PROTEX SERIES

User's Handbook
AD-4991

X-RAY INSPECTION SYSTEM

A&D Company, Ltd.

Discover Precision

www.aandd.jp

X-ray Inspection SystemAD4991 Series

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1. What is the X-ray inspection system?

The X-ray inspection system is an inspection device with which we can determine the presence / absence of contaminants, appropriateness of the products' shape, quantity, assumed weight and the position of the products.

1.1. What are X-rays?

X-rays are electromagnetic waves with specific wavelengths discovered by a German scientist Wilhelm Conrad Roentgen. They are named after the unknown quantity X in mathematics. X-rays are radioactive rays which have a very small wavelength. There are several types of radioactive rays including alpha rays, beta rays, gamma rays, neutron rays and X-rays. Gamma rays and X-rays are electromagnetic waves.

Wavelength	Name	Use
1km 100m 10m 1m 100mm 10mm 1mm 10 μ m 1 μ m 700nm 360nm 100nm 10nm 10pm	Low frequency Medium frequency High frequency Very high frequency Ultra-high frequency Microwave Millimeter wave Sub-millimeter wave (Radio Wave) Far infrared Intermediate infrared Near infrared (Infrared rays) Red Green Blue violet (Visible lights) Near ultraviolet Vacuum UV (Ultraviolet lights) X-rays Gamma rays (Radioactive rays)	Maritime communication AM radio FM radio (analog TV broadcasting) Terrestrial digital broadcasting Satellite broadcasting, microwave oven, mobile phone Radar Radio astronomy Heater Thermography Infrared ray remote control Sunburn, disinfection, Semiconductor manufacturing X-ray inspection system, baggage inspection, Roentgen photograph





X-ray Inspection SystemAD4991 Series

X-rays are produced when thermal electrons emitted by the cathode filament of an X-ray tube hit the anode target at high speed accelerated by a high voltage applied between the cathode and anode. The voltage is approximately 20 to several hundred kV (referred to as the “tube voltage” in the AD4991 series).
An X-ray tube is composed of the elements illustrated in Fig. 1. The efficiency of X-ray production is quite low. Approx. 0.5 to a few per cent of energy is converted into X-radiation, whereas most of the energy is converted into heat.

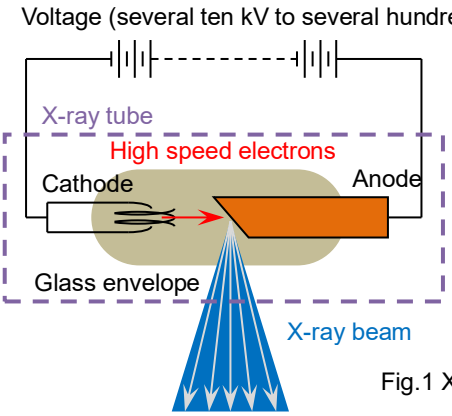


Fig.1 X-ray Generation

The X-rays emitted by the X-ray tube show the distribution of the wavelength and the radiation intensity as shown in Fig. 2. The X-ray tube emits X-rays with many different wavelengths. When the tube voltage increases, total radiation intensifies while covering a shorter wavelength.

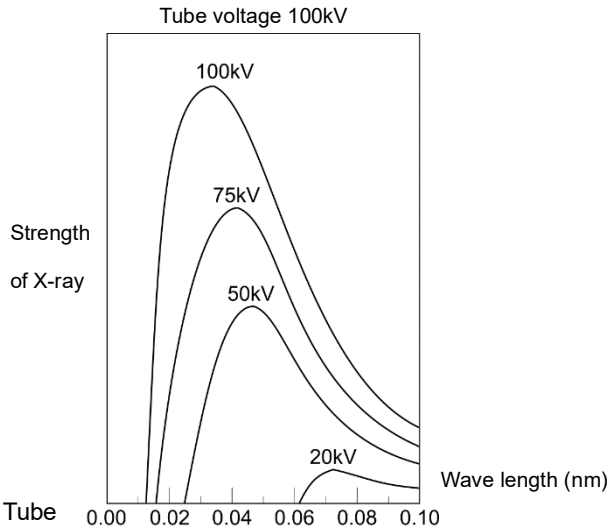


Fig. 2 X-ray Strength Emitted by the X-ray Tube

1.2. Main properties of X-rays

1) When X-rays hit a crystal, they diffract and interfere.
   Applied product: X-ray diffraction equipment
2) Chemical properties: X-rays can sensitize photographic film.
   Applied product: Roentgen photograph, film badge
3) Fluorescence reaction: When X-rays hit a fluorescent substance, it emits fluorescence.
   Applied product: Scintillator
4) Physiological effects: X-rays can cause damage to cells, which is also called radiation exposure.
5) Penetrating action: X-rays pass through the material.
   Applied product: Thickness gage, density meter, nondestructive tests
6) Ionizing action: X-rays ionize the gas, which thereby becomes conductive.
   Applied product: Dosimeter

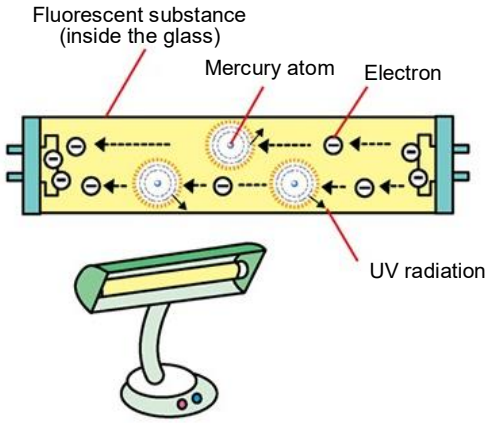
An X-ray inspection system inspects the presence or absence of contaminants in the product and the appropriateness of the shape by converting the X-ray penetration amount into a two-dimensional image, utilizing the above 3) fluorescence and 5) penetrating actions.

1.2.1. Fluorescence reaction

When ultraviolet rays or radiation hits a special substance, the substance emits light that it absorbed. This is called the fluorescence reaction. The light is called fluorescence, and the substance which emits fluorescence is called a fluorescent substance. This mechanism is applied to the fluorescent lamps, which are quite familiar to most people.

In the AD4991 series, a scintillator (rare earth fluorescent substance such as Gd2O2S:Tb) is mounted as a fluorescent substance on the line sensor unit embedded under the conveyer belt. The fluorescence generated when the X-ray hits the scintillator is converted to an electric quantity by the photodiode and determines the brightness of the X-ray image.

When the intensity of the X-rays that hits the scintillator is high, the amount of electricity also increases and the X-ray image becomes brighter.



Mechanism of fluorescent lamp
When a voltage is applied to the two electrodes, electrons flow between the electrodes. The moving electrons collide with mercury atoms in the tube, which generate the UV radiation. The UV is converted into visible light by the fluorescent substances.

Fig.3 Mechanism of Fluorescent Lamp

Prepared by A&D based on the information provided by the Ministry of Education, Culture, Sports, Science and Technology
(http://www.mext.go.jp/b_menu/shuppan/sonota/attach/1314239.htm)

1.2.2. Penetrating action

Penetrating action refers to the action of X-rays passing through the material. Passing through the material is called penetration.

In theAD4991 series, X-ray intensity before and after penetrating the material is represented by below formula:

$$\frac{I}{I_0} = e^{-\mu d}$$

$$\mu \cong kZ^3\lambda^3\rho$$

- I : X-ray intensity after penetration
- I_0 : X-ray intensity before penetration
- e : Napierian number（$= 2.718$ ...）
- μ : Attenuation coefficient
- k : Constant
- Z : Atomic number of the substance
- λ : Wavelength of X-ray
- ρ : Density of the substance

(Since approximate values are included, the above formula does not always apply.)

The 1st formula indicates that the thicker the substance through which X-rays are penetrated, the weaker the intensity of the X-rays will be after penetration.
The 2nd formula indicates that the bigger the atomic number or the higher the density of the substance through which X-rays are penetrated, the weaker the intensity of X-rays will be after penetration.

