Ultra-Early Machine Failure Sign & QA

AE Logging System



Early Observer

User Guide

for Pegasus_Freddo

JCC Co., Ltd.

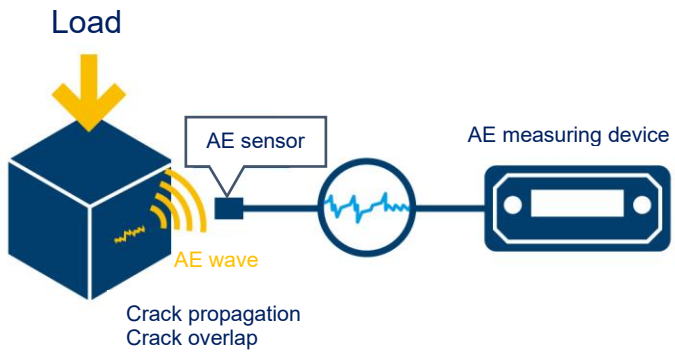
History

Document No.	Date Revision	Description
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FNF 0040 931	10, Aug., 2026	P11,16,17 Correction of error

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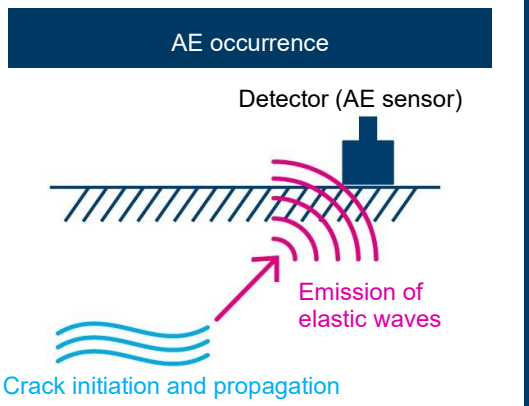
1. AE(Acoustic Emission) for quickly capturing primary information.



Basic knowledge of AE technology

Acoustic emission (AE) is elastic wave (AE wave) generated by cracks and wear, and among the many sensing methods, the AE method is the fastest way to capture the internal state of a material.

When cracks or wear occur in a material, an AE sensor captures elastic waves and converts them into voltage. The AE monitoring system analyzes this large volume of signals along with filtering them, processing them into data that can be used by the customer.



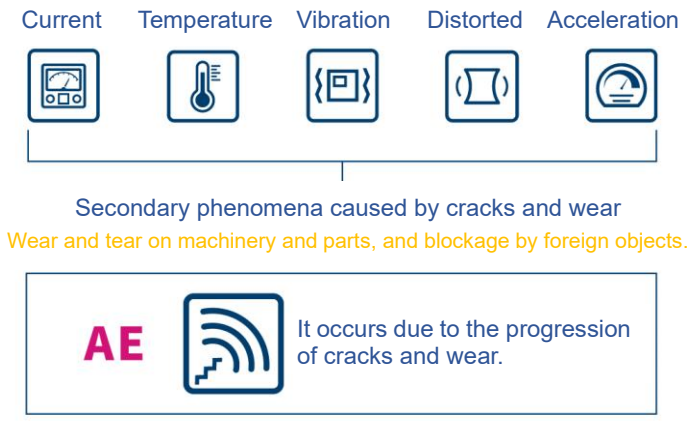
What is acoustic emission (AE)?

Acoustic emission (AE) is a phenomenon in which, when a material deforms or cracks, the elastic energy stored within the material is released as an acoustic signal called an "elastic wave" with a high frequency. This AE (Acoustic Energy) technology, which detects and evaluates these "elastic waves," allows for the non-destructive detection of defects (cracks) within materials, including their occurrence and progression. Along with non-destructive testing methods such as ultrasonic testing and X-rays, it is a technology used worldwide and has a proven track record to date.

AE and earthquakes?

The occurrence of AE and the occurrence of earthquakes are equivalent in that they are both caused by the generation of elastic waves resulting from rapid changes occurring within a solid. The theoretical formula for AE generation is the same as the formula for earthquake generation. AE can be described as an extremely small earthquake.

AE waves are high-frequency elastic waves (acoustic signals) that occur during plastic deformation, cracking, and wear of materials.



Advantages of AE

AE waves can detect cracks, wear, and other damage. Other sensors detect secondary phenomena such as vibrations and temperature changes caused by cracks or wear.

AE sensors do not require directional mounting and can measure within the wave propagation range, allowing for flexible installation.

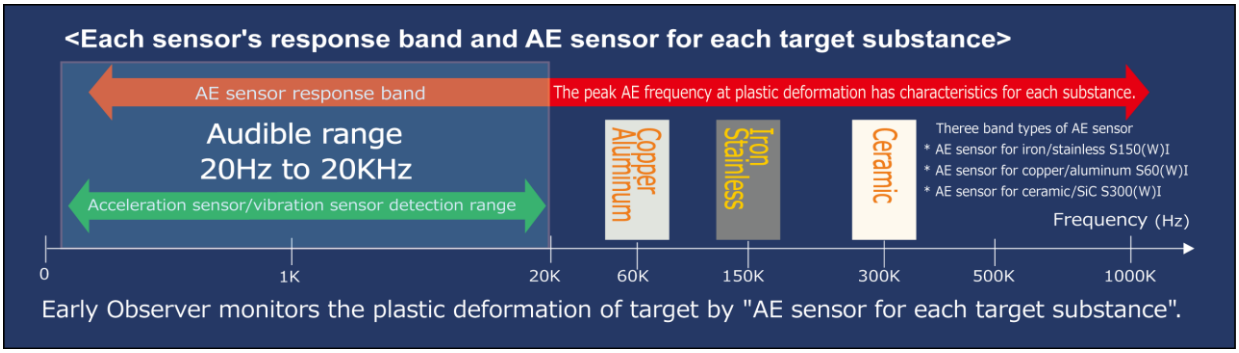
AE waves can also measure damage or lubrication problems at low rotational speeds, which is difficult with other sensors.

Because this AE method is so user-friendly, it allows you to quickly grasp the condition of machinery and equipment.

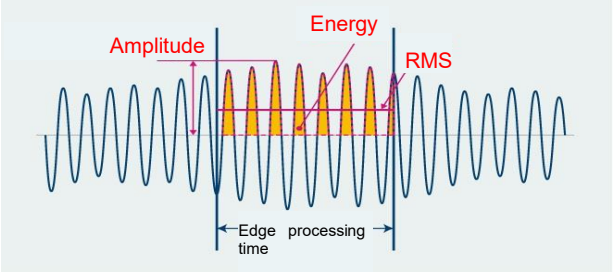
Comparison of AE sensor and other sensors

Sensors	Installation method ○ : Easy × : Difficult	Mounting direction ○ : Easy × : Difficult	Detection in low-speed rotational state	
			Scratch detection	Lubrication detection
Amperometer	○	○	×	×
Thermometer	○	○	×	×
Vibration sensor	○	×	×	×
Strain sensor	×	×	×	×
Accelerometer	○	×	×	×
AE sensor	○	○	○	○

About AE sensing



Main parameters of the AE signal

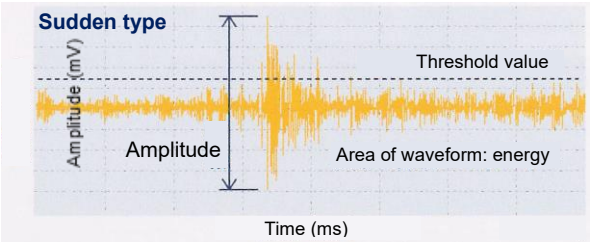


Three main parameters used in AE measurement

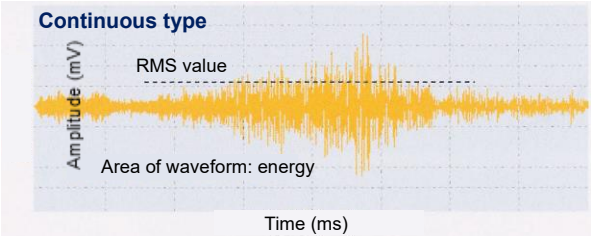
■Amplitude: The maximum amplitude value of the AE signal within the edge processing time.
Sensitive to scratches and cracks.
■Energy: The integral value of the AE signal during edge processing time.
Proportional to the smoothness of sliding and rotation.
■RMS:The effective value of the AE signal within the edge processing time.
There is correlation accounting with the friction coefficient.

