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   Appropriate test piece for common risks
   A&D Checkweigher and Metal Detector Questionnaire
1. What is a metal detector?

Metal detectors detect metal contaminants in products and contribute to the improved quality and safety of products.

1.1. AD4971 configuration

1.2. Principal use

Generally, metal detectors are used for security checks, land mine detection, archaeological digs or wall scanners.

Industrial metal detectors including the AD4971 are also used on production lines for the products below:

- Food and confectionery
- Agricultural, animal or seafood products
- Medical products
- Clothes
- Shoes
- Cardboards
- Chemical materials
It is commonly said that we don’t perceive contaminants in food products if their size is less than 1mm. Therefore, it is common for food products suppliers to set their inspection standards to detect contaminants larger than 1mm. On the other hand, inspection standards for chemical materials are set as low as 0.1mm. Materials for semiconductors are more rigorously checked and requirements in this industry are to detect stainless foil even at 0.02mm size. (This is a special requirement and cannot be achieved with ordinary metal detectors.)

Needle detection is performed on clothes or shoes production lines, as small needle-like shards of metal becoming intertwined in these products may cause serious hazard. Detection sensitivity for detecting needles depends on the orientation of the needles, so special metal detectors for needles with multiple sensor heads set unevenly have been developed.

### 1.3. Types of metal detectors

#### 1.3.1. Detection method

The main types of metal detectors are as follows:

- Electromagnetic induction type
- X-ray type
- Magnetic sensor type

AD4971 series metal detectors are electromagnetic induction type. The X-ray type is better in performance, but the electromagnetic induction type is better in terms of unit price, running cost and ease of maintenance.

#### 1.3.2. Configuration for metal detectors

The following are the main types of metal detector configurations:

- Hand-held type
- Conveyor type
- Chute type
- Gravity fall type
- Pipeline type
- Gate type

The AD4971 is a conveyor type metal detector. We manufacture conveyor type, gravity fall type and pipeline type metal detectors.
1.4. Construction of sensor head

There are 3 types of sensor head construction for electromagnetic induction type metal detectors:

- Coaxial type
- Opposing type
- Permanent magnet type

1. **Coaxial type**

The AD4971 has adopted the coaxial type which is commonly used nowadays due to its high detection sensitivity and water resistance.

2. **Opposing type**

The opposing type metal detector allows for the manufacturing of a large size sensor head or for possible adjustment of the height of the aperture on request.

3. **Permanent magnet type**

The permanent magnet type which can generate DC magnetic flux is used for detection of metal contaminants in aluminum foil packages.
1.5. Principle of detection

A sensor head of an electromagnetic induction type metal detector consists of a transmitter coil and two receiver coils that are equally spaced and are differentially connected. A transmitter coil broadcasts a radio frequency signal and generates an electromagnetic field between the transmitter coil and the receiver coils. The magnetic flux balance is disturbed and creates a differential output signal when a contaminant passes through the aperture. Metal detectors detect metal contaminants by processing this differential output signal.

When no contaminant exists, both receiver coils receive an equal amount of magnetic flux and differential signal output is balanced at zero.

When an item contains magnetic metal (iron, Fe), magnetic flux to a receiver coil increase and this makes the differential signal output positive.

When a product contains a non-magnetic metal (stainless steel, SUS), magnetic flux to a receiver coil decrease due to occurrence of an eddy current and this makes the differential signal output negative.
1.6. Detection sensitivity

Detection sensitivity is expressed by the size, shape and material of contaminants that can be detected. An iron or stainless steel (sometimes brass) ball bearing is used as a test piece and detection sensitivity is expressed by its diameter. In terms of needle detectors, detection sensitivity is represented by diameter and length of a wire shaped test piece.

The smaller the sensitivity is, the better the detection performance of a metal detector.

1.7. Oscillating frequency and detection sensitivity

Dry products: The higher the oscillating frequency is, the better for detecting non-magnetic metals.

Wet products: The lower the oscillating frequency is, the better for detecting magnetic metals.

Products packaged in aluminum metalized film or aluminum foil: The lower the oscillating frequency is, the better for detecting magnetic metal. It is difficult to detect non-magnetic metal in aluminum metalized film or aluminum foil packaged products.

