

Electron beam Processing System Manufacturer
Changing materials with EB



NHV Corporation

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**NISSIN
ELECTRIC**

EPS Technical guide

NHV Corporation products

Electron beam
Processing
System

NHV Corporation

ELECTRON BEAM PROCESSING SYSTEM(EBPS)

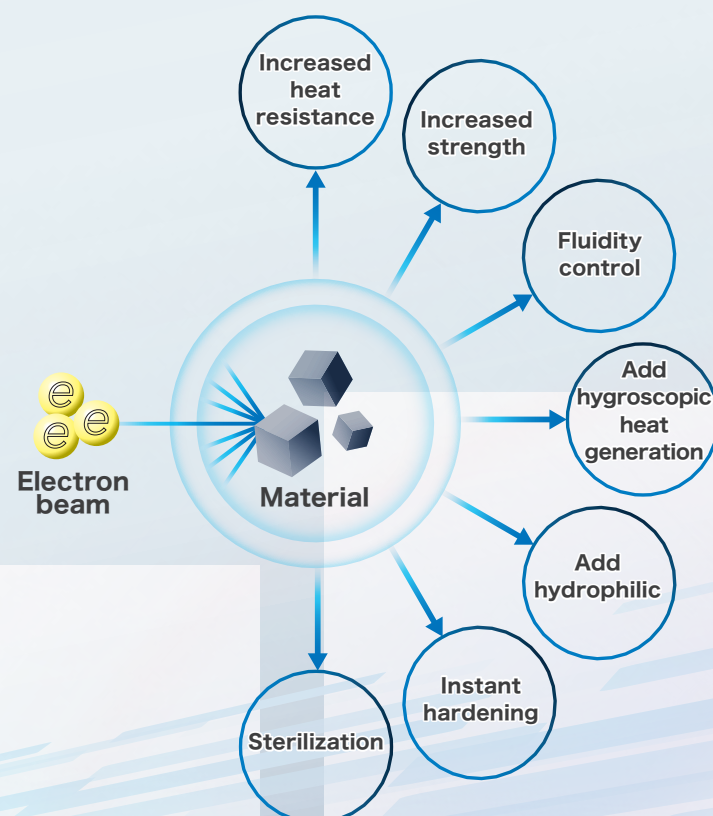
INCREASING THE POTENTIAL OF MATERIALS

ELECTRON BEAM (EB)

Electrons are accelerated to high speed by high voltage and used as a beam (Electron Beam : EB) to create reactions not possible with conventional heat and light methods.

When EB is applied to the material, electrons pass through the material while giving energy. This energy causes chemical reactions as it interacts at the molecular level.

EB has high energy transfer rate making it suitable for high speed processing used in manufacturing for many products in our daily lives.



NHV Corporation offers a broad selection of products for our customers.

First developing our electron beam processing system in 1957, more than 450 units are installed in 35 countries around the world. Through the development and sales of electron beam processing systems for more than 60 years we have cultivated original technology enabling consistently high quality EB irradiation. We contribute to future manufacturing by our assorted lineup and ability to propose novel solutions.



EB changes materials and improves our way of life.

EB technology enables highly specialized fields as well as products surrounding us in our everyday lives changing our lifestyles across a wide variety of fields.

Foam sheets
Improving quality

Wires
Improving heat resistance

Tires
Cost reduction
Higher quality

SiC fibers
Improving heat resistance of engine material

Clothing
Creating functional materials

Printing/packing
Hardening ink

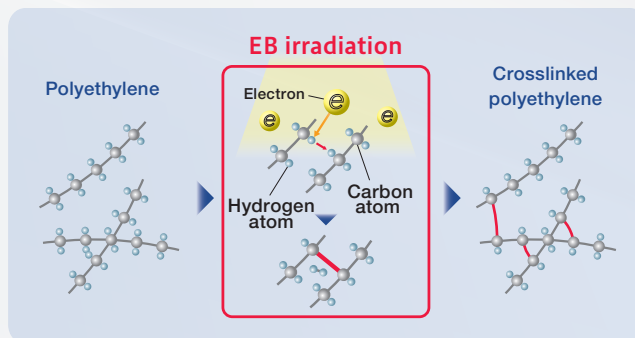
Wafers
Improving properties of power semiconductors

Sterilization
Medical devices
Inspection tools

Crosslinking

Wire and automotive fields

EB generates crosslinking between molecules that have separated bonds creating a three-dimensional lattice structure to improve heat resistance and strength, etc.



Fluidity control

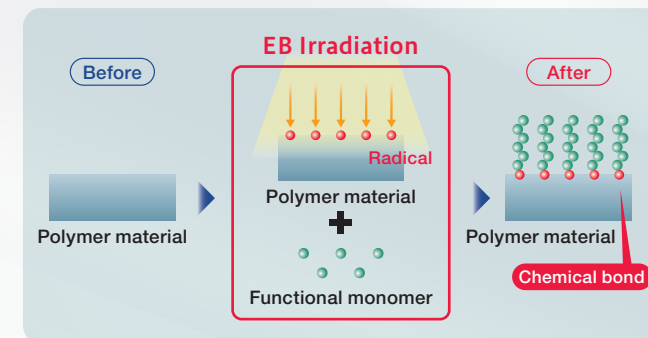
Increased heat resistance

Increased strength

Grafting

Clothing and battery separator, etc.