Differences in AE depending on the source

AE occurs during crack propagation



AE is generated when friction and wear occur.



2. Examples of Early Observer Use

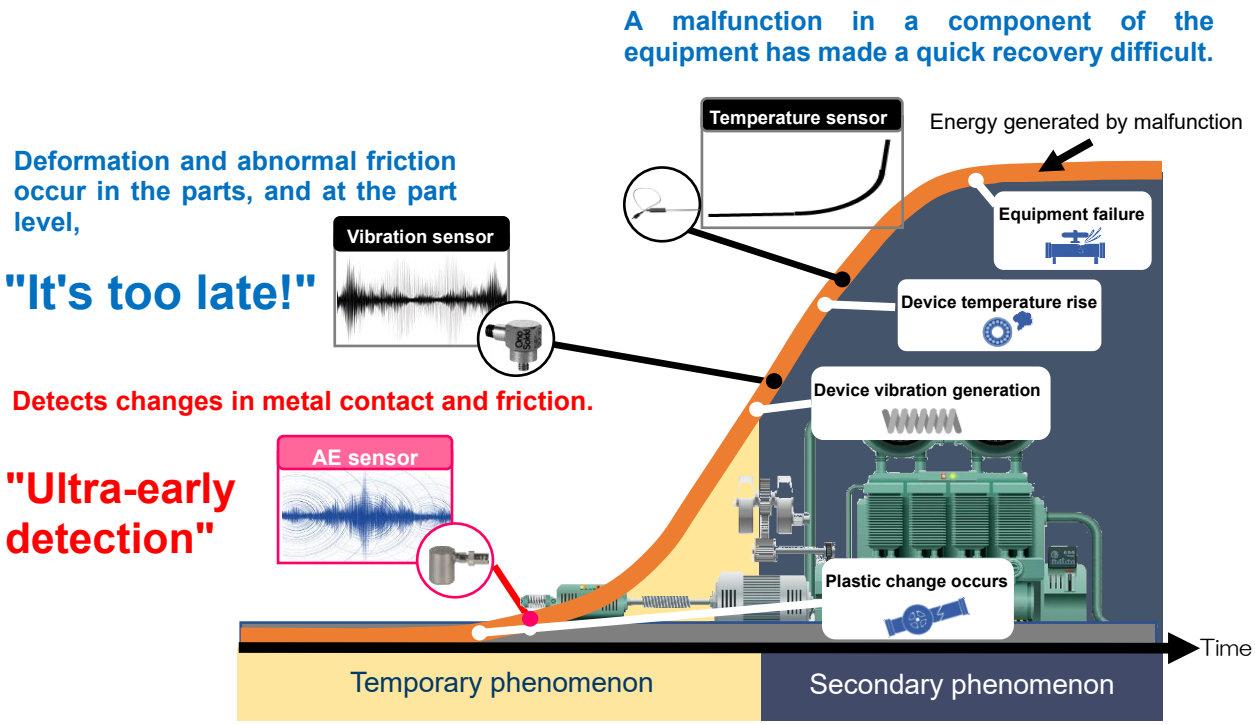
Here are some examples of how to use Early Observer.

- ■ Automobile and motorcycle manufacturers
- ■ Automotive parts manufacturer
- ■ Small boat manufacturers
- ■Bearing manufacturers
- ■Transmission manufacturers
- ■Beverage manufacturers
- ■ Research and development

*Example of achievements

- ■ Food manufacturers
- ■ Pharmaceutical manufacturers
- ■ Semiconductor manufacturing equipment
- ■ Factory equipment maintenance
- ■ Energy related
- ■ Public infrastructure
- ■ Others

Early Observer Field Application Examples, Until the robot or machine breaks down



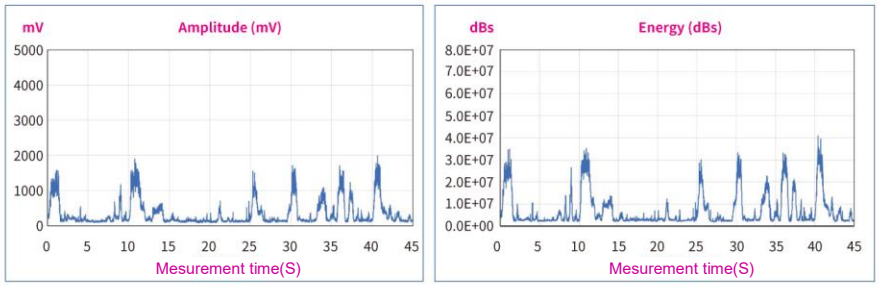
2-1. Examples of Early Observer use in conservation

Checking the status of the robot's gearbox

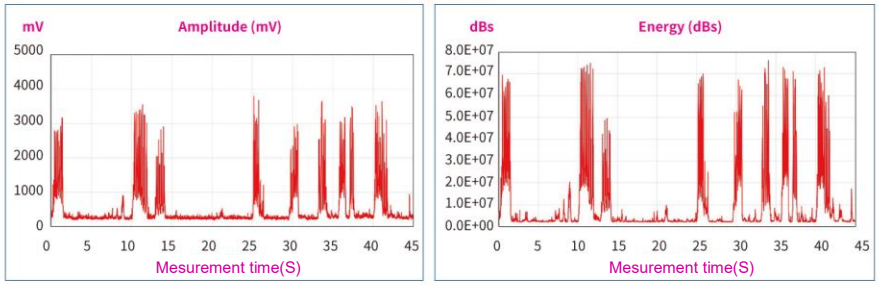


If there is a problem with the gears or bearings inside the reduction gear, the Amplitude and Energy values will increase, and a significant change will be observed in the waveform.

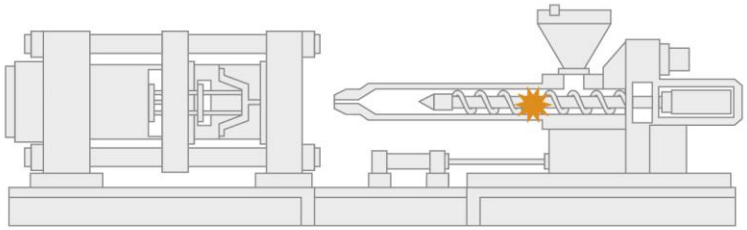
Normal equipment



Abnormal equipment

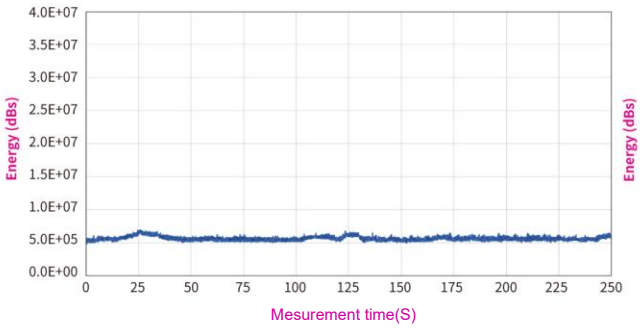


Barrel wear detection in Injection molding machine

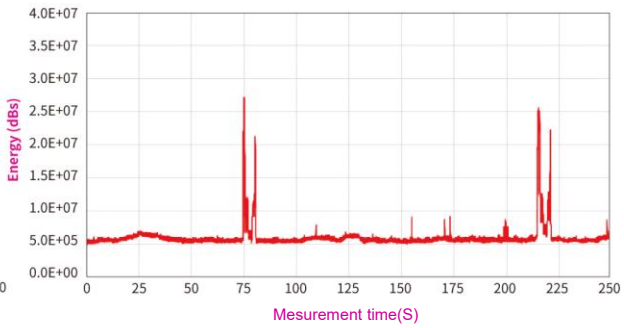


If screws are in contact and wear occurs on one side, the energy value will increase periodically.