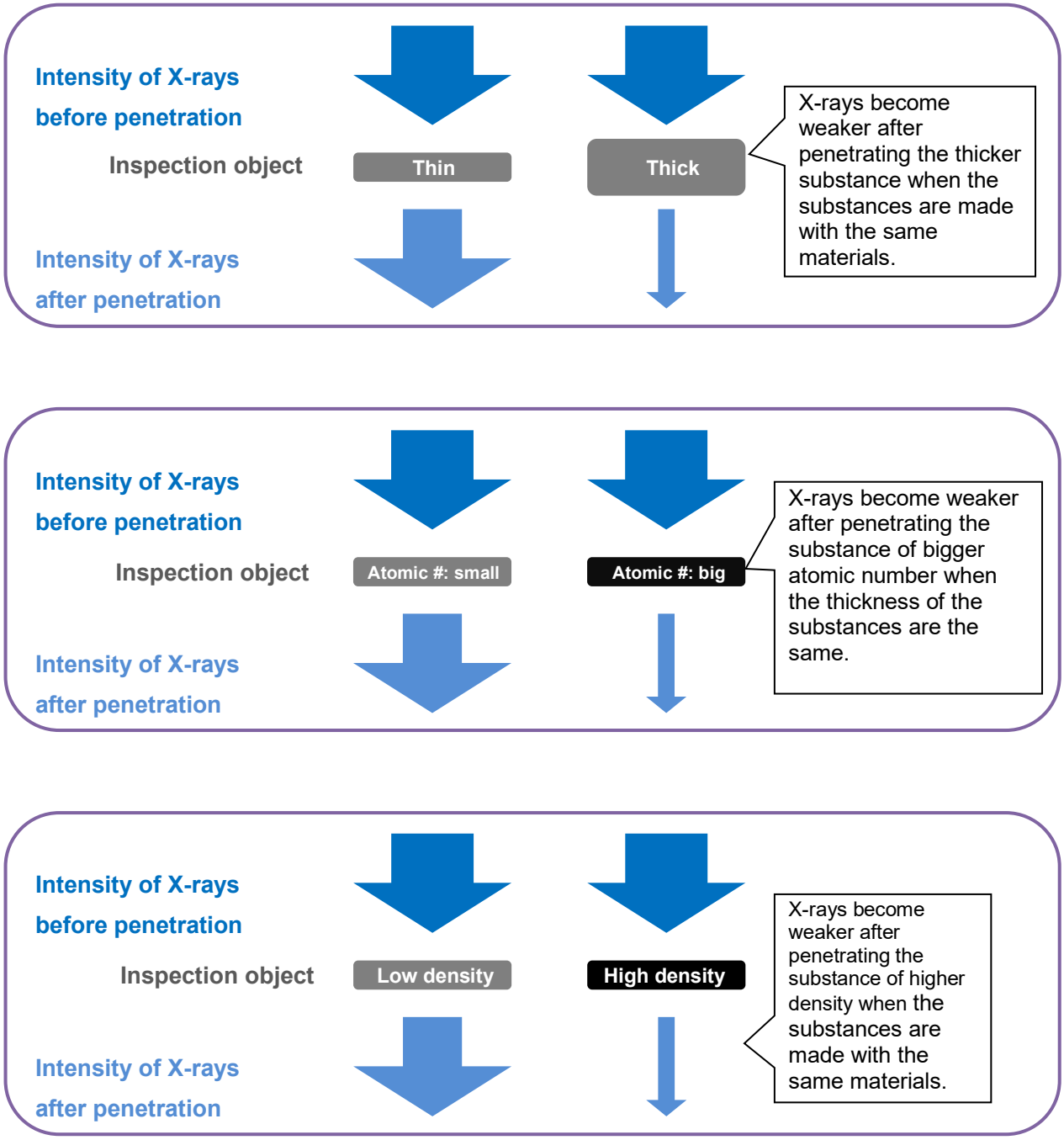


Fig. 4 Image of X-ray Penetration of Different Substances to be Inspected

1.3. What is the radiation quality of X-rays?

The radiation quality of X-rays corresponds to the colors such as blue and red of the visible rays. Although the colors of visible rays can be detected by human eyes, X-rays are invisible; therefore, the radiation quality is defined by the penetrating power.

As a qualitative expression, X-rays with higher penetrating energy are called hard X-rays, and X-rays with less penetrating energy are called soft X-rays. Hard X-rays have wavelengths of approx. 0.01nm to 0.06nm, and soft X-rays have wavelengths of approx. 0.6nm to 12nm.

Food and medical inspection systems including the AD4991 series mainly use hard X-rays whose wavelengths are approx. 0.01nm or more with the tube voltage of 20kV to 100kV.

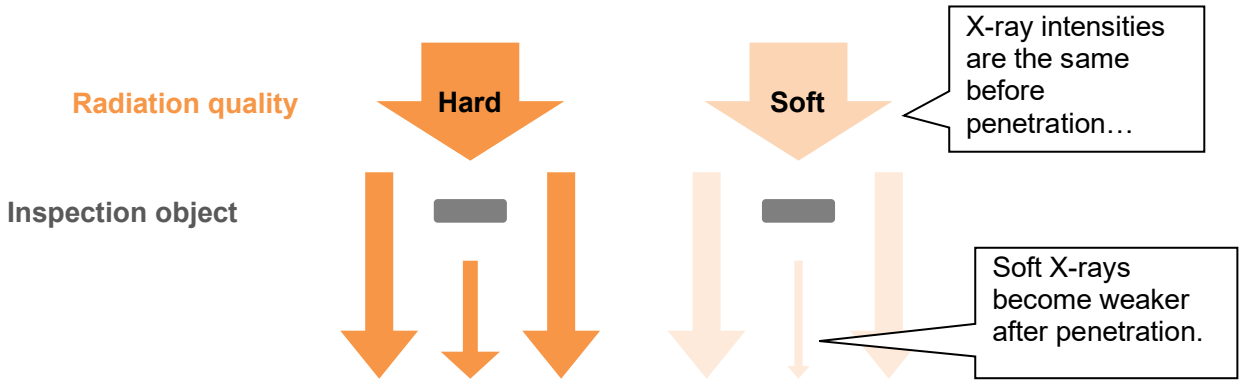


Fig. 5 Image of X-ray Penetration of Different Radiation Quality

1.4. Irradiation of X-rays

When X-rays are irradiated to the inspection object through the glass tube, the glass decreases the X-rays intensity.

In order to irradiate X-rays efficiently, there are X-ray tubes equipped with thin beryllium plates attached to the glass tubes, which provide 6 to 10 times higher permeability of X-rays. However, they cost higher when compared to glass-only X-ray tubes.

Among the AD4991 series, AD4991-2510 has glass-only X-ray tubes, and theAD4991-2515/AD4991-3530 systems have X-ray tubes with beryllium plates.

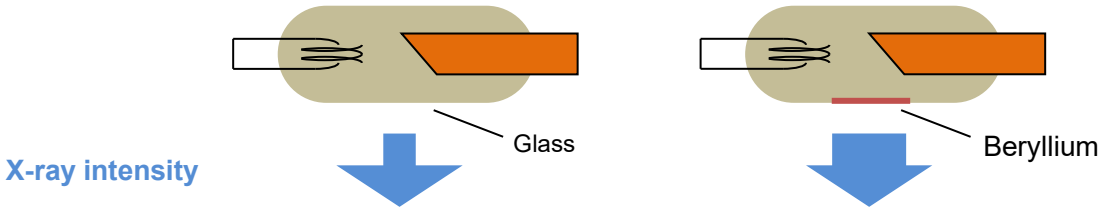


Fig. 6 Image of X-rays Irradiated from X-ray Tube

1.5. Main applicable areas

In general, X-ray inspection systems are broadly used for baggage inspection in airports, examinations in hospitals, and nondestructive testing to check inside materials.

X-ray inspection systems, such as theAD4991 series, are used for contaminant and shape inspection in the product lines for the below industries:

- Food, beverage, confectionary
- Agricultural products, livestock products, fishery products
- Pharmaceutical products
- Clothing
- Toys
- Industrial products such as resin molded products

To check for metal contaminants, metal detectors are widely used. The X-ray inspection system can detect nonmetal contaminants as well as contaminants in aluminum packages, which cannot be detected by a metal detector.

