


ROTANODE™
E7865X  0197

Rotating Anode X-ray Tube Assembly

- ◆ Rotating anode X-ray tube assembly for the purpose of general diagnostic procedures.
- ◆ Specially processed rhenium-tungsten faced molybdenum target of 74 mm diameter.
- ◆ This tube has foci 1.0 and 0.3, and is available for a maximum tube voltage 150 kV.
- ◆ Accommodated with IEC60526 type high-voltage cable receptacles.



General Data

IEC Classification (IEC60601-1:2005) Class I ME EQUIPMENT

Electrical:

Circuit:

High Voltage Generator Constant Potential High-Voltage Generator
Grounding Center-grounded

Nominal X-ray Tube Voltage (IEC60613:2010):

Radiographic 150 kV

Nominal Focal Spot Value (IEC60336:2005):

Large Focus 1.0
Small Focus 0.3

Nominal Anode Input Power (at 0.1s) See rating charts

	50 Hz	60 Hz
Large Focus	36.5 kW	40 kW
Small Focus	3.2 kW	3.5 kW

Nominal Radiographic Anode Input Power (IEC60613:2010):

	50 Hz	60 Hz
Large Focus	34 kW	38 kW
Small Focus	3.2 kW	3.5 kW

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Motor Ratings:

Stator: XS-AV

Driven Frequency [Hz]	Starting		Running
	50/60		50/60
Input Power [W]	1050	270	43
Voltage ^{1) 3)} [V]	200	100	40
Current ²⁾ [A]	6.0	3.0	1.2
Min. Speed Up ⁴⁾ [s]	0.8	1.5	-
Capacitor [μ F]	24	24	24

Note: 1) Applied voltage between common and main terminal.

2) Common current.

3) The every applied voltage must be never exceeded 110% of the above specification.

4) The speed-up time is allowed up to 110% of the above specification.

Anode Speed:

50 Hz	Minimum 2700 min ⁻¹
60 Hz	Minimum 3200 min ⁻¹

Stator Resistance:

Common-Main Winding	27.5 Ω
Common-Auxiliary Winding	58.0 Ω
Resistance between Housing and Low Voltage Terminals	Minimum 2 M Ω
Normal Operating Range of The Housing Temperature	16 ~75 °C
Mode of Operation	Intermittent

Mechanical:

Dimensions	See dimensional outline
Overall Length	479 mm
Maximum Diameter	152.4 mm
Target:	
Anode Angle	12 degrees
Diameter	74 mm
Construction	Rhenium-Tungsten faced Molybdenum
Permanent Filtration	1.3 mm Al / 75 kV IEC60522:1999
Radiation Protection (In accordance with IEC60601-1-3:2008):	
Leakage Technique Factor	150 kV, 3.4 mA
X-ray Coverage	430 × 430 mm at SID 1000 mm
Weight (Approx.)	16 kg
High Voltage Receptacle	To meet the requirements of IEC60526 Corrigendum1:2010
Cooling Method	Natural or forced air
Tube Housing Model Number	XH-121

Absolute Maximum and Minimum Ratings (At any time, these values must not be exceeded)

Maximum X-ray Tube Voltage (IEC60613:2010):	
Radiographic	150 kV
Between Anode (or Cathode) and Ground	75 kV
Minimum X-ray Tube Voltage	40 kV
Maximum X-ray Tube Current (IEC60613:2010)	
Large Focus	See rating charts
Small Focus	640 mA
Small Focus	70 mA
Maximum Filament Current:	
Large Focus	5.5 A
Small Focus	5.0 A
Filament Voltage:	
Large Focus (At maximum filament current 5.5 A)	11.2 ~ 15.0 V
Small Focus (At maximum filament current 5.0 A)	4.3 ~ 5.8 V
Filament Frequency Limits	0 ~ 25 kHz
Continuous Anode Input Power (IEC60613:2010)	60 W (85 HU/s)
Thermal Characteristics:	
Anode Heat Content	100 kJ (140 kHU)
Maximum Anode Heat Dissipation	475 W (667HU/s)
X-ray Tube Assembly Heat Content	900 kJ (1250 kHU)
Nominal Continuous Input Power (IEC60613:2010):	
Without Air-circulator	180 W (15 kHU/min)

Environmental Limits

Operating Limits:	
Temperature	10 ~ 40 °C
Humidity	30 ~ 85 %
	(No condensation)
Atmospheric Pressure	70 ~ 106 kPa
Shipping and Storage Limits:	
Temperature	-20 ~ 70 °C
Humidity	20 ~ 90 %
	(No condensation)
Atmospheric Pressure	50 ~ 106 kPa

The information about EMC conformity (IEC60601-1-2:2007)

As the result of reviewing the test requirements in the following Tables, an X-ray tube assembly as a component of X-ray system or apparatus does not fall within the scope of the EMC directive of IEC60601-1-2:2007. Therefore, X-ray system manufacturer shall conduct the required test and evaluate EMC.

CAUTION: The diagnostic X-ray system can only allow to use the designated cables and components. If the different cables or components are used, they may deteriorate the performance of electromagnetic emissions and immunity.

