20	25	31	39	50	63	78	100	125

1.7.2014

2 ASSOCIATED DOCUMENTATION

The Planmeca ProX X-ray unit is supplied with the following manuals:

- User's Manual (10029963, Original English language publication)
- Installation Manual (10029964, Original English language publication)
- Technical Manual (10029965, Original English language publication)
- These manuals are intended to be used in conjunction with the documentation for the Planmeca Romexis/Dimaxis imaging software. The imaging software package contains the following manuals:
- User's Manual (10014593, Original English language publication)
- Installation Manual (10014600, Original English language publication)

2.1 Manual versions

Planmeca pursues a policy of continual product development. Although every effort is made to produce up-to-date product documentation this publication should not be regarded as an infallible guide to current specifications. We reserve the right to make changes without prior notice.

NOTE

This manual is only valid for the software version 4.00 and later.

3 EMC INFORMATION

WARNING

Use of any accessories and cables other than those specified in Planmeca ProX intraoral X-ray unit's documentation, with exception of cables sold by Planmeca as replacement parts for internal components, may result in increased emission or decreased immunity of the X-ray unit.

WARNING

Planmeca ProX intraoral X-ray unit should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the Planmeca ProX intraoral X-ray unit should be observed to verify normal operation in configuration which it will be used.

Guidance and manufacturer's declaration - electromagnetic emissions		
Planmeca ProX intraoral X-ray unit is intended for use in the electromagnetic environment specified below. The customer or the user of the Planmeca ProX intraoral X-ray unit should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment – guidance**
RF emissions CISPR 11	Group 1	Planmeca ProX intraoral X-ray unit uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	Planmeca ProX intraoral X-ray unit is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Complies	

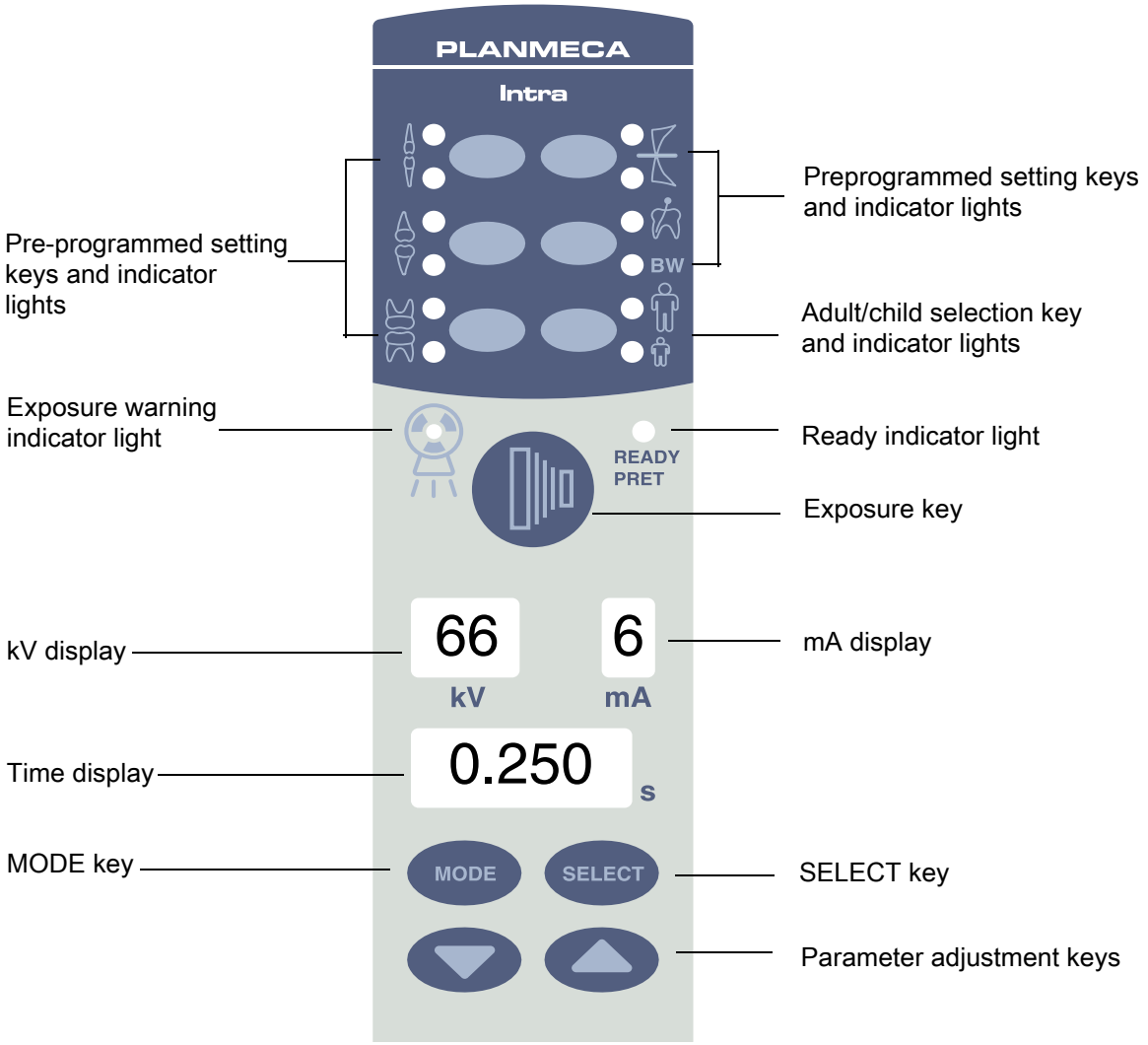
Guidance and manufacturer's declaration - electromagnetic immunity			
Planmeca ProX intraoral X-ray unit is intended for use in the electromagnetic environment specified below. The customer or the user of Planmeca ProX intraoral X-ray unit should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment-guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines	±2 kV for power supply lines ±1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment
Surge IEC 61000-4-5	±1 kV line to line ±2 kV line to earth	±1 kV line to line ±2 kV line to earth	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5 % U_T (>95 % dip in U_T) for 0,5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles <5 % U_T (>95 % dip in U_T) for 5 s	<5 % U_T (>95 % dip in U_T) for 0,5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles <5 % U_T (>95 % dip in U_T) for 5 s	Mains power quality should be that of a typical commercial or hospital environment. If the user of Planmeca ProX intraoral X-ray unit requires continued operation during power mains interruptions, it is recommended that Planmeca ProX intraoral X-ray unit be powered from an uninterruptible power supply.
Power frequency(50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment. The power frequency magnetic field should be measured in the intended installation location to assure that it is sufficiently low.
NOTE U_T is the a.c. mains voltage prior to application of the test level.			

Guidance and manufacturer's declaration - electromagnetic immunity			
Planmeca ProX intraoral X-ray unit is intended for use in the electromagnetic environment specified below. The customer or the user of Planmeca ProX intraoral X-ray unit should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment-guidance**
Conducted RF IEC 61000-4-6 Radiated RF IEC 61000-4-3	3 Vrms 150 kHz to 80 MHz 3 V/m 80 MHz to 2.5 GHz	3 Vrms 3 V/m	Portable and mobile RF communications equipment should be used no closer to any part of the Planmeca ProX X-ray unit, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance** $\mathbf{d} = 1{,}2\sqrt{P}$ $\mathbf{d} = 1{,}2\sqrt{P}$ 80 MHz to 800 MHz $\mathbf{d} = 2{,}3\sqrt{P}$ 800 MHz to 2.5 GHz where **P** is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and **d** is the recommended separation distance in metres (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,[a] should be less than the compliance level in each frequency range.[b] Interference may occur in the vicinity of equipment marked with the following symbol: 
NOTE 1: At 80 MHz and 800 MHz, the higher frequency range applies. NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which Planmeca ProX intraoral X-ray unit is used exceeds the applicable RF compliance level above, Planmeca ProX intraoral X-ray unit should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating Planmeca ProX X-ray unit. [b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.			

Recommended separation distances between portable and mobile RF communications equipment and Planmeca ProX X-ray unit			
Planmeca ProX intraoral X-ray unit is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of Planmeca ProX intraoral X-ray unit can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the Planmeca ProX intraoral X-ray unit as recommended below, according to the maximum output power of the communications equipment.			
Rated maximum output power of transmitter **W**	**Separation distance according to frequency of transmitter m**		
	150 kHz to 80 MHz $d = 1{,}2\sqrt{P}$	**80 MHz to 800 MHz** $d = 1{,}2\sqrt{P}$	**800 MHz to 2.5 GHz** $d = 2{,}3\sqrt{P}$
0.01	0.2	0.2	0.3
0.1	0.4	0.4	0.7
1	1.2	1.2	2.4
10	4.0	4.0	8.0
100	12.0	12.0	24.0

4 SERVICE MODE

4.1 Control panel



4.2 How to enter/exit service mode

Press and hold down the select key for 4 seconds.

Press and hold down the Mode key for more than 2 seconds, until the four uppermost preprogrammed setting indicator lights come on.

To exit service mode

Press the Mode key for 2 seconds.

NOTE

The service mode parameters 1 - 13 and 20 are for factory use only. Do NOT adjust these parameters.

4.3 X-ray tube filament preheating voltage calibration

Enter the service mode according to the instruction given in section 4.2 “How to enter/exit service mode” on page 19.

Press and hold down the adult/child mode selection key for 2 seconds or until the indicator light starts to blink. The indicator lights will start to blink indicating that you are in the preheating voltage calibration mode.

Move as far away from the x-ray tube as the length of the cable from the control panel permits.

Press and hold the exposure key on the control panel until 9 exposures are performed (approx. 60 seconds).

To exit the service mode press the Mode key for 2 seconds.

4.4 kV range selection

Enter the service mode according to the instruction given in section 4.2 “How to enter/exit service mode” on page 19.

Press the parameter adjustment up key until the parameter number 14 appears on the kV display.

The code of the kV range is shown on the time display.

The kV ranges are:

2 = 60-70,

3 = 66-70,

4 = 70,

7 = 60-68,

8 = 66-68 and

9 = 68 kV.

Press the Select key until the kV range code starts to blink, and the range can now be changed with the parameter adjustment keys.

Accept the new kV range by pressing the Select key.

To exit the service mode press the Mode key for 2 seconds.

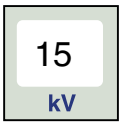
NOTE

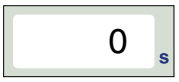
Perform the X-ray tube filament preheating voltage calibration after the kV range selection.

4.5 Operation of pre-programmed settings keys (kV hold)

Enter the service mode according to the instruction given in section 4.2 “How to enter/exit service mode” on page 19.

Press the parameter adjustment up key until the parameter number 15 appears on the kV display.



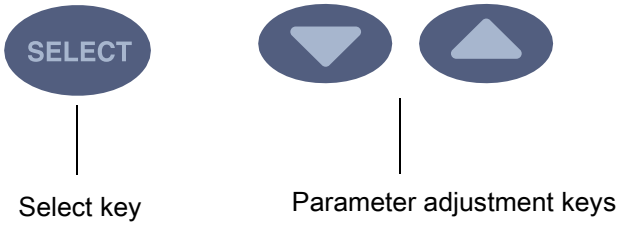


The number indicating the operation of preprogrammed settings keys (0 or 1) is shown on the time display.

0: Normal operation (factory setting). The preprogrammed settings keys operate as described in the Planmeca ProX user’s manual.

1: kV hold. The selection of a preprogrammed setting does not affect the prior manually inserted kV value, but the exposure time is recalculated to achieve constant optical density on the film. In the case the kV value is now manually altered, the exposure time will also be changed automatically. If the exposure time is manually altered, the unit will return into manual mode. At any time, the preprogrammed setting for the kV value, mA value and exposure time for any tooth position is called by selecting the preprogrammed setting and pressing the child mode selection key twice.

Press and hold down the Select key until the number starts to blink, and the number can now be changed with the parameter adjustment keys.



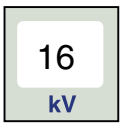
Accept the new setting by pressing the Select key.

To exit the service mode press the Mode key for 2 seconds.

4.6 Dimming displays

Enter the service mode according to the instruction given in section 4.2 “How to enter/exit service mode” on page 19.

Press the parameter adjustment up key until the parameter number 16 appears on the kV display.



Parameter adjustment up -key

The number indicating the brightness of the displays (from 1 to 5, factory default is 5) is shown on the time display.

Press the Select key until the number starts to blink, and the value can now be changed with the parameter adjustment keys.

Select key

Parameter adjustment keys

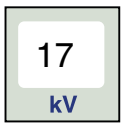
Accept the new setting by pressing the Select key.

To exit the service mode press the Mode key for 2 seconds.

4.7 Duration of displays dimming time-out

Enter the service mode according to the instruction given in section 4.2 “How to enter/exit service mode” on page 19.

Press the parameter adjustment up key until the parameter number 17 appears on the kV display.



Parameter adjustment up -key

The number indicating the time-out value (0, 1, 2, 3, 4, 5) is shown on the time display. The time-out values are: 0 = no dimming, 1 = 1 min., 2 = 2 min., 3 = 5 min., 4 = 20 min. and 5 = 60 min. Factory default is 1.

Press the Select key until the number starts to blink, and the value can now be changed with the parameter adjustment keys.

Select key

Parameter adjustment keys

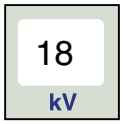
Accept the new setting by pressing the Select key.

To exit the service mode press the Mode key for 2 seconds.

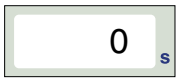
4.8 Disabling exposure key

Enter the service mode according to the instruction given in section 4.2 “How to enter/exit service mode” on page 19.

Press the parameter adjustment up key until the parameter number 18 appears on the kV display.



Parameter adjustment up -key



The number indicating the mode of exposure key operation is shown on the time display. 0 = exposure key normal operation, 1 = exposure key operation disabled. The factory default is 0.

Press the Select key until the number starts to blink, and the value can now be changed with the parameter adjustment keys.

Select key

Parameter adjustment keys

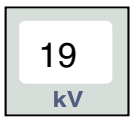
Accept the new setting by pressing the Select key.

To exit the service mode press the Mode key for 2 seconds.

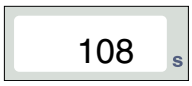
4.9 Automatic identification of cascade card

Enter the service mode according to the instruction given in section 4.2 “How to enter/exit service mode” on page 19.

Press the parameter adjustment up key until the parameter number 19 appears on the kV display.



Parameter adjustment up -key



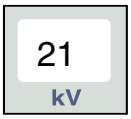
The value indicating the type of the cascade card is shown on the time display. Value < 108 equals an old card and value ≥ 108 equals a new card. The type of the cascade card affects the adjustment functionality of the preheat and mA.

4.10 Ready-state setting

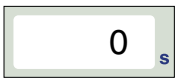
The Planmeca ProX intraoral X-ray unit can be set so that the Ready indicator light will only come on when the Planmeca Romexis program is ready for the exposure, i.e. the *Waiting for exposure* message is on the computer screen.

Enter the service mode according to the instruction given in section 4.2 “How to enter/exit service mode” on page 19.

Press the parameter adjustment up key until the parameter number 21 appears on the kV display.



Parameter adjustment up -key



The number indicating the ready-state setting (0 or 1) is shown on the time display.

0: Normal operation (factory setting). The Planmeca ProX intraoral X-ray unit will go into Ready-state regardless of PC operation.

1: The Ready indicator light will only come on when the Planmeca Romexis program is ready for the exposure

Press and hold down the Select key until the number starts to blink, and the number can now be changed with the parameter adjustment keys.

Select key

Parameter adjustment keys

Accept the new setting by pressing the Select key.

To exit the service mode press the Mode key for 2 seconds.

4.11 mA minimum value selection

Enter the service mode according to the instruction given in section 4.2 “How to enter/exit service mode” on page 19.

Press the parameter adjustment up key until the parameter number 22 appears on the kV display

Parameter adjustment up -key

The minimum mA value (2 - 6) is shown on the time display.

Press the Select key until the mA minimum value starts to blink. The minimum value can now be changed with the parameter adjustment keys.

Select key

Parameter adjustment keys

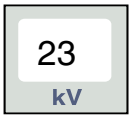
Accept the new mA minimum value by pressing the Select key.

To exit the service mode press the Mode key for 2 seconds.

4.12 Exposure count display mode

Enter the service mode according to the instruction given in section 4.2 “How to enter/exit service mode” on page 19.

Press the parameter adjustment up key until the parameter number 23 appears on the kV display.



Parameter adjustment up -key

1: Display is in Service mode.

2: Display is in both Normal operating mode / Service mode.

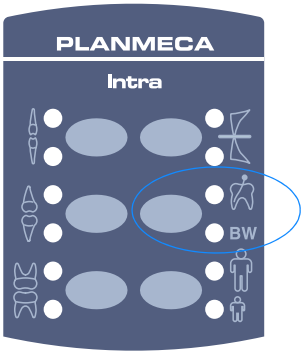
Press and hold down the Select key until the number starts to blink. The number can now be changed with the parameter adjustment keys.