You may think that the X-ray inspection system can detect any type of contaminants? However, it is not true. The X-ray inspection system and the metal detector work on the different operational principles, therefore, you should choose the correct one for your application. Alternatively, you may use both by first obtaining a good understanding of the inspection procedures required.

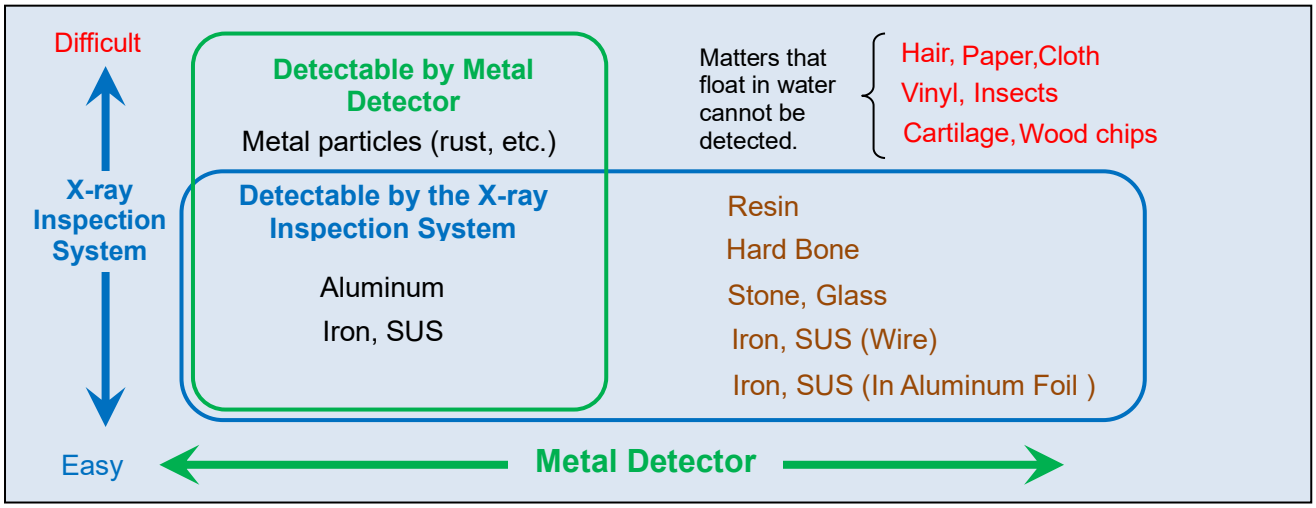


Fig. 7 Inspectable Range of X-ray Inspection System

1.6. Overall view of theAD4991 series

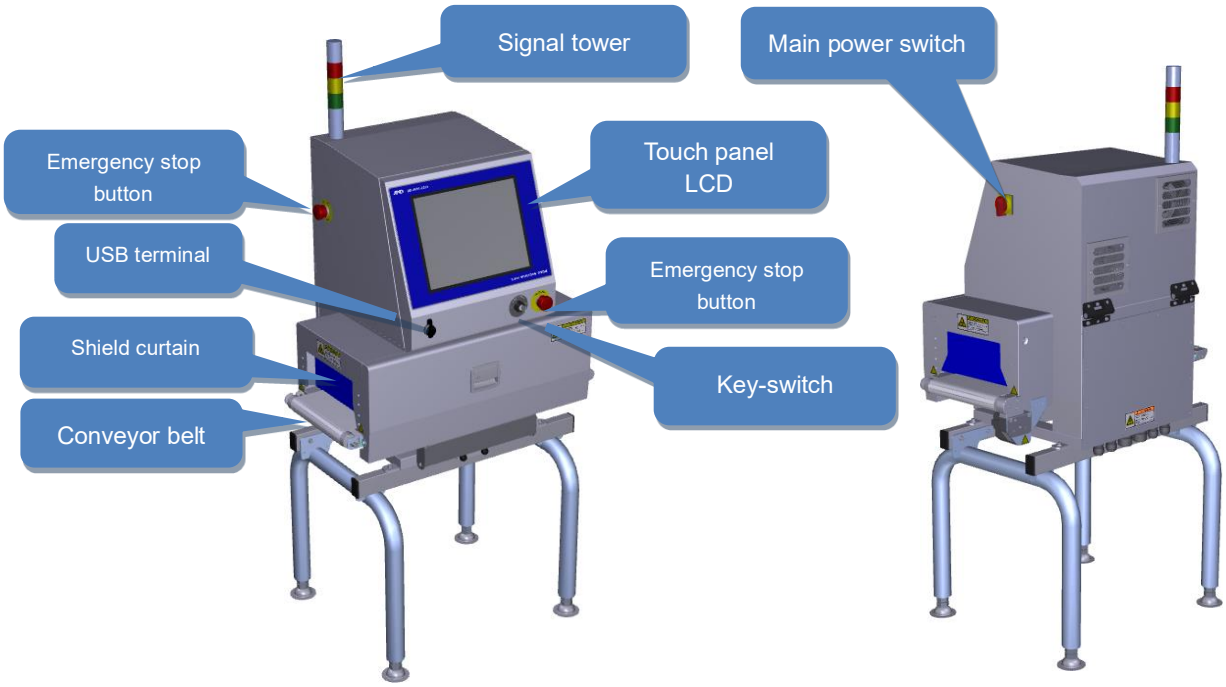


Fig. 8 AD4991-2515

1.7. Outline of X-ray inspection

Step 1: Shooting of X-ray images

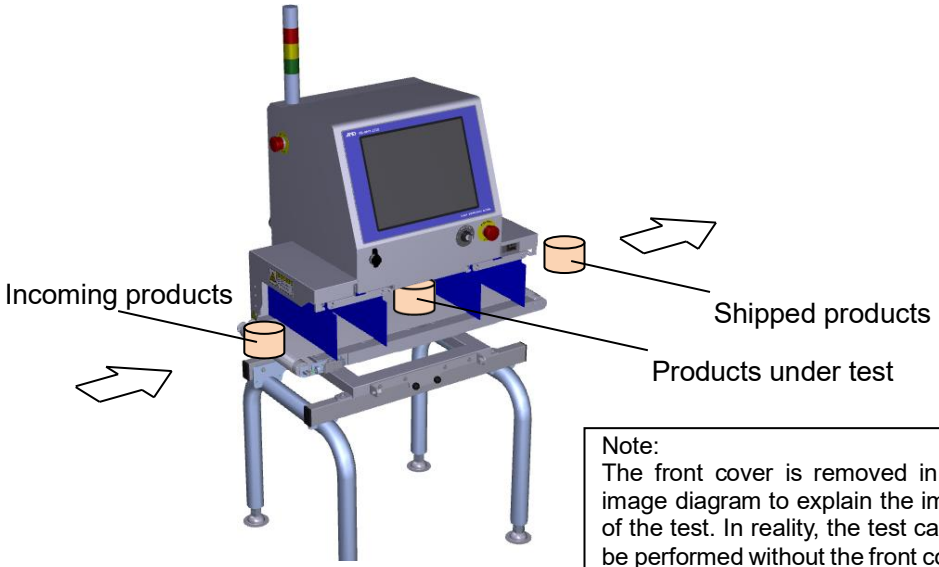


Fig. 9 Image of Inspection

Note:
The front cover is removed in this image diagram to explain the image of the test. In reality, the test cannot be performed without the front cover.

1) Products are conveyed into the inspection room through the inspection room opening.
2) X-ray images are taken in the inspection room.
3) Preset mask processing, inspection, and judgment are performed on X-ray images.
4) Products are transported out of the inspection room through the inspection room opening on the side opposite to 1).