The following tables are the copies of statements in IEC60601-1-2:2007


Table 1 – Guidance and manufacturer's declaration – electromagnetic emissions – for all EQUIPMENT and SYSTEMS (see 6.8.3.201 a) 3))

Guidance and manufacturer's declaration – electromagnetic emissions		
The [EQUIPMENT or SYSTEM] is intended for use in the electromagnetic environment specified below. The customer or the user of the [EQUIPMENT or SYSTEM] should assure that it is used in such an environment.		
Emission test	Compliance	Electromagnetic environment - guidance
RF emissions CISPR 11	Group 1	The [EQUIPMENT or SYSTEM] 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	Group 2	The [EQUIPMENT or SYSTEM] must emit electromagnetic energy in order to perform its intended function. Nearby electronic equipment may be affected.
RF emissions CISPR 11	Class [A or B]	
Harmonic emissions IEC61000-3-2	Class [A, B, C, D, or Not applicable]	
Voltage fluctuations/ flicker emissions IEC61000-3-3	[Complies or Not applicable]	
	[See 6.8.3.201 a) 3) and Figure 201	The [EQUIPMENT or SYSTEM] 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.
	[See 6.8.3.201 a) 3) and Figure 201	The [EQUIPMENT or SYSTEM] is suitable for use in all establishments other than domestic and these directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
RF emissions CISPR 14-1	Complies	The [EQUIPMENT] is not suitable for interconnection with other equipment.
RF emissions CISPR 15	Complies	The [EQUIPMENT] is not suitable for interconnection with other equipment.

Table 2 – Guidance and manufacturer's declaration – electromagnetic immunity – for all EQUIPMENT and SYSTEMS (see 6.8.3.201 a) 6))

Guidance and manufacturer's declaration – electromagnetic immunity			
The [EQUIPMENT or SYSTEM] is intended for use in the electromagnetic environment specified below. The customer or the user of the [EQUIPMENT or SYSTEM] should assure that it is used in such an environment.			
Immunity test	IEC60601 test level	Compliance level	Electromagnetic environment – guidance
Electrostatic discharge (ESD) IEC61000-4-2	±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 IEC61000-4-4	±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 IEC61000-4-5	±1 kV differential mode ±2 kV common mode		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. IEC61000-4-11	<5 % U_T (>95 % dip in U_T) for 0.5 cycle 40 % U_T (60 % dip in U_T) for 5 cycle 70 % U_T (30 % dip in U_T) for 25 cycle <5 % U_T (>95 % dip in U_T) for 5 sec		Mains power quality should be that of a typical commercial or hospital environment. If that user of the [EQUIPMENT or SYSTEM] requires continued operation during power mains interruptions, it is recommended that the [EQUIPMENT or SYSTEM] be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC61000-4-8	3 A/m		Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Note: U_T is the A.C mains voltage prior to application of the test level.			

Table 3 – Guidance and manufacturer's declaration – electromagnetic immunity – for LIFE-SUPPORTING EQUIPMENT and SYSTEM (see 6.8.3.201 b))

Guidance and manufacturer's declaration - electromagnetic immunity -			
The [EQUIPMENT or SYSTEM] is intended for use in the electromagnetic environment specified below. The customer or the user of the [EQUIPMENT or SYSTEM] should assure that it is used such an environment.			
Immunity test	IEC60601 test level	Compliance level	Electromagnetic environment - guidance
Conducted RF IEC61000-4-6	3 Vrms 150 kHz to 80 MHz outside ISM bands ^a	[V ₁] V	Portable and mobile RF communications equipment should be used no closer to any part of the [EQUIPMENT or SYSTEM], including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance $d = \left[\frac{3.5}{V_1} \right] \sqrt{P}$ $d = \left[\frac{12}{V_2} \right] \sqrt{P}$
	10 Vrms 150 kHz to 80 MHz in ISM bands ^a	[V ₂] V	
Radiated RF IEC61000-4-3	10 V/m 80 MHz to 2.5GHz	[E ₁] V/m	$d = \left[\frac{12}{E_1} \right] \sqrt{P}$ 80 MHz to 800 MHz $d = \left[\frac{23}{E_1} \right] \sqrt{P}$ 800 MHz to 2.5 GHz Where <i>P</i> is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and <i>d</i> is the recommended separation distance in meters (m). ^b Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, ^c should be less than the compliance level in each frequency range ^d . Interference may occur in the vicinity of equipment marked with the following symbol: 


Continued to the next page.

Note: 1 At 80 MHz and 800 MHz, the higher frequency range applies.

2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, object and people.

- a. The ISM (industrial, scientific and medical) bands between 150kHz and 80MHz are 6,765MHz to 6,795MHz; 13,553MHz to 13,567MHz; 26,957MHz to 27,283MHz; and 40.66MHz to 40.70MHz.
- b. The compliance levels in the ISM frequency bands between 150kHz and 80MHz and in the frequency range 80MHz to 2.5GHz are intended to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas. For this reason, an additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in these frequency ranges.
- c. 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 the [EQUIPMENT or SYSTEM] is used exceeds the applicable RF compliance level above, the [EQUIPMENT or SYSTEM] should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the [EQUIPMENT or SYSTEM].
- d. Over the frequency range 150kHz to 80MHz, field strengths should be less [V_1] V/m.