EB creates polymer radicals forming a base and is able to add new functionality by bonding separate molecules.



Add hydrophilicity/
water repellency

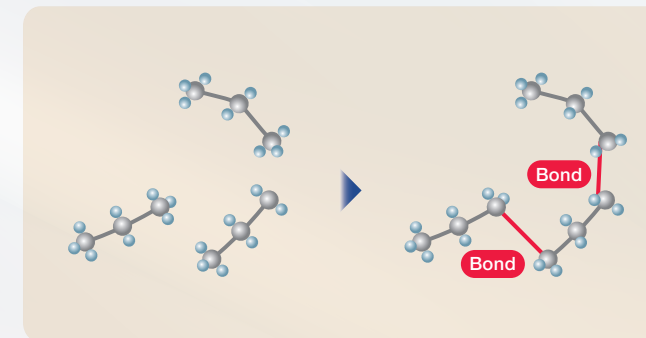
Add moisture absorption
and heat generation

Add ion absorption

Curing

Printing fields and coating, etc.

EB instantly polymerizes a small molecular monomer. This is used to harden inks, coatings, adhesives, etc.



Instant hardening

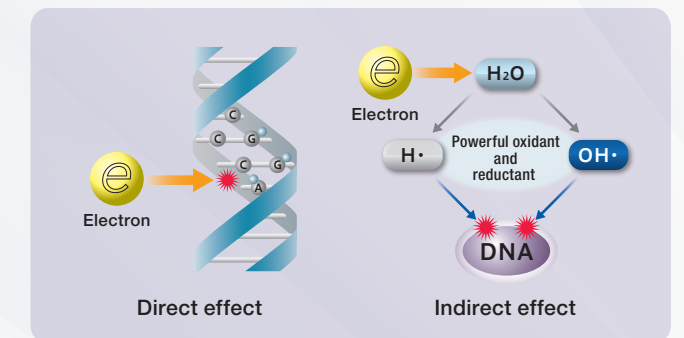
Increased wear resistance

Increased stain resistance

Sterilization

Medical fields, etc.

EB's direct and indirect effects can sterilize by damaging cells without using chemicals or gas.



Medical device

Inspection tools

Medical device/
Beverage containers

Characteristics of Electron Beam (EB)

Possibilities of EB irradiation based on the product

Penetration

EB has penetrative ability and can penetrate deeply based on the accelerator voltage. Selecting accelerator voltage based on the product thickness enables improvement of internal properties or just the surface.

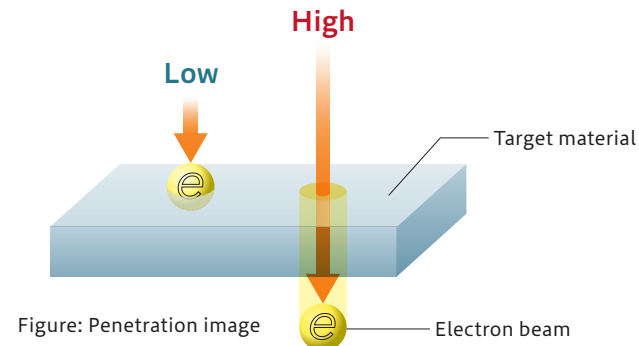
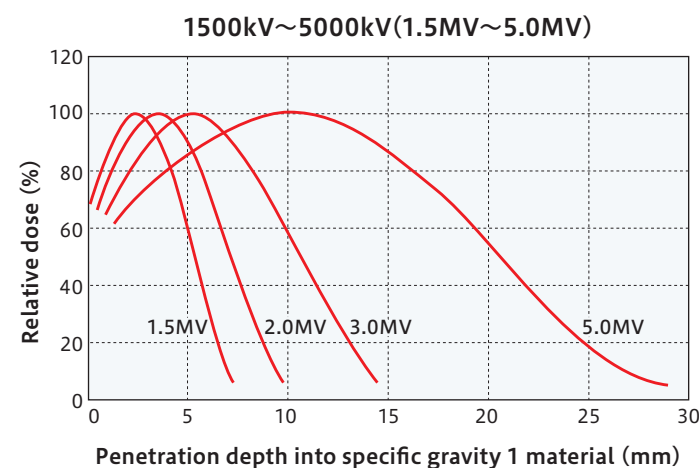
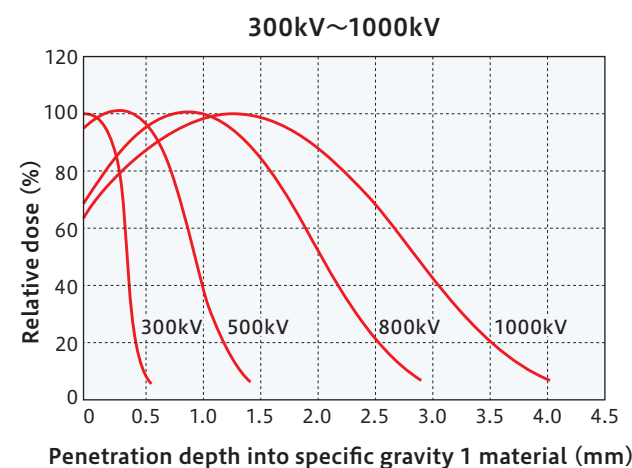