Step 2: Analysis of X-ray image taken

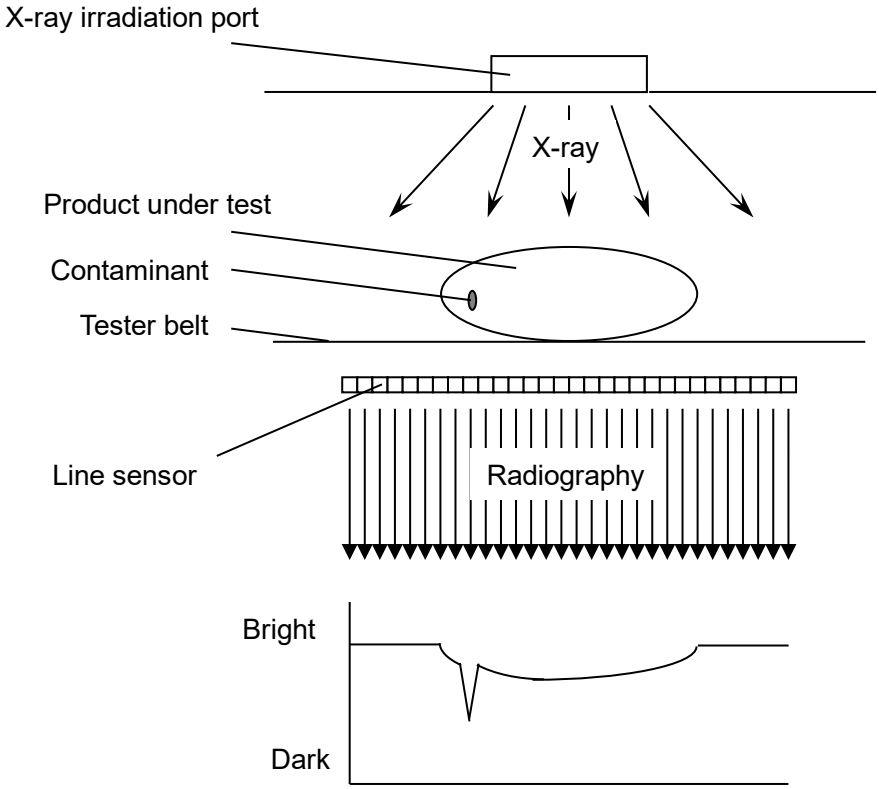


Fig. 10 Image of X-ray Image Shooting

1) When the product passes between the X-ray irradiation port and the line sensor, X-rays pass through the product and reach the line sensor. The x-rays are weakened when they pass through the product, and the x-ray image becomes darker when compared to the image taken when there is nothing on the conveyer belt.
2) When contaminants with higher density than the product are present in the product, the X-ray image becomes darker when compared to the image of the product without the contaminant. The X-ray image similarly becomes darker when contaminants are adhered to the product.
3) The X-ray image is assessed in quality for each inspection purpose, such as contaminant inspection and shape inspection.

1.8. Contaminant Inspection

TheAD4991 series has 5 kinds of contaminant inspection methods.

Inspection method	Function
Small contaminant	Designed to detect small-sized contaminants. Estimated size - AD4991-2510: ϕ 4mm or less - AD4991-2515: ϕ 2mm or less
Medium contaminant	Designed to detect medium-sized contaminants. Estimated size - AD4991-2510: ϕ 8mm or less - AD4991-2515: ϕ 4mm or less
Large contaminant	Designed to detect large-sized contaminants. Estimated size - AD4991-2510: ϕ 16mm or less - AD4991-2515: ϕ 8mm or less
Brightness contaminant	Designed to detect X-ray images that are darker than the set value. Use this method when the contaminant cannot be detected with the large contaminant inspection method due to its size being greater than listed above.
Wire contaminant	Designed to detect wire contaminants. Use this method when the contaminant cannot be detected with the large contaminant inspection method due to it being too long.

1.9. Masking Function

TheAD4991 series has a masking function that excludes a specified area from the contaminant inspection in order to avoid false detection. The following mask functions are available:

Mask Area	Masking Function
Dirt or water droplets surrounding the product	Brightness Mask
Edges of the product	Edge Mask
Specific regions of a product (example: plastic clips attached to sausages.)	Pattern Mask

Note:

When using a masking function, if there are unwanted contaminants in an excluded area, the product may still be judged as a product that does not contain contaminants. Please make sure that any masked area will not contain unwanted contaminants before using this function.

1.9.1. Brightness Mask

You can set the area where the brightness of the X-ray image is either equivalent or more than the set value that should be excluded during the contaminant inspection.

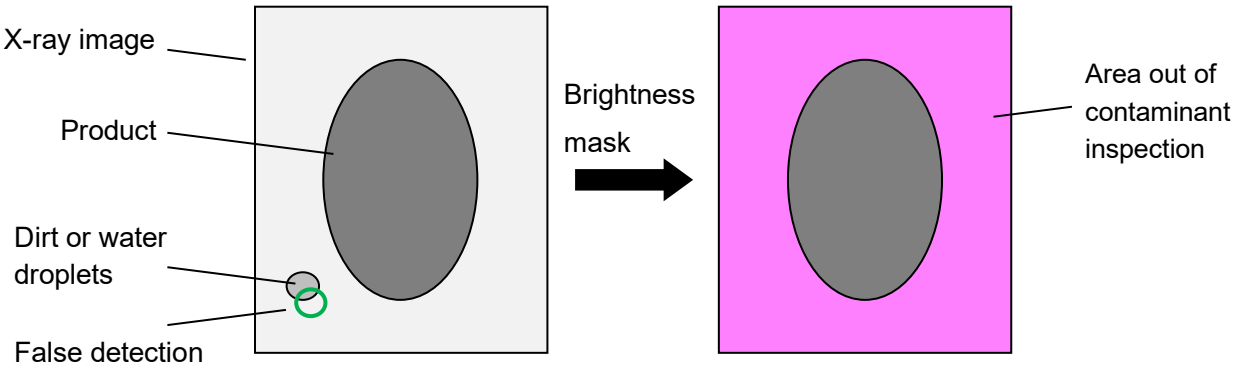


Fig. 11 Brightness Mask

1.9.2. Edge Mask

You can set the boundary line of the area where the brightness of the X-ray image is either equivalent or more than the set value that should be excluded during the contaminant inspection.

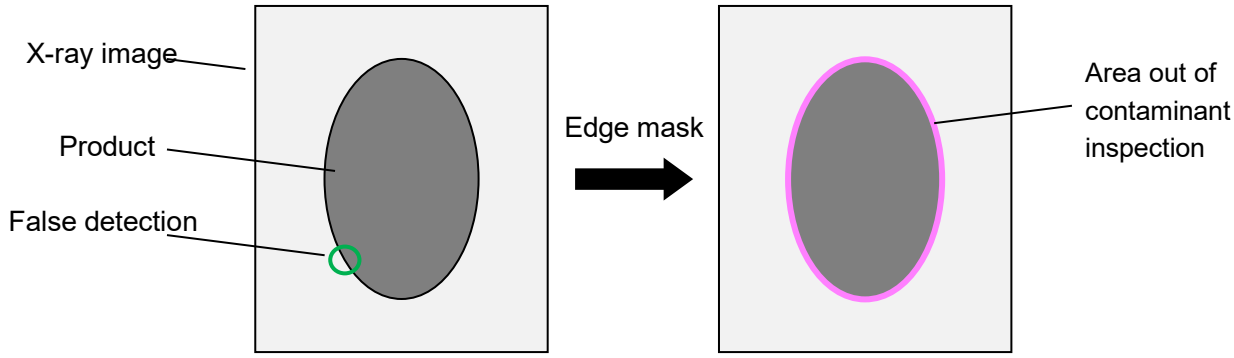


Fig. 12 Edge Mask

1.9.3. Pattern Mask

By registering a certain area of the product, you can set an area to be out of contaminant inspection zone by placing a shape over the X-ray image.

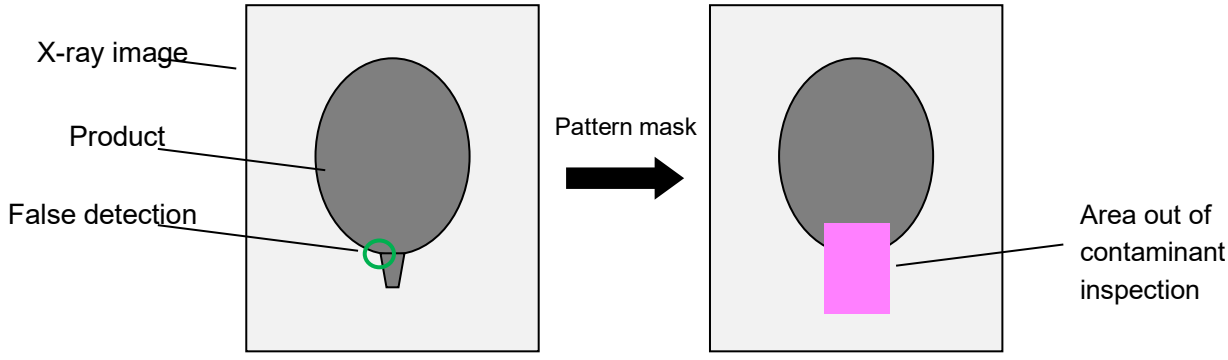


Fig.13 Pattern Mask

1.10. Shape Inspection

The AD4991 series has 5 kinds of shape inspection methods. Please select an appropriate method in accordance with the shape of the contaminant to be detected.