Table 4 – Guidance and manufacturer's declaration – electromagnetic immunity – for EQUIPMENT and SYSTEM that are not LIFE-SUPPORTING (see 6.8.3.201 b)

Guidance and manufacturer's declaration - electromagnetic immunity -			
The [EQUIPMENT or SYSTEM] is intended for use in the electromagnetic environment specified below. The customer or the user of the [EQUIPMENT or SYSTEM] should assure that it is used in such an environment.			
Immunity test	IEC60601 test level	Compliance level	Electromagnetic environment - guidance
Conducted RF IEC61000-4-6	3 Vrms 150 kHz to 80 MHz	[V1] V	Portable and mobile RF communications equipment should be used no closer to any part of the [EQUIPMENT or SYSTEM], including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance $d = [\frac{3.5}{V1}] \sqrt{P}$
Radiated RF IEC61000-4-3	3 V/m 80 MHz to 2.5GHz	[E1] V/m	$d = [\frac{3.5}{E1}] \sqrt{P}$ 80 MHz to 800 MHz $d = [\frac{7}{E1}] \sqrt{P}$ 800 MHz to 2.5 GHz Where <i>P</i> is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and <i>d</i> is the recommended separation distance in meters (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: 
<p>Note: 1 At 80MHz and 800MHz, the higher frequency range applies. 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, object and people.</p>			
<p>^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 the [EQUIPMENT or SYSTEM] is used exceeds the applicable RF compliance level above, the [EQUIPMENT or SYSTEM] should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the [EQUIPMENT or SYSTEM]. ^b. Over the frequency range 150kHz to 80MHz, field strengths should be less [V₁] V/m.</p>			

Warning

Warning to Interface with X-ray Generator

1. Housing Rupture

Never input over rated power to X-ray tube assembly.

If the input power exceeds tube specification, it causes the over temperature of anode, insert tube glass shatter and ultimately the following serious problems due to generating over-pressure by oil vaporization inside housing assembly.

In such a critical condition causing housing rupture by over load, the safety thermal switch can not protect X-ray tube even if it works.

- * Housing sealing parts rupture.
- * Human injury including burns due to hot oil escape.
- * Fire accident due to flaming anode target.

The X-ray generator should have a protective function which manages input power to be within tube specification.

2. Electric Shock

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

Cautions

Caution to Interface with X-ray Generator

1. Over Rating

X-ray tube assembly can be broken with applying just one over rated shot.
Please read the technical data sheets carefully and follow the instructions.

2. Permanent Filtration

The total filtration and the distance between X-ray focal spot and human body are regulated legally.
They should be complied with the regulation.

3. Safety Thermal Switch

X-ray tube assembly has safety thermal switch to prohibit further input power when the tube housing reaches to the temperature of switch-open.

The switch should be hooked up with the X-ray generator which control output power to X-ray tube assembly.

The switch is not recommended connecting stator coil in series circuit.

Even if the switch works, never turn the system power off. The cooling unit should be activated if used with the system.

4. Unexpected Malfunction

X-ray tube assembly may have the risk to be unexpectedly malfunctioning due to life termination or failure. If the serious problems caused by the above risk is expected, you are requested to have a contingency plan to avoid such a case.

5. New Application

If you use the product with new application not to be mentioned in this specification or with different type of X-ray generator, please contact to us for confirming its availability.

Caution for Installation, Adjustment and Maintenance

1. Qualified Persons

Only qualified persons who have technical training and professional knowledge can handle X-ray tube assembly.

2. Fragile Glass

X-ray tube is assembled with glass, therefore, it can be broken with the mechanical vibration or pulsed shock over 19.6m/s^2 (2G).

Careful handling is required to treat or transport.

3. Ground Terminal

X-ray tube assembly has ground terminal. Ground cable should be connected.

4. High Voltage

All X-ray tubes operate at voltages high enough to kill through electrical shock. Never touch the high voltage delivered plugs or terminals.

When direct access to such parts is required, the primary circuit should be disabled and high voltage capacitors/cables discharged.

5. High Voltage Plug

High voltage plug should be cleaned up and free from any physical damages. Silicon compound application is required for high voltage stability.

6. Rotating Anode

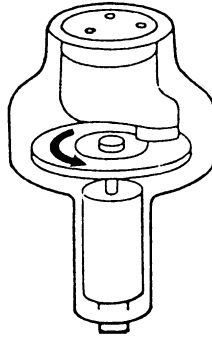
(1) Test rotation of the anode with the large focus filament at the preheat condition. At this time, do not apply the tube voltage.

(2) When the hand switch "READY" button is pressed, the filament will become brighter and the anode target will start rotating. The anode for normal speed will reach the predetermined number of revolution in 0.4 to 1 sec., and it will continue rotation for some time after the stator drive input is cut off.

The anode for high speed shall be automatically braked to reduced speed and continue coasting after the drive input to the stator is cut off.

- (3) Ensure that the anode target rotates in the proper direction.
X-ray tube should always rotate counter-clockwise, viewing from the cathode side.