Select key

Parameter adjustment keys

To show the exposure counter (EC 00000 - 50000)on the *mA* and *s* display press briefly the MODE key.

After the exposure counter is shown on the display it can be set to zero by pressing and holding down the ENDODONTIC / BW key for 5 seconds.



The counter is automatically set to zero after 50000 exposures.

SELECT

Accept the display mode by pressing the Select key.

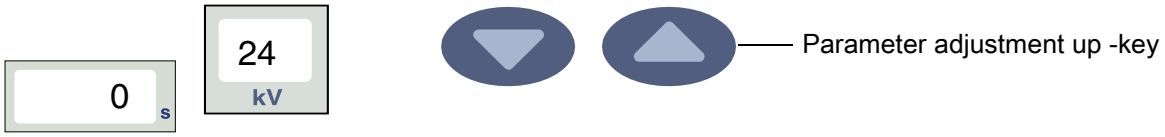
MODE

To exit the service mode press the Mode key for 2 seconds.

4.13 DAP display mode

Enter the service mode according to the instruction given in section 4.2 “How to enter/exit service mode” on page 19.

Press the parameter adjustment up key until the parameter number 24 appears on the kV display.



Press and hold down the Select key until the number starts to blink. The number can now be changed with the parameter adjustment keys.

Select key

Parameter adjustment keys

0: OFF

1: DAP display after exposure

2: DAP display using MODE key

3: 1+2

SELECT

Accept the new DAP mode by pressing the Select key.

MODE

To exit the service mode press the Mode key for 2 seconds.

4.14 DAP display correction factor

NOTE

Only qualified service technician is allowed to modify the DAP display correction factor. The factor is adjusted using DAP/radiation dose meter.

Enter the service mode according to the instruction given in section 4.2 “How to enter/exit service mode” on page 19.

Press the parameter adjustment up key until the parameter number 24 appears on the kV display.

Parameter adjustment up -key

Press and hold down the Select key until the number starts to blink. The number can now be changed with the parameter adjustment keys. The correction factor can be adjusted between 50 and 200%.

Select key

Parameter adjustment keys

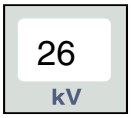
Accept the new DAP display correction factor by pressing the Select key.

To exit the Service mode press the Mode key for 2 seconds.

4.15 Maximum mA value

Enter the service mode according to the instruction given in section 4.2 “How to enter/exit service mode” on page 19.

Press the parameter adjustment up key until the parameter number 26 appears on the kV display.

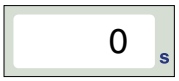


Parameter adjustment up -key

Press and hold down the **Select** key until the number starts to blink. The number can now be changed with the parameter adjustment keys.

Select key

Parameter adjustment keys



0: maximum mA value 6 mA

1: maximum mA value 8 mA

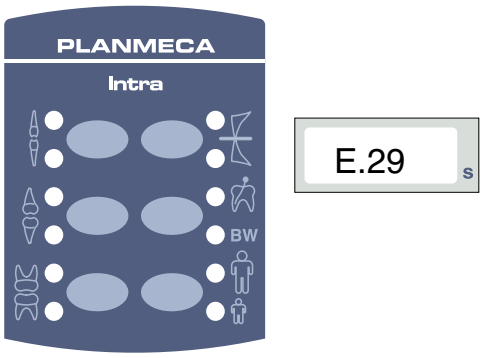
Accept the new maximum mA value by pressing the Select key.

To exit the service mode press the Mode key for 2 seconds.

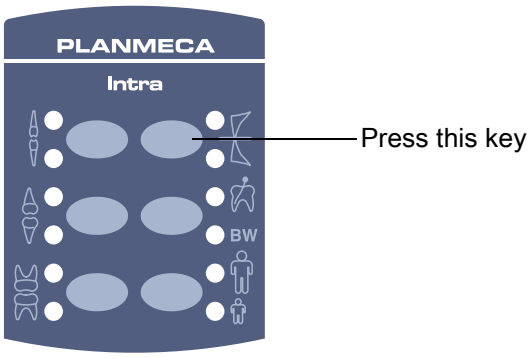
5 RECALLING FACTORY PREPROGRAMMED EXPOSURE VALUES

The factory preprogrammed exposure values can be found in the Planmeca ProX User's manual, section "EXPOSURE VALUES".

Press and hold down any of the preprogrammed setting keys when switching the unit on. The error code E.29 will appear on the time display.



Do not clear the error code by pressing the select key, but press the Occlusal exposure key for 6 seconds. The factory preprogrammed values and density value 0 will be stored into memory.



6 PREVENTIVE MAINTENANCE

6.1 Cleaning

Surfaces

NOTE

When cleaning the unit surfaces, always disconnect the unit from mains.

The unit surfaces can be cleaned with a soft cloth damped in a mild cleaning solution.

Stronger agents can be used for disinfecting the surfaces. We recommend Dürr System-hygiene FD 322 or respective disinfecting solution.

Film holder

The film holder can be autoclaved up to 145°C or cleaned with alcohol-based solutions.

6.2 Operation checks

Indicator light for ready status

Confirm that the green ready status indicator light comes on when the unit is ready to take an exposure.

Exposure warning indicator light and signal

Confirm that the yellow exposure warning light will come on when you take an exposure.

Confirm also that the audible warning sound is heard during the exposure.

Exposure key

Confirm that the exposure key requires continuous activation to maintain the exposure.

Labels

Check that no labels are detached or worn and that they are all legible.

6.3 Preventive maintenance adjustments

- Check arm balance and friction

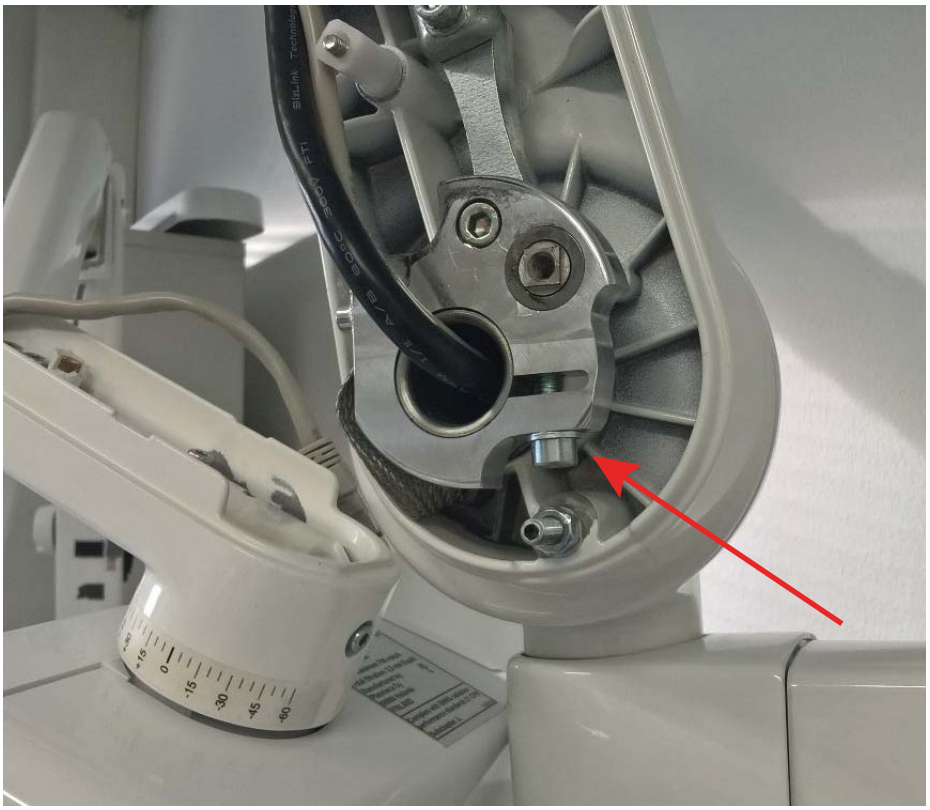
  Adjust if needed. Refer to section 9.1 “Adjusting balance of arm” on page 41 and section 9.2 "Adjusting rotational friction of bracket arm" on page 43.
- Check bracket arm angles

  Adjust if needed. Refer to section 9.3 “Adjusting tube head’s rotational friction” on page 43.
- Check stiffness of tube head’s horizontal axle

  Adjust if needed. Refer to section 9.3 “Adjusting tube head’s rotational friction” on page 43.
- Check tube head vertical stiffness

Adjust if needed. Refer to section 9.4 “Adjusting tube head arm’s rotational friction” on page 44.

- Check and tighten the tightening screw for 10 Nm torque if needed

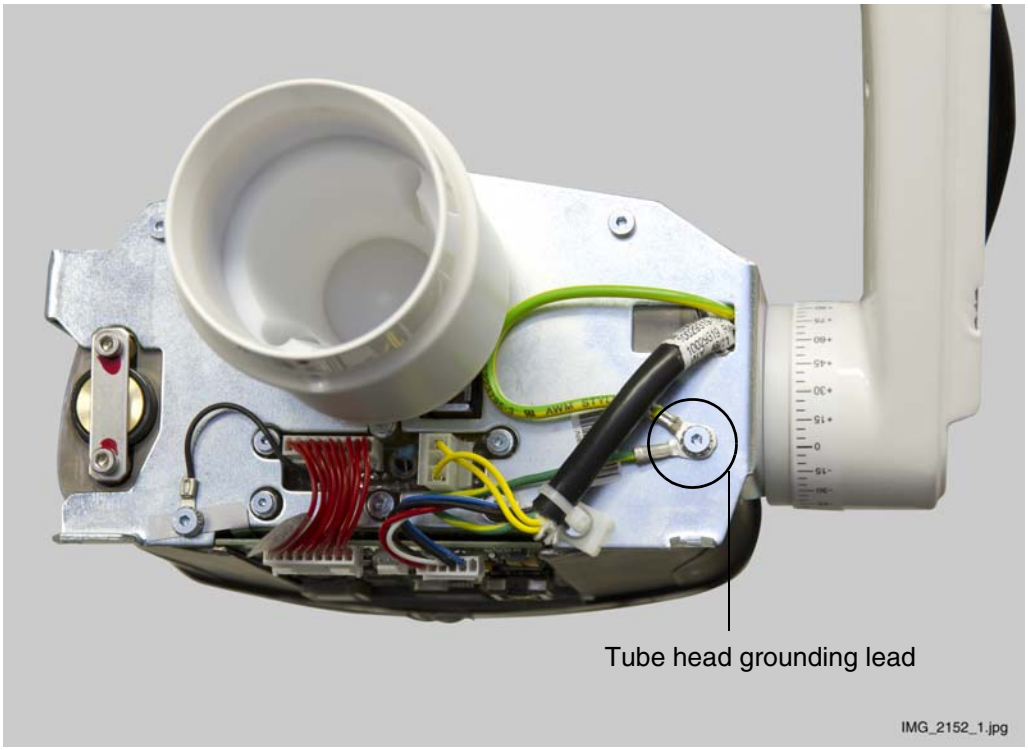


6.4 Power supply cable

Check the strain relief of the power supply cable. The tightening torque must be 4 Nm.

6.5 Tube head grounding lead

Check the tightness of the tube head grounding lead. Tighten the screw, if needed.



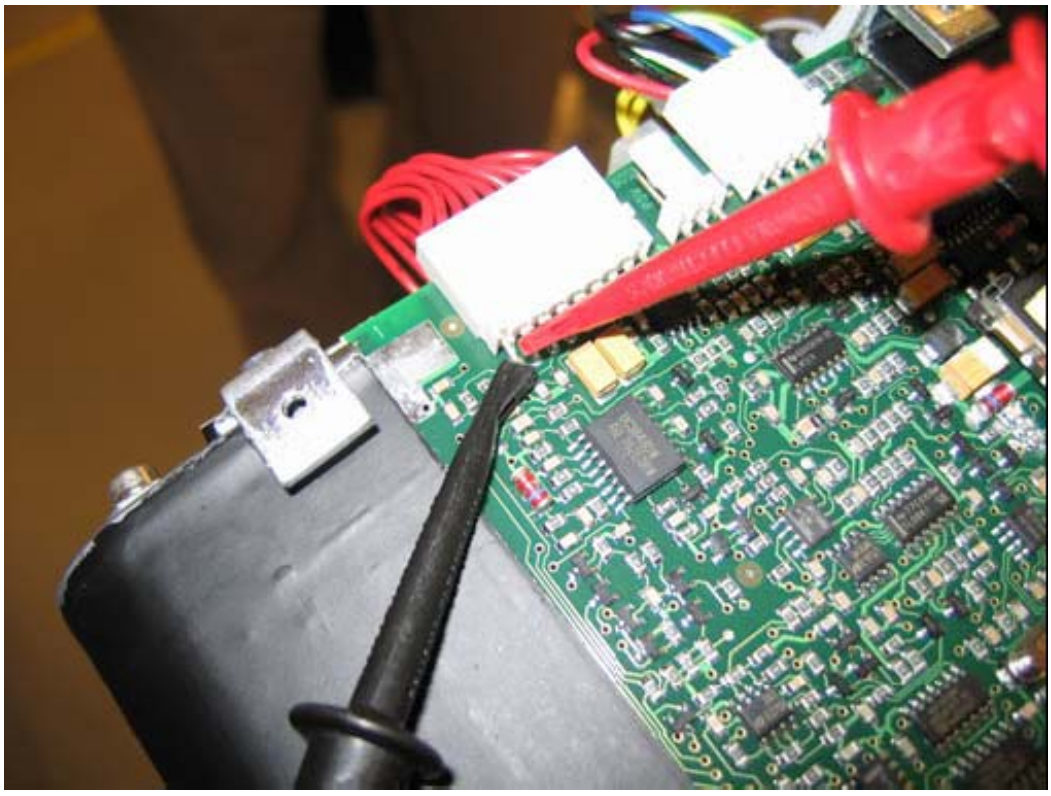
6.6 Measuring KV / MA signals (invasive testing)

NOTE

The manufacturer does not require the invasive testing. The invasive test must only be performed if the local authorities require it.

An invasive method should be used for checking the tube current (mA), and can be used for checking the kV. This method requires that the covers around the tube head assembly are removed. The analog feedback voltage signals can be measured with a calibrated multimeter.

1. Unscrew the two M4x20 DIN 7984 fastening screws of the cone.
2. Remove the tube head front cover and the cone.
3. Unscrew the six fastening screws of the tube head cover and remove the cover.
4. Attach sprung hook test leads from multimeter to P1-connector pins 1 (negative kV) and 2 (positive kV) in the tube head PCB..

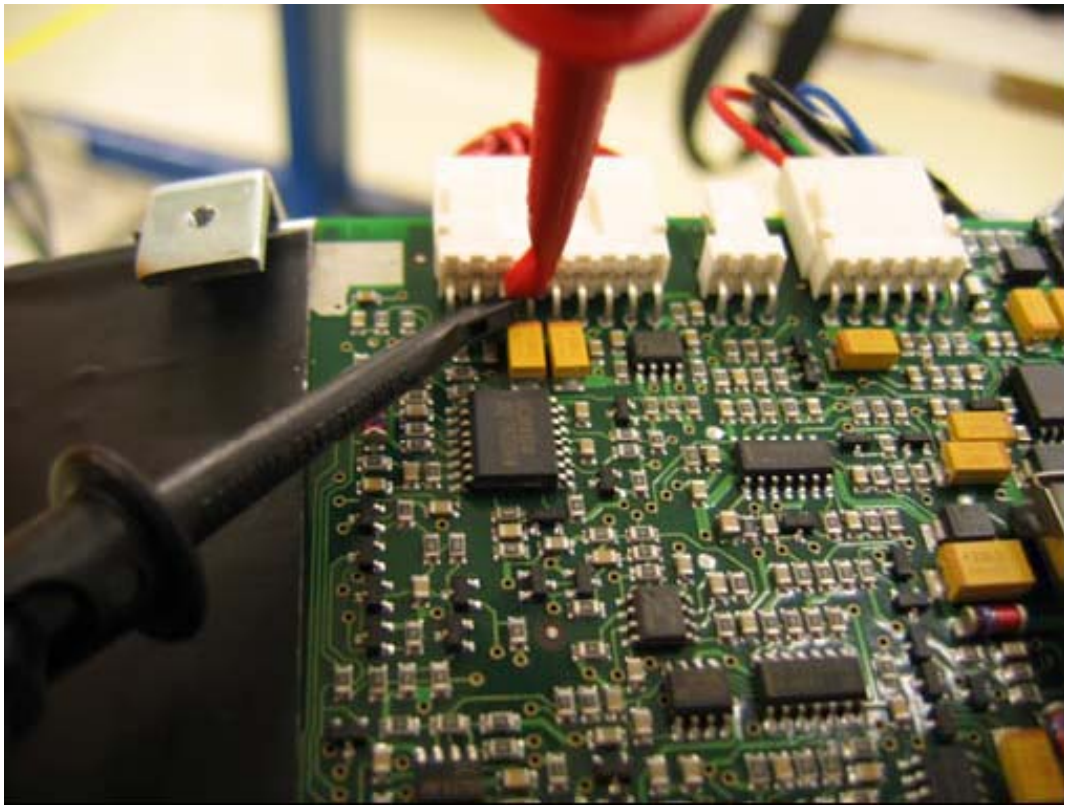


5. Set multimeter to DC voltage mode with a measurement range of 1 to 5V signal level. Take 2 seconds exposure with desired kV setting. Selected mA value has no effect, however lowest possible mA should be used to minimise the amount of unnecessary radiation. When the voltage reading has been stabilized, record it.