Method	Function
Area	Check that the product area is within the set value range.
Perimeter	Check that the perimeter of the product is within the set value range.
Brightness peak	Check that the brightness of the X-ray image of the product is within the set value range.
Brightness variation	Check that the variation in the brightness of the X-ray image of the product is within the set value range.
Crack	Detect cracks within the product.

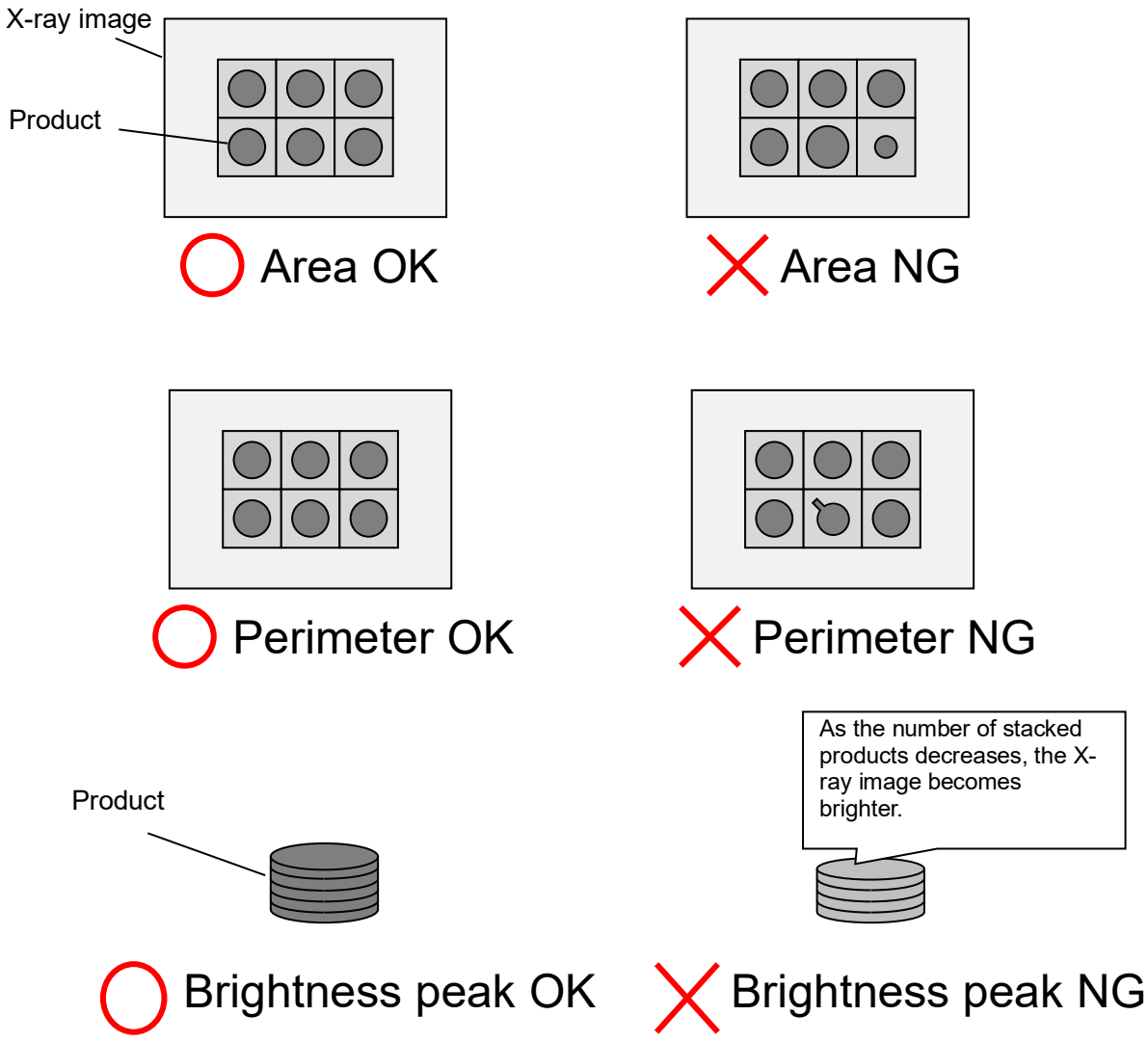


Fig. 14 Shape Inspection (1/2)

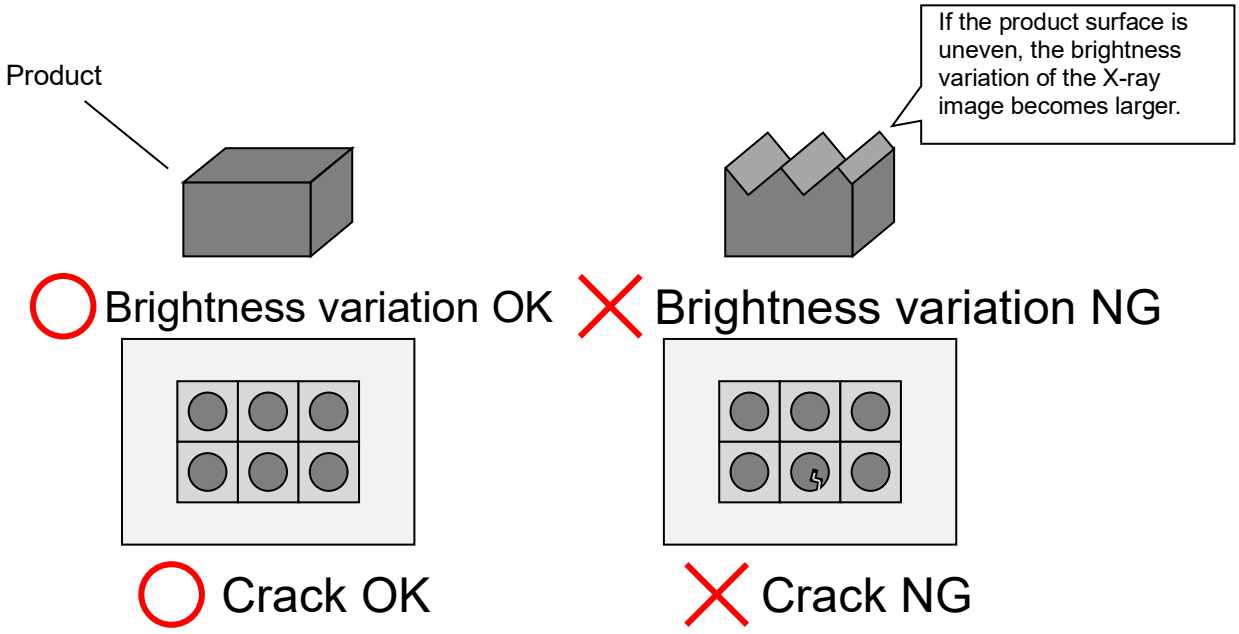


Fig. 15 Shape Inspection (2/2)

1.11. Count Inspection

You can inspect if the quantity of the product is within a set value range.

