
PIEZOELECTRIC SENSORS

BUYERS GUIDE

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Info.

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SELECTING THE RIGHT SENSORS

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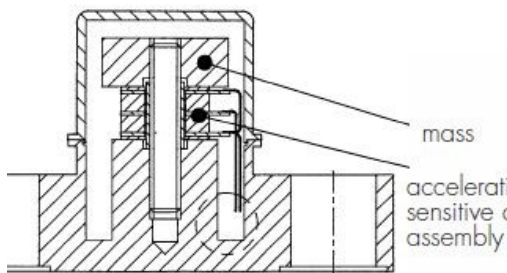
WHAT IS A PIEZOELECTRIC SENSOR?

THE PRINCIPLE OF OPERATION AND DESIGN

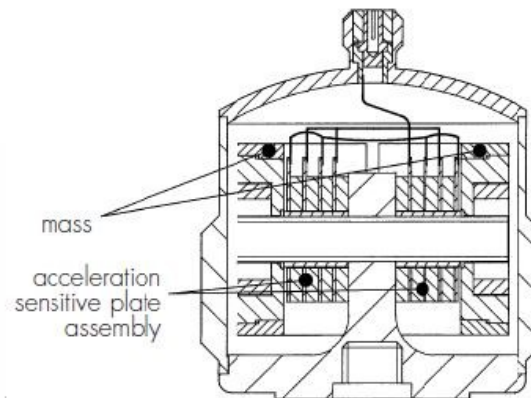
All piezoelectric accelerometers operate on the same principle, a mass applies a force to a piezoelectric material (crystal or ceramic) and the subsequent stress caused on the material outputs a charge which is proportional to the force. The force is affected by the mass size as well as the acceleration level. The amount of charge output can also be affected by the amount of piezoelectric material, so high sensitivity accelerometers tend to be quite large and heavy.

THE THREE PRIMARY DESIGNS OF AN ACCELEROMETER

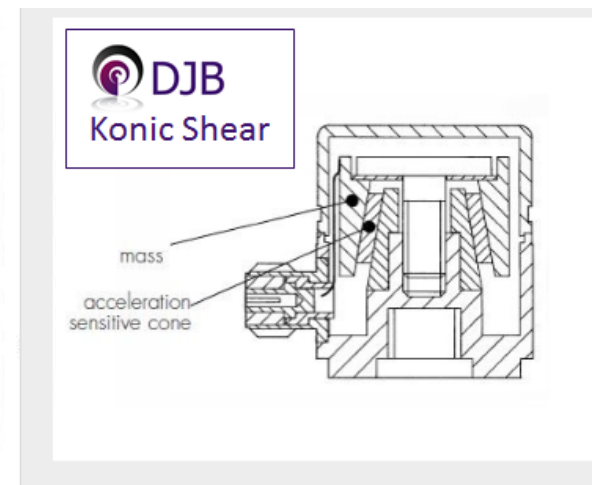
COMPRESSION



SHEAR



KONIC SHEAR



1 - VOLTAGE OUTPUT IEPE TYPE

DESCRIPTION

This type of accelerometer features an integrated circuit within the accelerometer converting the charge from the piezoelectric crystal before it leaves the sensor. This voltage can then be transmitted across a standard coaxial cable, as it is more stable and inherently immune to noise and interference from the cable.

These kinds of accelerometers have a maximum operating temperature of 257°F (125°C), with some high temperature variants of these accelerometers which can withstand temperatures of up to 365°F (185°C). There is also a water cooled accelerometer that can operate on surface temperatures in excess of 1652°F (900°C). IEPE accelerometers can be connected to the measuring equipment, or a computer with minimal interfacing/instrumentation, and does not require a charge amplifier. It is important that the accelerometer is powered by a stable, constant current supply to reduce noise on the signal generated by the accelerometer. The disadvantage of low impedance accelerometers is that the sensor has an internally fixed range and time constant, potentially limiting their uses in some applications.

FACTORS TO CONSIDER

- Fixed sensitivity. Range and time constant are fixed within the sensor.
- More expensive per unit.
- Lower operating temperature than a charge accelerometer.
- Less robust.