- Confirm direction of rotation -



- (4) If the inside of any tube unit cannot be observed (for example, the tube unit with a beryllium window, etc.), check the tube unit to ensure again that the terminal numbers of the drive circuit of the low-voltage terminals are properly connected.

7. Operation Atmosphere

X-ray tube assembly is not allowed to be used in the atmosphere of flammable or corrosive gas.

8. Protective Cover

X-ray tube assembly is not allowed to be used without the protective cover attached.

9. Handling

Appropriate jig or tools are required for tube installation to avoid physical damages.

10. Returning Tube

X-ray tube assembly should be repackaged with the original material when it is returned back for quality examination in our factory. Be careful to put the tube upside cathode. If the packaging is not proper, the tube may not be correctly examined. TETD does not warrant it if returned X-ray tube assembly is in damage at receiving.

Caution in Rupture Disc

The Rupture Disc is mounted on anode side housing wall.

When external cover is removed, it is visibly recognized as labeled with label 3 in Caution Labels page.

Followings are important notice of the Rupture Disc:

Function:

When housing inner pressure reaches to the working pressure of the Rupture Disc, the Rupture Disc collapses and vaporized oil and hot oil flow through the collapsed Rupture Disc.

The external cover can protect the initial impact of oil flow, however, it can not protect oil drop or oil leakage.

Caution:

1. Never touch the Rupture Disc or remove the label and the screws.
Otherwise, it could cause collapse of Rupture Disc.
2. Please note the Rupture Disc is not the device to protect X-ray tube from destruction when over rated power input but just to reduce the impact of housing rupture.

Caution in Operation

1. X-ray Radiation

X-ray tube assembly should have the beam limiting equipment mounted on the X-ray port to protect unnecessary radiation.

2. Dielectric Oil

X-ray tube assembly has dielectric oil contained for high voltage stability. As it is poisonous for human health, if it is exposed to the non-restricted area, it should be disposed as following to the local regulation.

3. Operation Atmosphere

X-ray tube assembly is not allowed to be used in the atmosphere of flammable or corrosive gas.

4. Disposal

X-ray tube housing is lined with lead to protect unnecessary radiation.

The lead powder or vapor is harmful for human health.

Dispose the scrapped products according to the requirement of local regulation.

5. Adjust the Tube Current

Depending on the operating conditions the filament characteristics might be changed.

This change might lead to the over rate exposure to X-ray tube assembly.

To prevent the X-ray tube assembly from being damaged, adjust the tube current regularly.

Besides when "ROTANODE" has arcing problem in a long time use, adjustment of the tube current is required.

6. X-ray Tube Housing Temperature

Do not touch on X-ray tube housing surface just after operation due to high temperature.

Stay X-ray tube to be cooled.

7. Operating Limits

Prior to usage, please confirm the environmental condition is within the operating limits.

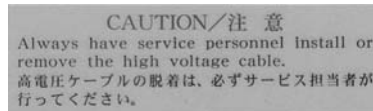
8. Any Malfunction

Please contact to TETD immediately, if any malfunction of the X-ray tube assembly is noticed.

Caution Labels

These labels are caution label to notify the user of the following point.

1. "Always have service personnel install or remove the high-voltage cable."



2. "Housing end caps must always be mounted to the tube housing assembly properly and correctly for X-ray protection and safety."



3. "Do not impact on this fragile face."