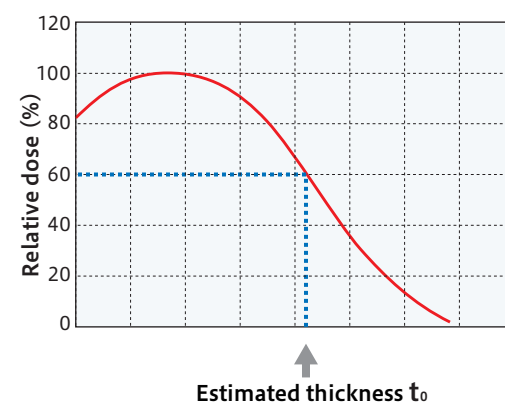
Figure: Penetration image

Depth-Dose curve



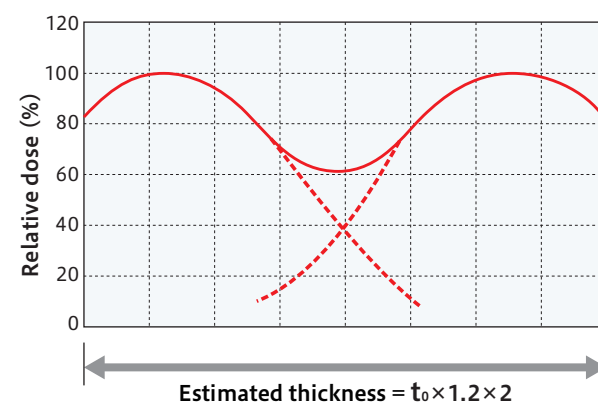
EB treatment thickness

EB treatment thickness is generally the thickness to receiving 60% of the relative dose. (80% for curing)
For materials with specific gravity ρ , the value on horizontal axis is divided by ρ .
For example, when 1.5MV EB is irradiated to a material with specific gravity 0.9, estimated treatment thickness is $(=5\text{mm})/0.9=5.5\text{mm}$.



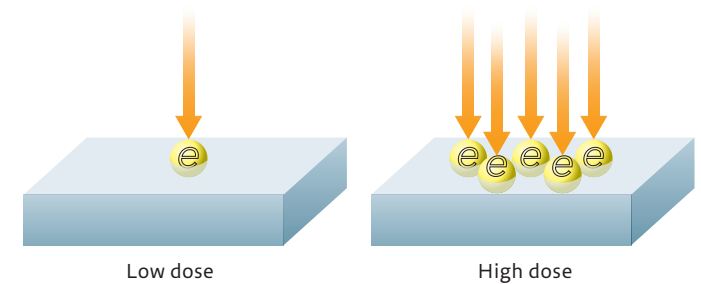
Both sides irradiation

When penetration insufficient, both sides irradiation can treat even thick products.
For example, when 1.5MV EB is irradiated to a material with specific gravity 0.9 from both side, estimated treatment thickness $t_0(=5\text{mm})/0.9 \times 1.2 \times 2 = 13.3\text{mm}$.

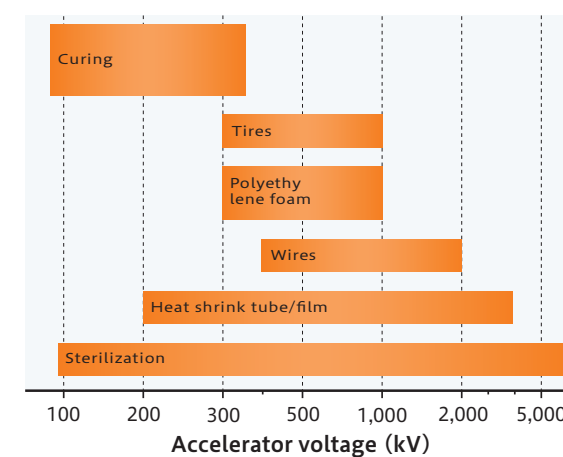


Absorbed dose

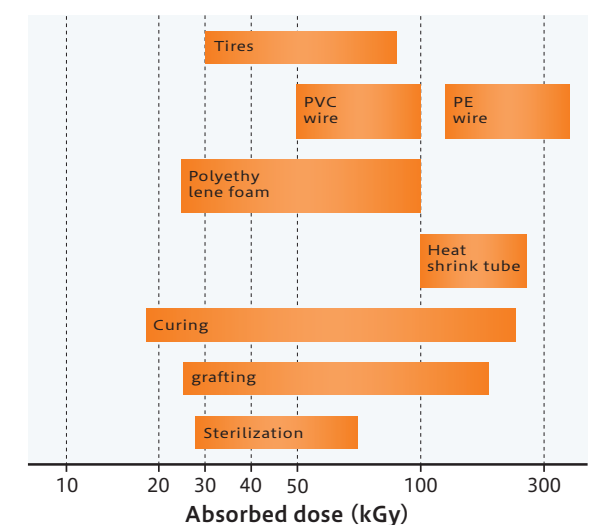
The energy applied by the EB is represented using the dose unit grays (Gy=J/kg) and required dose differs depending on product and application. The dose by EPS is controlled based on the value of electron irradiation (beam current) and product line speed.