   Actual tube voltage (in volts) = 21 672 * measured feedback voltage (in volts)

   The resulting tube voltage should be within ±5% of the voltage indicated in the user interface.

6. Move test leads to P1-connector pins 3 (negative mA) and 4 (positive mA).



7. Set multimeter to DC voltage mode with a measurement range of 100mV to 5V signal levels. Take 2 seconds exposure with desired mA setting. Selected kV value has no effect, however lowest possible kV should be used to minimise the amount of unnecessary radiation. When the voltage reading has been stabilized, record it.

   Actual tube current (in mA) = 2.5 * measured feedback voltage (in volts)

   The resulting tube current should be within ±10% of the current indicated in the user interface.

7 TROUBLESHOOTING

The control panel displays do not come on

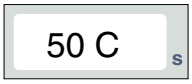
1. Problems in mains voltage, or a fuse is blown.

   Check the mains voltage. Check the mains cable. Check and replace, if necessary, the fuses located on the lower left side of the generator box. Open the generator box and check and replace, if necessary, the generator fuse F2. Replace the generator. (Perform the checks and parts replacements in this order).

2. Control panel power failure, or the control panel is defective. The control panel operates with 12 V produced on the generator low voltage supply.

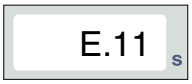
   Check the control panel cable and the telephone cable. Replace the control panel. (Perform the checks and parts replacements in this order).

Temperature of the tube head too high



If the temperature of the tube head exceeds 50 °C, the temperature will appear on the time display. The control panel does not operate. Wait until the temperature drops.

8 ERROR MESSAGES



The error code is displayed on the time display.

Press the select key to clear the error from the display.

8.1 Error message shortform table

ERROR CODE	ERROR MESSAGE EXPLANATION
E.00	Exposure key was released too early during the exposure.
E.10	X-ray tube Anode voltage (kV) overshoot.
E.11	X-ray tube Anode voltage (kV) dropped suddenly.
E.12	X-ray tube cathode filament preheating voltages are not calibrated.
E.13	Filament preheating voltage calibration failed.
E.29	Membrane keyboard key short-circuited/pressed during the self test or faulty display board.
E.30	kV value does not reach or it exceeds the given value (difference more than 10%).
E.31	X-ray tube Anode current (mA) missing, or not in specified limits.
E.33	X-ray tube Filament voltage (V) missing, or outside the range (too low or too high).
E.34	X-ray tube Anode voltage (kV) missing, or below the specified limit.
E.36	Too long exposure.
E.37	kV feedback signal open circuit or short circuit.
E.38	mA feedback signal open circuit or short circuit.
E.50	Tube head temperature sensor short circuit.
E.51	Tube head temperature sensor open circuit.
E.52	Filament voltage feedback not in specified limits
E.57	Exposure key pressed during self test.
E.60	± 15VDC voltage is out of limits
E.61	Communication error between control panel and tube head CPU.
E.71	FLASH memory check-sum error (tube head CPU).
E.81	EEPROM memory defective (tube head CPU).
E.83	Config register error (tube head CPU).

8.2 Detailed error message explanations

E.00 Exposure key was released too early during exposure

The most probable cause (if the key really was pressed firmly during the whole exposure) is faulty control panel or faulty separate exposure switch.

Replace the control panel or the separate exposure switch. Check the control panel cable, telephone cable and the arm cable.

E.10X-ray tube anode voltage (kV) overshoot

This condition is monitored by the watch-dog circuit on the tube head PCB during the whole exposure and if the anode voltage rises above 95 kV the exposure is immediately aborted and this error indicated. A knocking sound may be heard from the tube head at the same time. This kind of arcing can occur now and then without any special reason, and should be considered a normal phenomenon. If however the occurrence frequency becomes too high, it could be an indication of a degrading tube head.

If this error occurs constantly it is probably caused by a faulty tube head or tube head PCB or generator PCB (replace in this order). The possible reason is also faulty feedback cable (9 pole) in the tube head.

E.11X-ray tube anode voltage (kV) dropped suddenly

The x-ray tube voltage suddenly drops, and a knocking sound is heard from the tube head at the same time. The exposure is aborted and this error indicated. This phenomenon should be considered quite normal if it doesn't occur frequently. If the generator is damaged during the exposure, or the arm/extension cable is broken, this error is indicated and during next exposure the error E.30 occurs.

If this error occurs constantly it is probably caused by a faulty tube head or tube head PCB or generator PCB (replace in this order). The possible reason is also faulty feedback cable in the tube head.

E.12X-ray tube cathode filament preheating voltages are not calibrated

The tube head PCB has been replaced, but the X-ray tube cathode filament preheating voltages are not calibrated.

See paragraph 4.3 "X-ray tube filament preheating voltage calibration" on page 20 for details how to perform the calibration.

E.13Filament preheating voltage calibration failed

During preheat calibration the filament voltage is measured to be in specified limits. The filament circuit in the tube head or in the tube head PCB is faulty or the tube head is faulty.

Perform the calibration procedure again. If it fails, replace the tube head or tube head PCB (in this order). The possible reason is also faulty feedback cable in the tube head.

E.29Control panel key short-circuited/pressed during the self test

This error can occur only during the self-test. During the self test the unit checks that all keys are open (normal state if not pressed). If a key is found to be in short circuit, this error is displayed. Because the control panel keys are arranged in a matrix, one key's short could cause the whole keyboard to operate erroneously, therefore this check is important.

Replace the control panel.

The factory predetermined settings are recalled and the density value is set to zero by pressing any of the keys during the self test. The error code E.29 appears on the time display, after which the right-hand preprogrammed setting key must be pressed and held down for 6 seconds. See section 5 “RECALLING FACTORY PREPROGRAMMED EXPOSURE VALUES” on page 29.

E.30kV value does not reach or it exceeds the given value (difference more than 10%)

The tube voltage is sampled periodically (by the tube head CPU) and if the actual measured kV-value differs more than ± 10% from the specified value this error is displayed. The tube head, tube head PCB, generator PCB or arm/extension cable signals HV1, HV2 or KVC (see wiring diagram) can be faulty. See also error E.11 and E.34.

Check the incoming mains voltage during the exposure. Check the arm/extension cable and the tube head feedback cable. Replace the generator PCB, tube head PCB or tube head (replace in this order).

E.31X-ray tube anode current (mA) missing, or not in specified limits

The tube current is sampled periodically (by the tube head CPU) and if the actual measured mA-value differs more that ± 20% from the specified value this error is displayed. The tube head, tube head PCB or tube head feedback cable can be faulty.

Proceed with the filament definition, see paragraph 4.3 “X-ray tube filament preheating voltage calibration” on page 20 for details. If this does not help and the error occurs constantly check the tube head feedback cable, replace the tube head PCB, or tube head (in this order).

E.33X-ray tube filament voltage (V) missing, or outside the range (too low or too high)

The tube filament voltage is sampled periodically (by the tube head CPU) and if the actual measured filament voltage is not in the specified limits (1.0 - 4.5 V) then this error is displayed. The filament circuit in the tube head or on the tube head PCB can be faulty.

Check the tube head feedback cable. Replace the tube head PCB or the tube head (in this order).

E.34X-ray tube anode voltage (kV) missing, or below the specified limit

This error occurs in the beginning of the exposure, when the tube anode voltage does not rise. The tube head, tube head PCB, generator PCB or arm/extension cable signals HV1, HV2 or KVC (see wiring diagram) can be faulty. See also error E.11 and E.30.

Check the incoming mains voltage during the exposure. Check the arm/extension cable and the tube head feedback cable. Replace the generator PCB, tube head PCB or tube head (replace in this order).

E.36Too long exposure

The control panel CPU monitors the exposure time by measuring the state of the exp-signal. If, however, the tube head CPU continues the exposure more than the maximum exposure time, then the control panel CPU terminates the exposure and this error occurs. This is a safety procedure, that guarantees that the exposure is terminated under all conditions.

Replace the tube head PCB if this error occurs repeatedly.

E.37 kV feedback signal open circuit or short circuit

The kV feedback signal is monitored by the tube head CPU. The internal connection of the tube head or tube head feedback cable is faulty.

Check the condition of the feedback cable, replace the tube head PCB or the tube head (in this order).

E.38 mA feedback signal open circuit or short circuit

The mA feedback signal is monitored by the tube head CPU. The internal connection of the tube head or tube head feedback cable is faulty.

Check the condition of the feedback cable, replace the tube head PCB or the tube head (in this order).

E.50 Tube head temperature sensor short circuit

The tube head temperature sensor signal is measured by the tube head CPU. The sensor is short-circuited, the tube head PCB or the tube head feedback cable is faulty.

Check the feedback cable. Replace the temperature sensor (beside the signal connectors of the tube head), or the tube head PCB (in this order).

E.51 Tube head temperature sensor open circuit

The tube head temperature sensor signal is measured by the tube head CPU. The temperature sensor is damaged, the tube head PCB or the tube head feedback cable is faulty.

Check the feedback cable. Replace the tube head PCB.

E.52 Filament voltage feedback not in specified limits

The filament voltage is monitored by the tube head CPU. The amplifier is faulty.

Replace the tube head PCB.

E.57 Exposure key pressed/failure during self test

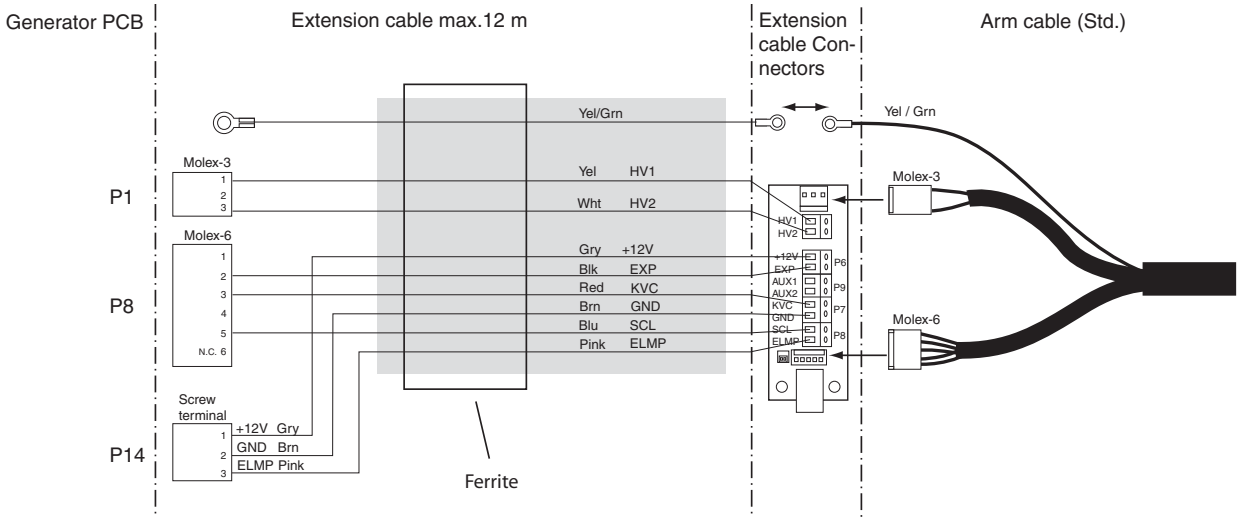
The tube head CPU checks the state of the exp-signal when the unit is switched on. The exposure key or the separate exposure switch can be short-circuited. The arm, extension, control panel, sync or telephone cable can be faulty. The tube head PCB or the generator PCB can be faulty.

Check the cables and the separate exposure switch. Replace the control panel, tube head PCB or the generator PCB (in this order).

E.60 ± 15VDC voltage is out of limits

The tube head CPU measures the internal voltages generated by tube head PCB power supply from the 12V operating voltage. If this error occurs before exposure, the tube head PCB is faulty. If the error occurs after the exposure, the generator 12V power supply is faulty, or the mains filtering capacitors charging circuit is faulty. The extension cable can be too long and/or the wire cross sections too small.

If the error occurs immediately after switching the unit on, replace the tube head PCB. If the error occurs only after starting the exposure, measure the 12 V voltage at the generator PCB P13 connector. If the voltage drops at the beginning of the exposure (generator's green indicator light dims), replace the generator PCB. Check the connectors of the arm cable and the length of the extension cable, as well as the wire cross sections. The properties of extension cable are given in the figure below.



E.61 Communication error between control panel and tube head CPU

The tube head PCB's 12V voltage feed or the communication between the control panel and tube head CPU is failed. The arm/extension cable or control panel/telephone cable is faulty.

Check the cables. Measure the 12V voltage at the tube head PCB P2 connectors pins 1 and 4. Check if the red LED D7 on the tube head PCB is on. Replace the tube head PCB, control panel or the generator PCB (in this order).

E.71 FLASH memory check-sum error (tube head CPU)

Tube head CPU internal error.

Replace the tube head PCB.

E.81 EEPROM memory defective (tube head CPU)

Tube head CPU internal error.

Replace the tube head PCB.

E.83 Config register error (tube head CPU)

Tube head CPU internal error.

Replace the tube head PCB.

9 MECHANICAL ADJUSTMENTS

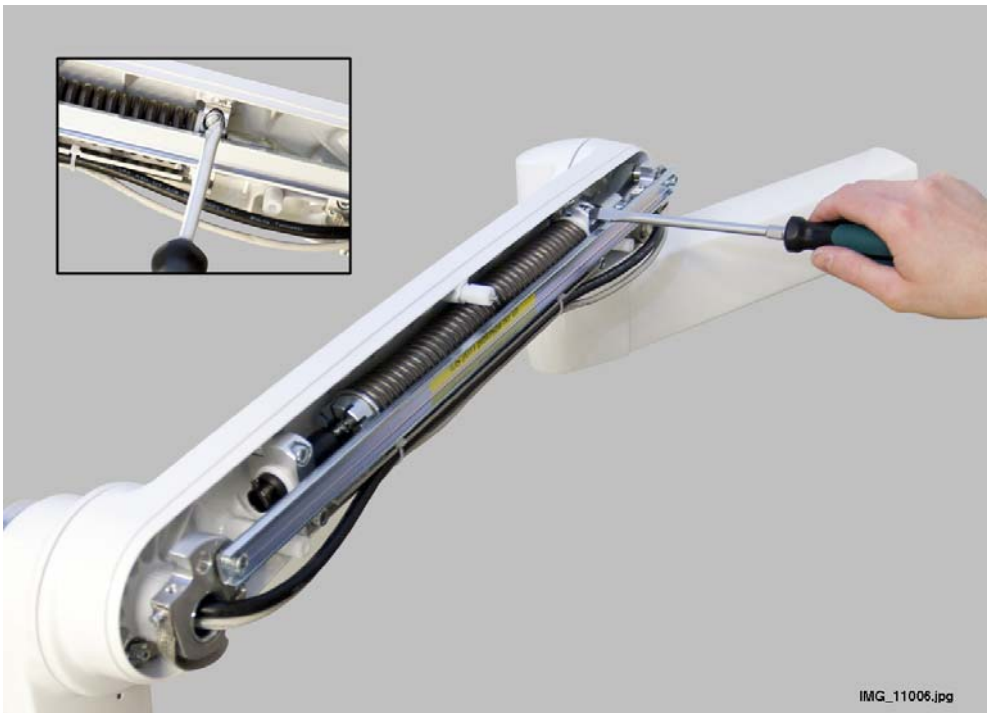
CAUTION
Switch off the X-ray unit before adjustments.

9.1 Adjusting balance of arm

Remove the cover plugs from the screw openings. Loosen three arm cover attachment screws using a 3mm Allen key. Remove the cover. Remove also the cover of the other arm.

Adjust the balance of the arm by turning the adjustment nuts with a slot head screwdriver. Tightening the nut will increase the tension.

If needed, increase the arm friction after adjusting the balance with the adjustment screw using a slot head screwdriver. Tightening the screw will increase the friction.



9.2 Adjusting rotational friction of bracket arm

Adjust the friction with one adjustment screw located below the arm using a 3 mm Allen key. Tightening the screw will increase the friction.

9.3 Adjusting tube head's rotational friction

Adjust the friction with one adjustment screw located below the joint using a 3 mm Allen key. Tightening the screw will increase the friction.

9.4 Adjusting tube head arm's rotational friction

Adjust the friction with one adjustment screw located below the arm curve using a 3 mm Allen key. Tightening the screw will increase the friction.