Definition Symbol Marks

CE MARKING OF CONFORMITY



SERIAL NUMBER



MANUFACTURER



DATE OF MANUFACTURE



AUTHORIZED REPRESENTATIVE IN THE EUROPEAN COMMUNITY



PROTECTIVE EARTH



EARTH



CAUTION



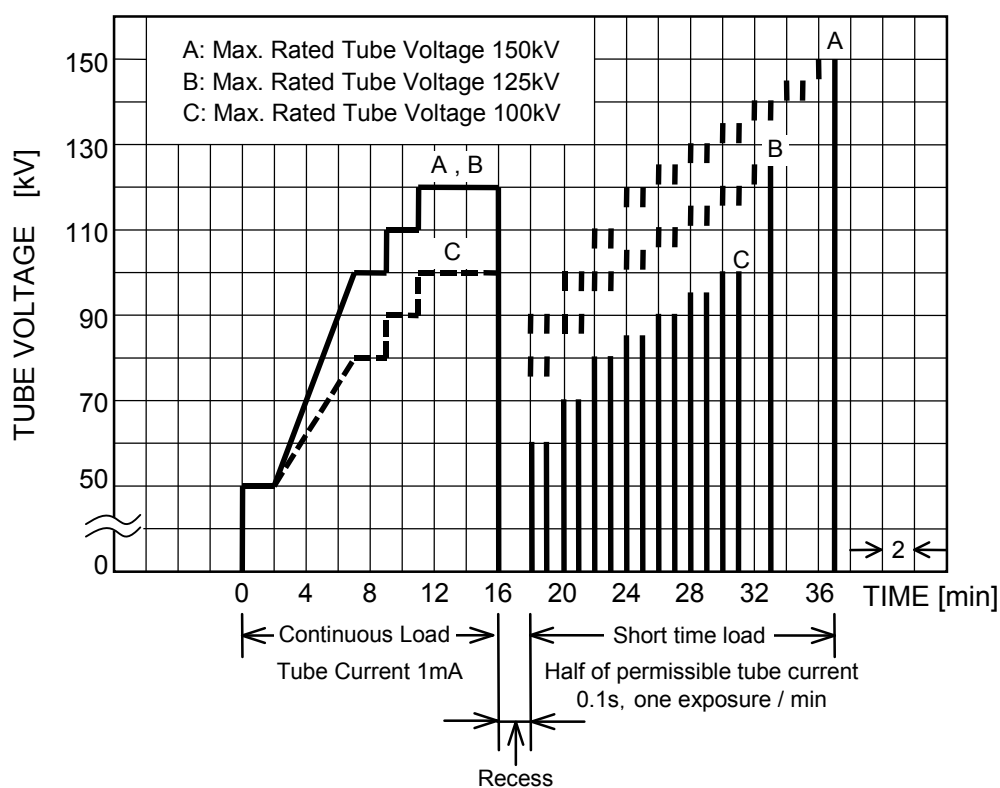
To Keep "ROTANODE" Well for a Long Time

In order to use "ROTANODE" for a long time, the seasoning before every day's start, adjust the tube current and the cooling after every day's finish are recommendable.

Seasoning

1. When "ROTANODE" is used first after the installation or after the pause more than two weeks, recommend the seasoning of "ROTANODE". Refer to the seasoning schedule. Execute the seasoning when "ROTANODE" is unstable.
2. When the seasoning is conducted, followings are recommended:
To put X-ray protector on X-ray detector. To close X-ray shutter to avoid unnecessary X-ray leakage.
3. If the tube current is unstable on the way to raise a tube voltage, lower the tube voltage until disappearing the instability, and raise the tube voltage slower than before.
4. The seasoning is carried out by service engineers who has sufficient technical and safe knowledge.

Seasoning schedule in installation

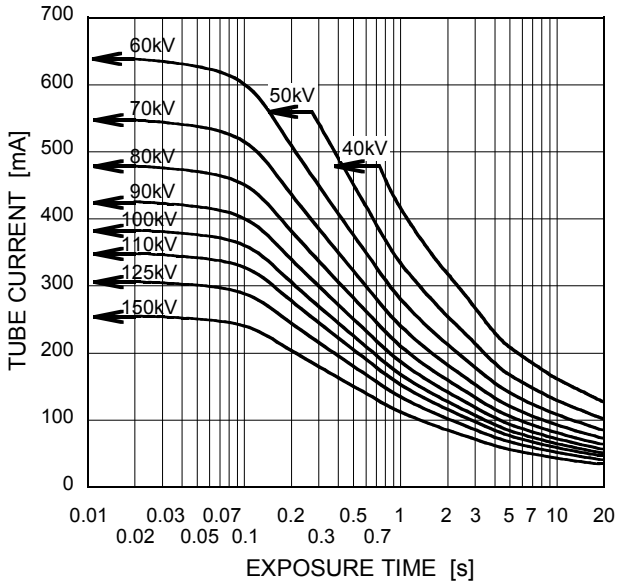


Execute the seasoning by mA close to 50% mA and not exceeding it if 50% mA cannot be set.

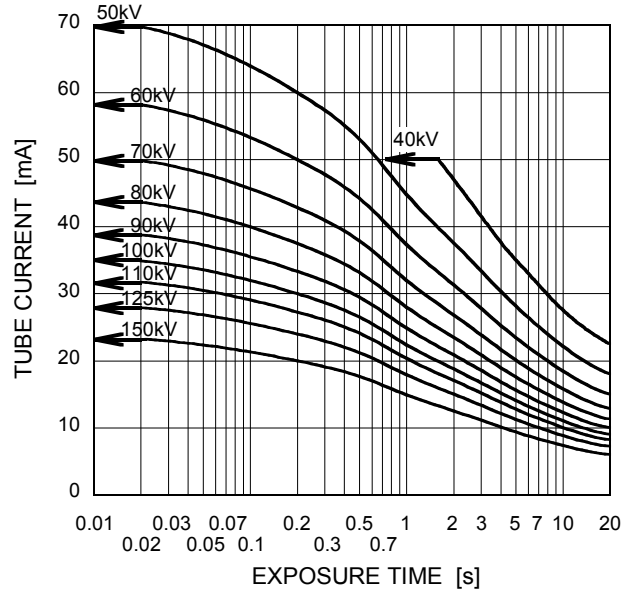
Maximum Rating Charts (Absolute Maximum Rating Charts)

Conditions: Constant Potential High-Voltage Generator
Stator Power Frequency 50Hz