The oscillating frequency of AD4971 is 300 KHz, which responds to both dry and wet products.
1.8. Product phase

Product phase is a phase of a vector normal to the detection signal shown on the Lissajous display.

On the product effect graph, product phase is represented by the phase at the point of the V-shaped waveform. (See ④ and ⑤ on the diagram below.)

The signal level of this phase is used for contaminant judgments, as it significantly increases when a contaminant is detected.

“P” on the bar graph stands for the signal level of product phase.
“Fe” indicates the signal level of the Q-axis.
“SUS” indicates the signal level of the I-axis.
## 2. Typical detection sensitivity

Figures in this chapter are actual measurements results obtained by us. The figures represent the diameters of ball bearings.

The figures are not guaranteed as they may change by shape, size, weight and packaging of products or change in environment.

### 2.1. Dry products

<table>
<thead>
<tr>
<th>Inspected product</th>
<th>Package</th>
<th>Dimension (mm)</th>
<th>Weight (g)</th>
<th>Fe φ (mm)</th>
<th>Test piece on a product</th>
<th>Test piece on a conveyor belt</th>
<th>SUS φ (mm)</th>
<th>Test piece on a product</th>
<th>Test piece on a conveyor belt</th>
<th>Product Phase(*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry noodles</td>
<td>Bag</td>
<td>95x240x30</td>
<td>320</td>
<td>1.0</td>
<td>0.9</td>
<td>1.5</td>
<td>1.5</td>
<td></td>
<td></td>
<td>166.5</td>
</tr>
<tr>
<td>Dry pasta</td>
<td>Bag</td>
<td>275x80x30</td>
<td>507</td>
<td>0.5</td>
<td>0.5</td>
<td>0.8</td>
<td>0.8</td>
<td></td>
<td></td>
<td>14.0</td>
</tr>
<tr>
<td>Dry lasagna</td>
<td>Paper package</td>
<td>190x95x45</td>
<td>300</td>
<td>0.5</td>
<td>0.5</td>
<td>1.0</td>
<td>0.8</td>
<td></td>
<td></td>
<td>14.2</td>
</tr>
<tr>
<td>Sugar 1kg</td>
<td>Bag</td>
<td>170x230x30</td>
<td>1000</td>
<td>0.6</td>
<td>0.6</td>
<td>1.0</td>
<td>1.0</td>
<td></td>
<td></td>
<td>167.0</td>
</tr>
<tr>
<td>Seaweed (with an antioxidant, with no iron-response)</td>
<td>Bag</td>
<td>150x250x20</td>
<td>68</td>
<td>0.5</td>
<td>0.5</td>
<td>0.8</td>
<td>0.8</td>
<td></td>
<td></td>
<td>167.3</td>
</tr>
</tbody>
</table>
### 2.1. Dry products

<table>
<thead>
<tr>
<th>Inspected product</th>
<th>Package</th>
<th>Dimension(mm)</th>
<th>Weight (g)</th>
<th>Fe φ(mm)</th>
<th>Test piece on a product</th>
<th>Test piece on a conveyor belt</th>
<th>SUS φ(mm)</th>
<th>Test piece on a product</th>
<th>Test piece on a conveyor belt</th>
<th>Product Phase(°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seaweed (with an antioxidant with no iron-response)</td>
<td>Bag</td>
<td>200x260x10</td>
<td>58</td>
<td>0.6</td>
<td>0.6</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>167.8</td>
<td></td>
</tr>
<tr>
<td>Rice crackers with peanuts</td>
<td>Bag</td>
<td>130x210x20</td>
<td>155</td>
<td>1.0</td>
<td>0.9</td>
<td>1.5</td>
<td>1.5</td>
<td>166.8</td>
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<td></td>
</tr>
<tr>
<td>Sweets</td>
<td>Bag</td>
<td>—</td>
<td>—</td>
<td>0.5</td>
<td>0.5</td>
<td>0.8</td>
<td>0.8</td>
<td>166.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice crackers</td>
<td>Bag</td>
<td>200x260x60</td>
<td>150</td>
<td>0.6</td>
<td>0.5</td>
<td>1.0</td>
<td>0.8</td>
<td>167.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chocolate</td>
<td>Bag</td>
<td>240x75x35</td>
<td>210</td>
<td>0.5</td>
<td>0.5</td>
<td>0.7</td>
<td>0.7</td>
<td>15.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chocolate</td>
<td>Bag</td>
<td>210x105x10</td>
<td>203</td>
<td>0.5</td>
<td>0.5</td>
<td>0.7</td>
<td>0.7</td>
<td>14.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green tea</td>
<td>Bag</td>
<td>260x80x50</td>
<td>260</td>
<td>0.4</td>
<td>0.4</td>
<td>0.8</td>
<td>0.7</td>
<td>14.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## 2.1. Dry products

