

**MEIDEN**

Quality connecting the next

# Cold Cathode X-ray Tube Using Carbon Nanostructures

**Compact, lightweight,  
and low power  
consumption enable  
mobile non-destructive  
inspection applications**



[90 kV]

[180 kV]

[120 kV]

Made  
in  
Japan

**RoHS  
compliant**  
(10 substances)

Reliable vacuum  
technology from Meidensha

# Cold Cathode X-ray

Cold cathode X-ray tubes generate X-rays when an electric field is applied to device.  
There is no Cathode heater as used in conventional X-ray tubes, no warm-up/stabilization period is required and X-ray irradiation is possible instantaneously.



Full-scale [90 kV]



## Compact and Lightweight

No need for a heating element means a slim and compact shape.  
It is less than 50% the size of conventional products.



## Instant Irradiation

X-rays are emitted instantly upon power application, there is no cathode heater warm-up/stabilization period.  
Intermittent operation is possible because there is no standby time.



## Low Power Consumption

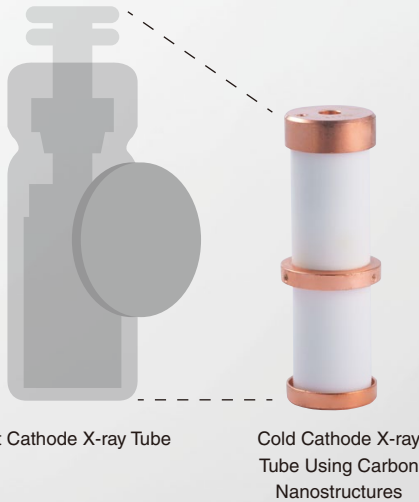
Power consumption is reduced because the cathode does not need to be heated.  
X-rays can be output even using dry batteries.



## Life Expectancy Prediction

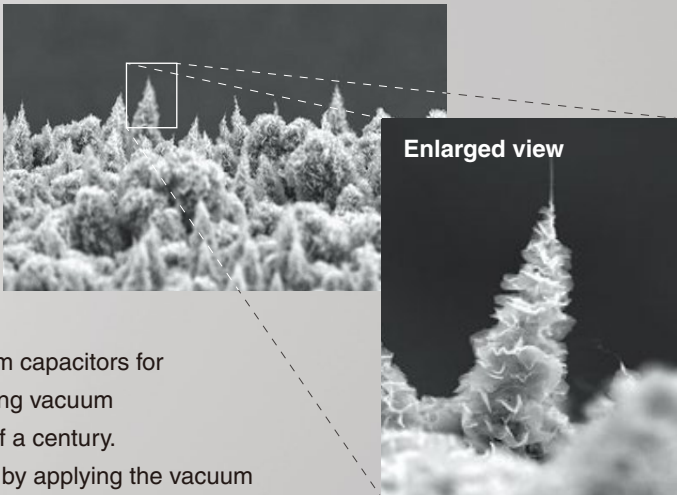
Optimum replacement timing can be predicted by detecting signs of life expectancy coming to an end from dose reduction.