Nominal Focal Spot Value: 1.0 ■



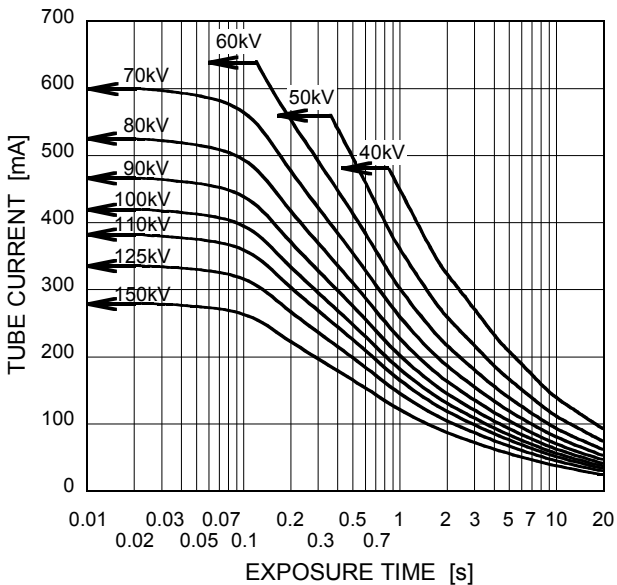
Nominal Focal Spot Value: 0.3 □



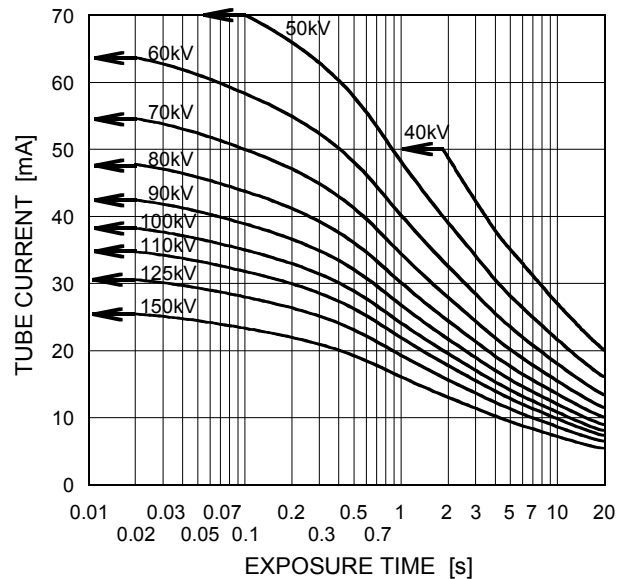
Refer to IEC60613:2010

Conditions: Constant Potential High-Voltage Generator
Stator Power Frequency 60Hz

Nominal Focal Spot Value: 1.0 ■



Nominal Focal Spot Value: 0.3 □

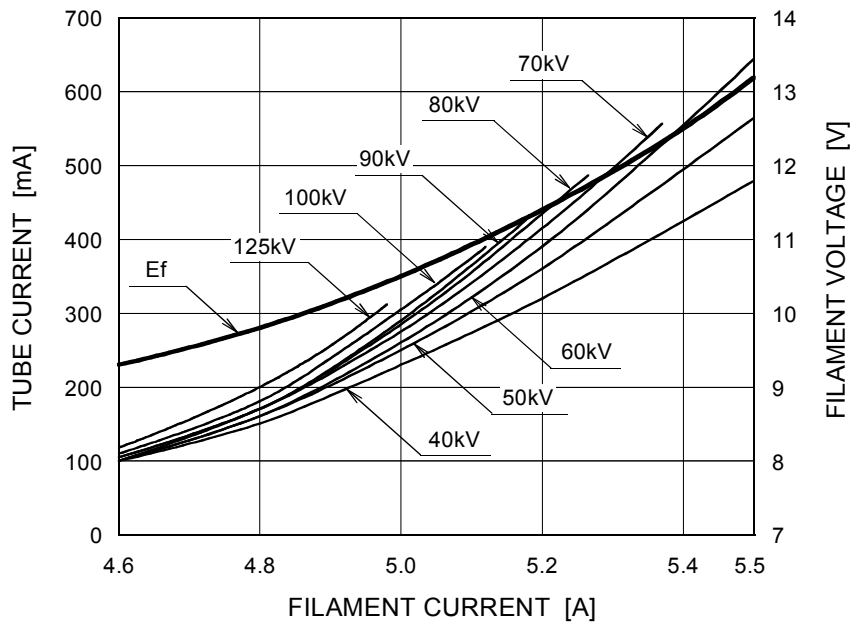


Refer to IEC60613:2010

Emission & Filament Characteristics

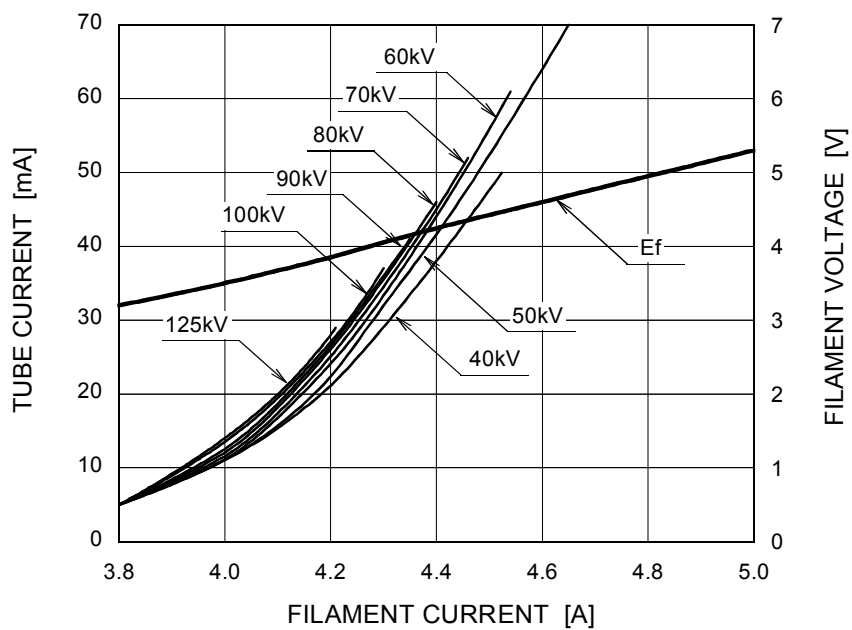
Constant Potential High-Voltage Generator