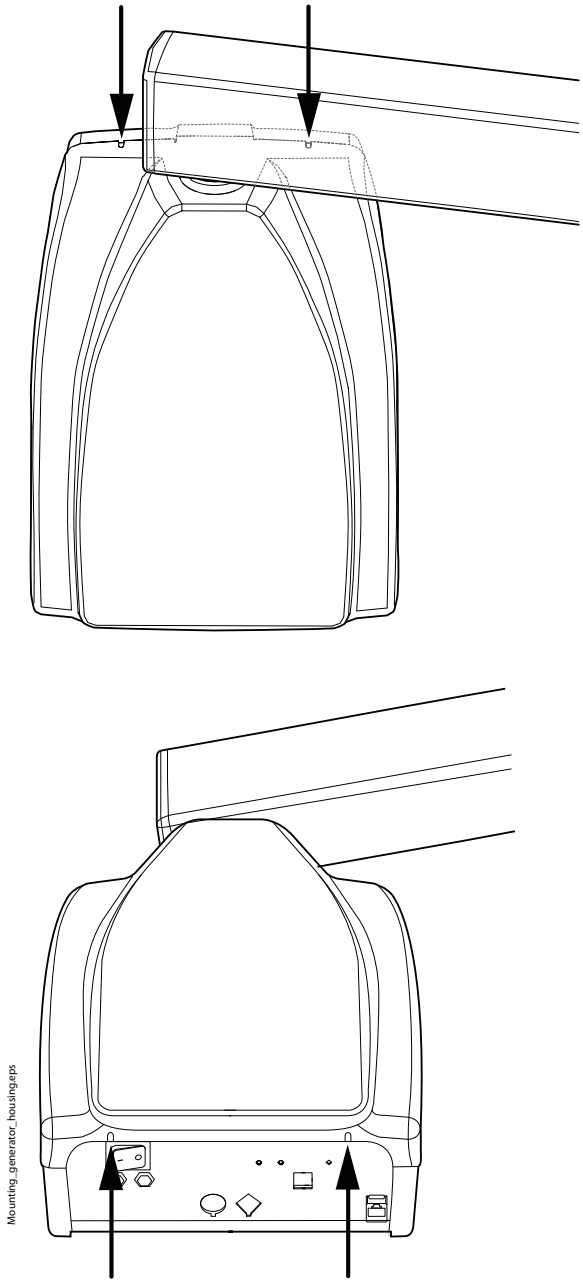
10 PARTS REPLACEMENT & REPAIR

WARNING

Make sure that the power supply is switched off before starting parts replacement.

10.1 Removing generator housing

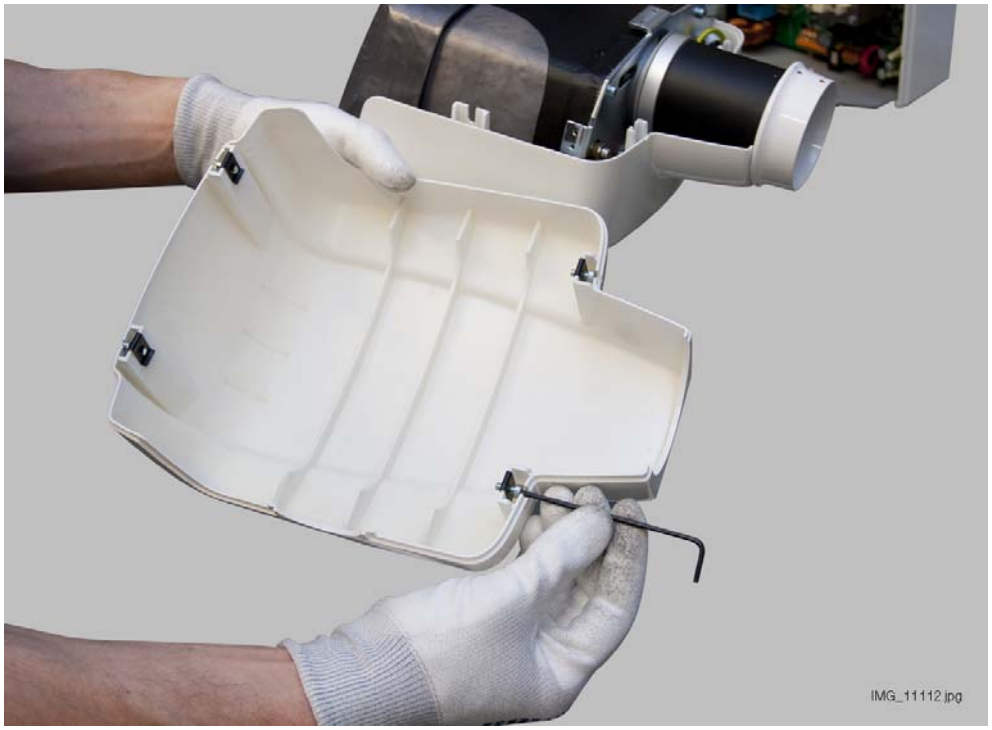
1. Disconnect the X-ray unit from the mains or switch off the power supply.
2. Unscrew four attachment screws and remove the generator housing.



10.2 Removing tube head covers

1. Disconnect the X-ray unit from the mains or switch off the power supply.
2. Loosen four attachment screws of the upper cover using a 2.5 mm Allen key.

3. Lift off the upper cover.



4. Loosen the side attachment screws of the lower cover.

5. Unscrew two front attachment screws and remove the cover.

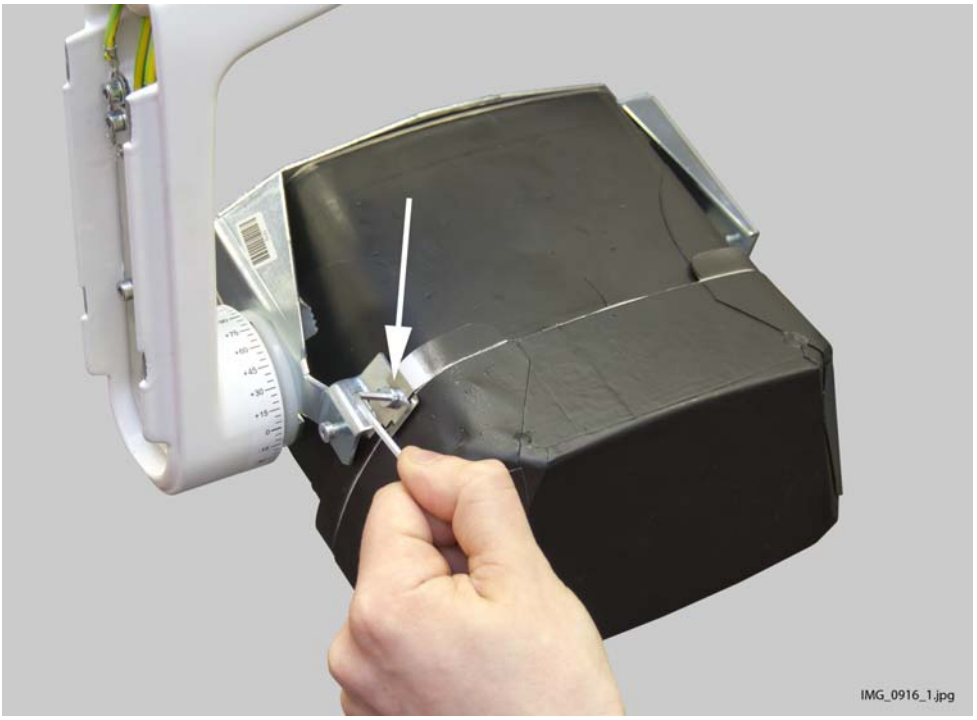
10.3 Removing tube head support cover

1. Disconnect the X-ray unit from the mains or switch off the power supply.
2. Remove the cover plugs from the tube head support.

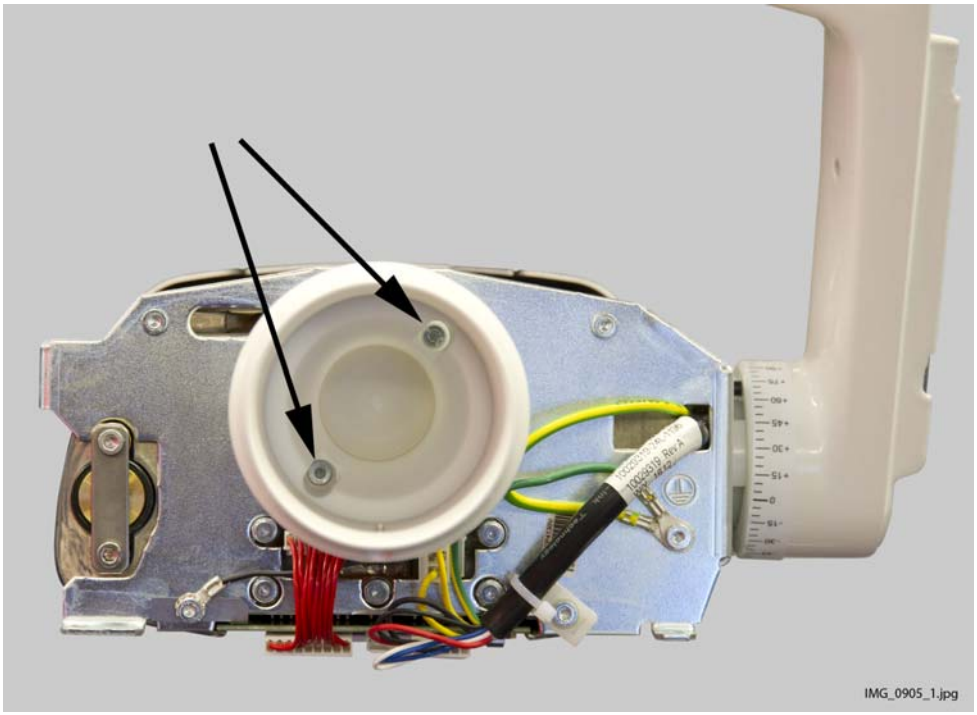
3. Loosen the tube head support cover attachment screws using a 3 mm Allen key and remove the cover.

10.4 Replacing tube head

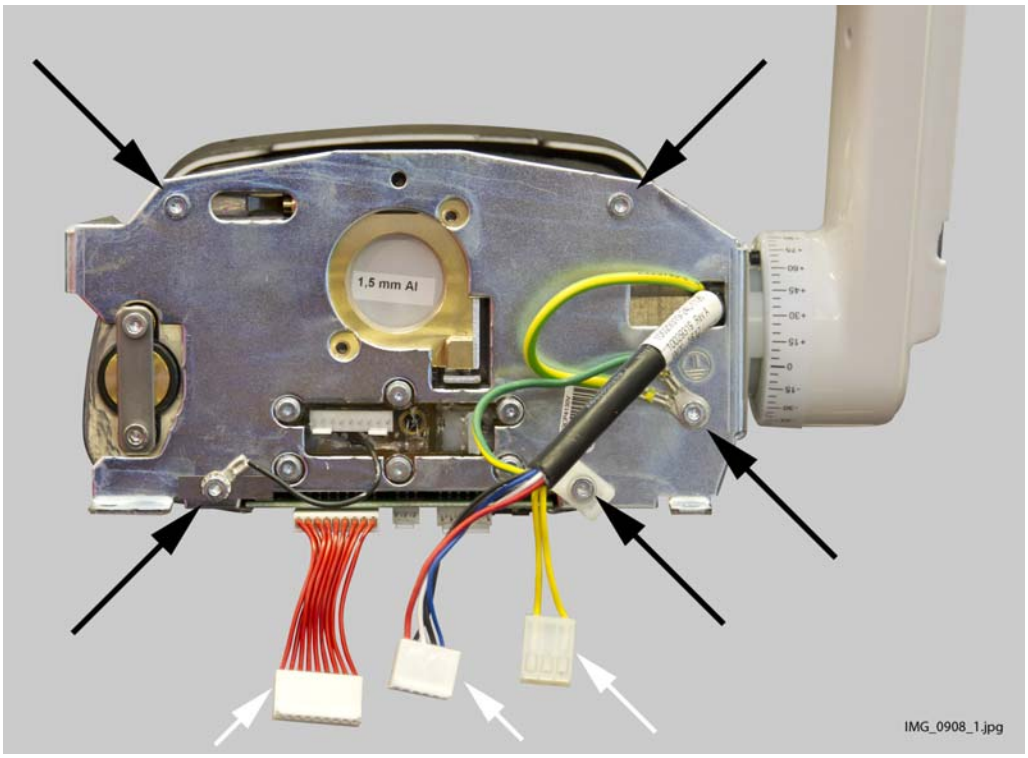
1. Disconnect the X-ray unit from the mains or switch off the power supply.
2. Remove the tube head covers as described in section 10.2 “Removing tube head covers” on page 46.
3. Unscrew the attachment screw of the protective lead using a 2.5 mm Allen key and remove the lead.



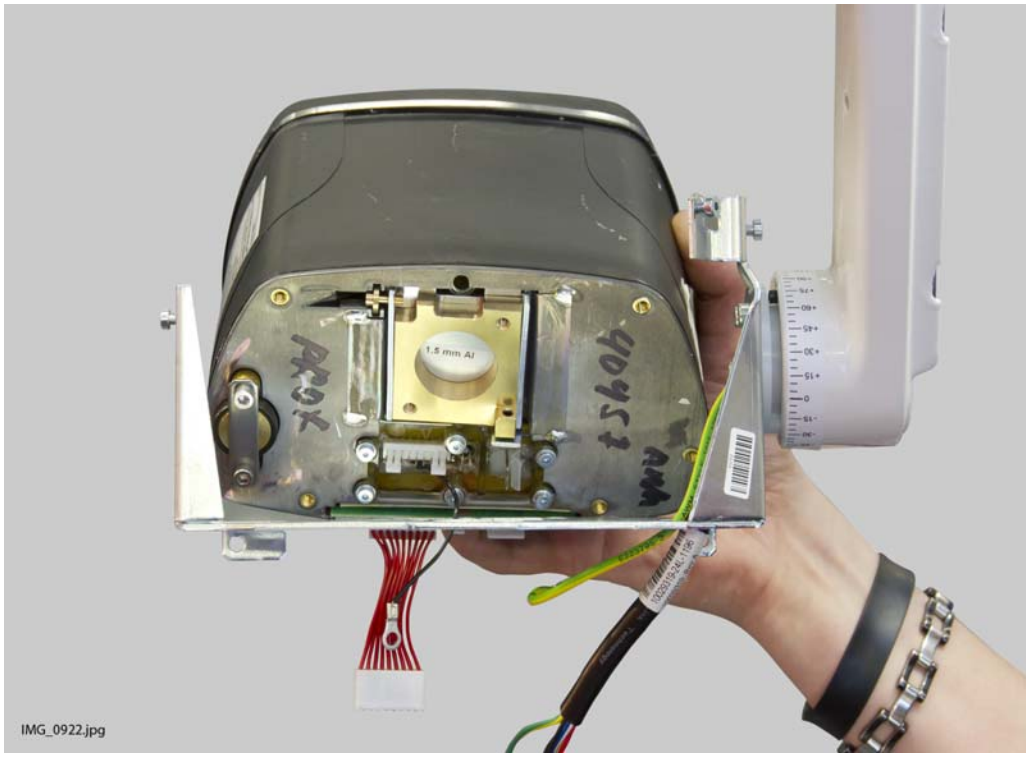
4. Unscrew two collimator attachment screws using a 2.5 mm Allen key and remove the collimator.



5. Disconnect the tube head cables (white arrows). Cut the cable tie. Unscrew three grounding lead/tube head attachment screws from the lower side of the support frame. Then unscrew two upper attachment screws. Use a 2.5 mm Allen key.