Volume and weight both reduced by 50% or more



## Carbon Nanostructure Emitter

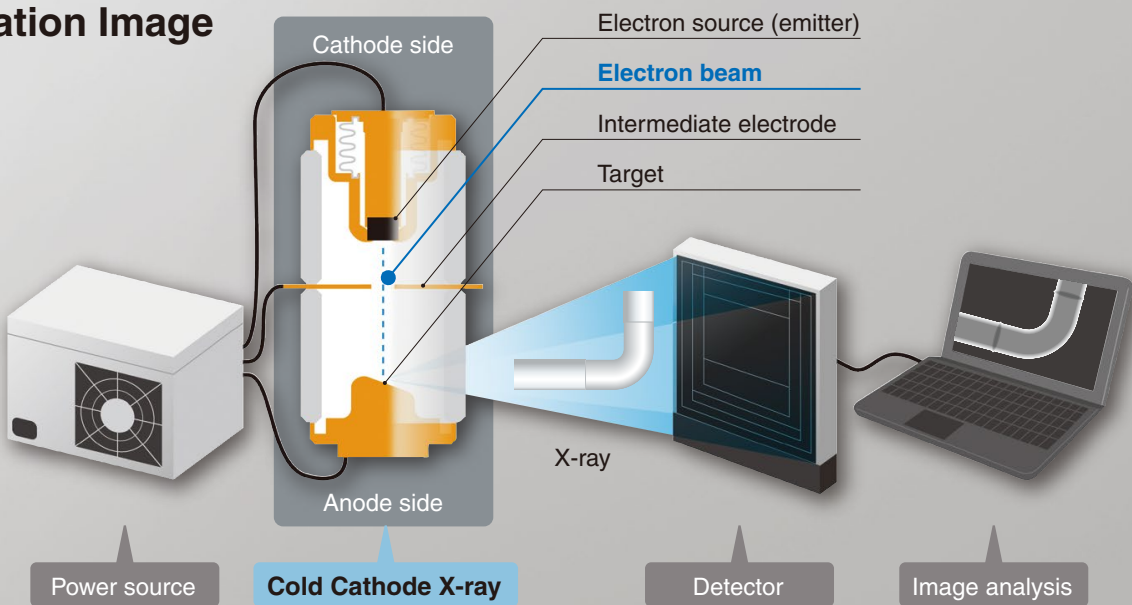
Carbon nanostructures (CNX) are used as the electron source (emitter).  
CNXs have a pine tree-like structure and are characterized by the ease with which they emit electrons.



## Reliable Vacuum Technology

Meidensha has been developing and manufacturing vacuum capacitors for semiconductor manufacturing equipment since 1994, utilizing vacuum technology and know-how accumulated over more than half a century.  
Commercialization of this product has been made possible by applying the vacuum technology acquired through those efforts (Meidensha's patented technology).

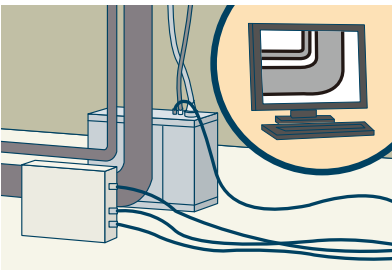
## Operation Image



## Main Applications

Utilizing the ability of X-rays to penetrate objects, it is possible to non-destructively check the internal structure of objects.  
In addition to medical X-rays, the product is also expected to play an active role in a variety of industrial applications such as industrial goods and baggage inspection.

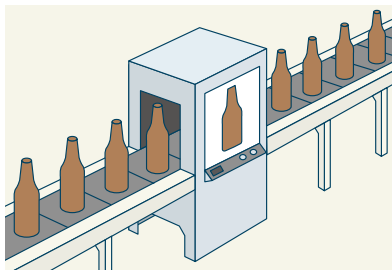
### Infrastructure inspection



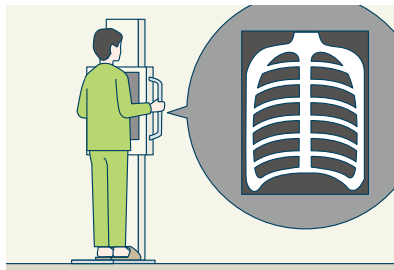
### Security



### Manufacturing



### Medical



\* This product uses technology of the National Institute of Advanced Industrial Science and Technology (AIST) and Life Technology Research Institute, Inc. Meidensha has entered into a patent licensing agreement with both institutes for the manufacture and sale of this product.