Accelerator voltage and application



Dose and application



Achieve high productivity

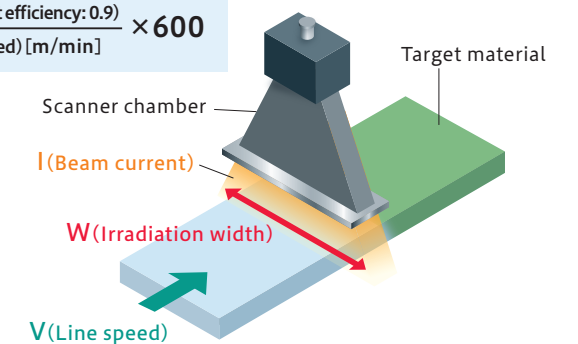
EB processing capacity

The relationship between energy (absorbed dose) applied to the product and line speed is shown below.

$$D \text{ (Absorbed dose) [kGy]} = \frac{\Delta E}{\Delta R} \text{ (Constant)} \times \frac{I \text{ (Beam current) [mA]} \times \eta \text{ (Beam current efficiency: 0.9)}}{W \text{ (Irradiation width) [cm]} \times V \text{ (Line speed) [m/min]}} \times 600$$

$\frac{\Delta E}{\Delta R}$ = Energy loss based on accelerator voltage

Accelerator voltage	300kV	500kV	800kV	1,000kV or more
$\frac{\Delta E}{\Delta R}$	3.6	2.9	2.45	2



Electric power cost reduction

Compared to conventional heat or light treatments, EB directly modifies molecular composition and uses energy without waste.



EPS

Electron beam
Processing System

Electron beam Processing System

5 Characteristics of EPS

The EPS (Electron beam Processing System) has 5 characteristics based on the high voltage, beam control, high vacuum and safety systems technologies cultivated over many years by NHV Corporation.

01 High precision

EB uniformity has a significant impact on product quality variability. Our EPS achieves a high level of uniformity in EB irradiation due to NHV Corporation's unique magnetic field control technology.

02 High energy efficiency

The power supply circuit, which has high function/compact capacitors developed over many years of experience with electrical devices, has unparalleled power conversion efficiency and contributes to power savings.

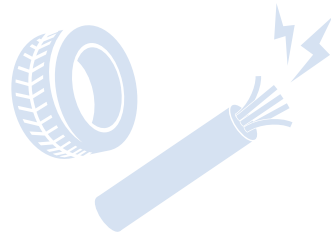


03 Stable beam output

Our product is well recognized for its trustworthiness, an acclaim earned through more than 60 years of use and improvement in industries including tires and wire manufacturing.

04 Designed for the customer

- Proposal for conveyor line based on customer product
- Proposal for layout matching installation space
- Support for standards of delivered country
Example support: CE mark, UL standard



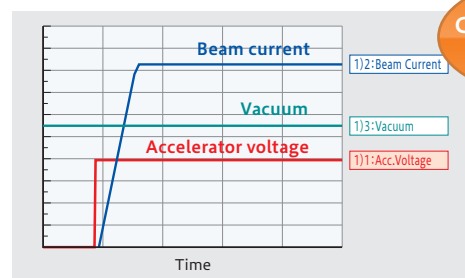
05 Simple and safe operation

Operated easily by touch panel. When an error is detected in the interlock function, EPS stops immediately and you can use it with confidence.



