Evolution of Hot-wire Probes:
An Explanation of Shapes and Types

KANOMAX
The Ultimate Measurements

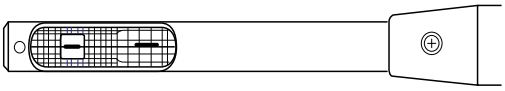
Application Note

Kanomax has extensive experience creating hot-wire anemometers to measure airflow in a wide variety of circumstances. In fact, the number of options we've added to our catalog over the years can be bewildering to new customers or to someone suddenly assigned to a project that requires accurate measurement of airflow. Sometimes even industry veterans don't fully understand the different options available to them. If either of the proceeding two sentences sounds like it may apply to you don't worry! You're in the right place to get help understanding what the different options are and which is best for your application.

Four common types of hot-wire probes

Let's start with the basics. The purpose of any hot-wire probe is to measure, as accurately as possible, the speed of the air passing over it. This is accomplished by heating up the probe by applying an electrical current to it. The air blowing over the sensor then causes it to cool and the instrument is forced to add more current to maintain a constant heated temperature. By measuring the amount of current being supplied the instrument can tell us how fast the air is moving. Of course it's a little more complicated than that as temperature, humidity, and air pressure can all have an impact on how fast the sensor cools, but for purposes of this article we don't need to go that deep into it.

The first type of probe we'll examine is the uni-directional hot-wire, this is the first type that Kanomax manufactured and is still very popular today.



Uni-directional Hot-wire Probe

This probe is basically a thin rod that contains an exposed wire sensor somewhere near the tip. The wire sensor is often (but not always) enclosed in a mesh screening to keep it protected. The reason for this screen is the wire itself is both delicate and very sensitive. Touching the sensor, even briefly, with your finger will contaminate it with the oil on your skin and cause your readings to be inaccurate. This is also why you only want to use the sensor in clean, non-condensing air. Once moisture condenses on the sensor it will no longer measure accurately and may be permanently damaged.

The sensor itself is a very thin, tiny plate of metal that needs to face directly into the airflow in order to give an accurate reading. It is not sensitive to airflow from above or below and if it is not kept perpendicular to the airflow it will not measure accuracy. However, because the sensor is so small and presents a decent surface area for the air to impact it is extremely fast to react to changes in airflow. This sensor is the fastest to acclimate to changes in air speed or temperature; that coupled with it's relatively low cost is why the sensor is still very popular today.

This type of sensor is used in our Anemomaster Professional, Anemomaster Lite, High Temperature Anemometer. It's just one of the options offered for the Climomaster, Airflow Transducers and Multi-channel systems.

The second type of probe we developed was similar, but had the capability to detect airflow in a 360° circle around the probe. Physically this probe resembles a needle attached to a metal rod, and is in fact often called a needle-type probe. With a round needle-shape sensor it's no longer necessary to keep the probe perpendicular to the direction of the airflow,

but it is still mostly limited to detecting the airflow in circular plane around the sensor. In other words, if you have air sources originating above or below the sensor it will not be measured accurately.

Omni-directional Needle Probe

The advantages of a needle-type probe are: it can detect airflow in a 360° circle around the needle and it's response time to changes in the airflow or temperature is still very good, although not as good as the uni-directional type.

The third evolution came about because we had customers who wanted to be able to measure the airflow from any direction, including above and below the sensor. This is typically seen in applications that involve low velocity readings as slower air tends to be more turbulent and it can be harder to pinpoint a single primary direction that the airflow is coming from.

The third type of sensor is also omni-directional, but instead of being needle shaped the sensor is a metal sphere placed at the end of a needle.

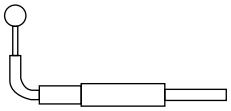
Omni-directional Spherical Probe

The sphere is perfect for detecting airflow from any direction, but because it has a greater mass it is the slowest to react to changes in the airflow or temperature. This is mitigated somewhat by making the sphere out of aluminum, which has a lower density than most other metals, and heats and cools much more quickly. Even so a spherical probe may need up to 5-7 seconds to react to a sudden change in airflow which makes it unsuitable for applications where frequent changes in airflow or temperature occur.

For most applications the spherical probe is ideal though, and it's slower response is actually a benefit for some users or applications where fluctuations in readings caused by very minor, but very frequent changes in air flow make it difficult to get a stable measurement.

The spherical probe was further refined by miniaturizing it so the entire probe is only about 25mm long. These probes are easy to locate near the surface of a circuit board or other small tight space where many high-end electronics manufacturers need to measure airflow to ensure adequate cooling of their components.

The miniature probe started as a straight piece of metal with the sphere on the end, but some customers had issues placing the probe near the measuring point as sometimes the wire would get in the way, so Kanomax developed an "L" shaped mini-probe that places the sensor at a ninety degree angle from the wire.



A "L" shaped mini-spherical probe

So which probe is right for your particular application? There are two main factors to consider:

How big is the area where the probe will be located? Is it large enough to accommodate one of the rod-type sensors? If not then you may need to go with a mini probe.

How turbulent is the airflow? Will the airflow mostly be blowing from a single direction? If you can identify the direction and know that the airflow will mainly be moving in a single direction than a uni-directional probe is your best choice. It's the cheapest and it has a great response time. If the airflow is turbulent, but mostly on a single plane than the needle-style is the best choice. If it's turbulent and not confined to a single plane than you need a spherical shaped probe for accurate measurements.

If you have multiple types of applications we can help you with that too. Our Climomaster, airflow

transducers and multi-channel systems are all designed to work with all the styles of probes we discussed here. These are great tools for airflow professionals who are looking for versatile solutions to measurement applications.

If you're still not sure which probe is right for you, give us a call at 973-786-6386 or send us an email at info@kanomax-usa.com and we'll be happy to help you find the right probe for your application.
We're always happy to hear from you and help you find the right solution for your problem.

Climomaster shown with all the available probes

About Kanomax USA, Inc.

Kanomax has delivered the best measurement solutions in its products and services that adapt precision measurement technology for fluids and particles. Kanomax product lines include anemometers, particle counters, dust monitors, and IAQ monitors. Kanomax is contributing to technological innovation and quality improvement for the processes of quality management, environment management, and technology development in the areas of environment, health , and energy, which are essential to sustain human well-being, as well as in other industrial areas including automobile, aerospace, semiconductor, electronics manufacture, heavy industry, steel, shipbuilding, pharmaceutical, biotechnology, food-processing, medical, construction, and civil engineering.

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