Nominal Focal Spot Value: 1.0 ■



Note 1) For Reference Only
 Note 2) Refer to IEC60613:2010

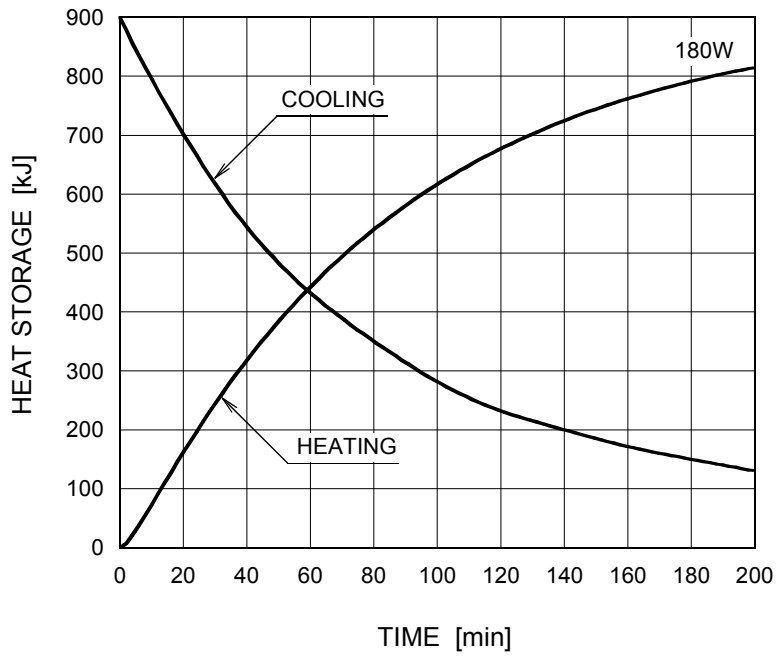
Nominal Focal Spot Value: 0.3 □



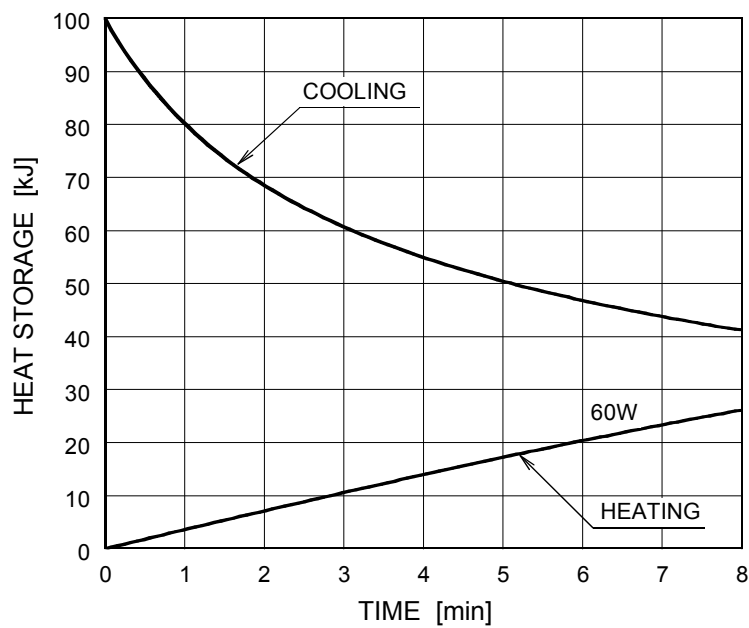
Note 1) For Reference Only
 Note 2) Refer to IEC60613:2010