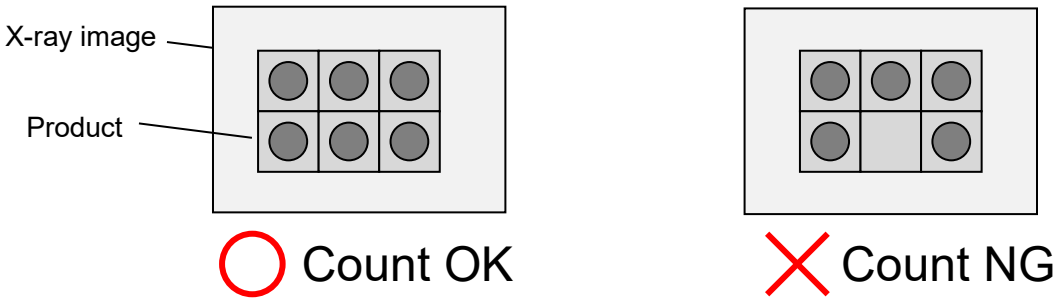


Fig. 16 Count Inspection

1.12. Weight Estimation

The AD4991 series has a function to estimate the weight of the product based on the brightness of the X-ray image. You can inspect that the estimated weight is within the set value range, both for the total package and individual product. The estimated weight can be displayed on the screen.

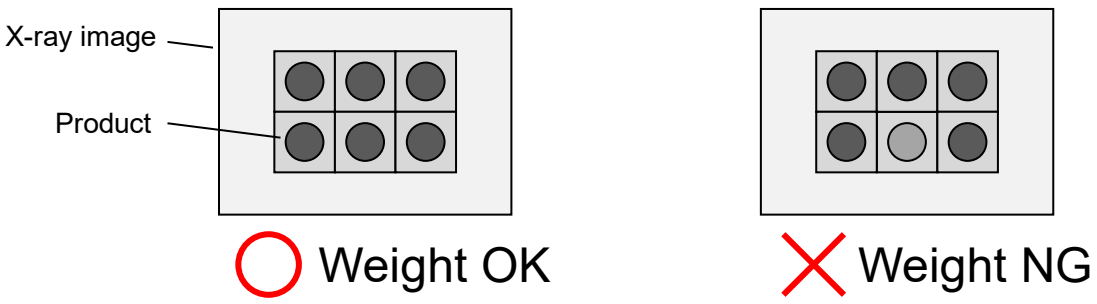


Fig. 17 Weight Estimation

2. Procedure to set up contamination inspection

This chapter provides examples for the procedure to set up the fail limit for contamination inspection. We conduct the sample tests, following the same procedure to confirm the optimal fail limit and inspection performance. The fail limit can be set for each inspection method.

Note:
In the AD4991 series, the fail limits can be stored up to 1,000 per product.

2.1. What is the optimal fail limit?

The optimal fail limit means the set values with which neither **"false detection"** nor **"inspection failure"** occurs**.** "False detection" means the rejection of good products and "inspection failure" means the failure in detecting contaminant.
The below chart illustrates the relationship between the fail limit, false detection, and inspection failure.

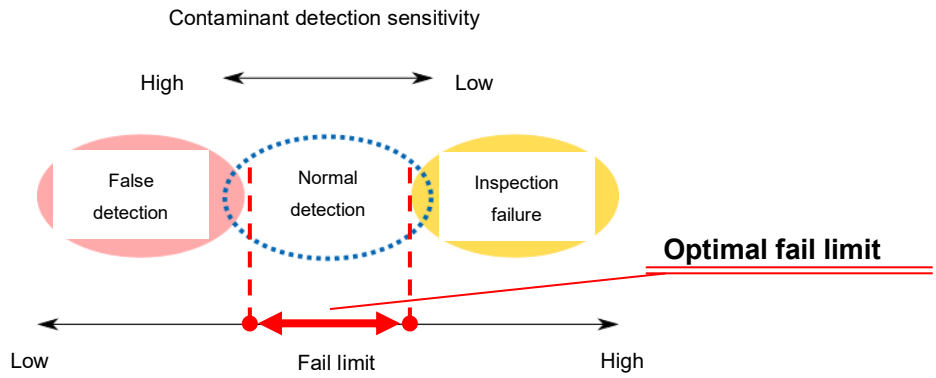


Fig.18 Relationship between the fail limit, false detection, and inspection failure

- If the fail limit is set too low, the possibility of false detection will increase.
- If the fail limit is set too high, the possibility of inspection failure will increase.

The optimal fail limit, the range indicated by the red arrow, can be obtained by searching the points where neither false detection nor inspection failure occur, and fine-tuning the fail limit value.
However, depending on the shape and/or density of the product or the shape, density and/or position of the contaminant, there may be cases where the optimal fail limit cannot be obtained. In such cases there is no point where both false detection and inspection failure do not occur. In such situations, it is considered that required inspection exceeds the limit of detection capabilities.

2.2. Set-up procedure of fail limit

1) By using Auto-set, the fail limit can be automatically set.

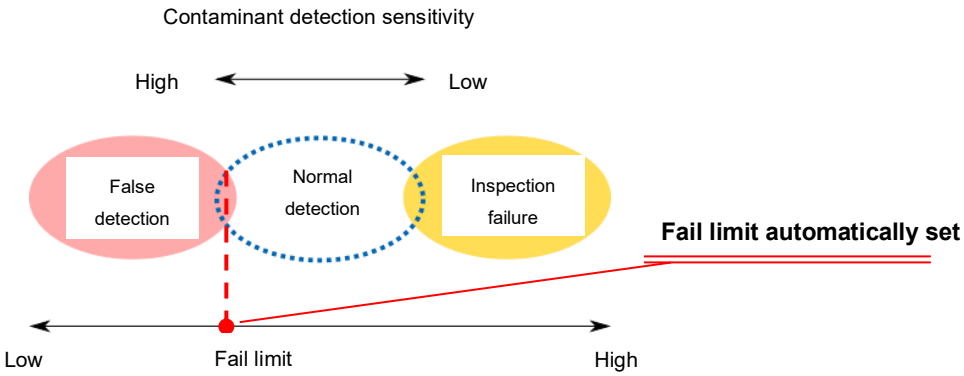


Fig. 19 Image of the fail limit automatically set

Note:

The fail limit set by Auto-set is not always at the position shown in Fig. 19. If the margin is automatically set where inspection failure often occurs, it can be fine-tuned with the following procedure.

2) Inspect a good product several times and confirm that there is no false detection.
3) If there is a false detection, set the fail limit higher and repeat the procedure 2).

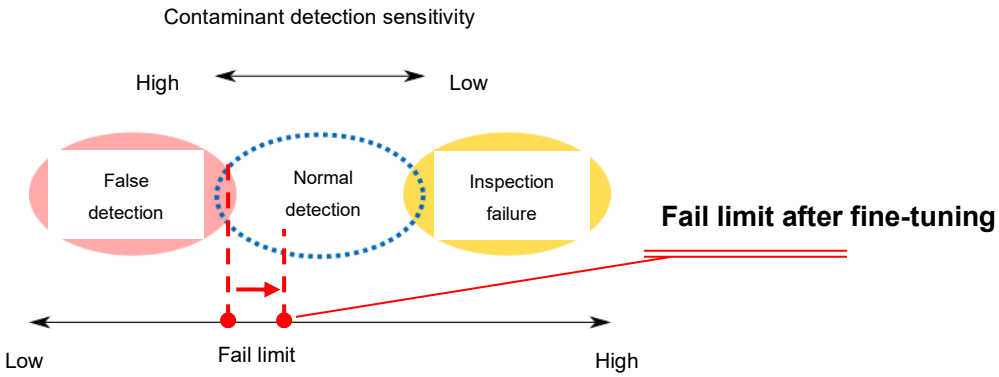


Fig. 20 Image of the fail limit fine-tuning when false detection occurs

4) Inspect a contaminated product several times and confirm that there is no inspection failure. Use a contaminated test piece or a product with real contaminants for the above test.

5) If there is inspection failure, set the fail limit lower and repeat procedure 4). If the fail limit is set lower than the fail limit defined in 2), repeat the procedure from 2).