Touch panel

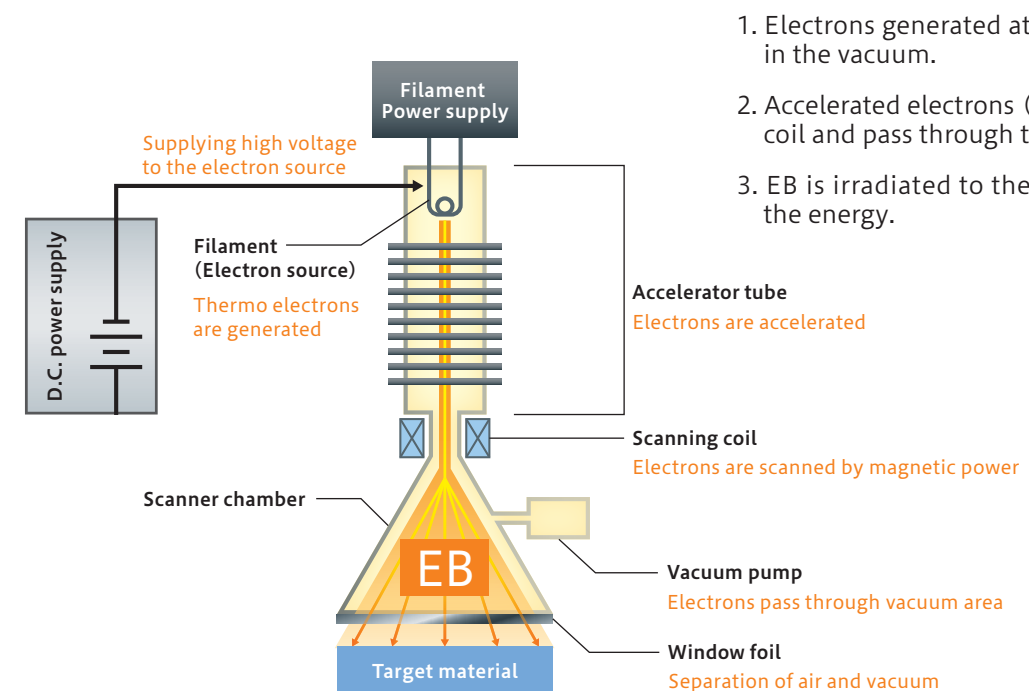
Simple operation
on the touch panel



Operation chart

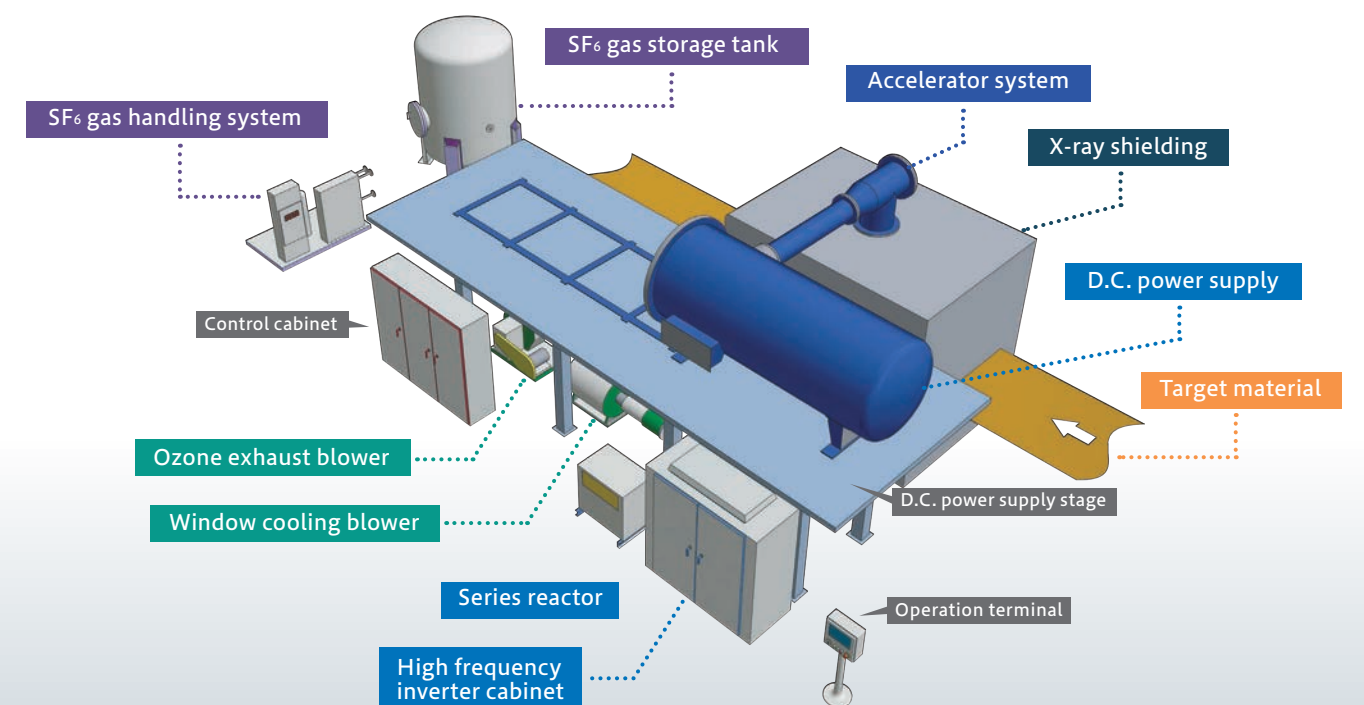
Check the operation
chart with the log

EPS Principles



1. Electrons generated at the filament are accelerated in the vacuum.
2. Accelerated electrons (EB) are scanned by scanning coil and pass through the window foil.
3. EB is irradiated to the target material and applies the energy.

System composition



EPS

Electron beam
Processing System

EPS product examples

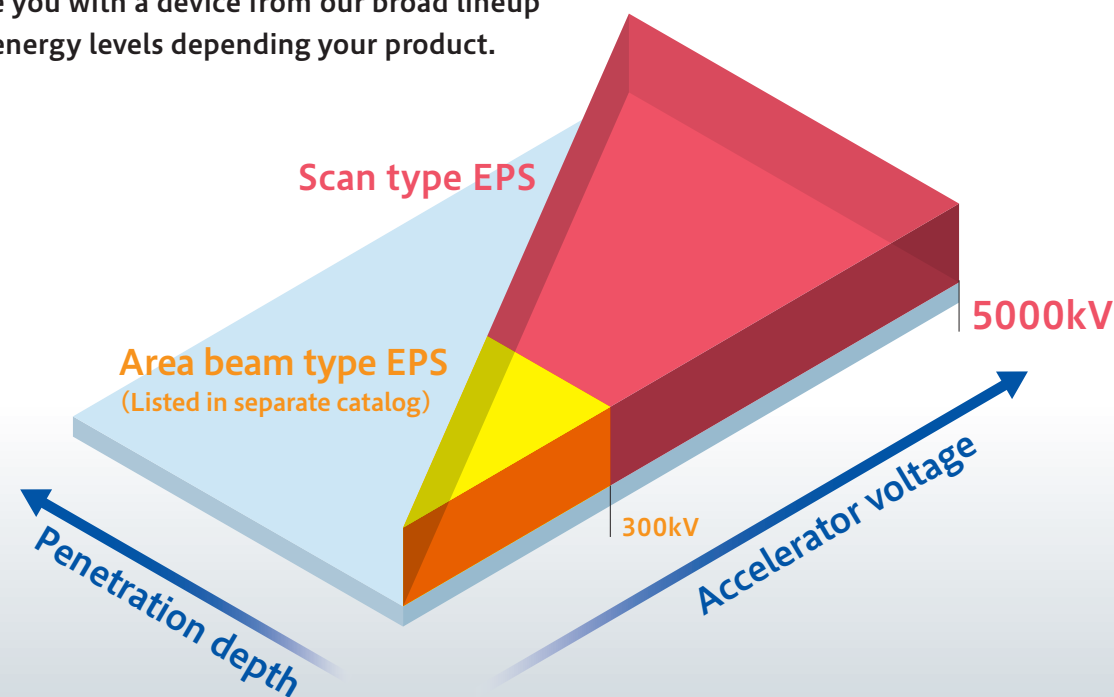
Proposal of optimal device according to product/application
Continual support from irradiation test to device selection
and installation.