Thermal Characteristics

X-ray Tube Assembly Heating / Cooling Curve



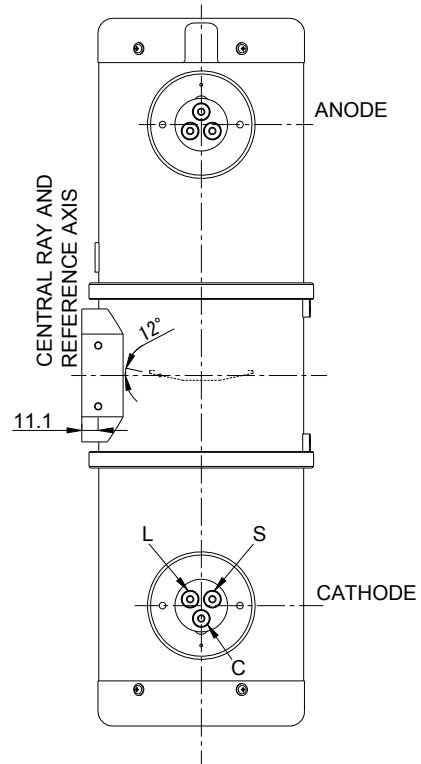
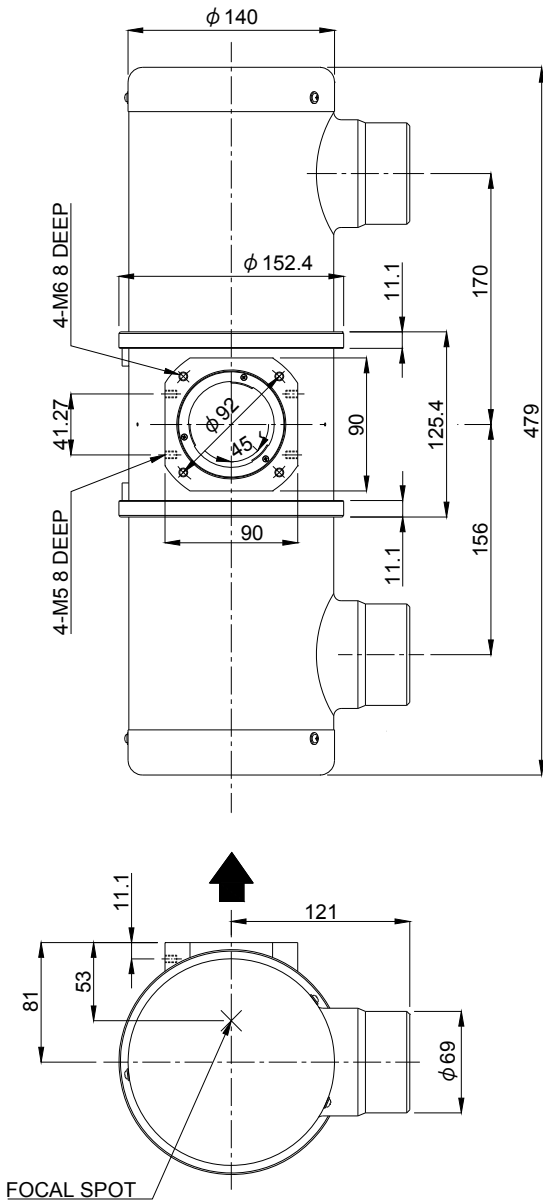
Anode Heating / Cooling Curve



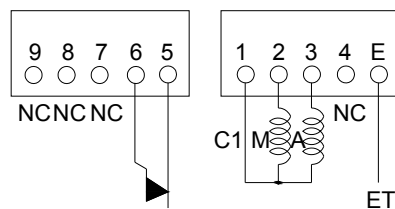
The heating curves are showing example of average input power to anode in operation.

Dimensional Outline

Unit mm



TERMINAL CONNECTIONS



TEMPERATURE RELAY
(NORMALLY CLOSED)

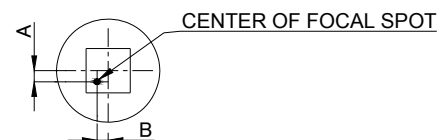
Note) Do not connect terminal No.1 and No.5 or 6 in series circuit.

CATHODE TERMINAL

- C : COMMON
- L : LARGE FOCUS
- S : SMALL FOCUS

TERMINAL CONNECTIONS

- C1 : COMMON
- M : MAIN WINDING OF THE STATOR
- A : AUX. WINDING OF THE STATOR
- NC : NON-CONNECTION
- ET : EARTH TERMINAL



$$-1.5\text{mm} \leq A \leq 1.5\text{mm}$$

$$-1.5\text{mm} \leq B \leq 1.5\text{mm}$$

▲ : CENTRAL X-RAY
ANODE & CATHODE TERMINAL
: IEC60526 TYPE

OVERSEAS SUBSIDIARIES AND AFFILIATES



EU REPRESENTATIVE

· **TOSHIBA ELECTRONICS EUROPE GMBH**

HANSAALLEE 181 40549 DÜSSELDORF, GERMANY
PHONE +49 (211) 5296-107 FAX +49 (211) 5296-402

For Sales & Technical Services, please contact the following representative:

· **TOSHIBA ELECTRONICS EUROPE GMBH**

HANSAALLEE 181 40549 DÜSSELDORF, GERMANY
PHONE +49 (211) 5296-107 FAX +49 (211) 5296-402

· **TOSHIBA AMERICA ELECTRONIC COMPONENTS, INC.**

2150 EAST LAKE COOK ROAD, SUITE 310
BUFFALO GROVE, ILLINOIS 60089 USA
PHONE +1 (847) 484-2400 FAX +1 (847) 541-7287

· **TOSHIBA ELECTRON DEVICES & MATERIALS (SHANGHAI) CO., LTD. (TEMS)**

RM1606, SH-PLAZA,
No.336, XIZANG ROAD (MIDDLE), SHANGHAI, 200001, CHINA
PHONE +86 (21) 6361-0077 FAX +86 (21) 6351-5760