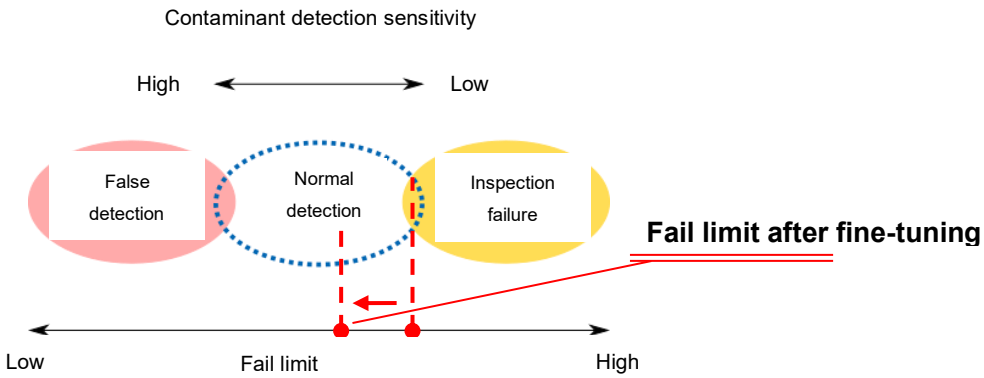


Fig. 21 Image of the fail limit fine-tuning when detection leakage occurs

Note :

The attached position of contaminants sometimes negatively affects the inspection performance. When you use the contaminated test piece or a product with real contaminants, it is recommended to try every position at which contaminants will possibly be present.

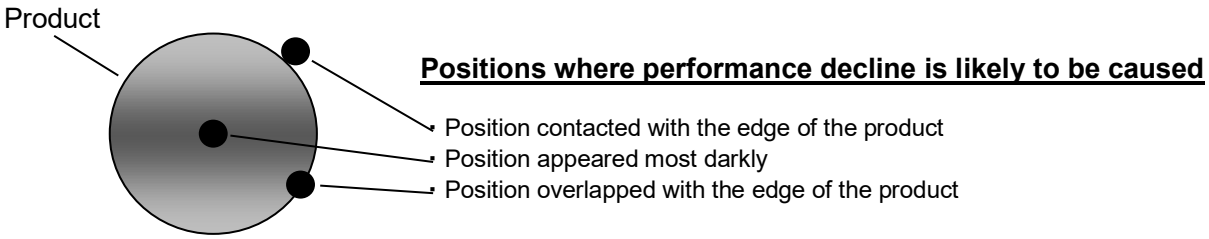


Fig.22 Contaminants' positions which performance decline is likely to be caused

6) If there is no false detection and inspection failure, it is judged that an optimal fail limit is set. If either false detection or inspection failure still occurs, it is considered that required inspection exceeds the limit of detection capabilities.

Note:

The optimal fail limit is subject to change depending on the consecutive inspection conditions or the environment of the production line.

3. Frequently Asked Questions

3.1. Key features of the AD4991 series

3.1.1. What are the key features of the AD4991 series?

1) Cost effectiveness

   AD4991 offers excellent cost effectiveness while offering high accuracy and reliability.

2) Compact design

   The minimum size of 488 mm(AD4991-2510) / 532mm(AD4991-2515) width, which are the most compact system on the market, makes integration painless.

3) Easy and intuitive operation

   AD4991 is designed to allow for easy and intuitive operation, just like A&D'S highly recognized weight checkers and metal detectors.

4) Test reports can be output and screenshots stored in USB memory

   A) To check the inspection performance, the results are output to USB memory up to 10 times for a product in an AD4991 original reporting format. The report includes test conditions, registered pre-settings for the product, test piece image and X-ray image (patent pending).

   B) The screenshot can be saved in USB memory only by pressing a button, making it easy to prepare reports.

5) Up to 1,000 products can be stored with image data

   For convenience, the products can be stored in 10 groups with 100 products in each group.

6) Various inspection functions

   Contaminant inspection, shape inspection, piece counting, mass estimation and positioning inspection can be conducted in combination.

7) The belt can be attached/detached with single operation, which allows for easy maintenance and cleaning (patent pending).

8) The inspection room complies with IP66

   Even wet products can be inspected.

9) Safety design

   A) The shield curtains and the safety sensors are equipped as standard.

   B) When an error occurs, inspection automatically stops and the error location is visually displayed.

   C) The emergency stop buttons and signal tower are equipped as standard.

   Emergency stop can be operated and X-ray irradiation can be confirmed from completely around the device (compliant with FDA standards).

3.1.2. Is it possible to set the fail limit automatically?

Yes.

AD4991 has an Auto-set function with which the fail limit is automatically set by inspecting a good product 1 to 10 times. You can manually change the automatically-set fail limits after this function is enabled.

Depending on the product, the automatically-set fail limits sometimes induce a lot of false detection or inspection failure. In such cases, you should adjust the fail limit manually.

3.1.3. What is the level of X-ray leakage?

The leakage is 1 μSv/h (0.001 mSv/h) or less.

If an operator works near the AD4991 series for 8 hours a day and 5 days a week, the exposure level would be 0.52 mSv per three months or 2.08 mSv annually.

In Japan, the exposure dose limits to radiation workers are specified in Article 4 and 6 of the Ordinance on the Prevention of Ionizing Radiation Hazards. Please refer to the provisions for details.

Radiation dose examples:

Air radiation dose	Exposure dose (approx. value)
Tokyo	0.03～0.08 μSv/h
Top of Mt. Fuji	0.1 μSv/h
Kerala area, India	1.05 μSv/h
Flight between Tokyo and New York	7.4 μSv/h (177 μSv/ 1 round trip)
Inside International Space Station	20～40 μSv/h

Medical examination	Exposure dose (approx. value)
Chest radiography	0.06 mSv
Upper GI series (barium swallow)	3 mSv
CT	5～30 mSv
PET	2～10 mSv
Mammography	2 mSv
Dental X-rays	0.002～0.01 mSv

3.1.4. What is the shield curtain made of?

The material of the shield curtain is made of tungsten sheet.

The sheet is made of a thermoplastic elastomer filled with tungsten powder and laminated with resin on its surface. It is more harmless and environmental friendly than a lead sheet.

3.1.5. Is there a designated angle to set the product?

There is no specific angle to convey the products except when the pattern mask or positioning inspection functions are being used.

When using the pattern mask function, the products should be conveyed at the same angle as what was set in order to put the mask in a correct position.

For a positioning inspection, the products should be conveyed so that their longitudinal direction is precisely in parallel with the conveying direction to avoid detection errors.

3.2. Detection performance

3.2.1. Is it possible to detect contaminants other than metal?

Yes.

But it is difficult to detect contaminants whose density is lower than or similar to the product.

AD4991 does not always detect the contaminants depending on the shape of the product or the contaminant.

3.2.2. Is it possible to detect hair or insects?

It is difficult to detect matters that float in water.

3.2.3. Is it possible to detect hard bones and cartilages in meats?

Hard bones can be detected depending on the conditions. It is difficult to detect cartilages.

It is difficult to detect matters that float in water.

3.2.4. Is it possible to detect the contaminants in aluminized film packages?

Yes.

But it is difficult to detect contaminants whose density is lower than or similar to the product.

AD4991 does not always detect the contaminants depending on the shape of the product or the contaminant.

3.2.5. Is it possible to detect the contaminants in aluminum foil packages?

Yes.

But it is difficult to detect contaminants whose density is lower than the product.

AD4991 does not always detect the contaminants depending on the shape of the product or the contaminant.

3.2.6. Is it possible to detect the contaminants in canned items?

Yes.

But it is difficult to detect contaminants whose density is lower than the product.

AD4991 does not always detect the contaminants depending on the shape of the product or the contaminant.

3.2.7. Is it possible to detect the contaminants in a product which contains an oxygen absorber in the package?

It is possible depending on the conditions.

It is difficult to detect the contaminants located in the position of the oxygen absorber, depending on the density of the contaminants.

3.3. Connection with external devices

3.3.1. Is it possible to connect a rejector?

Yes.

A&D offers several types of rejectors. For detailed specifications, please consult with your sales person.

3.3.2. Does the AD4991 have a signal tower?

The signal tower with buzzer is equipped as standard.

3.3.3. Is it possible to customize the lighting setting of the signal tower?

The lighting conditions and time can be customized or configured.

3.3.4. Is it possible to connect the PLC?

It is possible to connect the DIO, Modbus RTU and Modbus TCP as standard.