<table>
<thead>
<tr>
<th>Inspected product</th>
<th>Package</th>
<th>Dimension (mm)</th>
<th>Weight (g)</th>
<th>Fe φ (mm)</th>
<th>SUS φ (mm)</th>
<th>Product Phase (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tea</td>
<td>In a box</td>
<td>125x95x60</td>
<td>76</td>
<td>0.5</td>
<td>0.8</td>
<td>19.5</td>
</tr>
<tr>
<td>Coffee</td>
<td>Bag</td>
<td>160x90x55</td>
<td>205</td>
<td>0.5</td>
<td>0.8</td>
<td>13.7</td>
</tr>
<tr>
<td>Nuts</td>
<td>Bag</td>
<td>200x130x25</td>
<td>96</td>
<td>0.5</td>
<td>0.7</td>
<td>14.0</td>
</tr>
<tr>
<td>Cereal</td>
<td>In a box</td>
<td>230x140x60</td>
<td>509</td>
<td>0.4</td>
<td>0.7</td>
<td>14.0</td>
</tr>
</tbody>
</table>
## 2.2. Wet products

<table>
<thead>
<tr>
<th>Inspected product</th>
<th>Package</th>
<th>Dimension(mm)</th>
<th>Weight (g)</th>
<th>Test piece on a product</th>
<th>Test piece on a conveyor belt</th>
<th>Test piece on a product</th>
<th>Test piece on a conveyor belt</th>
<th>Test piece on a product</th>
<th>Test piece on a conveyor belt</th>
<th>Product Phase(°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bananas</td>
<td>Bag</td>
<td>130x200x75</td>
<td>590</td>
<td>1.0</td>
<td>1.0</td>
<td>2.0</td>
<td>2.0</td>
<td>42.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kiwis</td>
<td>Plastic package</td>
<td>170x140x60</td>
<td>433</td>
<td>1.0</td>
<td>1.0</td>
<td>2.38</td>
<td>2.38</td>
<td>78.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pineapple</td>
<td>Plastic package</td>
<td>145x120x55</td>
<td>223.4</td>
<td>0.8</td>
<td>0.8</td>
<td>2.38</td>
<td>2.38</td>
<td>111.0</td>
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<td></td>
</tr>
<tr>
<td>Tomatoes</td>
<td>Plastic package</td>
<td>210x165x50</td>
<td>210</td>
<td>0.5</td>
<td>0.4</td>
<td>1.5</td>
<td>1.5</td>
<td>94.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olives</td>
<td>Plastic package</td>
<td>110x110x60</td>
<td>108</td>
<td>0.7</td>
<td>0.7</td>
<td>2.0</td>
<td>2.0</td>
<td>108.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bean sprouts</td>
<td>Bag</td>
<td>200x175x50</td>
<td>264</td>
<td>1.0</td>
<td>1.0</td>
<td>2.0</td>
<td>2.0</td>
<td>64.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetables</td>
<td>Bag</td>
<td>190x240x45</td>
<td>342</td>
<td>0.9</td>
<td>0.8</td>
<td>2.38</td>
<td>2.38</td>
<td>84.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 2.2. Wet products