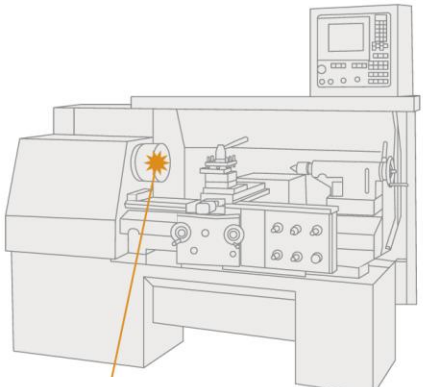
Normal equipment



Abnormal equipment



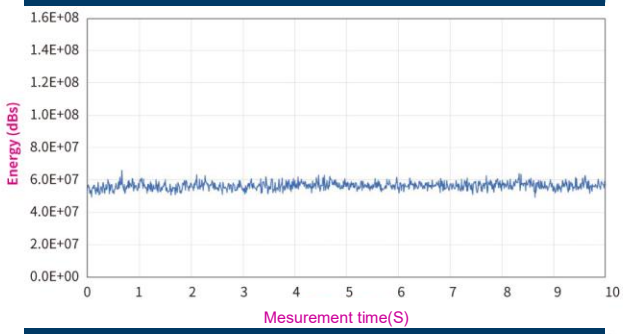
Bearing wear condition management



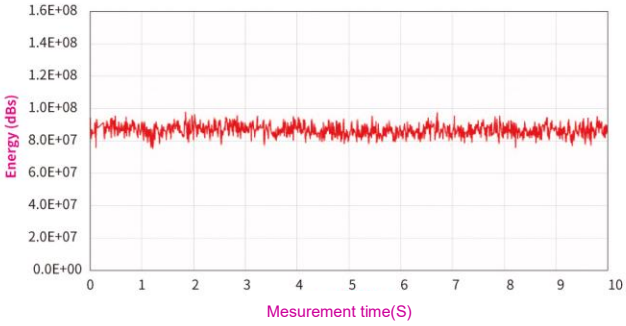
Main spindle lubrication failure management and damage detection

When lubrication deteriorates, surface roughness occurs, increasing friction and thus the overall Energy value increases.

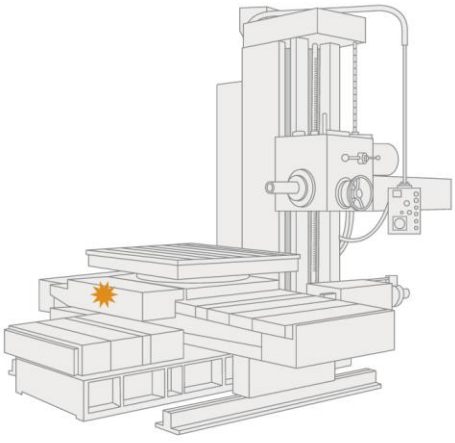
New bearings



Initial surface roughness of bearings

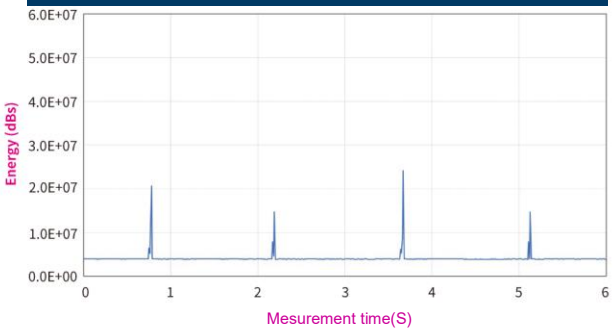


Cylinder wear detection

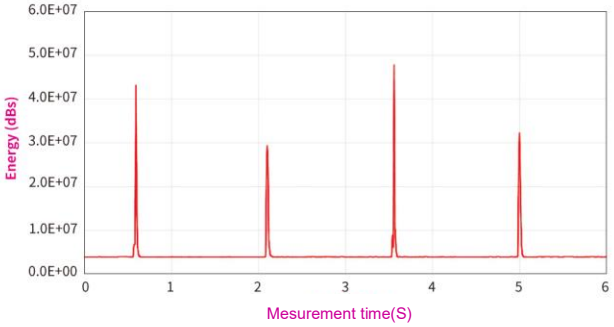


When the cylinder operation exceeds 300,000 times, wear progresses and friction increases, causing the Energy value to rise.

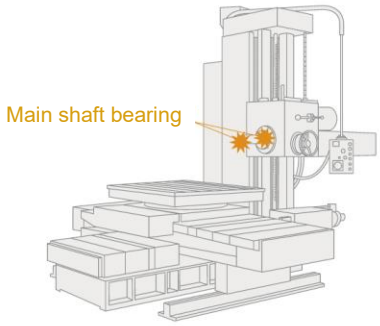
New cylinder



Used cylinder

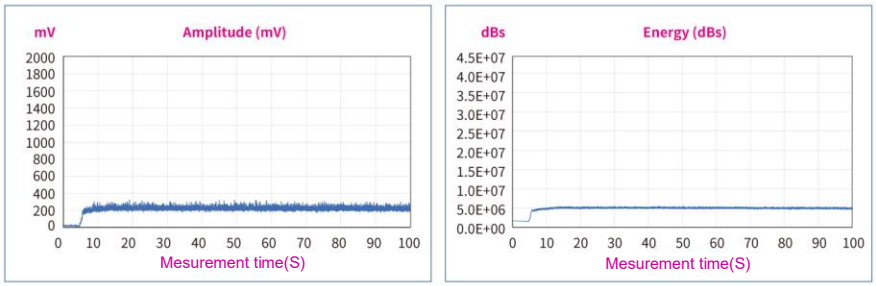


Detection of poor lubrication in the main shaft bearing in cutting machine

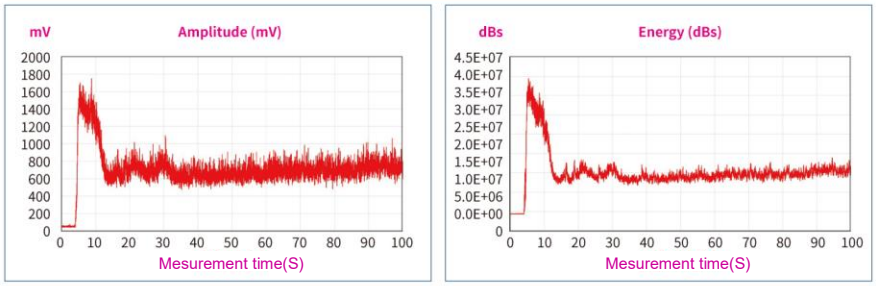


If there is a lubrication problem in the main shaft bearing, the values of Amplitude and Energy will increase, and a significant change will be observed in the waveform.

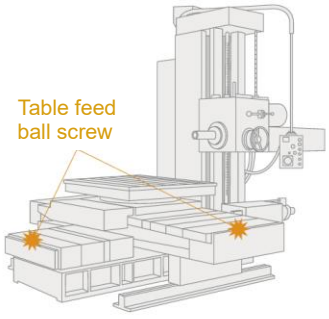
Normal equipment



Abnormal equipment



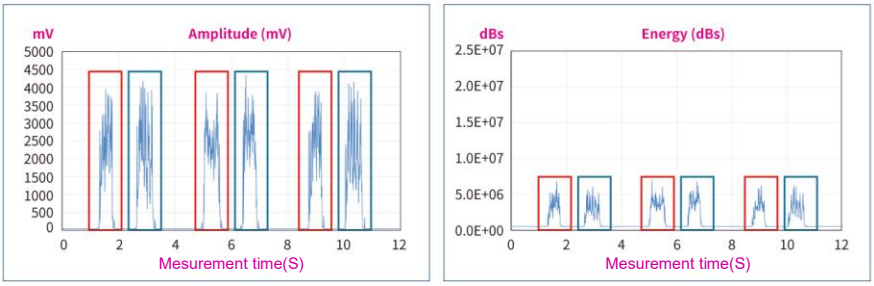
Ball screw wear detection in cutting machine



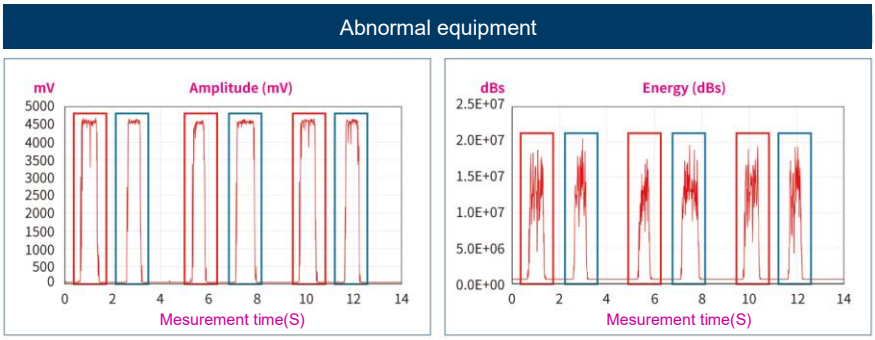
If the ball screw's lubrication deteriorates and wear occurs, the Amplitude and Energy values will increase, and a significant change in the waveform will be observed.