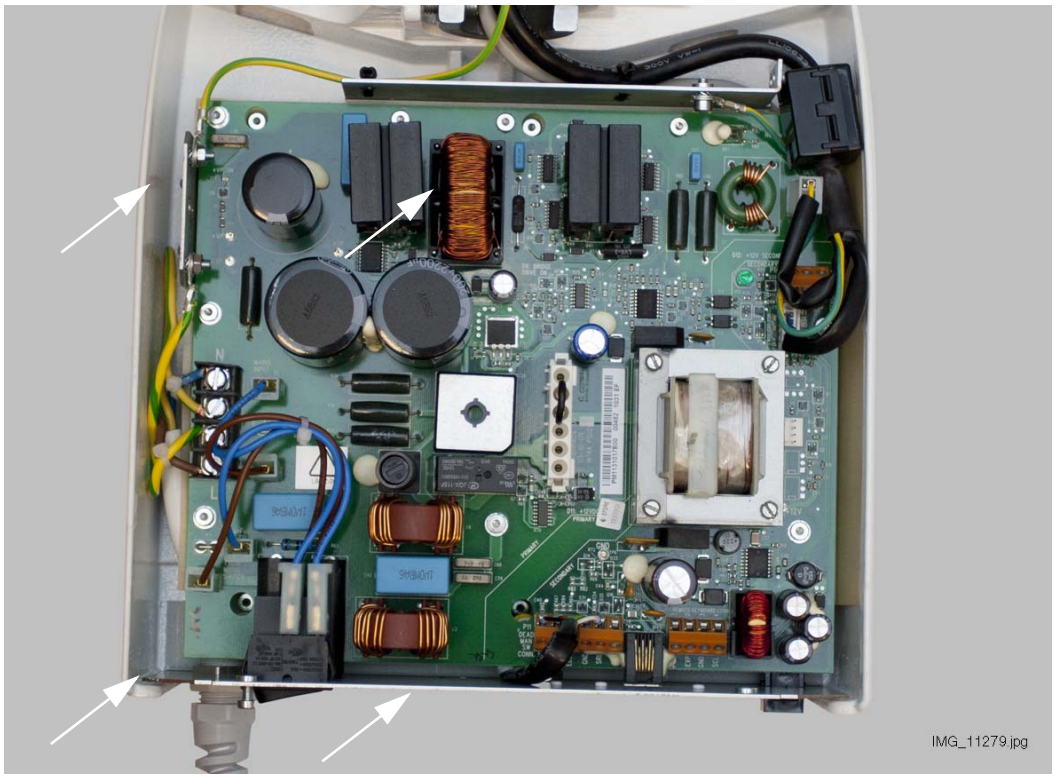


6. Turn the tube head upwards and lift it away from its position.



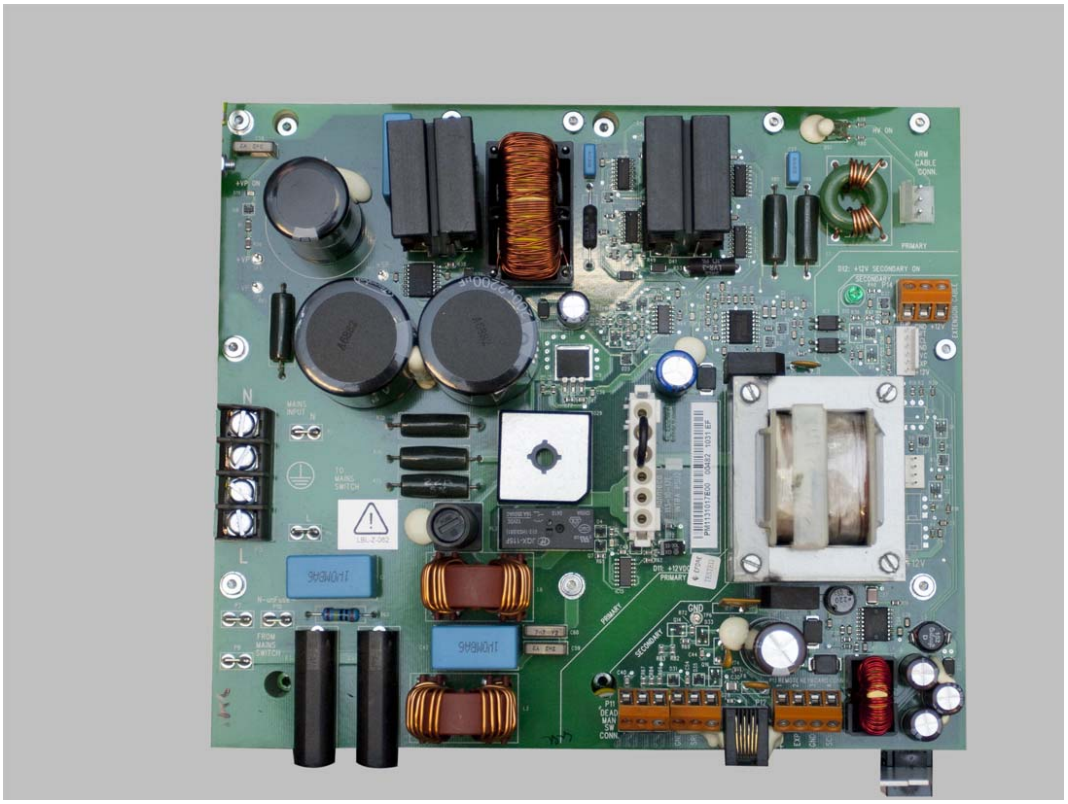
10.5 Replacing Generator PCB

1. Disconnect the X-ray unit from the mains or switch off the power supply.
2. Remove the generator housing. Refer to section 10.1 “Removing generator housing” on page 45.
3. Measure that the mains voltage is not present at the mains input terminals (P5) marked N and L (see figure below).
4. Disconnect the connectors from terminals P1, P3, P5, P6 P7, P8 and P9.



5. Loosen the four M4x8 ISO 7380 screws of the generator assembly frame (white arrows in the figure). Lift the generator assembly upwards. The generator assembly can now be lifted away from the wall adapter.
6. Remove the ten M4x8 DIN 912 attachment nuts and ø4.3 DIN 6798 washers from the Generator PCB. Lift the generator assembly away from the wall adapter and open the two M3x6 DIN 912 screws located behind the generator assembly frame.

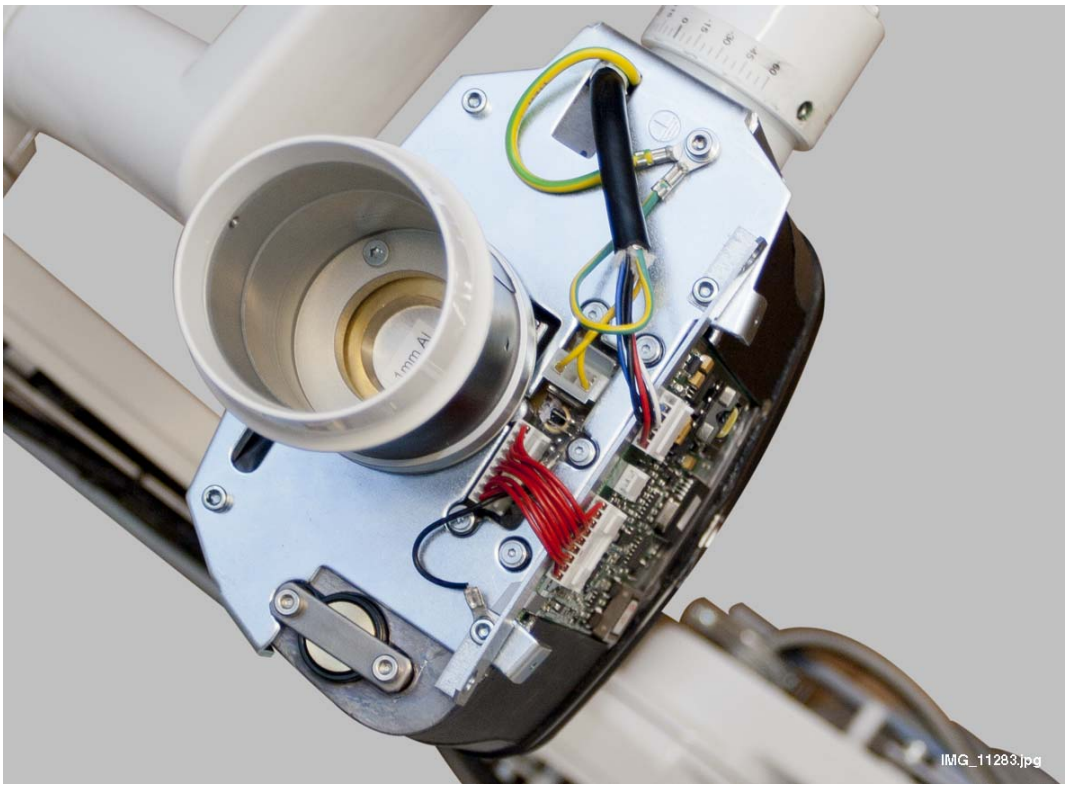
7. Remove the Generator PCB.



8. Install the new Generator PCB in reverse order. Note, that the new Generator PCB is not attached to the frame with the two M3x6 DIN 912 screws located behind the generator assembly frame.

10.6 Replacing tube head PCB

1. Disconnect the X-ray unit from the mains or switch off the power supply.
2. Remove the tube head covers, refer to section 10.2 “Removing tube head covers” on page 46.
3. Disconnect the two connectors from the tube head PCB.
4. Pull the tube head PCB from the tube head.
5. Install the new PCB in reverse order.
6. Perform the x-ray tube filament preheating voltage calibration, see section 4.3 “X-ray tube filament preheating voltage calibration” on page 20.



10.7 Replacing software

WARNING

Always turn the X-ray unit off before removing the software chip from its socket. Never turn the unit on if the software chip is not in its socket.

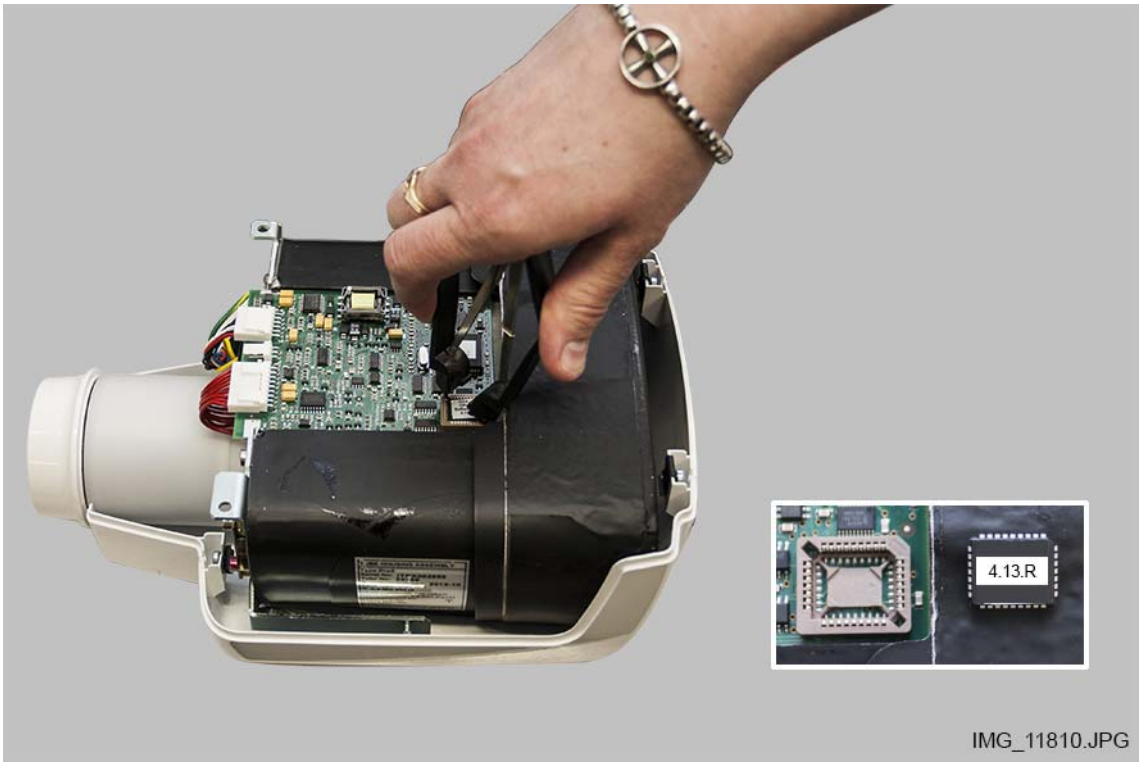
NOTE

Antistatic precautions must be performed when handling the software chip. Touch any grounded metal part of the unit before touching the software chip.

1. Disconnect the X-ray unit from the mains or switch off the power supply.
2. Remove the tube head covers, refer to section 10.2 “Removing tube head covers” on page 46.
3. Remove the software chip from its socket with the special tool as illustrated below.

NOTE

The orientation of the software chip is critical. Never try to force the chip into the socket.



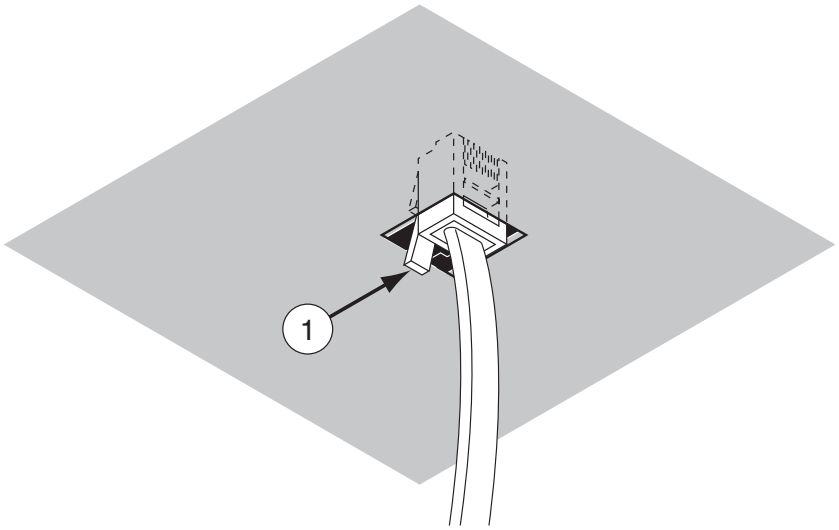
4. Carefully place the new software chip into the socket so that the slanted corner of the chip hits the slanted corner of the socket. Note, that the label on the chip must be outwards.
5. Attach the tube head covers.

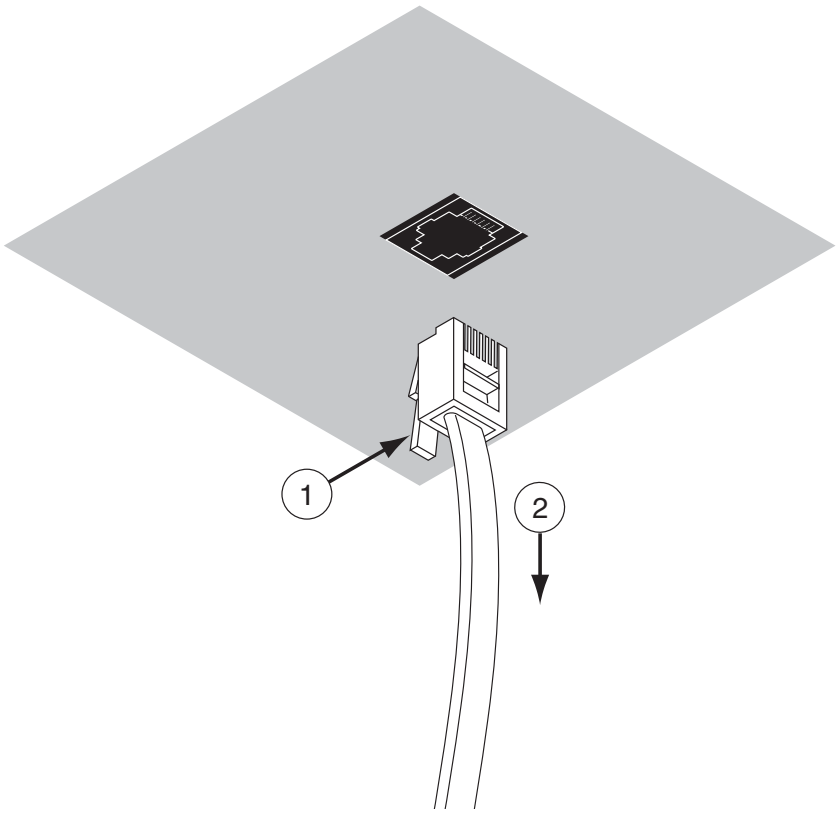
10.8 Replacing control panel cable

1. Disconnect the X-ray unit from the mains or switch off the power supply.
2. Press the clip of the connector (1) and pull the socket from the terminal of the generator box (2).
3. Detach the connector from the control panel in the same way as from the generator box.
4. Connect the new cable to the generator box and to the control panel.

CAUTION

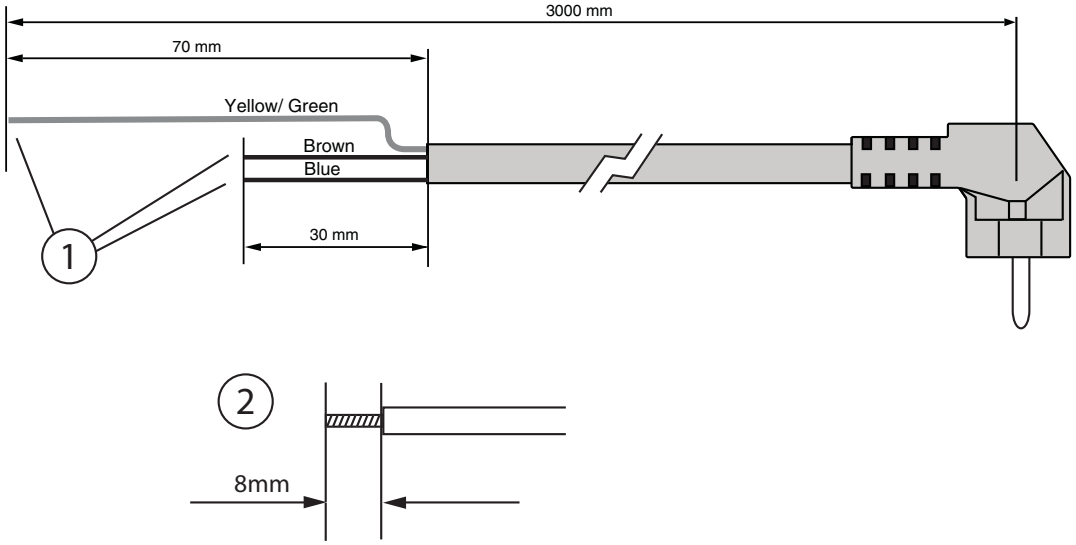
Do not connect any other equipment to the terminal of the generator box.