Specifications

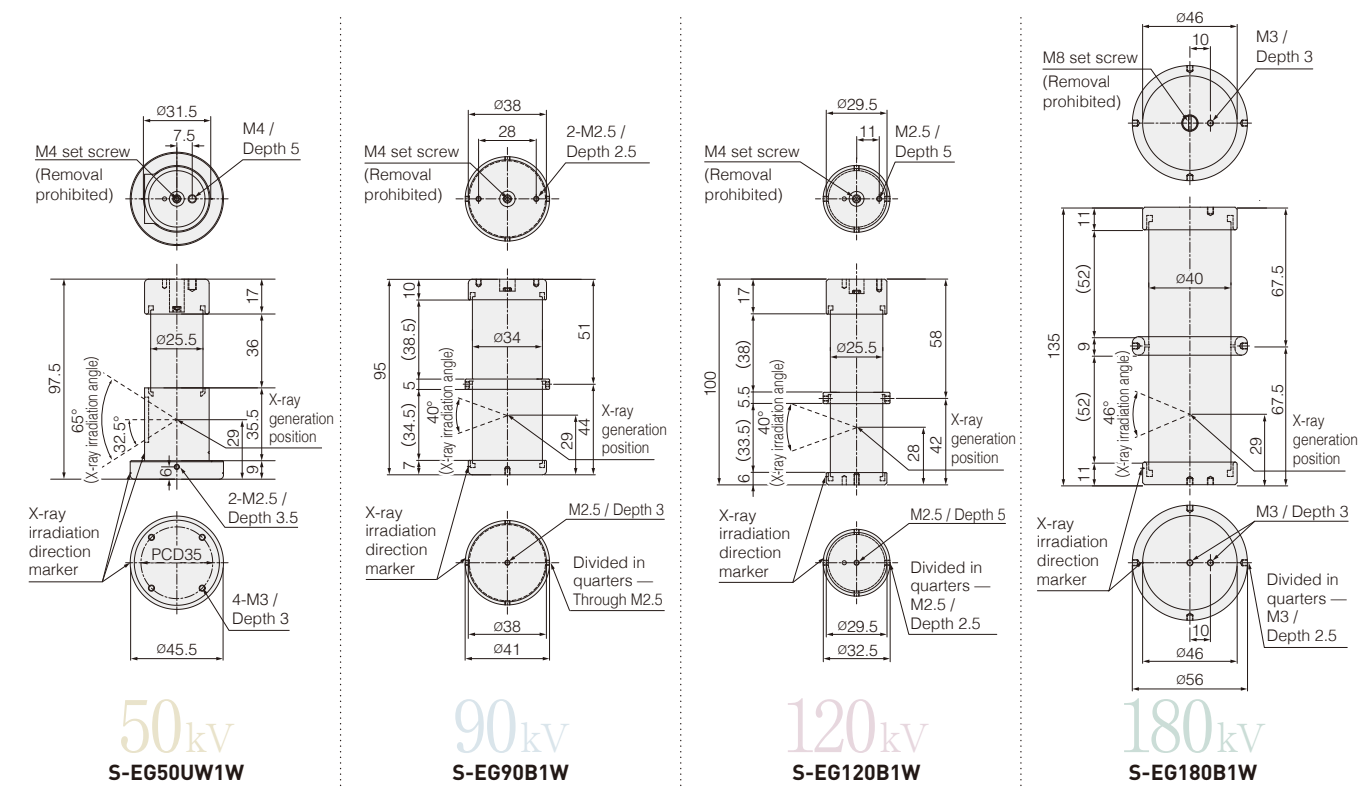
Maximum tube voltage used		50 <sub>kV</sub>	90 <sub>kV</sub>	120 <sub>kV</sub>	180 <sub>kV</sub>
					
Specifications		S-EG50UW1W <sup>*1</sup>	S-EG90B1W	S-EG120B1W	S-EG180B1W
Maximum tube voltage		50 kV	90 kV	120 kV	180 kV
Rated voltage between poles	Cathode-Intermediate electrode	—	−35~−45 kV	−40~−60 kV	−60~−90 kV
	Anode-Intermediate electrode	—	30~55 kV	40~60 kV	70~100 kV
Maximum tube current		1 mA	1 mA	1 mA	1 mA
Focal spot size		2.1×1.4 mm	1.0×0.4 mm	1.6×0.8 mm	1.2×2.2 mm
Weight		395 g	340 g	240 g	670 g
Outer diameter		Φ45.5 mm	Φ41 mm	Φ32.5 mm	Φ56 mm
Total length		91.7 mm	95 mm	100 mm	135 mm
Target angle		32.5° (Cone)	20° (Cone)	20° (Cone)	23° (Cone)
Target		Tungsten	Tungsten	Tungsten	Tungsten
Electron source (emitter)		Carbon nanostructure	Carbon nanostructure	Carbon nanostructure	Carbon nanostructure
Solid filtration		Beryllium 0.2 mm	Alumina 3 mm	Alumina 3.3 mm	Alumina 4 mm
Ambient environment conditions	Operating environment	Insulated between poles	Insulated between poles	Insulated between poles	Insulated between poles
	Ambient temperature in use	10~60°C	10~60°C	10~60°C	10~60°C
	Pressure	70~140 kPa	70~140 kPa	70~140 kPa	70~140 kPa
Transport and storage conditions	Ambient temperature	10~60°C	10~60°C	10~60°C	10~60°C
	Relative temperature	0~85 % <sup>*2</sup>	0~85 % <sup>*2</sup>	0~85 % <sup>*2</sup>	0~85 % <sup>*2</sup>
	Atmospheric pressure	50~106 kPa	50~106 kPa	50~106 kPa	50~106 kPa