Feed Back

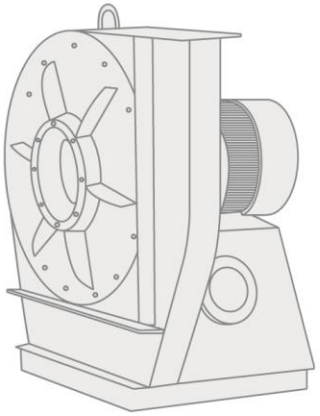
Normal equipment



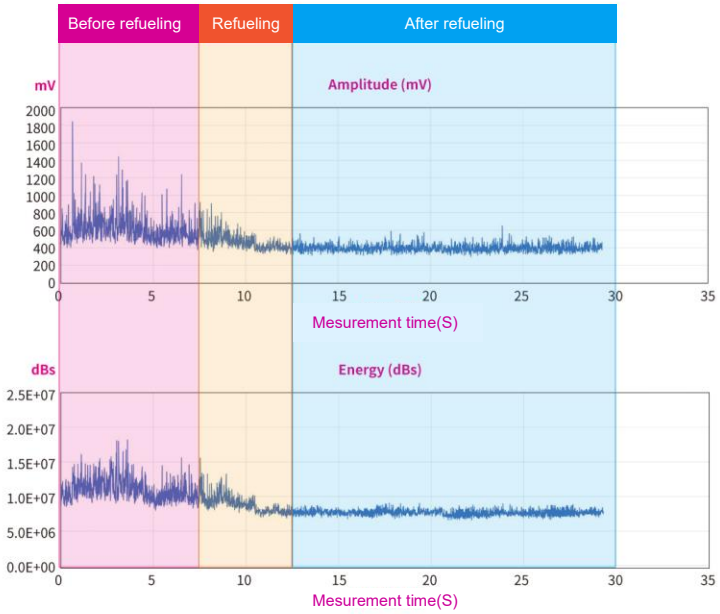
Abnormal equipment



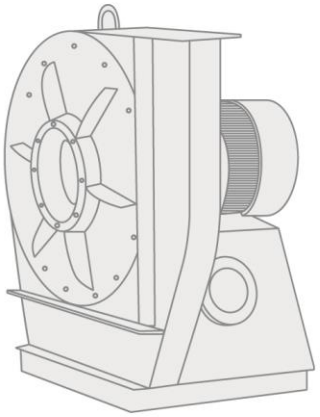
Check the motor's status



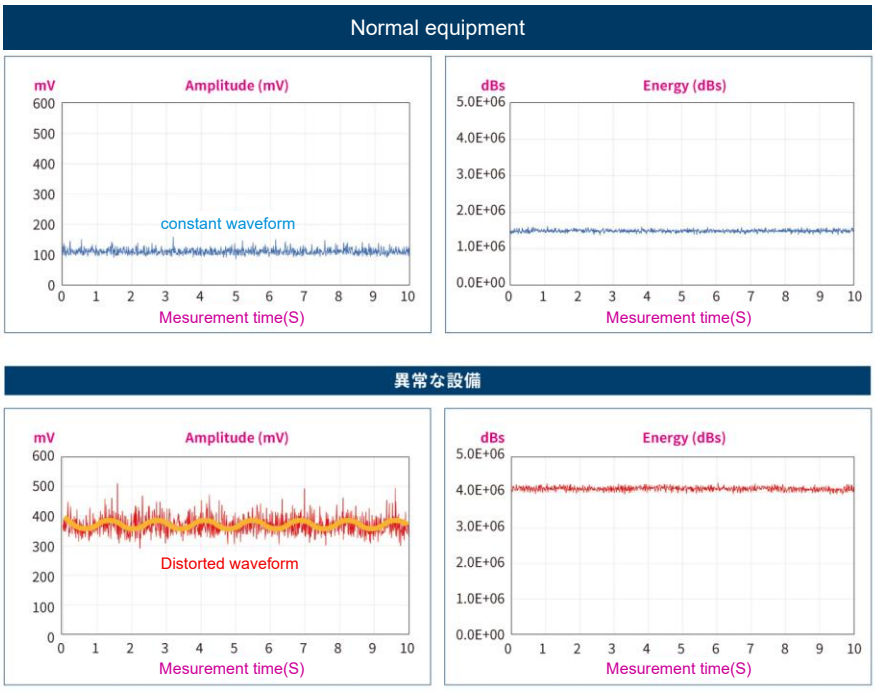
While vibration sensors cannot detect changes, AE sensors allow us to observe changes in lubrication status using waveforms.



Checking the blower balance

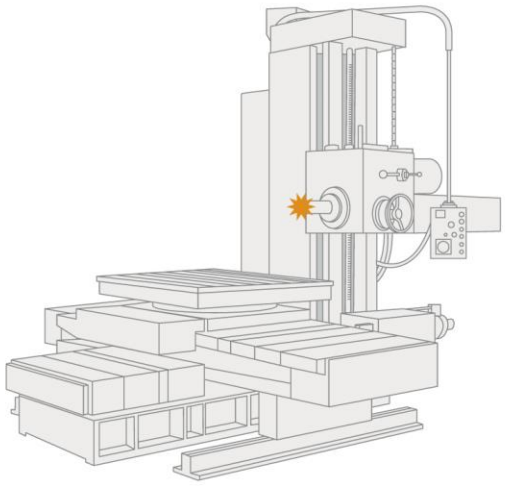


When rotational imbalance occurs, the Amplitude value increases, and waveform distortion is observed.



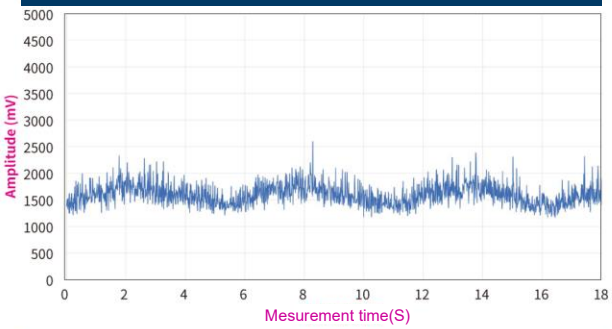
2-2. Examples of Early Observer usage in quality control

Product processing control in cutting machines

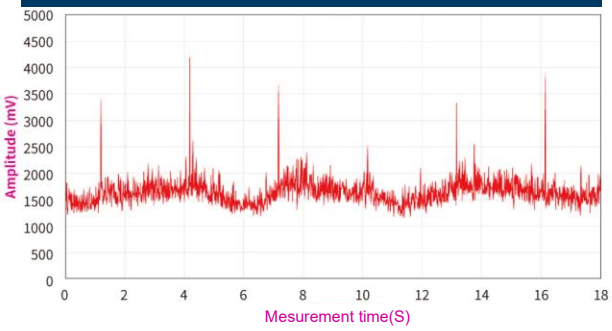


If there are scratches on the machined part, the Amplitude value will increase periodically.