10.9 Replacing power supply cable

1. Switch off the X-ray unit and disconnect the power supply cable from mains.
2. Remove the generator housing as described in section 10.1 “Removing generator housing” on page 45.
3. Disconnect the power supply cable from the Generator PCB. Unscrew the power supply cable strain relief and remove the cable.
4. Use the correct power supply cable: for mains voltage 100 V~/110-115 V~ power supply cable Planmeca part number is **10006683** and for 220-240 V~ **10006584**.
5. Check that the wires extend from the outer housing as shown below (1). If not, peel the outer housing.
6. Peel 8 mm housing from the lead ends (2).



7. Route the power supply cable through the frame opening and attach the strain relief. Tighten the strain relief as described in section 6.4 “Power supply cable” on page 31.

8. Connect the power supply cable to the Generator PCB. Secure the wires with a cable tie.

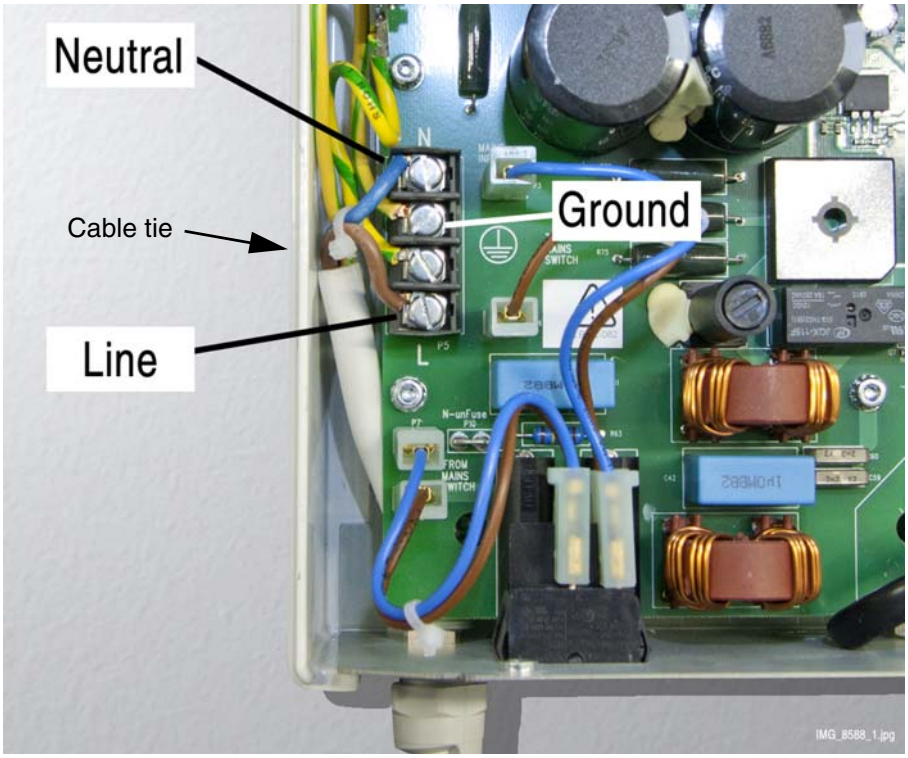


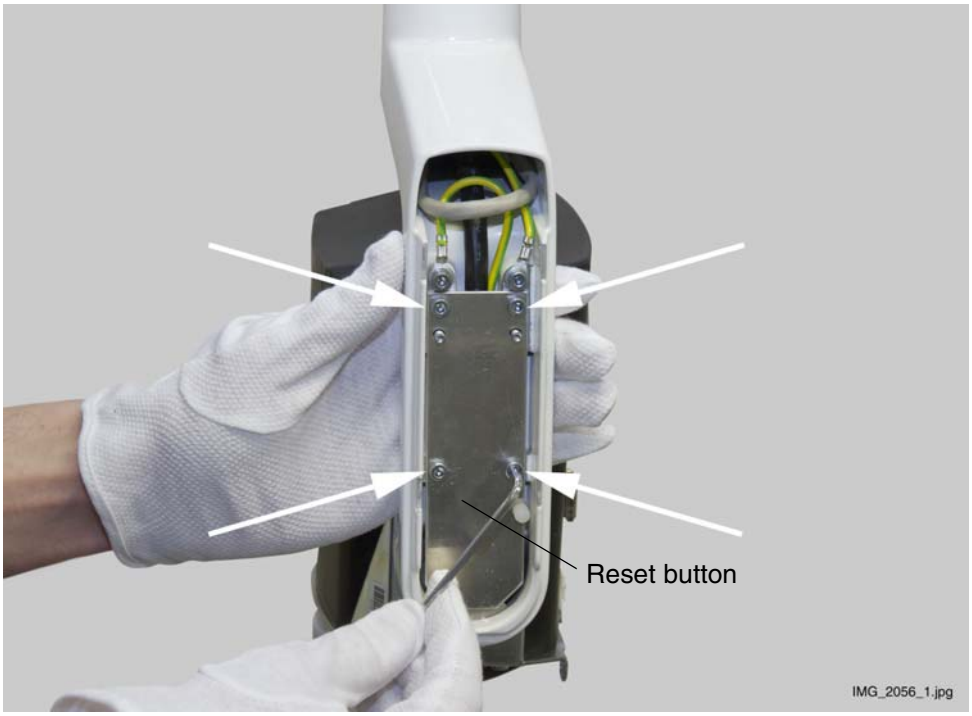
Figure 1

9. Attach the generator housing to its position.

10.10 Replacing arm cable

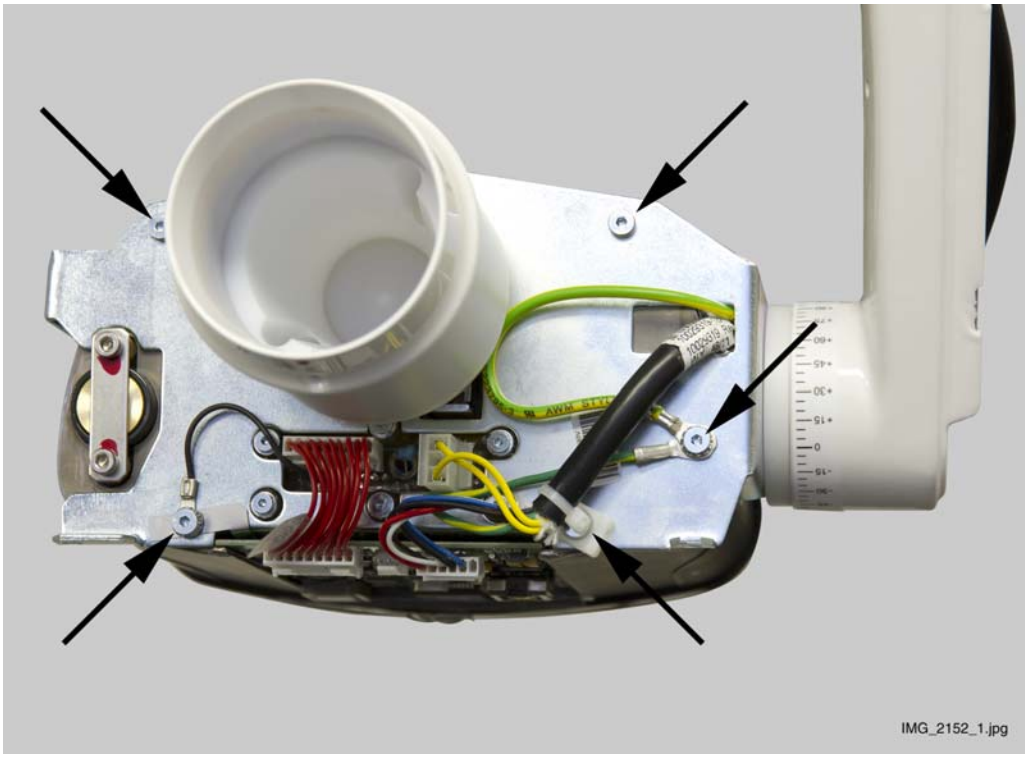
1. Disconnect the X-ray unit from the mains or switch off the power supply.
2. The arm cable kit includes drawing tool (1), arm cables (2) and cable ties and ferrite (3).

3. Remove the following covers: generator housing, tube head covers, tube head support cover and bracket arm covers. Remove the control panel from the generator assembly. Refer to the appropriate sections.
4. Unscrew four baffle plate attachment screws using a 3 mm Allen key (white arrows). Note, that the white reset button and the two cover attachment screws will drop away from its position when you remove the plate. The reset button and the attachment screws must be replaced to the same position when attaching the plate back to its position.

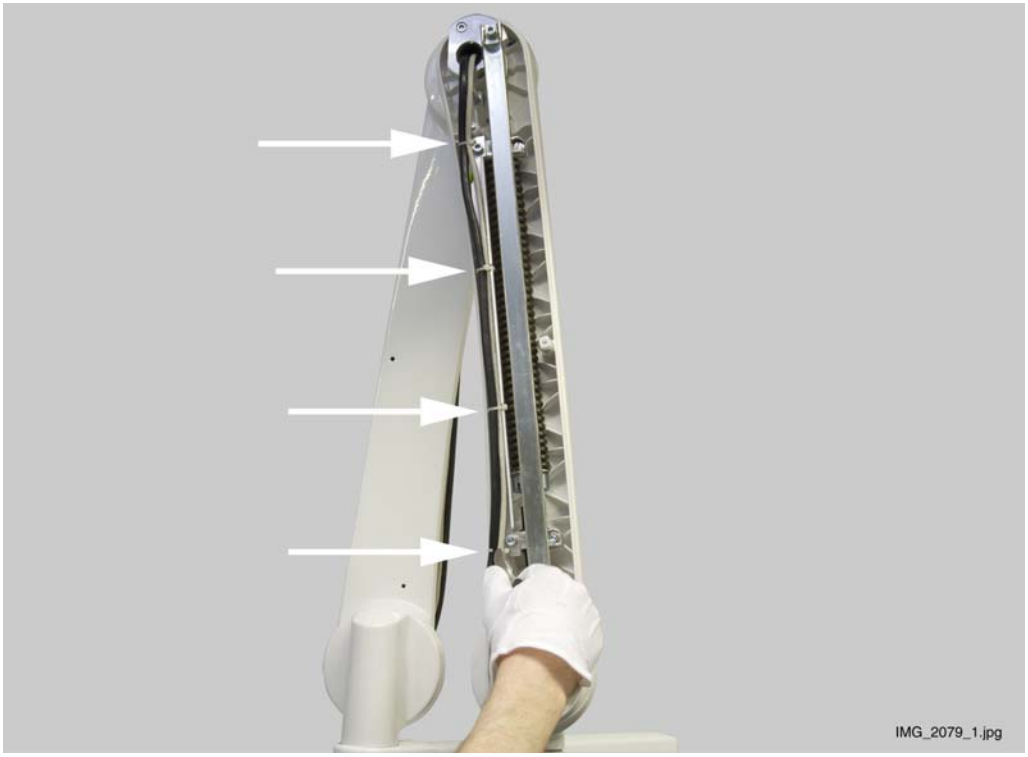


5. Unscrew the attachment screw of the protective lead using a 2.5 mm Allen key and remove the lead.

6. Disconnect the tube head cables. Unscrew three grounding (potential equalizer) lead/tube head attachment screws from the lower side of the support frame. Then unscrew two upper attachment screws. Use a 2.5 mm Allen key. Remove the tube head.



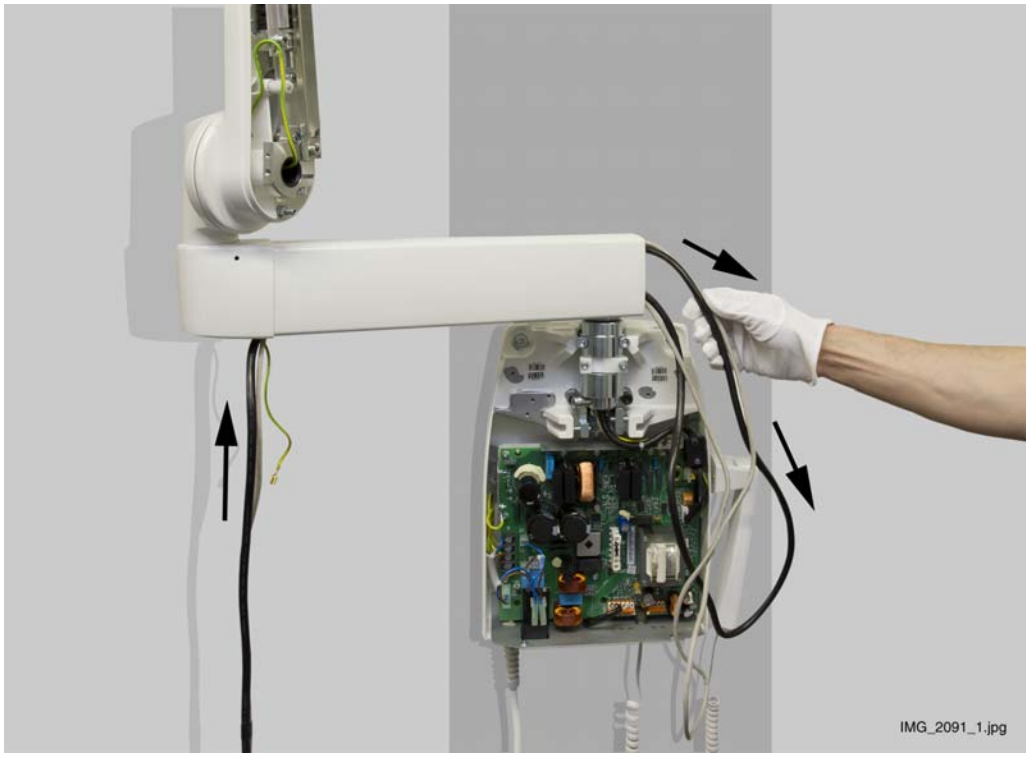
7. Mark down the cable tie positions. It is important to attach the new cable ties to the exact same positions. Cut all the cable ties.



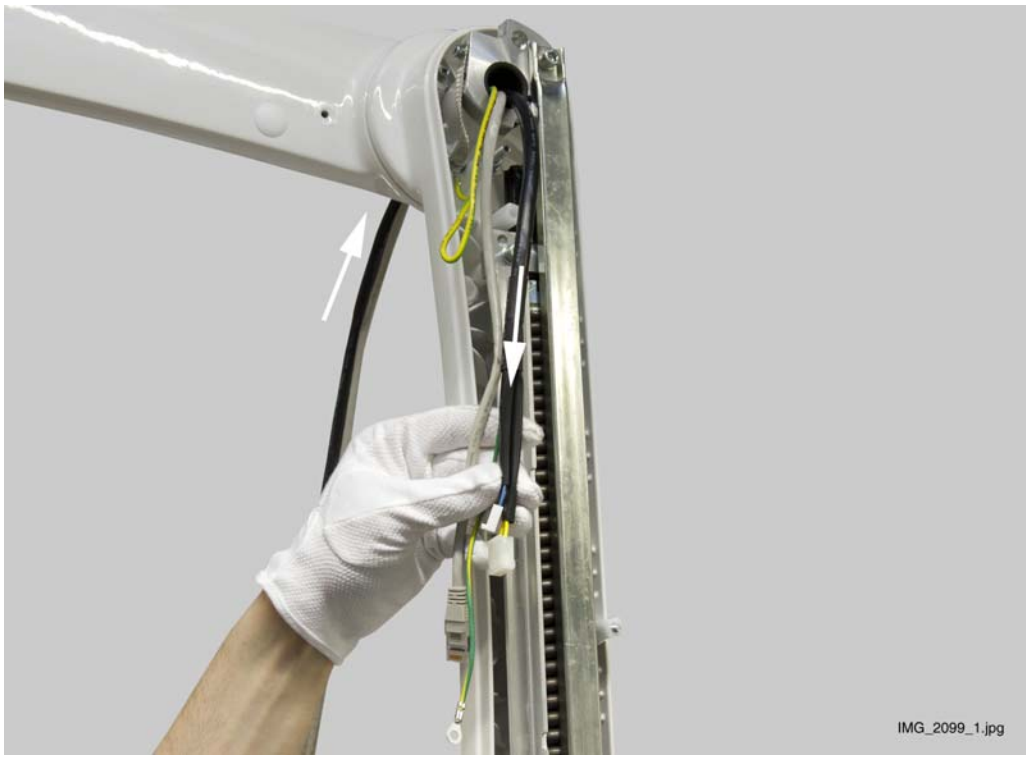
8. Cut the old cables so that it is easier to remove them.