\*1 Power applied to negative between single electrodes (no intermediate electrode)

\*2 No condensation



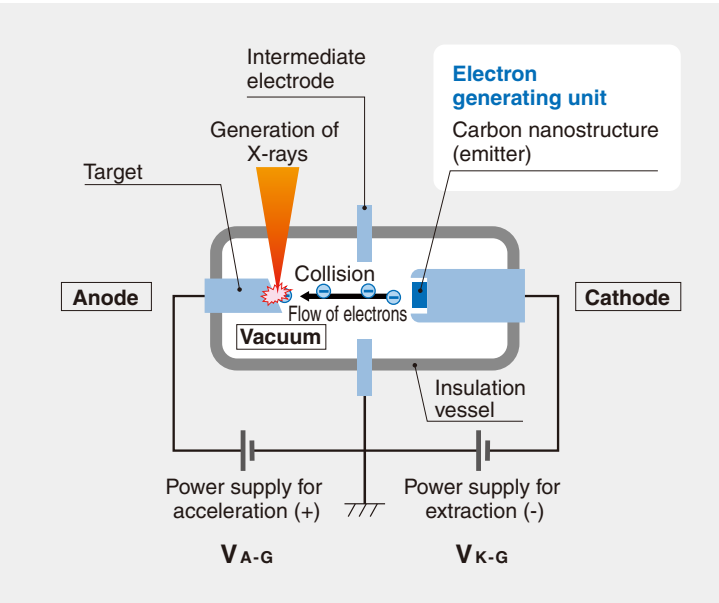
External Drawing



Technical Information

1. Composition of Cold Cathode X-ray Tube

The X-ray tube consists of an extraction power supply to generate electrons and an acceleration power supply to accelerate electrons. The tube voltage and tube current can be set by controlling input cathode voltage  $V_{K-G}$  and input anode voltage  $V_{A-G}$ .



1.1 Tube voltage

The tube voltage is the sum of the absolute values of input anode voltage  $V_{A-G}$  and input cathode voltage  $V_{K-G}$ .

1.2 Tube current

Tube current is the value of current  $I_A$  between the anode and intermediate electrode.  $I_A \leq I_K$  because some of the electrons emitted from the emitter are lost at the intermediate electrode.

Technical Information

2. Tube Voltage and Tube Current Adjustment

Tube voltage is adjusted by anode voltage  $V_{A-G}$ , and tube current is adjusted by cathode voltage  $V_{K-G}$ .

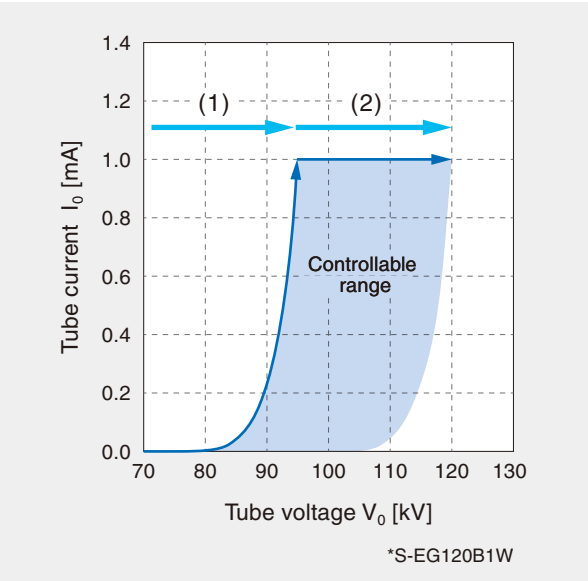
Adjustment procedure

- (1) Apply cathode voltage  $V_{K-G}$  until the desired current is obtained.
- (2) Apply anode voltage  $V_{A-G}$  to achieve the desired voltage.