<table>
<thead>
<tr>
<th>Inspected product</th>
<th>Package</th>
<th>Dimension(mm)</th>
<th>Weight (g)</th>
<th>Fe φ(mm)</th>
<th>Test piece on a product</th>
<th>Test piece on a conveyor belt</th>
<th>SUS φ(mm)</th>
<th>Test piece on a product</th>
<th>Test piece on a conveyor belt</th>
<th>Product Phase(°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salad</td>
<td>Plastic package</td>
<td>210x210x40</td>
<td>235</td>
<td>0.9</td>
<td>0.8</td>
<td>2.0</td>
<td>2.0</td>
<td>117.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seasoning</td>
<td>Plastic package</td>
<td>110x180x35</td>
<td>118</td>
<td>0.8</td>
<td>0.7</td>
<td>2.0</td>
<td>2.0</td>
<td>140.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miso paste 1kg</td>
<td>Bag</td>
<td>150x210x40</td>
<td>1000</td>
<td>1.5</td>
<td>1.5</td>
<td>3.0</td>
<td>3.0</td>
<td>77.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packed lunch</td>
<td>Plastic package</td>
<td>195x235x60</td>
<td>569</td>
<td>1.2</td>
<td>1.2</td>
<td>3.0</td>
<td>2.5</td>
<td>78.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pickles</td>
<td>Plastic package</td>
<td>155x155x60</td>
<td>682</td>
<td>2.5</td>
<td>2.5</td>
<td>4.0</td>
<td>4.0</td>
<td>74.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kimchi (Korean pickles)</td>
<td>Plastic package</td>
<td>155x155x50</td>
<td>356</td>
<td>2.0</td>
<td>2.0</td>
<td>3.18</td>
<td>3.18</td>
<td>74.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natto (fermented soybeans)</td>
<td>Plastic package</td>
<td>100x100x60</td>
<td>142</td>
<td>1.0</td>
<td>1.0</td>
<td>2.5</td>
<td>2.5</td>
<td>126.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 2.2. Wet products

<table>
<thead>
<tr>
<th>Inspected product</th>
<th>Package</th>
<th>Dimension (mm)</th>
<th>Weight (g)</th>
<th>Fe φ (mm)</th>
<th>Test piece on a product</th>
<th>SUS φ (mm)</th>
<th>Test piece on a conveyor belt</th>
<th>Test piece on a product</th>
<th>Test piece on a conveyor belt</th>
<th>Product Phase(°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tofu (soft)</td>
<td>Plastic package</td>
<td>95x130x40</td>
<td>325</td>
<td>0.6</td>
<td>0.6</td>
<td>2.38</td>
<td>2.0</td>
<td></td>
<td>84.5</td>
<td></td>
</tr>
<tr>
<td>Tofu (hard)</td>
<td>Plastic package</td>
<td>140x110x40</td>
<td>430</td>
<td>0.6</td>
<td>0.6</td>
<td>2.0</td>
<td>2.0</td>
<td></td>
<td>110.0</td>
<td></td>
</tr>
<tr>
<td>Deep fried tofu</td>
<td>Plastic package</td>
<td>120x185x35</td>
<td>295</td>
<td>0.9</td>
<td>0.8</td>
<td>2.5</td>
<td>2.5</td>
<td></td>
<td>88.8</td>
<td></td>
</tr>
<tr>
<td>Pudding</td>
<td>Plastic package</td>
<td>φ71x45</td>
<td>120</td>
<td>0.5</td>
<td>0.5</td>
<td>1.5</td>
<td>1.5</td>
<td></td>
<td>94.5</td>
<td></td>
</tr>
<tr>
<td>Dumplings</td>
<td>Paper package</td>
<td>135x170x30</td>
<td>178</td>
<td>0.9</td>
<td>0.9</td>
<td>2.38</td>
<td>2.38</td>
<td></td>
<td>92.2</td>
<td></td>
</tr>
<tr>
<td>Pizza without antioxidant</td>
<td>Bag</td>
<td>280x260x30</td>
<td>400</td>
<td>1.5</td>
<td>1.2</td>
<td>2.5</td>
<td>2.38</td>
<td></td>
<td>106.7</td>
<td></td>
</tr>
<tr>
<td>Pizza with antioxidant</td>
<td>Bag</td>
<td>280x260x30</td>
<td>400</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td></td>
<td>17.5</td>
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</tr>
</tbody>
</table>
### 2.2. Wet products