9. Pull the cables out from the extension arm joint.

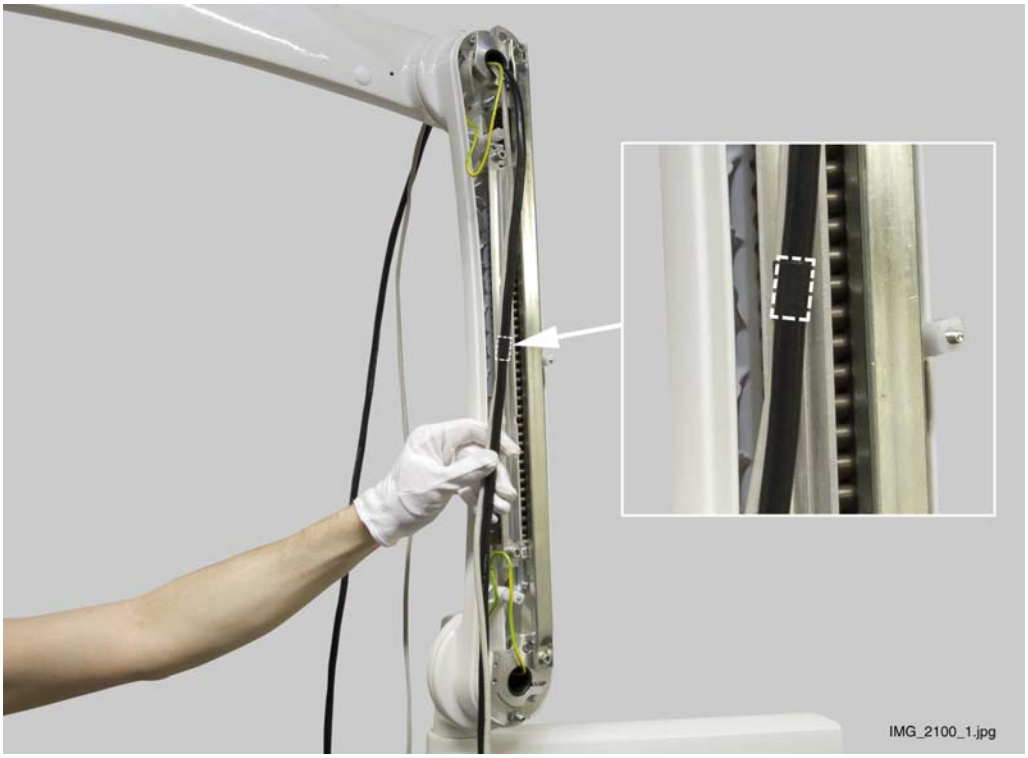
10. Pull the cables out from the extension arm. **NOTE:** if the extension arm is so long that cannot use the drawing tool, do not yet pull the old arm cable through the extension arm but use as a draw cord.



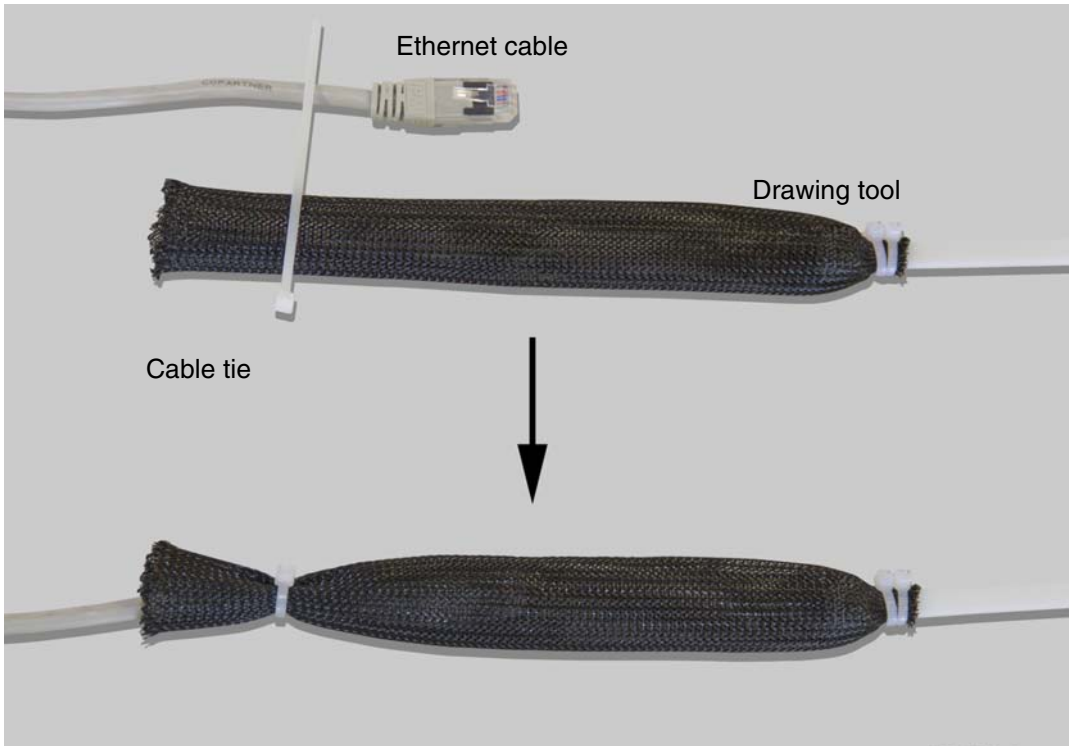
11. Pull the new cable through the bracket arm middle joint. The end **with** protective sleeves goes to the generator assembly.



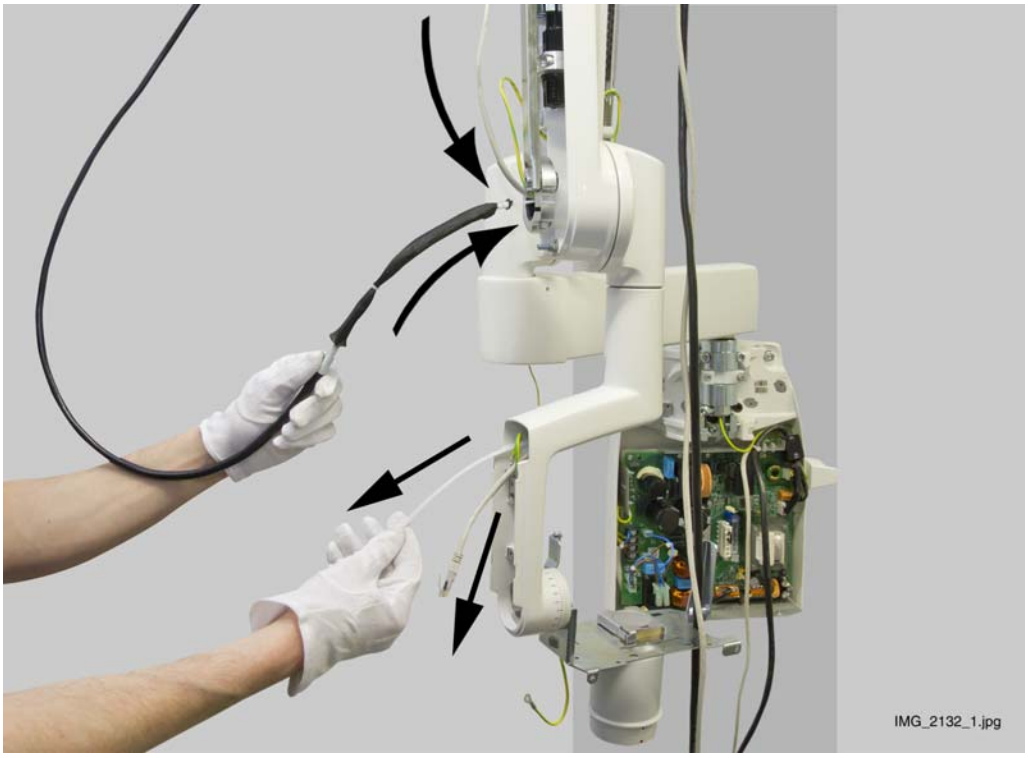
12. Place the cables so that the tape on the cables is in the middle of generator side bracket arm (see figure below).



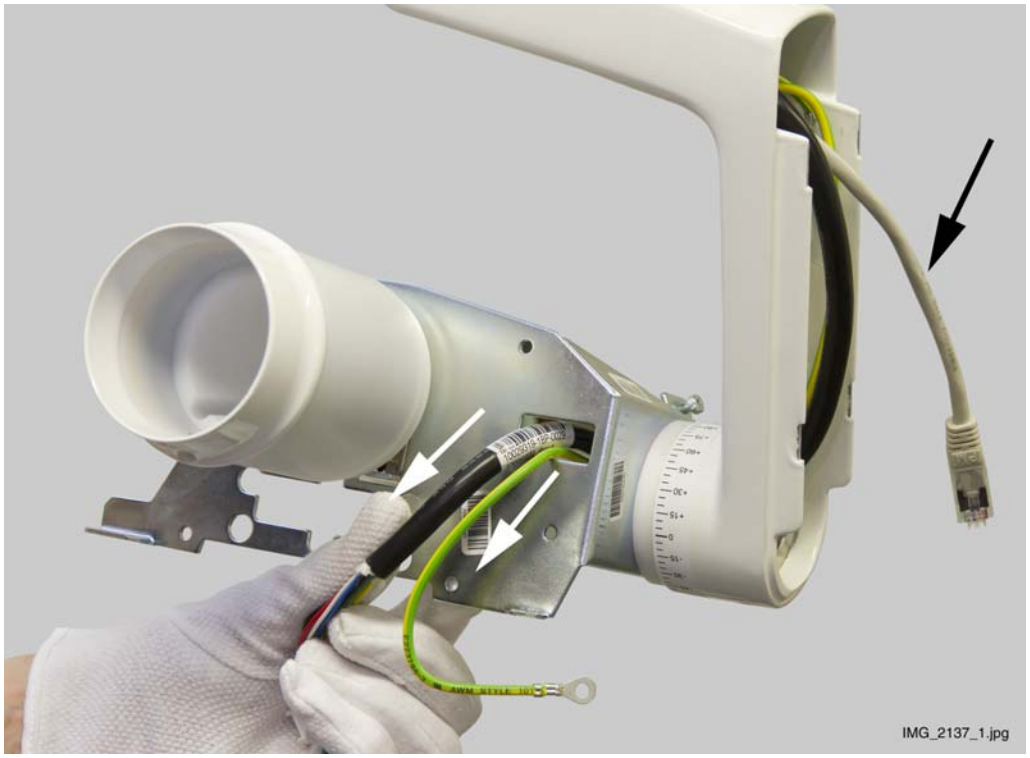
13. Attach the Ethernet cable to the drawing tool with a cable tie. Attach the cable from the cable sheath, **NOT** from the connector (see figure below).



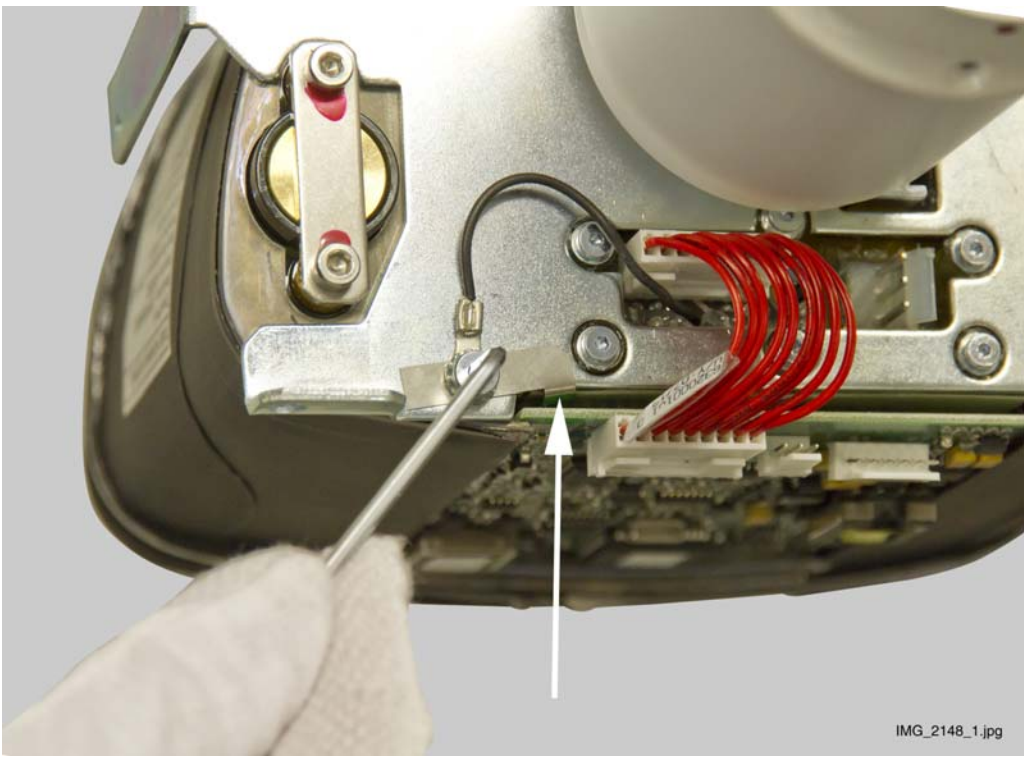
14. Turn the tube head support as shown on the figure below. Route the Ethernet cable through the support frame. Push the cable at the same time as you pull it. Remove the Ethernet cable from the drawing tool and attach the arm cable to it so that the cable tie is on the cable sheath. Route the arm cable through the tube head support.



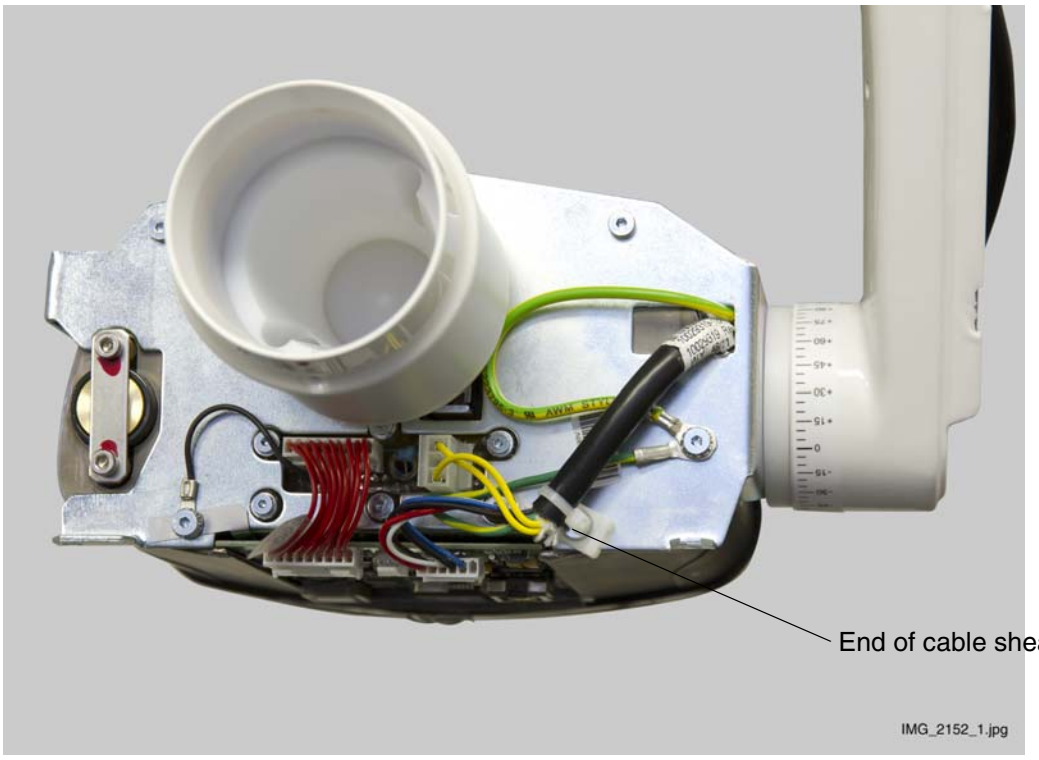
15. Route the arm cable through the tube head joint (white arrows). Leave the Ethernet cable to the tube head support (black arrow).