Product ratings/specifications

Please consult with us about what specifications
are right for your application and product.

Lineup

We can provide you with a device from our broad lineup
of low to high energy levels depending your product.



Standard ratings

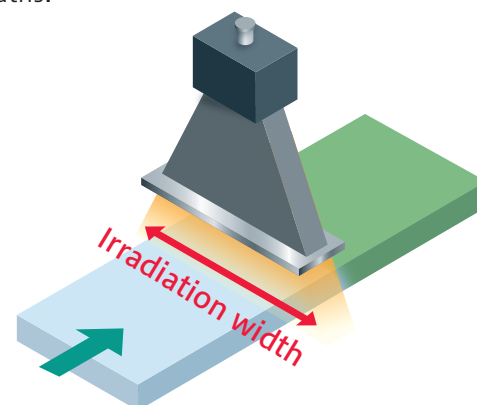
Model	Accelerator voltage*	Beam current
EPS-500	300-500kV	65mA/100mA/150mA
EPS-800	400-800kV	65mA/100mA
EPS-1000	500-1000kV	65mA/100mA
EPS-1500	800-1500kV	65mA
EPS-2000	1000-2000kV	50mA
EPS-3000	1500-3000kV	33mA
EPS-5000	3000-5000kV	20mA

*For variable type

Irradiation width

Standard 60cm / 120cm / 180cm

We also support a large variety of irradiation
widths.



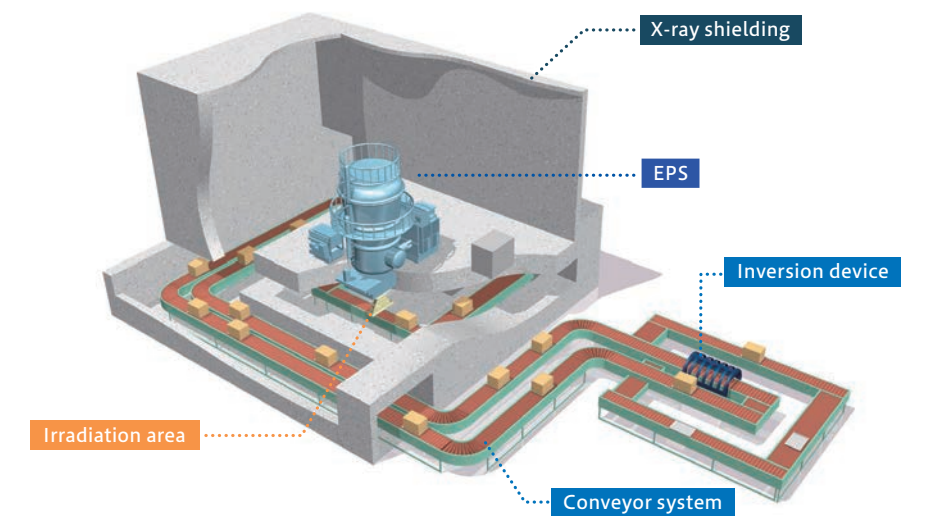
Concrete shielding type EPS(500~5000kV)

Since the EPS generates X-rays during EB irradiation, shielding is required to prevent X-ray leaks
to the outside and the high energy EPS uses concrete X-ray shielding.