<table>
<thead>
<tr>
<th>Inspected product</th>
<th>Package</th>
<th>Dimension (mm)</th>
<th>Weight (g)</th>
<th>Fe φ (mm)</th>
<th>Test piece on a product</th>
<th>Test piece on a conveyor belt</th>
<th>SUS φ (mm)</th>
<th>Test piece on a product</th>
<th>Test piece on a conveyor belt</th>
<th>Product Phase(°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh pasta</td>
<td>Bag</td>
<td>215x135x20</td>
<td>142</td>
<td>2.5</td>
<td>2.5</td>
<td>3.0</td>
<td>3.0</td>
<td>16.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sausage</td>
<td>Bag</td>
<td>250x120x30</td>
<td>206</td>
<td>0.5</td>
<td>0.4</td>
<td>2.0</td>
<td>2.0</td>
<td>109.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parma ham</td>
<td>Bag</td>
<td>190x250x30</td>
<td>120</td>
<td>0.7</td>
<td>0.7</td>
<td>2.0</td>
<td>2.0</td>
<td>104.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheese</td>
<td>Bag</td>
<td>130x130x40</td>
<td>320</td>
<td>0.8</td>
<td>0.7</td>
<td>2.38</td>
<td>2.38</td>
<td>111.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bun</td>
<td>Bag</td>
<td>130x130x35</td>
<td>116</td>
<td>1.0</td>
<td>1.0</td>
<td>2.5</td>
<td>2.5</td>
<td>174.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Puddings</td>
<td>Plastic package</td>
<td>φ71x205x60</td>
<td>241</td>
<td>1.5</td>
<td>1.5</td>
<td>2.5</td>
<td>2.5</td>
<td>78.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 2.3. Aluminum metalized film packaged products

<table>
<thead>
<tr>
<th>Inspected product</th>
<th>Package</th>
<th>Dimension(mm)</th>
<th>Weight (g)</th>
<th>Fe φ(mm)</th>
<th>SUS φ(mm)</th>
<th>Product Phase(°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potato chips</td>
<td>Bag</td>
<td>200x220x60</td>
<td>68</td>
<td>×</td>
<td>×</td>
<td>71.0</td>
</tr>
<tr>
<td>Biscuits</td>
<td>in a box</td>
<td>85x135x30</td>
<td>80</td>
<td>3.0</td>
<td>2.5</td>
<td>80.0</td>
</tr>
<tr>
<td>Cheese</td>
<td>Bag</td>
<td>110x110x25</td>
<td>150</td>
<td>3.0</td>
<td>2.5</td>
<td>—</td>
</tr>
<tr>
<td>Chocolate</td>
<td>in a box</td>
<td>130x80x40</td>
<td>90</td>
<td>5.0</td>
<td>5.0</td>
<td>102.7</td>
</tr>
</tbody>
</table>

### 2.4. Aluminum foil packaged products

<table>
<thead>
<tr>
<th>Inspected product</th>
<th>Package</th>
<th>Dimension(mm)</th>
<th>Weight (g)</th>
<th>Fe φ(mm)</th>
<th>SUS φ(mm)</th>
<th>Product Phase(°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A bowl of rice topped with chicken and eggs</td>
<td>Retort pouch</td>
<td>125x170x30</td>
<td>190</td>
<td>×</td>
<td>×</td>
<td>—</td>
</tr>
</tbody>
</table>
3. FAQ

3.1. Features of AD4971

3.1.1. What are the features of AD4971?

- IP65 compliant dust and waterproof
- Adjustable conveyor belt speed from 10m/min to 60m/min
- 7 inch color touch panel
- Stores up to 1000 products with product images
- Equipped with Modbus RTU/TCP as standard
- Supports USB memory. Inspection and operation history can be recorded
- Accessibility to the IO box
- 230mm pass height model available
- Aperture width 350mm and conveyor belt width 250m

3.1.2. Is the AD4971 X-ray inspection equipment?

No. The AD4971 is an electromagnetic induction type metal detector.

3.1.3. Is auto sensitivity setting function available?

Yes. Sensitivity setting can be done by sending a product without metal contaminants through 3 times. The threshold level can be adjusted manually after auto sensitivity setting.

3.1.4. Is phase tracking function available?

Yes. In terms of wet products, changes of environment temperature or product temperature affect the phase of product effect. With the phase tracking function, the AD4971 automatically tracks the phase change caused by change of temperature.

The phase tracking function is to track continuous change. It may not track sudden temperature change. Please change the threshold manually or conduct an auto sensitivity setting when there was a big temperature change between the last inspection and the new inspection.