Note: Settings must below the rated voltage and rated current.  
Reference: Please refer to the current–voltage characteristics supplied at the time of purchase for the voltage values to be applied.

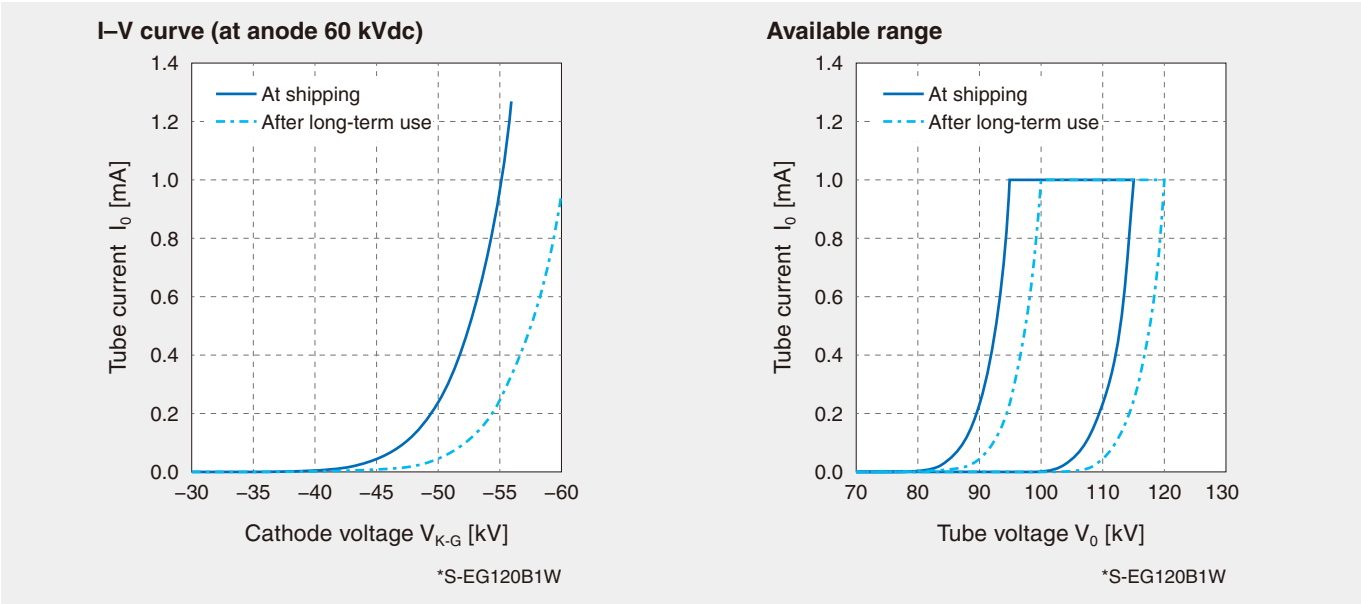
Example) When setting 120 kV 1 mA for S-EG120B1W,

- (1) Gradually apply cathode voltage  $V_{K-G}$  until 1 mA output is achieved.
- (2) Apply 120 kV minus the set cathode voltage  $V_{K-G}$  as the anode voltage  $V_{A-G}$ .



3. Change in Current–Voltage Characteristic

The current–voltage characteristic (I–V curve) of a cold cathode X-ray tube shifts to the high voltage side as the energization time progresses. At the same time, the operating range also tends to change.



4. Customized Cold Cathode X-ray Tubes

Please contact Meidensha for customization to meet your needs.