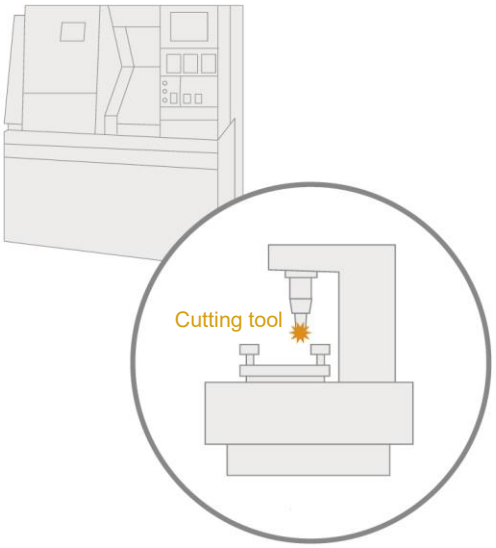
When machining normal parts



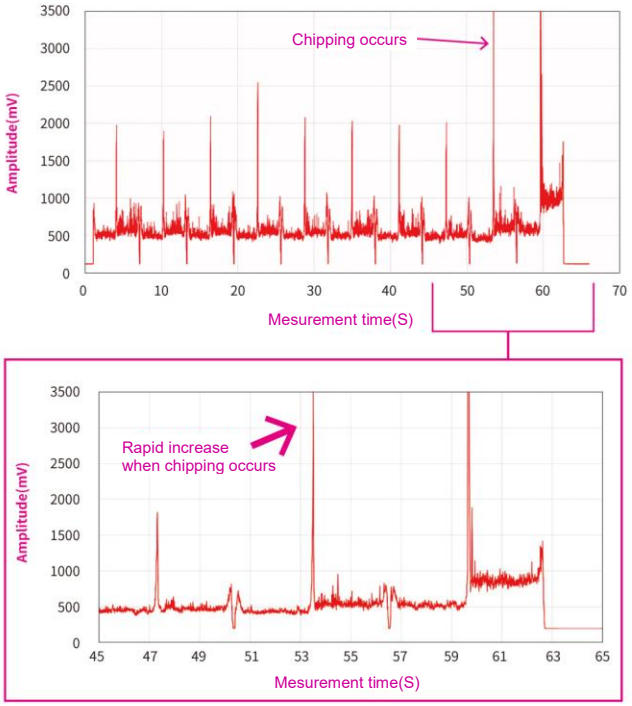
When machining vertical scratches parts



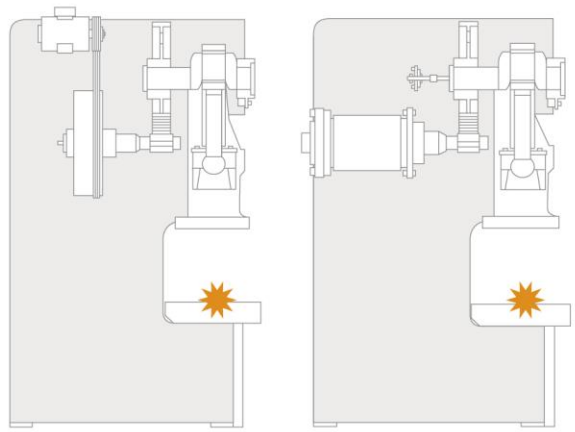
Chipping detection in machining centers



When chipping occurs, the amount of friction with the product increases, causing the Amplitude value to rise.



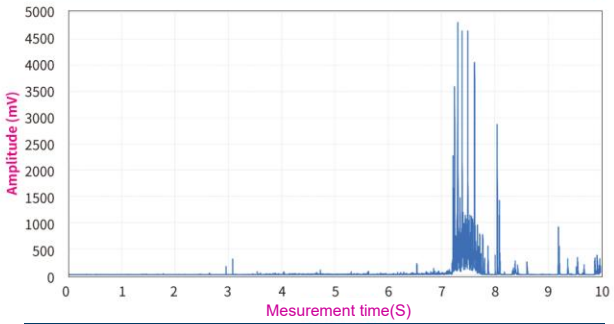
Product crack detection during pressing



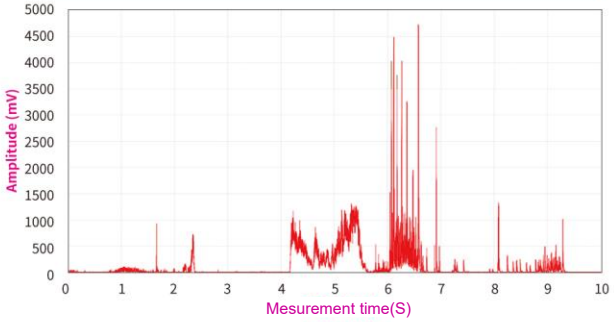
Mechanical press machine　　Servo press machine

When a workpiece cracks during press machining, the Amplitude value fluctuates, and a change in the waveform is observed.

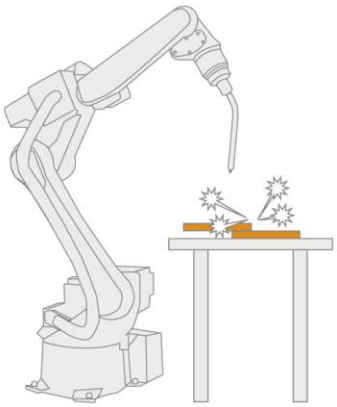
During normal pressing



When press crack occurs

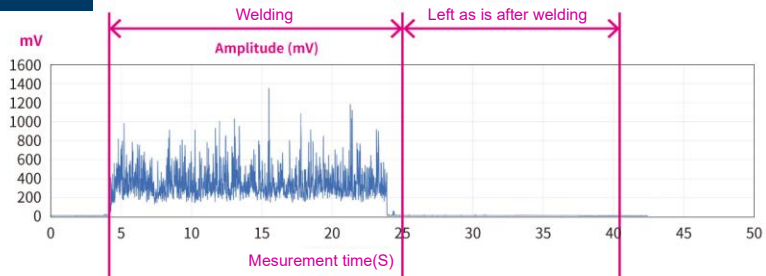


Checking for defects in arc welding (arc welding of dissimilar materials)

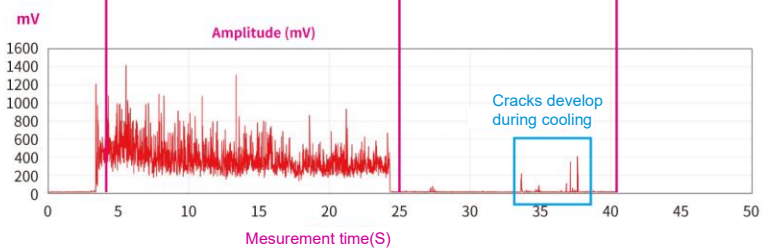


If cracks occur after welding is complete, the Amplitude value will increase.

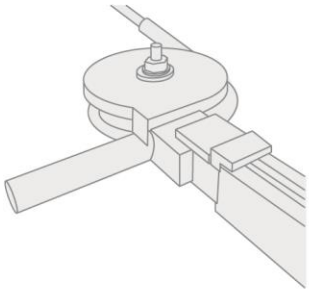
Good quality



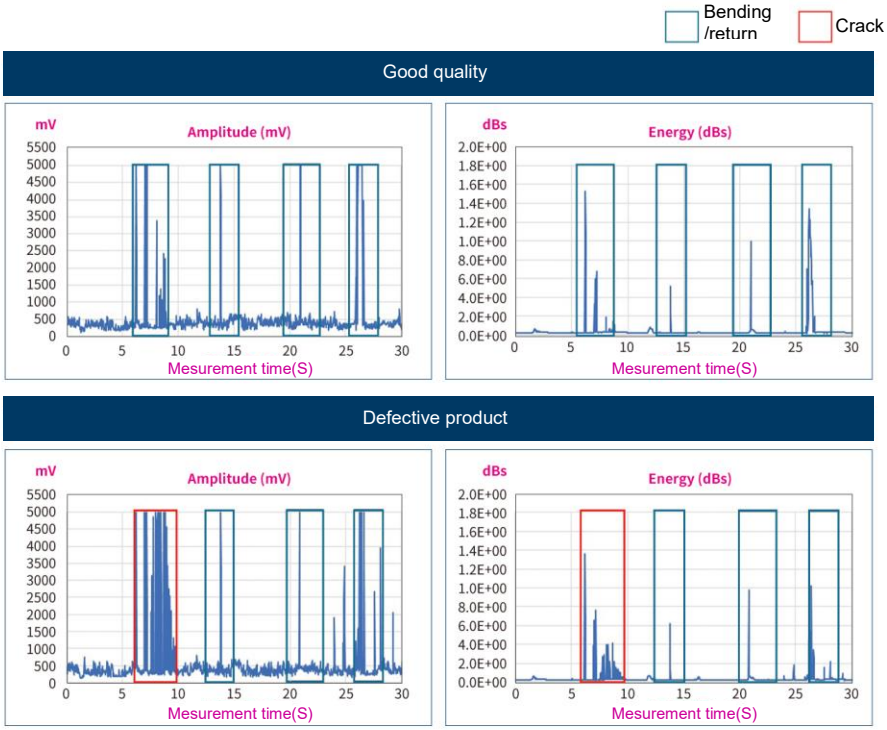
Defective product



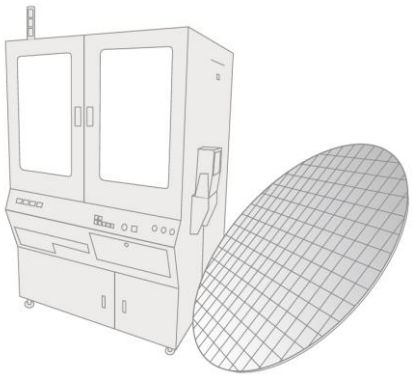
Checking for processing defects during pipe bending