3.1.5. What is product phase?

Product phase is a phase which is unlikely affected by product effect. Please refer to the chapter “Product phase” for more information. “P” on the bar graph display indicates the signal level of product phase.

3.1.6. What does the “P” on the bar graph display?

“P” stands for “Product phase” and indicates the signal level which is not likely to be affected by product effect.

3.1.7. What is the oscillating frequency of AD4971?

The oscillating frequency of AD4971 is 300 kHz.

3.1.8. Can conveyor belt speed be adjusted?

Yes. It can be adjusted from 10m/min to 60m/min.

3.1.9. Are multiple languages available?

Japanese and English are available. More languages will be added in the future.
3.2. Detection performance

3.2.1. What is the detection method for AD4971?
AD4971 is an electromagnetic induction type coaxial sensor head metal detector.

3.2.2. Can the AD4971 detect metal contaminants besides iron or stainless steel?
Both magnetic and non-magnetic metals can be detected. Not only Fe or SUS, but also other magnetic metals like nickel or non-magnetic metals like aluminum or brass can also be detected. Detection sensitivity varies by the properties of the metal.

3.2.3. What does the figure for detection sensitivity mean?
The size of detectable contaminant is represented by the diameter of a ball bearing. The smaller the ball bearing diameter is, the better the detection performance of the metal detector. Actual detection sensitivities differ from the ones on the catalog due to product effect. Please refer to “Typical Detection Sensitivity” for actual performances.

3.2.4. What is a dry product?
Products that contain low water or salt content and have a small product effect are called dry products. Frozen meat or seafood has less product effect, so they are equivalent to dry products.  
Ex. Frozen meat, clothes, cartons, plastic pellets

3.2.5. What is a wet product?
Products that contain water or salt content and have a large product effect are called wet products.  
Ex. Meat stored at room temperature, fresh fruits and vegetables, miso (bean paste), soy sauce, pickles

3.2.6. Can metal contaminants in aluminum metalized film packaged products be detected?
It is difficult to detect contaminants in aluminum metalized film packaged products. Big iron contaminants such as M4-M5 nuts can be detected. It is difficult to detect non-magnetic metals inside aluminum metalized film packaged products. The thickness of aluminum metalized film is less than 0.1 micro meters. Aluminum metalized film packaging is used for potato chips packages.

3.2.7. Can metal contaminants in aluminum foil packaged products be detected?
It is difficult to detect metal contaminants in aluminum foil packages. The AD4971 cannot detect a contaminant in aluminum foil packages. Please contact an A&D sales representative. According to the JIS standard, thickness of aluminum foil is 6 - 200 micro meters. Thermostabilized foods are packed in aluminum foil packages.

3.2.8. Can metal contaminants in cans be detected?
In principle, electromagnetic induction type metal detectors, including AD4971, cannot detect metal contaminants in cans. Please consider X-ray detectors as they may detect contaminants in cans. It is said that magnetic sensor type metal detectors can detect magnetic metal or magnetized stainless steel in cans.
3.2.9. What shall I do when a metal detector reacts to products without metal contaminants by mistake?

In terms of wet products, the phase of product effect changes when either the temperature of the environment or product changes.
The phase tracking function is to track continuous change, but it may not track sudden temperature change.
Please change the threshold manually or conduct auto sensitivity setting when there is a big temperature change.

3.2.10. What shall I do when environmental disturbance is significant?

External electromagnetic waves are disturbances to the detection signal and affect detection sensitivity.
With a large aperture size model, detection sensitivity may be improved by putting eaves or an external electromagnetic shield around the apertures.

Unnecessary vibration to a metal detector unit may increase the noise floor.
Please install the device in a stable environment and adjust the length of the feet with the adjusting bolt for proper installation.

3.2.11. What can be the source of external noise?

Big motors, switched-mode power supply or fluorescent lights can be noise sources.
Other metal detector units may also cause interference.
Please pay attention to the installation environment or use an electromagnetic shield or eaves to reduce noise effects.

A conveyor roller including ball bearing may form a one-turn coil and become a noise source.
Please pay close attention to conveyor lines installed before and after the metal detector.

If a frequency of a noise has a peak, protection against noise may be taken by adjusting the oscillating frequency.
Please consult with a sales representative.