EPS-5000



Model : EPS-5000
Accelerator voltage : 3000~5000kV

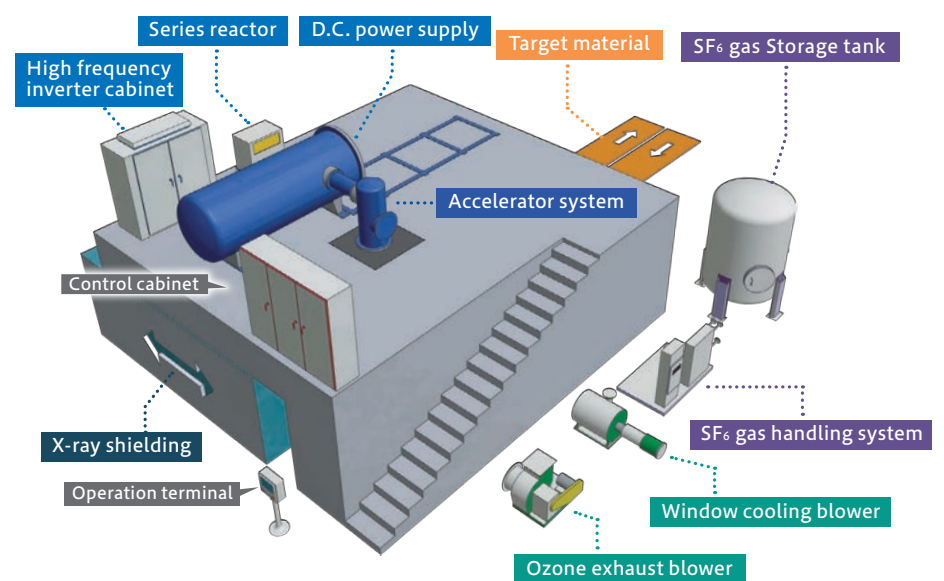


Example system composition

EPS-1000



Model : EPS-1000
Accelerator voltage : 500~1000kV



Example system composition

EPS

Electron beam
Processing System

EPS product examples

Proposal of optimal device according to product/application
Continual support from irradiation test to device selection
through design

Self shielding type EPS (300~800kV)

The self shielding type EPS adopts a shielding structure using lead and steel with high shielding functionality to achieve a compact device structure enabling inline use on the manufacturing line.

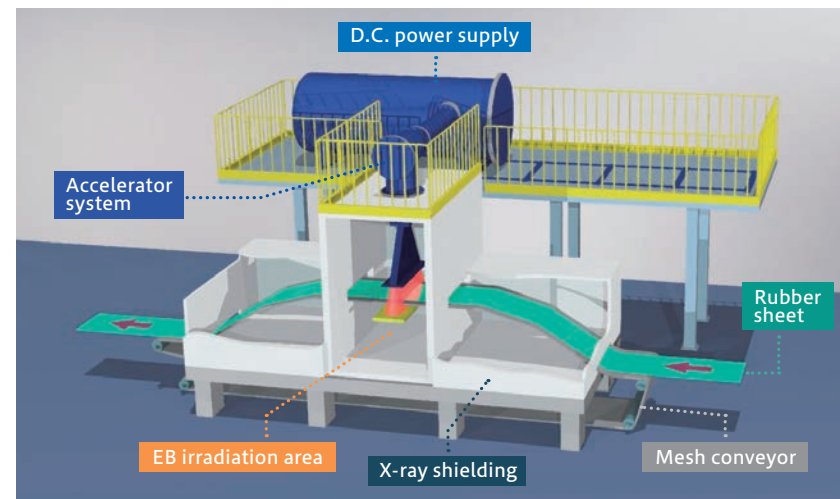
We offer the optimal device for the customer's product and manufacturing line.

Mesh conveyor type

For sheets



Model : EPS-500
Accelerator voltage : 300~500kV
Conveyor method : mesh conveyor



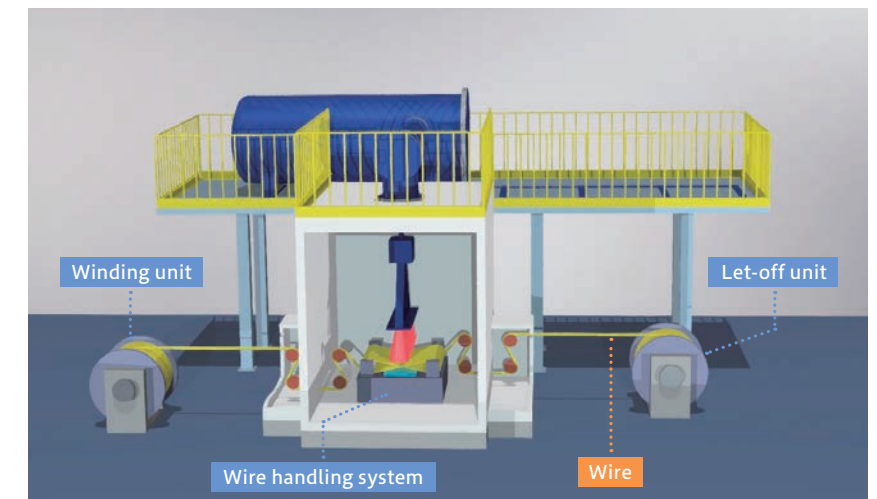
Example system composition

Line conveyor type

For wire & tube



Model : EPS-800
Accelerator voltage : 400~800kV
Conveyor method : Wire handling system