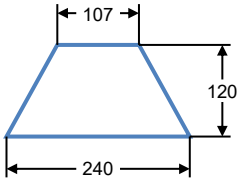
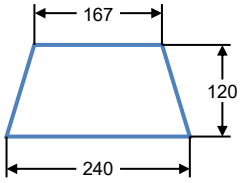
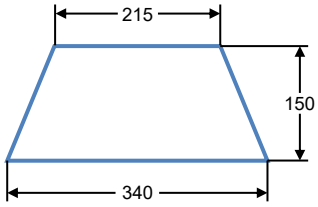
3.4. Model selection

3.4.1. What are the factors to consider when selecting a model?

The appropriate X-ray output, namely the suitable model, is determined by the thickness and density of the product, and intended inspection. We, in principle, recommend the most suitable model after conducting the sample tests. Please consult with your sales person for further information.

3.4.2. What is the detectable size?

Please see below chart for the maximum size of the products for each model.

Model	AD4991-2510	AD4991-2515	AD4991-3530
Detectable size			

Unit: mm

For the other models, please consult with your sales person.

3.4.3. What is the maximum conveying capacity?

Please see below chart.

Model	AD4991-2510	AD4991-2515	AD4991-3530 (to be released)
Maximum conveying capacity	5kg	10～30m/min: Max5kg　30～40m/min: Max 4kg 40～60m/min: Max 3kg　60～70m/min: Max 2kg	5kg

For the other models, please consult with your sales person.

3.5. Installation

3.5.1. Is there any legal requirement to notify of device installation?

Yes.

In Japan, you have to notify to the Chief of the Labour Standard Inspection Offices as specified in Article 88 of the Industrial Safety and Health Act and Article 85 and 86 of the Ordinance on Industrial Safety and Health, no later than 30 days prior to the date of commencement for the installation work. For details of the documentation, please consult with our sales person in charge.

For overseas regions, please comply with the applicable laws and regulations in each country and area.

3.5.2. Is it necessary to periodically inspect the X-ray leakage?

Yes.

In Japan, it is necessary to measure the X-ray leakage around the device once every six months in accordance with Article 54 of the Regulation on Prevention of Ionizing Radiation Hazards.

The measurement can be conducted by users (employers engaging in a business undertaking radiation work) and A&D provides this measurement service as well. For details, please consult with your sales person.

Article 54 of Regulation on Prevention of Ionizing Radiation Hazards
An employer must periodically measure the dose equivalent rate or dose equivalent due to external radiation in the Controlled Areas once every period within six months by using a radiation measuring instrument, record the following matters in each measurement, and store the records for five year. *(i) date and time of measurement;* *(ii) measurement method;* *(iii) type, model and performance of radiation measuring instrument;* *(iv) point of measurement;* *(v) measurement conditions;* *(vi) measurement results;* *(vii) name of the person who performed the measurement; and* *(viii) general description of the measures taken based on the measurement results.*

3.5.3. Do we need to hold a license to operate the device and measure X-ray leakage?

In Japan, it is not obliged under the law.

However, the Labor Standards Inspection Office recommends to have a license holder.

A&D also recommend to operate the device and measure X-ray leakage under the supervision of a license holder.

In Japan, the Regulation on Prevention of Ionizing Radiation Hazards specifies that areas where the X-ray dose due to leakage from the device is likely to exceed 1.3 mSv per every three months, it must be designated as a “Controlled Areas”. Additionally. an Operations Chief of Work with X-rays must be appointed.

However, the X-ray dose around the device is 1 μSv/h (0.001mSv/h) or less anywhere around the device, so there is no place where the dose exceeds 1.3 mSv per every three months.

Therefore, although the inside of the device falls under the “Controlled Areas” jurisdiction, you do not have to demarcate the area and appoint an operations chief of work with X-rays.

3.5.4. Are there any seminars or trainings on how to safely use X-ray devices?

Yes.

Article 19 of the Industrial Safety and Health Act specifies that “The employer shall endeavor to provide education and training or the chance of receiving education and training to the safety officers, health officers, safety and health promoters, health promoters and others in charge of other functions for preventing industrial accidents in order to enhance their individual abilities to improve the safety and health control level at the workplace.” Based on this provision, the Japan Inspection Instruments Manufacturers’ Association periodically holds a “Safety Seminar for X-ray Device Operators.”

3.5.5. Is grounding necessary?

Yes.

Be sure to ground with class D grounding (grounding resistance of 100Ω or less) before use. Failure to do so results in the risk of electric shock, fire and malfunction.

3.6. Maintenance

3.6.1. Are there any consumable parts?

Please see below list of major consumable parts.

Conveyer belt	Resin gear	Motor unit
Shield curtain	Driving pulley	Driven pulley
X-ray source	Line sensor	Fuse
Backup battery	Cooling fan	Fan filter
General-purpose external output relay	Safety relay	

For replacement, please consult with your sales person.

3.6.2. How long is the lifespan of the X-ray source?

We recommend to replace it after approx. 10,000 hours of use. The lifespan depends on the environment and conditions.

The AD4991 series provide one-year product guarantee after shipment.

3.6.3. What kind of tool is needed for belt adjustment?

Two spanners (width across flats: 8 mm) are needed.

3.6.4. What kind of tool is needed to adjust the pass line?

A spanner (width across flats: 30 mm) is needed.

3.7. Test piece

3.7.1. Are there any standard test pieces?

Yes.

We offer the standard test pieces provided by the Japan Inspection Instruments Manufactures' Association. Please consult with our sales person in charge of your area.

Material	Shape	Size	5 pieces／Single piece
SUS	Ball	φ0.3～3.0	5 pieces
SUS	Ball	φ0.3～3.0	Single piece
SUS	Wire	L=2 or 5、φ0.2～0.6	5 pieces
SUS	Wire	L=2 or 5、φ0.2～1.0	Single piece
Aluminum	Ball	φ1.5～7.0	5 pieces
Aluminum	Ball	φ1.5～9.5	Single piece
Ceramic	Ball	φ1.0～8.0	5 pieces
Ceramic	Ball	φ1.0～8.0	Single piece
EPDM rubber	Ball	φ3.0～8.0	5 pieces
EPDM rubber	Ball	φ3.0～8.0	Single piece
PTFE	Ball	φ1.6～8.0	5 pieces
PTFE	Ball	φ1.6～8.0	Single piece
Quartz	Ball	φ1.0～6.0	5 pieces
Quartz	Ball	φ1.0～6.0	Single piece

Spec Confirmation Sheet

Salesperson in change		
Company (Organization)		
Product	Name	
	Size (mm)	Max Length ×Width ×Height
		Min Length ×Width ×Height
	Weight (g)	
	Conveying interval (mm)	
	# of inspection (#/min)	Regular /min, Max /min
	Package	Bulk goods, Plastic bag, Resin-made package, Aluminized film package, Aluminum foil package, Aluminum top package, Others ( )
	Condition	Bulk goods, Individual packaging, Box, Others ( )
	Temperature	Room temperature, Refrigerator, Freezer, Others ( )
	Wetting	N/A, Applicable, Others ( )
Target detection sensitivity	Ball	SUS/Fe ϕ . mm・Aluminum ϕ . mm・ Ceramic ϕ . mm・EPDM rubber ϕ . mm・ PTFE ϕ . mm・Quartz ϕ . mm・ Others ( )
	Wire	SUS／Fe ϕ . ×Length mm, Others ( )
	Contaminants	Needle, Stapler needle, Screw/nut (size:), Others ( )
Conveying method		Conveyed at the pitch of ( ) mm in the first part (mechanically / manually) . The conveyor in the first part runs at ( ) m/min.
Environment		Temperature: 0 to 35°C, Humidity 30 to 85% RH, Others ( )
Waterproof		Non-waterproof, IP66,Others ( )
Transportation method		Belt conveyor, Pipe-type, Falling-type, Chute-type, Others ( )
Belt speed（m/min）		10 - 45, 10 - 70, Others ( )
Conveyor length（mm）		800, Others( )
Belt width（mm）		250, 350, Others ( )
Pass line height（mm）		720 - 860, Others( )
Caster		Without/ With
Signal tower		N/A, 1 color, 2 colors, 3 colors, 4 colors, buzzer, Others ( )
Rejector		N/A, Flipper, Conveyor drop, Pusher, Air jet, Others ( )
Other conditions including quotation and delivery		

* Appearance and specifications are subject to change without any prior notice.