When an arm, watches, buckles or coin purses move near a sensor head (metal free zone),
they become a noise source and may be detected as contaminants.

3.2.12. What is the metal free zone (MFZ)?

The area approximately twice the opening aperture height around the aperture is called the Metal Free Zone (MFZ).
Metal or people entering the MFZ may affect detection performance and these may be detected as metal contaminants.

Please install metal detectors where the MFZ is free from metals.
Please make sure not to put your arm in the MFZ when you place a product on the conveyor manually.
3.2.13. Effect of touch panel and button operation
Pressing the touch panel or the START/STOP button too hard transmits vibrations to the sensor head. This may increase noise level and cause false detection.

3.2.14. Effect of human body (arms)
The human body contains blood which can affect the detection signal. Arms in the MFZ may affect detection performance.

Please try to avoid the MFZ when you place and receive a product or a test piece on a conveyor manually.

3.3. Connectivity to external devices

3.3.1. Can a rejector be connected?
A rejector can be connected to a metal detector and controlled via DO (Digital Output). We supply AD4980 series rejectors.

3.3.2. Can a comparator light be connected?
A comparator light can be connected to a metal detector and controlled via DO (Digital Output). We supply AD4971-02 comparator lights.

3.3.3. Can the lighting condition of the comparator light be customized?
Lighting condition or time can be configured.

3.3.4. Does the metal detector operate simultaneously with a checkweigher?
They operate simultaneously via DIO (Digital Input Output). The metal detector can also be connected to the AD4961 checkweigher via serial interface.

3.3.5. Does the metal detector operate with PLC?
Supports DIO, ModbusRTU and Modbus TCP as standard.

3.4. Performance verification
Because of the product effect or installation environment, actual detection sensitivity is not always same as the one on the catalog.
It is important to conduct performance verification with the actual products to be inspected.
Please contact your local sales representative for verification.
3.5. Model selection

3.5.1. Is it better to choose a bigger aperture size?

The bigger the aperture size, the worse the detection sensitivity. Please choose an appropriate model considering the maximum size of the products.

3.5.2. What is the maximum carrier weight?

The maximum carrier weight is 3kg at 10 – 30m/min belt speed or 2kg at 30 – 60m/min belt speed. If a product is heavier than 3kg, please consult with our sales representative.

3.5.3. Are wheels available?

Wheels are a factory installation option. Please consult with our sales representative.

3.6. Installation

3.6.1. Where should a metal detector be installed?

Unnecessary vibration to a metal detector may increase the noise floor of the detection signal. Please install it in a stable environment, adjust the adjusting bolt and tighten nuts properly.

A big motor, switched-mode power supply or fluorescent lights can become noise sources. An environment far away from such noise sources is ideal.

Please avoid installing metal detectors where there are big temperature changes, direct sunlight or in windy places.

3.6.2. Is a ground connection necessary?

Ground connection is necessary. Please make sure to ground from both safety and noise perspectives.

3.7. Maintenance

3.7.1. Are there any replaceable items?

The conveyor belt, plastic gears, motor unit, conveyor deck, drive pulley, driven pulley, return roller, photo sensor, fuse, backup battery, waterproof packing and rubber damper are all replaceable items and need to be replaced periodically.
Appropriate test piece for common risks