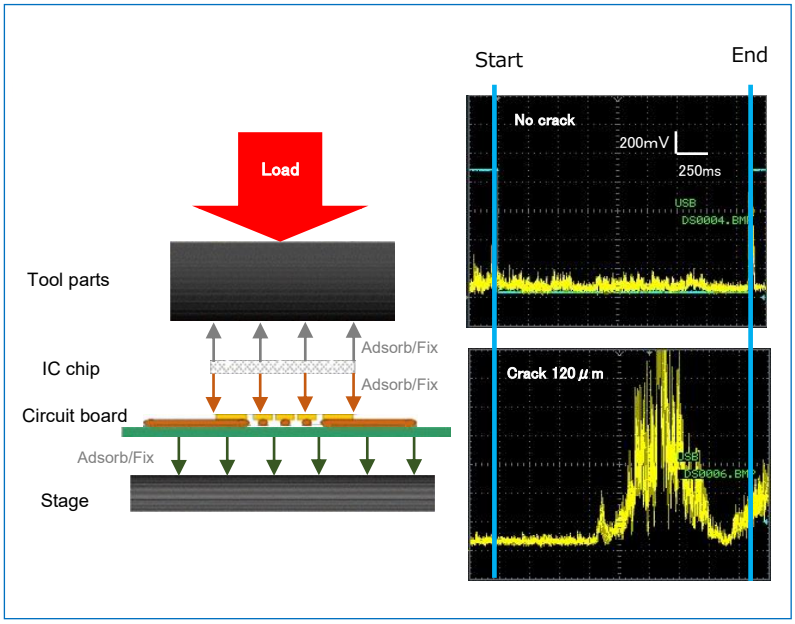
If cracks or distortions occur during processing, the Amplitude value will increase locally.



Chip crack detection in semiconductor manufacturing equipment



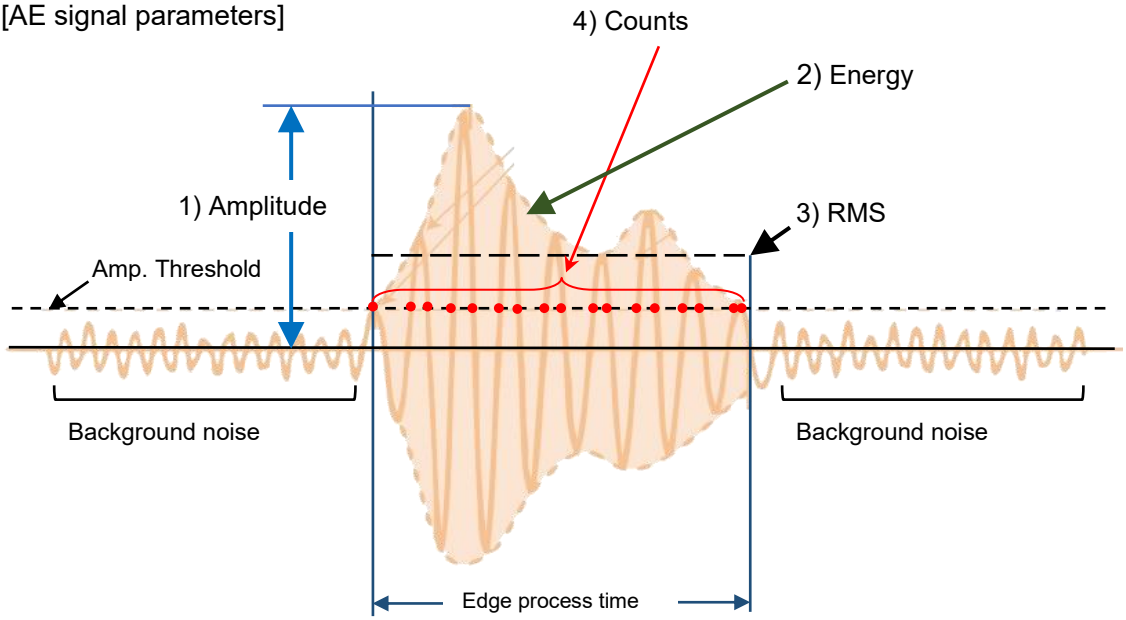
If cracks occur during machining, the Amplitude value will increase locally.



3. Main parameters of the AE signal

The AE signal is converted into four parameters and measured.

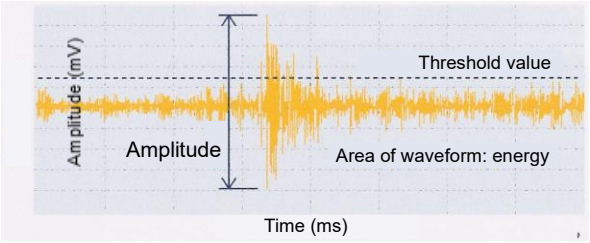
[AE signal parameters]



1) Amplitude-MAX : Max. amplitude value: Value of AE waveform within “edge process time”
2) Energy : Energy value: Integrated value of AE waveform within “edge process time”
3) RMS : Effective value: Value of AE signal acquired for each unit of “edge process time”
4) Counts : Count value: Number of intersections with OV or Amp. threshold within "edge process time”

[AE waveform and measurement points]

Sudden type



Source of occurrence: Crack growth, material transformation, etc.

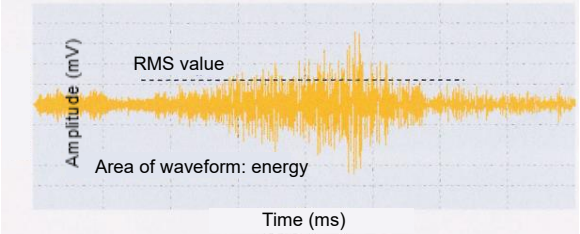
Waveform shape: Sharp rise

RMS (effective value): Correlation with Crack growth distance

Energy: Correlation with Crack growth distance

Frequency: Different characteristics for each object/material

Continuous type



Source of occurrence: Friction, wear, etc.

Waveform shape: Continuous signal

RMS (effective value): Correlation with Frictional force, Coefficient of friction

Energy: Correlation with Friction volume

Frequency: Different characteristics for each object / material

4. How to attach AE sensor and precautions

Please select an AE sensor that is suitable for the material being measured.

Copper, aluminum, concrete	: FAEN-S60I	（Focus frequency 60kHz）
Iron, stainless steel, FRP	: FAEN-S150I	（Focus frequency 150kHz）
Ceramic	: FAEN-S300I	（Focus frequency 300kHz）

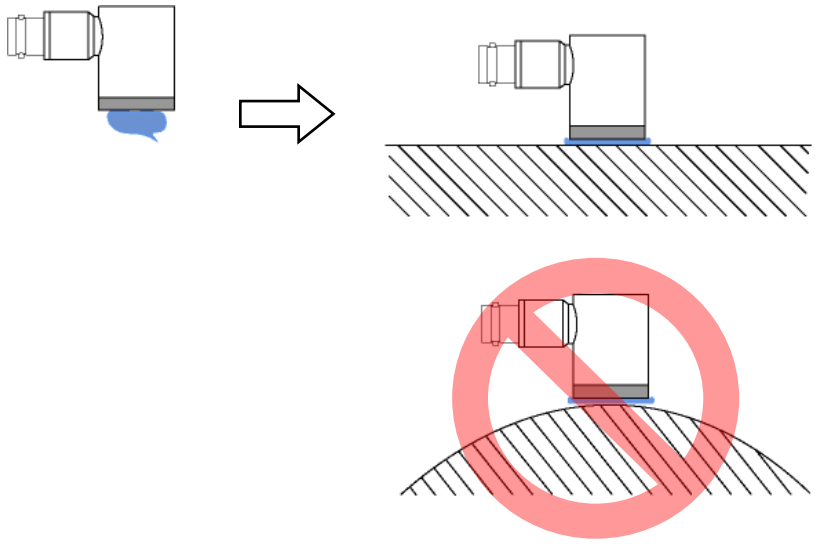
(1) Place to attach the AE sensor

Avoid installation at the following places.

1) Place where the ambient temperature exceeds the range -20 to +80 °C.
If the ambient temperature exceeds the range shown above, control the temperature range using a stethoscopic rod or other tools.
2) Place where there is a droplet of water, oil, chemicals, etc.
At a place where there is a droplet, use a waterproof AE sensor.