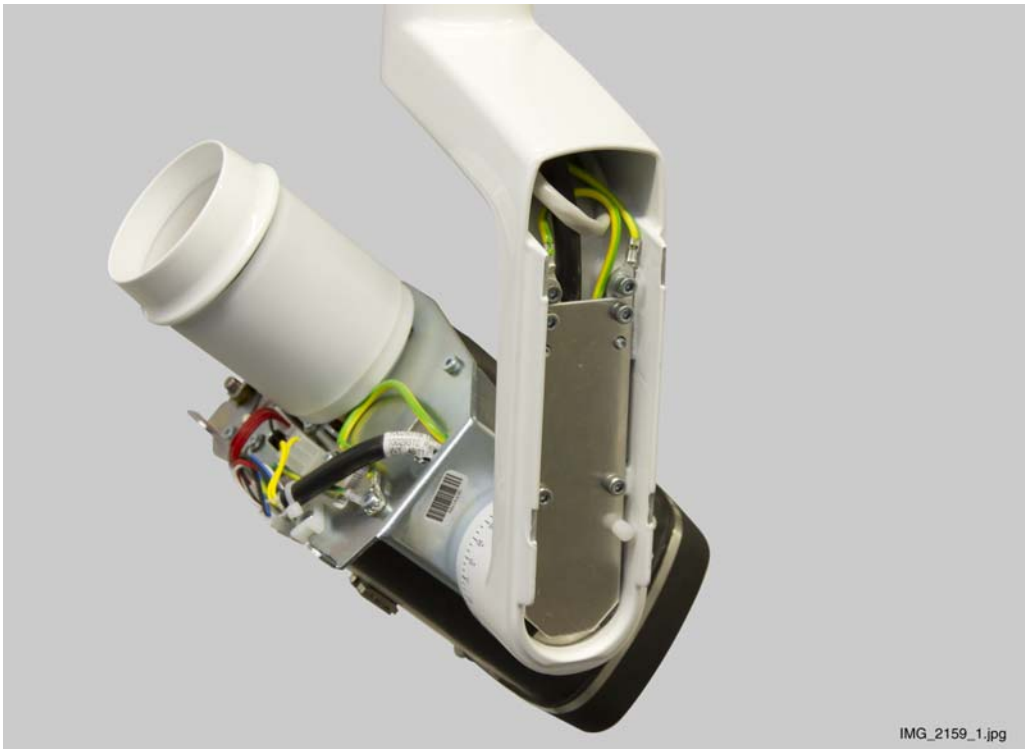
16. Place the tube head to its position. Attach the upper tube head attachment screws using a 2.5 mm Allen key. Place the tube head PCB to its position and connect the cables. Attach the protective lead to the tube head using a 2.5 mm Allen key.
17. Attach the potential equalizer lead and PCB grounding plate to support frame with an attachment screw using a 2.5 mm Allen key. Note the position of the PCB grounding plate (white arrow).



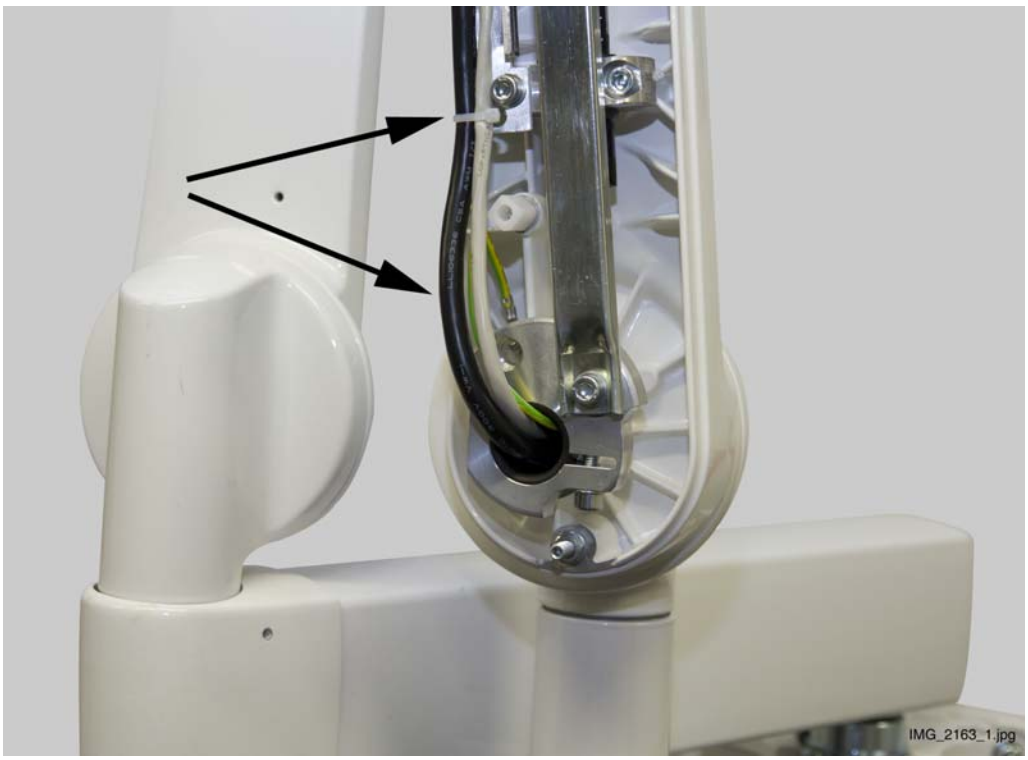
18. Attach the other tube head / grounding lead attachment screws using a 2.5 mm Allen key. Adjust the arm cable length so that the cable sheath just reaches the cable tie. Secure the cable to the frame with a cable tie.

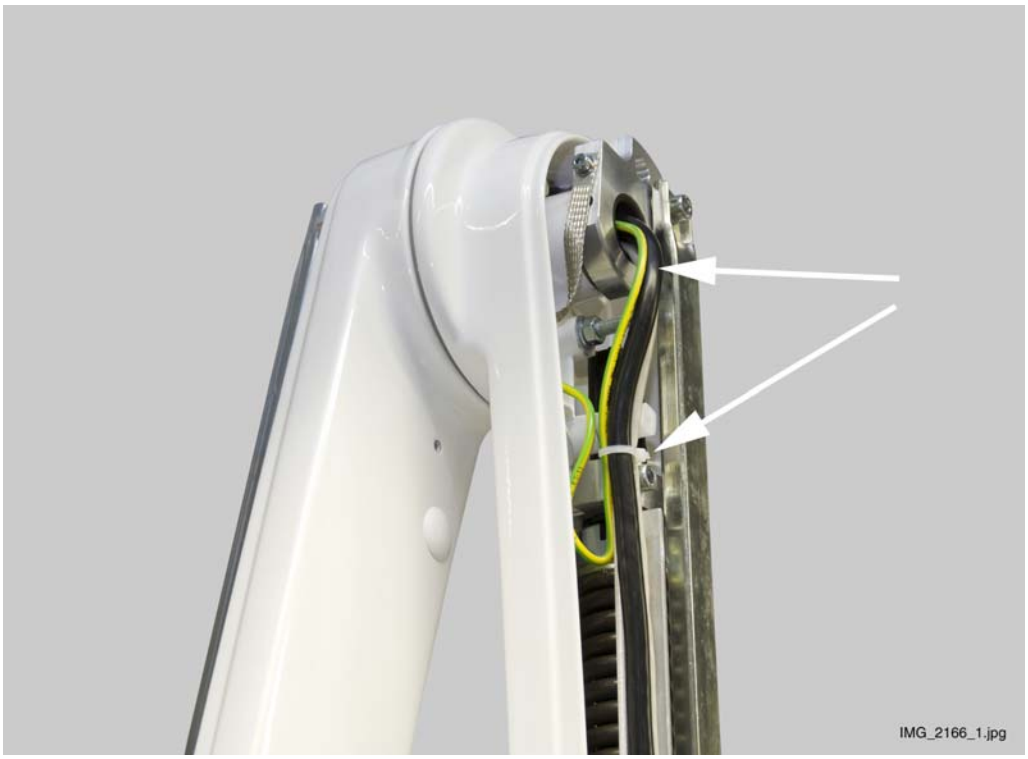


19. Place the reset button to its position and attach the baffle plate with four attachment screws using a 3 mm Allen key.

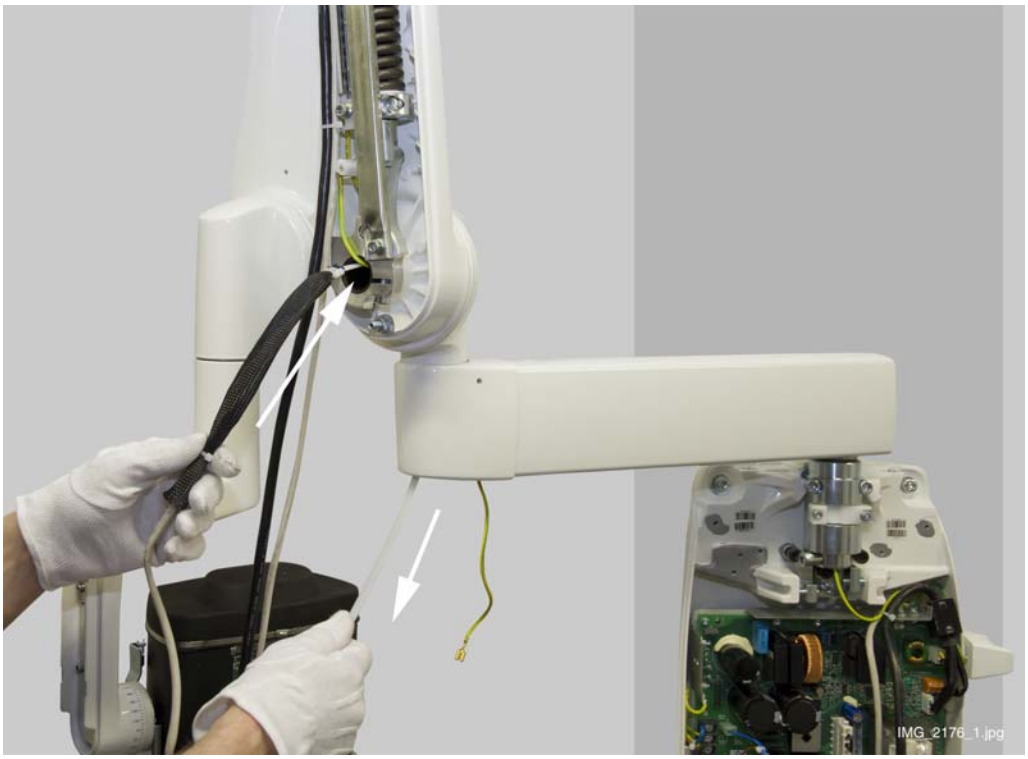


20. Attach the cables to the bracket arm with cable ties. **Do not tighten the cable ties yet.** Leave the cables slightly loose in the joints but make sure that the cables do not push the arm covers. Tighten the cable ties so that the attachment point is towards arm center.

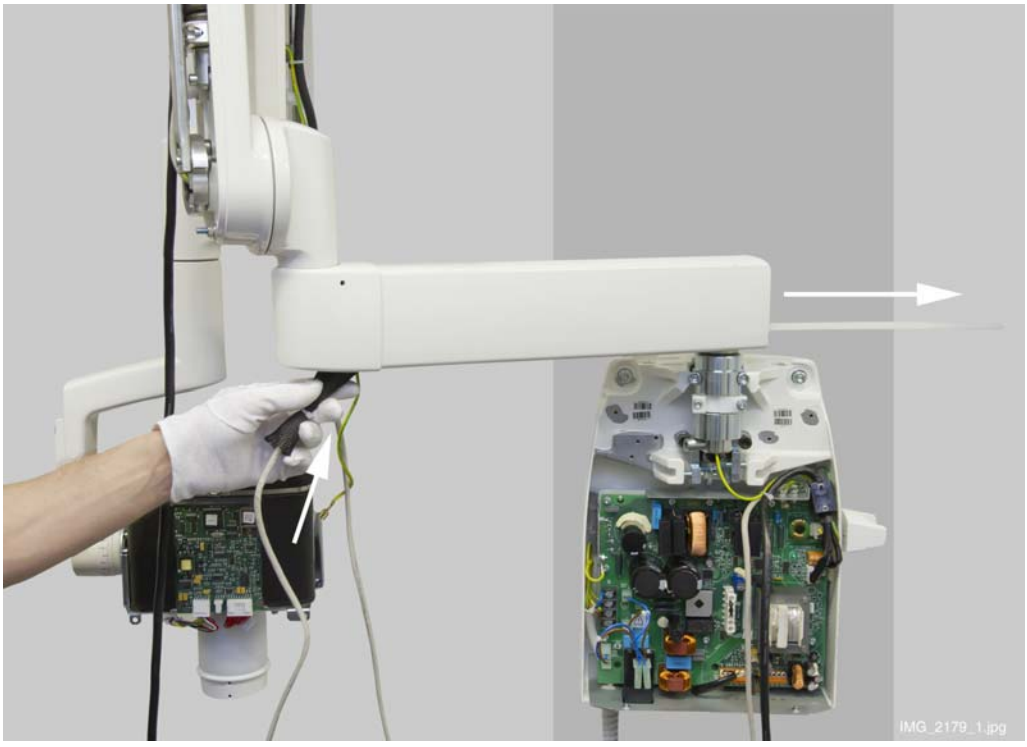




21. Attach the Ethernet cable to the drawing tool with a cable tie. Attach the cable from the cable sheath. Pull the cable through the extension arm joint.



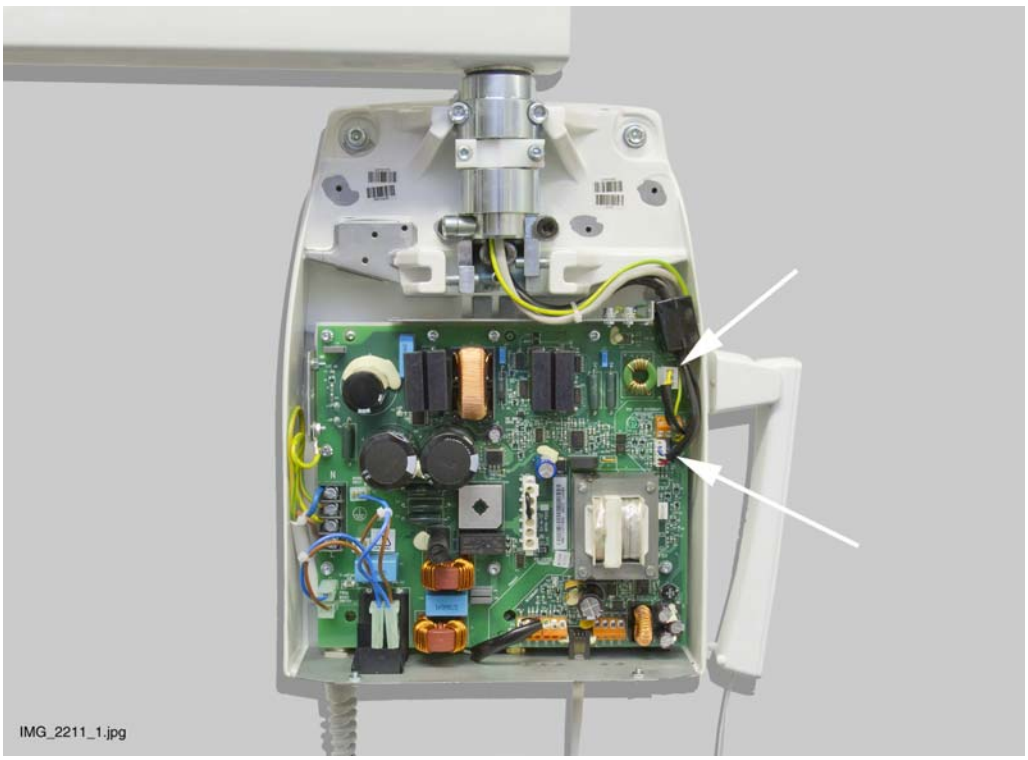
22. Route the Ethernet cable through the extension arm.



23. Route the Ethernet cable through the extension arm joint to the generator assembly.
24. Remove the Ethernet cable from the drawing tool and attach the arm cable to it so that the cable tie is on the cable sheath. Route the arm cable through the extension arm and through the extension arm joint to the generator assembly.

25. Loosen four generator assembly frame attachment screws using a 2.5 mm Allen key. Lift the generator assembly upwards. The generator assembly can now be lifted away from the wall adapter. Disconnect the old Ethernet cable from its position and attach the new Ethernet cable to the connector. Attach the assembly back to its position.
26. Remove the old arm cable from the Generator PCB.
27. Attach the ferrite to the new arm cable, to the middle of protective sleeve.
28. Attach the grounding lead to the frame using a 3 mm Allen key (white arrow).Secure the cables with cable tie (black arrow).

29. Connect the cables,



30. Pull the excess cable out from the generator side end of the extension arm. Push the excess cables into the arm.

31. Move the arm and check that the cables do not tighten too much or make any noise.
32. Attach the removed covers, switch on the X-ray unit and check the unit operation.

11 DIAGRAMS

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