<table>
<thead>
<tr>
<th>Size</th>
<th>Name</th>
<th>Shape</th>
<th>Flow direction</th>
<th>Test piece</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>M3</td>
<td>Spring washer</td>
<td></td>
<td></td>
<td></td>
<td>Equivalent to SUS2.0Φ</td>
</tr>
<tr>
<td></td>
<td>Flat washer</td>
<td></td>
<td></td>
<td></td>
<td>Equivalent to SUS1.8Φ</td>
</tr>
<tr>
<td></td>
<td>Nut</td>
<td></td>
<td></td>
<td></td>
<td>Equivalent to SUS2.0Φ</td>
</tr>
<tr>
<td></td>
<td>Round head screw</td>
<td>5L</td>
<td></td>
<td></td>
<td>Equivalent to SUS4.79Φ</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Equivalent to SUS4.0Φ</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Equivalent to SUS4.3Φ</td>
</tr>
<tr>
<td>M4</td>
<td>Spring washer</td>
<td></td>
<td></td>
<td></td>
<td>Equivalent to SUS3.0Φ</td>
</tr>
<tr>
<td></td>
<td>Flat washer</td>
<td>9.5L</td>
<td></td>
<td></td>
<td>Equivalent to SUS3.5Φ</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Equivalent to SUS2.5Φ</td>
</tr>
<tr>
<td></td>
<td>Nut</td>
<td>6</td>
<td></td>
<td></td>
<td>Equivalent to SUS5.5Φ</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Equivalent to SUS6.5Φ</td>
</tr>
<tr>
<td></td>
<td>Round head screw</td>
<td>5L</td>
<td></td>
<td></td>
<td>Equivalent to SUS7.0Φ</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Equivalent to SUS7.0Φ</td>
</tr>
<tr>
<td>M5</td>
<td>Spring washer</td>
<td>9L</td>
<td></td>
<td></td>
<td>Equivalent to SUS4.9Φ</td>
</tr>
<tr>
<td></td>
<td>Flat washer</td>
<td></td>
<td></td>
<td></td>
<td>Equivalent to SUS3.5Φ</td>
</tr>
<tr>
<td></td>
<td>Nut</td>
<td>8</td>
<td></td>
<td></td>
<td>Equivalent to SUS8.0Φ</td>
</tr>
<tr>
<td></td>
<td>Round head screw</td>
<td>5L</td>
<td></td>
<td></td>
<td>Equivalent to SUS10Φ</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Equivalent to SUS8.0Φ</td>
</tr>
</tbody>
</table>

*Unit : mm
*Please use this table only as a guide.
## A&D Checkweigher and Metal Detector Questionnaire

### Customer Contact Information:

<table>
<thead>
<tr>
<th>Date</th>
<th>Company Name</th>
<th>Contact Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Company Address:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tel:</td>
<td>Fax:</td>
</tr>
<tr>
<td></td>
<td>E-mail:</td>
<td></td>
</tr>
</tbody>
</table>

### Product Information:

<table>
<thead>
<tr>
<th>Product Name:</th>
<th>Packed</th>
<th>Unpacked</th>
<th>Dry</th>
<th>Wet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging Type:</td>
<td>Carton</td>
<td>Bag</td>
<td>Bottle</td>
<td>Other ( )</td>
</tr>
<tr>
<td>Packaging Material:</td>
<td>Paper</td>
<td>Plastic</td>
<td>Aluminum Metalized Film</td>
<td>Aluminum Foil</td>
</tr>
<tr>
<td>Dimensions (mm):</td>
<td>Max. Length x Width x Height</td>
<td>Min. Length x Width x Height</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (g):</td>
<td>g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product Temperature:</td>
<td>( )</td>
<td>☐ Celsius</td>
<td>☐ Fahrenheit</td>
<td></td>
</tr>
</tbody>
</table>

### General Information Details:

<table>
<thead>
<tr>
<th>Purchase Quantity:</th>
<th>☐ Checkweigher: sets / ☐ Metal Detector: sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveyor Width (mm):</td>
<td>Pass Line Height (mm):</td>
</tr>
<tr>
<td>Conveyor Speed:</td>
<td>m/min</td>
</tr>
<tr>
<td>Throughput:</td>
<td>Avg. pcs/min</td>
</tr>
<tr>
<td>Flow Direction (Facing the display unit):</td>
<td>☐ From left to right</td>
</tr>
<tr>
<td>Desired Accuracy (For Checkweigher):</td>
<td>± g (3σ)</td>
</tr>
<tr>
<td>Desired Sensitivity (For Metal Detector):</td>
<td>Fe [φ mm] / SUS [φ mm]</td>
</tr>
<tr>
<td>Reject Module:</td>
<td>☐ Conveyor Stop</td>
</tr>
<tr>
<td>Ambient Temperature:</td>
<td>( )</td>
</tr>
<tr>
<td>Waterproofness:</td>
<td>☐ Non-waterproof</td>
</tr>
</tbody>
</table>

### Options and Accessories:

For Checkweighers:
- ☐ Display Stand
- ☐ Tower Light
- ☐ Upper Breeze Break
- ☐ Lower Breeze Break
- ☐ Cross Plate
- ☐ Product Guide

For Metal Detectors:
- ☐ Tower Light

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