(2) Cautions on the attachment of the AE sensor

1) Attach the AE sensor on a flat surface as much as possible.
2) Before attaching the AE sensor, apply grease of vaseline on the contact surface of the AE sensor sufficiently not to generate a gap between the contact surface of the AE sensor and the measurement surface.
● Recommended grease: Shin-Etsu Chemical Co., Ltd. HIVAC-G

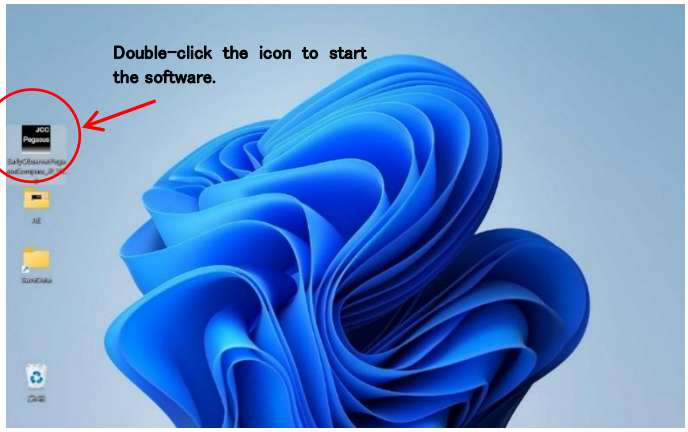


3) Fix the AE sensor using the dedicated sensor bracket.
4) When attaching the AE sensor to a non-magnetic material such as aluminum or stainless, fix the AE sensor with a tape or directly apply the adhesive agent such as "hot melt" on the contact surface of the AE sensor to fix it.
5) Install the AE sensor separately from a high-voltage line and power line as much as possible to prevent the effect of noise.

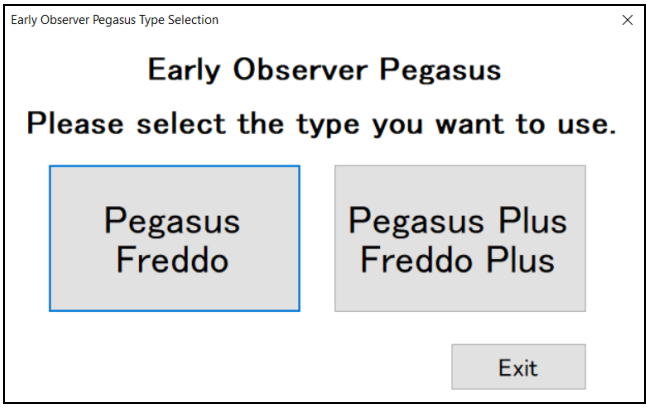
[Note]
An AE sensor is like a "stethoscope" that listens to elastic waves (acoustic signals) emitted when a material deforms.
Please attach the "AE sensor" as close as possible to the location you want to hear from.

5. Procedures and tips for AE test measurement

1. On a PC connected to Early Observer Pegasus or MEL-E Freddo,
   double-click “AE SYSTEM SUPPORT TOOL for Pegasus_Freddo” to launch the software.



2. Select the Early Observer type that you are going to use.

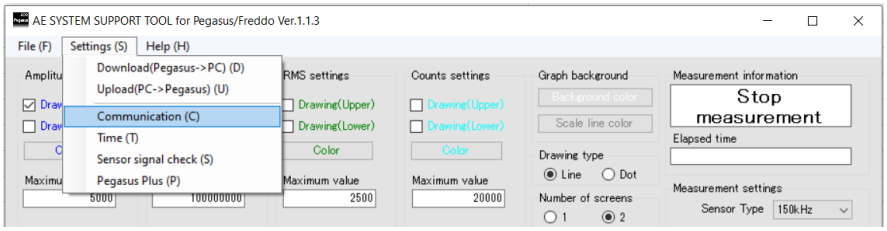


[Note]
Depending on the PC you are using, a virus warning may appear at the start.
In such a case, run “Windows Update” on the PC to update Windows to the latest state.

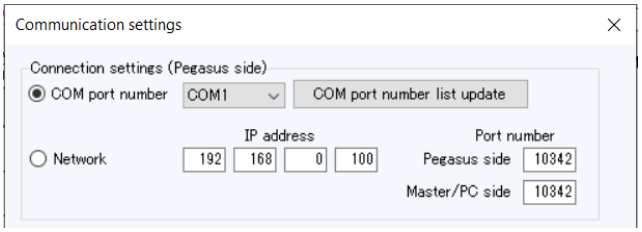
■A USB driver is required to connect Pegasus/Freddo to a PC via USB.
When connecting Pegasus/Freddo via USB for the first time, connect Pegasus/Freddo to your PC with a USB cable in an environment where you can perform Windows Update via the Internet.
The USB driver for "Pegasus/Freddo" will be automatically installed on your PC.
*If the USB driver does not install, download the driver from the website below and install it.
https://ftdichip.com/drivers/vcp-drivers/

*Installation of the USB driver is required only when connecting Pegasus/Freddo via USB for the first time.
There is no need to install the USB driver from the second time onwards.

3. After starting the AE TOOL, click the [Settings(S)] .
   Select the [Communication(C)]



4. Select the communication environment between Pegasus/Freddo and PC.
   Select the communication environment on the [Connection settings (Pegasus side)] screen.

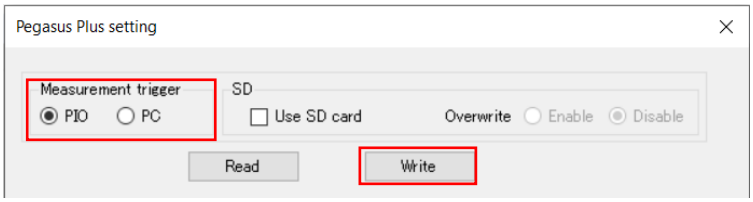


◎ COM port : Communicate with Pegasus/Freddo via a USB cable.
* If the USB cable is connected after starting the AE TOOL, click the [COM port number list update] button before selecting a COM port number.

◎ Network : Communicate with Pegasus/Freddo via Ethernet (LAN) cable.
* For details on network communications, see "11. Settings for Connecting to a PC via Ethernet" .

Click [Close(C)] to close the window.

5. For Pegasus/Freddo Plus, also set "Pegasus Plus(P)" from the "Settings(S)" tab.

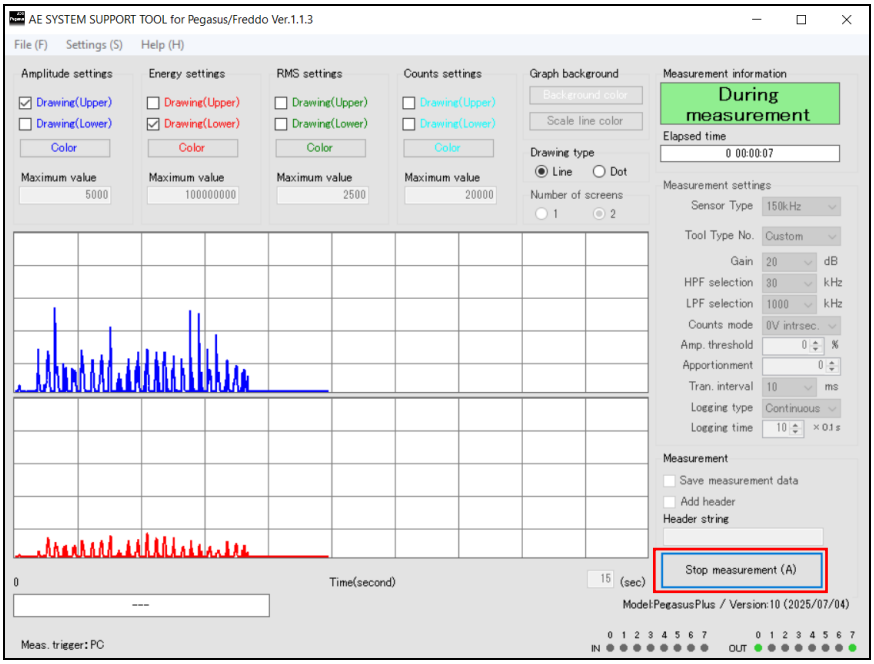


Select "PC" for "Measurement trigger".
Click "Write" to save the settings to Pegasus Plus.

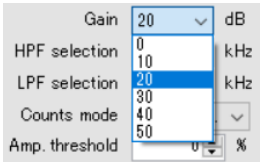
Click [Close(C)] to close the window.