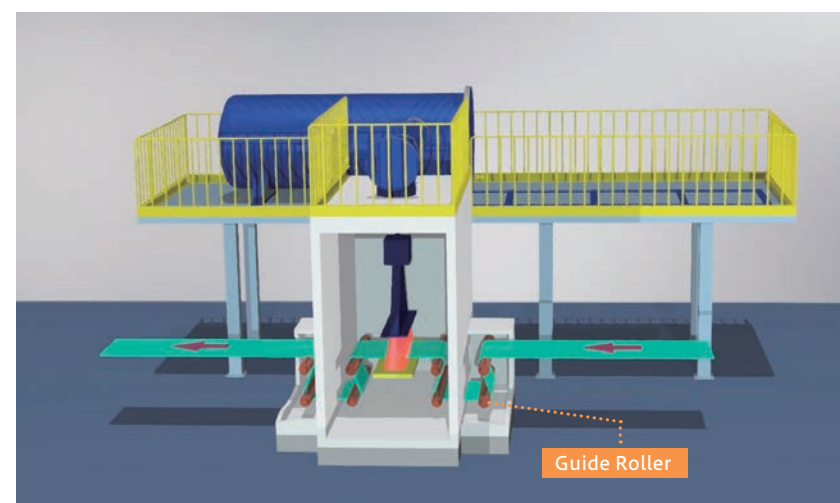
Example system composition

Roll conveyor type

For sheets



Model : EPS-500
Accelerator voltage : 300~500kV
Conveyor method : Free roll



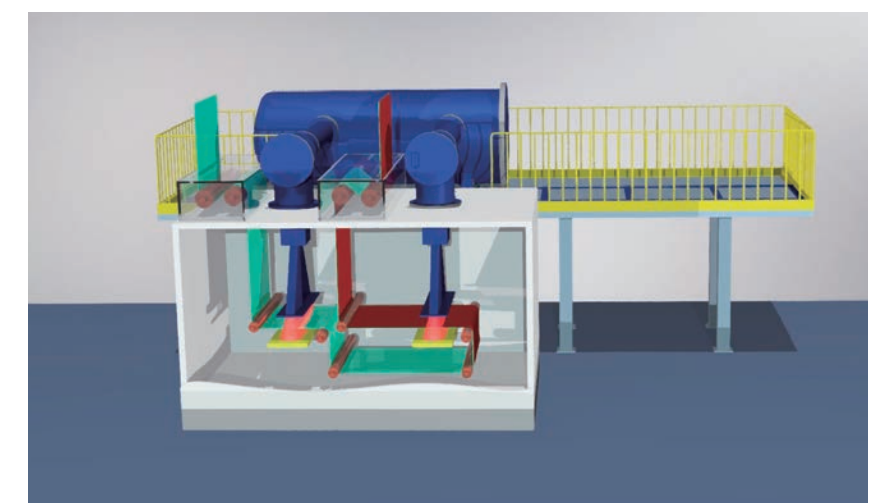
Example system composition

Roll conveyor - Both side irradiation type

For sheets



Model : EPS-500X2
Accelerator voltage : 300~500kV
Conveyor method : Free roll
Irradiation type : Both side irradiation



Example system composition

EPS

Electron beam
Processing System

Electron beam Processing System

Installing EPS and support system

Comprehensive support from irradiation testing through installation and after-sales servicing



Toll Service

The EB center responds to your needs in Irradiation test, product development with EB, consigned production and more. Even customers handling EB for the first time can receive proposals for optimal testing.



Equipment overview · Installation plan

We propose optimal equipment for each customer and support from design and planning through completion.

- Support for technical standards
- Proposals based on the production line



Installation·Commissioning

We dispatch experienced technicians to oversee installation and training is performed for EPS operation as well as maintenance.

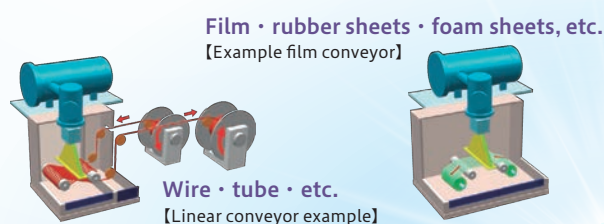


After-sales services

We provide full services and support worldwide after delivery.

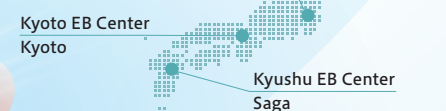
- Periodic maintenance
- Troubleshooting
- Proposals for maintenance plans
- Proposals for recommended spare parts lists

Japan's largest electron beam irradiation service center provides test irradiation and consigned production for many materials and shapes.



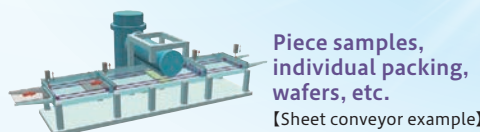
3 domestic locations

Our EB centers are located in Kyoto, Gunma and Saga.



Each type of product

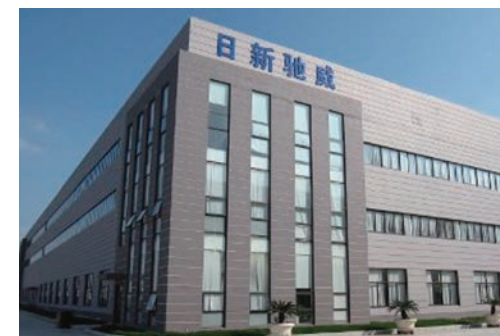
We have a wide selection of conveyors to match the shape of the product.



Matching thickness

Use a device with energy settings available from 150kV to 3,000kV based on thickness.

Related companies



NHV Accelerator Technologies Shanghai (NHV-AT)

Cutting edge production facilities responding to global demand for EPS (electron beam processing systems), providing EPS production, sales and after-sales services.

Established September 14, 2011
Capital USD3.7 million (100% NHV Corporation)
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NHV AMERICA, INC. (NHVA)

NHVA was established to strengthen the EPS business in USA, and perform sales and after-sales service for NHV Corporation products.

Established August 8, 1988
Capital USD 500 thousand (invested)
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