X-ray Source Specifications



S-ES50UW1W

Maximum usable tube voltage	50 kV
Maximum usable tube current	1 mA
Irradiation angle	65° (minimum)
Irradiation method	Continuous irradiation
Focal spot size	2.1×1.4 mm

External dimensions	296.0×412.2×118.5 mm (including protrusions)
Weight	Approx. 7 kg
Input	24 Vdc
Interface	RS-232C



## Handling Precautions

### 1. Safety Cautions

- (1) When using X-ray tubes, prevent radiation exposure to human bodies, etc., in accordance with applicable laws and regulations.

### 2. Transport and Storage

- (1) The structure of X-ray tubes makes them susceptible to damage from external shocks.
- (2) The allowable shock level for X-ray tubes is 294 m/s<sup>2</sup> (30 G). Do not subject X-ray tubes to greater impact by dropping, etc.
- (3) The allowable vibration level of X-ray tubes is 7 m/s<sup>2</sup> (0.7 G). Do not subject X-ray tubes to greater vibration.
- (4) If there is any problem with the appearance of the delivered X-ray tube, please keep it along with the packaging materials used and contact a sales representative. Note that discoloration of the ceramic or copper may occur during the manufacturing process and is not an abnormality.
- (5) When storing, it is recommended that X-ray tubes be stored under the storage conditions specified in standard specification documents in order to avoid insulation deterioration due to oxidation of the mounting surface and surface fouling of the film or insulation. In addition, avoid storing in an environment such that exposed to wind, rain, corrosive gases (especially sulfur and chlorine), etc., which may accelerate the deterioration of packaging materials and X-ray tubes.

### 3. Mounting X-ray tubes

- (1) If conductors, including the grounding phase, are placed near an X-ray tube, their influence may cause a drop in the X-ray tube withstand voltage. Please give sufficient consideration to the placement of equipment.
- (2) If there is dirt or condensation on the insulation tube part, wipe it off with a dry cloth, a cloth moistened with alcohol, etc. Do not use solvents containing chlorine (trichloroethane, etc.).
- (3) Tighten the mounting screws on the cathode side, anode side, and intermediate electrode with the specified tightening torque (M2.5:17, M3:29, M4:78

Ncm) or less. Tightening with greater than the specified tightening torque or inserting screws at an angle may result in damage to the screw taps.

- (4) Do not touch the M4 set screw. Performance is not guaranteed if touched.

### 4. During Operation

- (1) Please make every effort to prevent radiation exposure, including to third parties, while the equipment is in operation.
- (2) Do not touch the X-ray tube directly during operation.
- (3) The allowable vibration level of X-ray tubes is 7 m/s<sup>2</sup> (0.7 G). Do not subject X-ray tubes to greater vibration.
- (4) When using X-ray tubes, it is necessary to ensure insulation between the electrodes on the atmosphere side by means such as molding or immersion in insulating oil.
- (5) Operate X-ray tubes in an ambient environment that takes into consideration the operating environment conditions described in the specifications.
- (6) If a large discharge occurs in an X-ray tube, performance may be significantly degraded. Please confirm the characteristics.

### 5. Use After Long-term Storage

- (1) When using an X-ray tube after long-term storage, perform break-in operation by applying a low voltage to start with.

### 6. Power Supply

- (1) The combination of cathode and anode power supplies and the timing of power application may affect X-ray generation time, etc. The power supply voltage, including the peak voltage, should not exceed the rated voltage between the poles.

### 7. Technical Information

- (1) This document contains only part of the technical information. Upon request, data such as external dimensions and characteristics of all X-ray tube products can be provided.
- (2) Product specifications are subject to change without notice for improvement, etc. Please confirm the latest information when considering the product.



## MEIDENSHA CORPORATION

ThinkPark Tower, 2-1-1, Osaki, Shinagawa-ku, Tokyo, 141-6029 Japan

[www.meidensha.com](http://www.meidensha.com)

#### Contact Us

#### Cold Cathode X-ray Tube

[https://www.meidensha.com/xray\\_tube](https://www.meidensha.com/xray_tube)

Please click **Contact Us** on the product's web page.



#### Safety Precautions

Prior to using our products, please read through the relevant instruction manuals and related materials.

■ Due to our commitment to continually improving the function and performance of our products, specifications are subject to change without prior notice.



**BA92-3363B**

As of Oct., 2024

2024-10ME (1.5L) 1L