6. Click “Start measurement(A)” to begin AE measurement.

   To save measurement data, check “☑Save measurement data”.

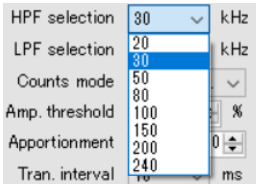


- The magnitude of the AE measurement value is adjusted using the “gain value”.
  If the measured value is low, increase the gain value.
  When the measurement value reaches the top of the graph scale, decrease the "gain value."
  * Select a gain value between 10 and 50.



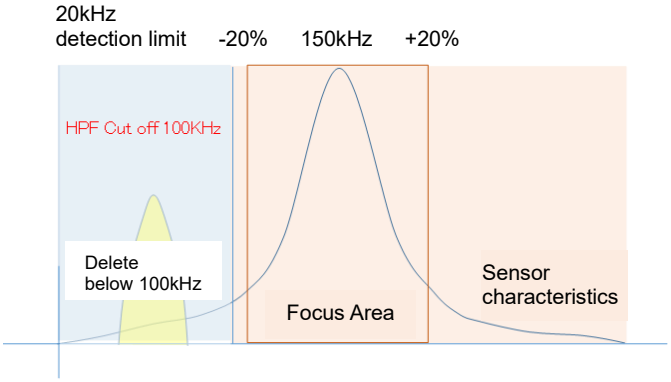
Gain/HPF/LPF setting tips

- When comparing two subjects in different conditions, measure the subject that is thought to be in worse condition first.
- Adjust the gain value so that the peak amplitude does not exceed 5,000.
- Set "HPF Selection" and "LPF Selection" according to the sensor type.



■ Image of HPF

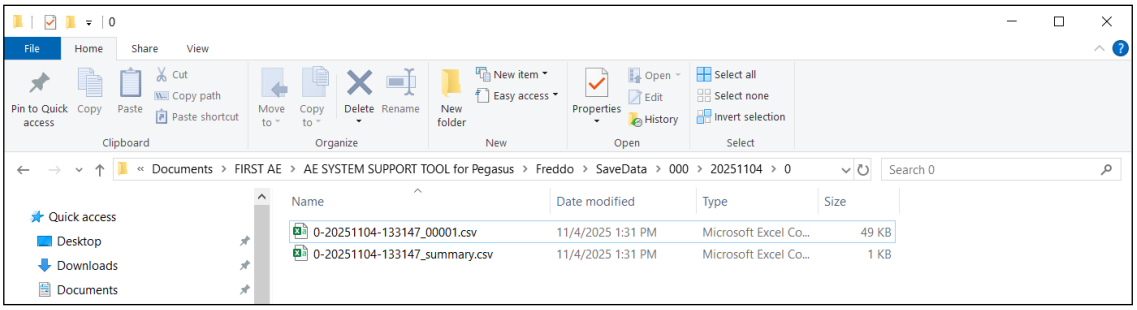
HPF: High Pass Filter
LPF: Low Pass Filter



Set according to the sensor type.

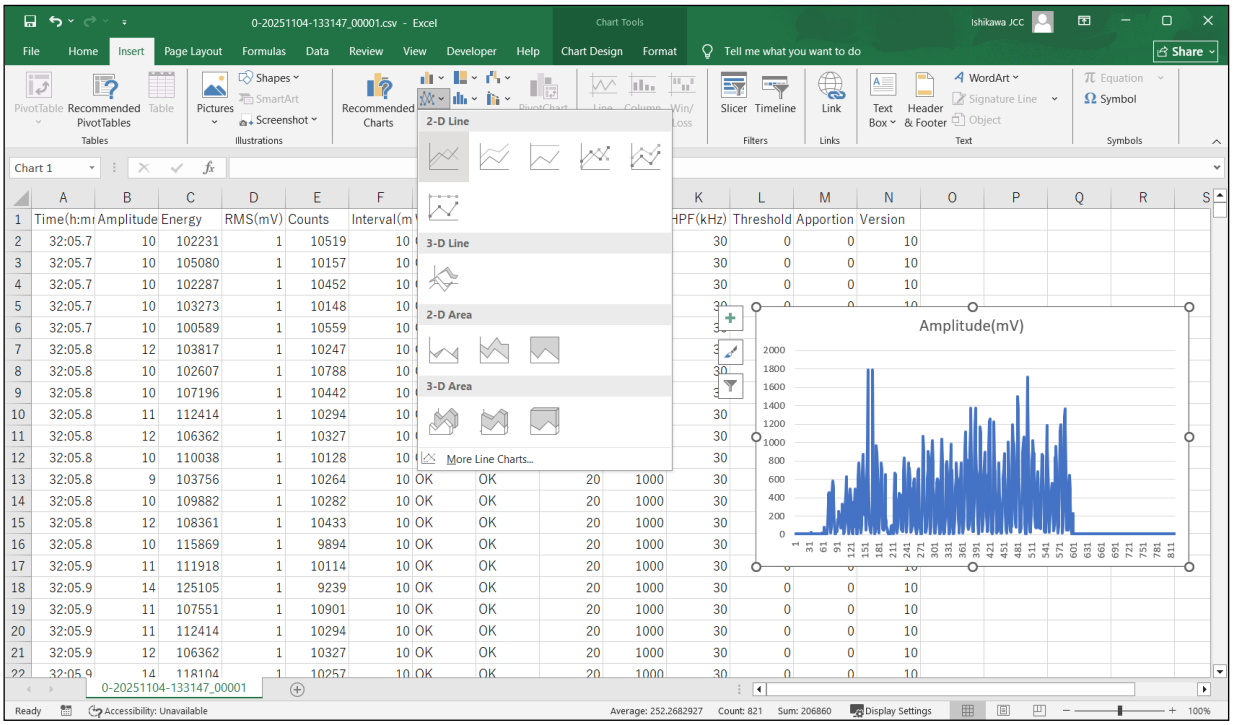
FAEN-60(W)I	HPF : 30	LPF : 100	: for copper/aluminum
FAEN-S150(W)I	HPF : 100	LPF : 200	: for iron/stainless
FAEN-S300(W)I	HPF : 200	LPF : 400	: for ceramic

7. Check the saved AE measurement data.



AE measurement data is saved in CSV format in the following location on your PC.
(Initial setup)
DocumentsFIRST AE\AE SYSTEM SUPPORT TOOL for Pegasus_Freddo\SaveData

- AE measurement data can be graphed using Excel or similar software.



8. Saved AE measurement data

The saved AE measurement data will be saved in "CSV format".

- Logging Data File

File name: Tool type number-Measurement date-Measurement time-Serial number of the file.

Example: 1-20250425-114953_00001.csv

Column	Item	Description
A	Time(h:mm:ss.000)	Time (h:mm:ss.000) *To show milliseconds on Excel, set the display format to “h:mm:ss.000” in the user definition.
B	Amplitude(mV)	Maximum amplitude value
C	Energy	Energy value
D	RMS(mV)	Effective value
E	Counts	0 V or number of intersection points of Amp. threshold value
F	Interval(ms)	Transmission interval
G	Wire	Sensor cable information (OK / NG)
H	Power	Power information (OK / NG)
I	Gain(dB)	Gain value
J	LPF(kHz)	LPF value
K	HPF(kHz)	HPF value
L	Threshold(%)	Amp. Threshold value
M	Apportion	Energy apportionment value
N	Out1	Threshold alarm 1（0:OFF / 1:ON）
O	Out2	Threshold alarm 1（0:OFF / 1:ON）
P	Version	Version information

- Summary File

File name: Tool type number-Measurement date-Measurement time_summary.

Example: 1-20250425-114953_summary.csv

Row	Item	Description
1	Amplitude-Maximum(mV)	Maximum amplitude value
2	Amplitude-Average(mV)	Average amplitude value
3	Amplitude-Variation(mV)	Variation amplitude value (maximum - minimum)
4	Energy-Maxmum	Maximum energy value
5	Energy-Total	Sum energy value
6	RMS-Maximum(mV)	RMS Maximum
7	RMS-Total	Sum RMS value
8	Energy-Apportionment	Energy apportionment value
9	RMS-Apportionment	RMS apportionment value
10	LPF(kHz)	LPF value
11	HPF(kHz)	HPF value



* This product is a data logging system adopting the AE sensor as a key technology, which does not guarantee machine failure sign diagnosis result or quality control.

■ **Contact**

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