2 - CHARGE OUTPUT

DESCRIPTION

In this type of accelerometer, a charge will be emitted proportional to the force applied on the piezoelectric accelerometer. This charge will be transmitted directly down the cable and will require special low noise cable, with a charge amplifier on the receiving end. Charge accelerometers have high impedance and are particularly suited to high temperature applications (more than 365°F, or 185°C) where IEPE accelerometers could not be used. It is important to note that due to the high impedance nature of these sensors, they require a low noise of cable to be used when connecting the sensor to the measurement equipment. This is due to the cable used having an effect on the signal movement on the cable can distort this signal. It is also important to note that cable length will have a significant effect on the signal from the sensor, and it is advisable to have a short cable between the accelerometer and charge amplifier. Low noise charge amplifiers, or amplifiers with integrated low pass filters can be used, meaning that the signal from the charge amplifier is useable without any further filtering. The main advantage of a charge system over an IEPE system is the ability of the accelerometer to operate at higher

temperatures. Charge systems are generally more versatile due to the time constant, gain and normalization, all being controlled from the charge amplifier.

DEDICATED PROCESSING

- Noise from the cable affects results and reduces resolution – Must use a low noise cable.
- More costly with the requirement for additional instrumentation, and special low noise cables.
- High impedance nature of the signal makes it more vulnerable to noise. i.e, sensitive to cable flex.
- Requires more expertise to operate the system.
- Sensitive to dirt on connectors.

3 - SENSITIVITY AND RESOLUTION

DESCRIPTION

Consider the measurement range you require. An IEPE accelerometer is limited by its voltage output, so the sensitivity you use needs to cover the whole range of your likely measurement.

The sensitivity of an accelerometer is given as a voltage/charge returned per unit of acceleration, (mV/g or pC/g). For applications measuring high-level vibrations a lower output accelerometer is recommended, and for applications measuring low vibrations a higher output is recommended. E.g An accelerometer with an output of 10mV/g measuring an acceleration of 0.1g would return a voltage of 1mV. In this case a higher output accelerometer would be recommended in order to obtain a higher resolution measurement.

An accelerometer with an output of 100mV/g measuring an acceleration of 500g would return a voltage of 50v. In this case a lower output accelerometer would be recommended in order to obtain a reading within the constraints of readout instrumentation.

4 - OTHER

ACCELEROMETER WEIGHT

When measuring the vibration of a structure, adding an accelerometer will alter the vibration. To minimize this effect, the accelerometer should not weigh more than 10% of the overall weight of the structure to be tested. DJB Instruments manufactures an accelerometer with masses of just 0.0067 oz. (0.19gm), even suitable for testing of PCB boards.

GROUND ISOLATION AND MOUNTING

For accelerometers mounted on conductive surfaces, it is important to opt for a ground isolated variant to prevent erroneous data. This is caused by a difference in ground voltages between the accelerometer and the readout instrumentation, resulting in a ground loop.

MASS

Mass loading is the effect of adding mass to a test item which then changes the dynamic characteristics of that item. Check out this link for a great video on DJB Instruments Youtube page to show this phenomena, well worth a look: https://www.youtube.com/watch?v=J_sCOiyDkvl

CALIBRATION

Accelerometers can last for decades if treated properly, however regular calibration is important, things can change with age.

TEMPERATURE RANGE

Charge accels usually operate up to 500°F (260°C) while standard IEPE accels operate up to 257°F (125°C). Make sure this matches your requirement. If you need a high temperature IEPE accelerometer, look at DJB's world leading HT range which operate up to 1652°F (900°C).

CABLE SELECTION

A charge output accelerometer must be used with a LOW NOISE cable. The term low noise refers to the cable's ability to reduce triboelectric noise (otherwise known as motion induced noise) rather than electrical noise. This reduction is accomplished by the inclusion of a graphite or silver wrap on the outer surface of the inner dielectric layer. If a non low noise cable is used movement of the cable will add an additional signal into the data causing errors in data analysis.

An IEPE accelerometer is much more forgiving and can be used with almost any type of cable. The more traditional coaxial cable is commonly used for these accelerometers. If using both charge and IEPE accelerometers within your facility, it is best to standardize all cables to be low noise types to avoid potential errors in using the wrong cable.

YOU'RE READY NOW!

We hope you found this buyer's guide helpful and you're ready to find the right sensors for your vibration testing. Feel free to share any feedback or questions you might have with us at:

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ABOUT.



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A BRIEF HISTORY OF ABOUT PEAK-G.

After 33 years in the test equipment industry, PEAK-G opened its Michigan doors in 2022 to offer high quality test equipment in North America from leading manufacturers around the globe. We know many companies view testing as a “necessary evil”, and for good reason. We want to change that. Our mission is to inspire testing by offering innovative yet budget-friendly test equipment. If our test products can improve the effectiveness of your testing and keep costs down, you will test because you want to, not because you have to.

If you have any questions or feedback please reach out to us anytime. Thank you for your trust and support.

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