УДК 536.5

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Thermometers

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A thermometer is an instrument that measures temperature. It can measure the temperature of a solid such as food, a liquid such as water, or a gas such as air. The three most common units of measurement for temperature are Celsius, Fahrenheit and Kelvin. Thermometers are widely used in technology and industry to monitor processes, in meteorology, in medicine, and in scientific research. In this article we will look at some types of thermometers.

The first type is liquid thermometers. Liquid-in-glass thermometers are based on the principle of thermal expansion of substances. A liquid in a glass tube (called a capillary) expands when heated and contracts when cooled. Such thermometers are also called capillary thermometers. When heat rises, the liquid expands from a bowl or bulb into the empty area, climbing up the tube. When the temperature falls, the liquid contracts and goes back down. Liquid thermometers often include both Celsius and Fahrenheit temperature scales, which are displayed on either side of the tube. The liquids used in such thermometers must have certain properties in order to be suitable for use. For example, they must not freeze at low temperatures. The liquids should also have a sufficiently high boiling point so that they do not vaporize at high temperatures. Liquids which have all the required properties and are suitable for use in liquid-in-glass thermometers are also referred to as thermometric liquids. In the past, the highly toxic mercury was used, which has a solidification temperature of - 39°C and a

boiling temperature of 357°C. Nowadays, usually blue or red colored ethanol (alcohol) with a melting point of - 115°C and a boiling point of 78°C is used instead of mercury. In this temperature range, the everyday temperatures in the range between - 20°C and + 50°C can be well covered [1].

The next type is electronic thermometers. Mercury and other liquid thermometers cannot be used to measure temperatures in kelvins. Kelvin thermometers are usually electric devices that can record tiny variations in radiation. These variations would not be visible and may not change air pressure enough to raise the level of mercury in a liquid thermometer.

Electronic thermometers work with an instrument called a thermistor. A thermistor changes its resistance to an electric current based on the temperature. A computer measures the thermistor's resistance and converts it to a temperature reading [2].

However, the thermistor is non-linear in its response to temperature, limiting its accuracy for use over a wide temperature range unless the computer has the ability to make the necessary corrections. The most common way these devices fail is damage to one of the two lead wires. Selecting a metal probe offers greater protection.

Thermistors find many uses in the electronics field. They replace fuses or circuit breakers and shut down sensitive electronics to prevent damage from overheating. In thermostats, they replace mercury switches and bimetallic strips to provide an electronic control rather than a mechanical one [3].

Liquid and electronic thermometers must directly touch the object from which the temperature is to be determined. This can be a disadvantage in many cases, for example with very hot materials such as metal melts or corrosive liquids. In such cases non-contact measuring methods are used.

The so-called pyrometer (IR thermometer) detects the thermal radiation (infrared radiation) from objects, which each body emits due to its temperature. The radiation spectrum recorded by the measuring device thus allows conclusions to be drawn about the temperature of the objects. With the help of such a radiation measuring device, the object to be measured no longer has to be touched directly in order to measure the temperature. Infrared thermometers are often equipped with a laser. However, this laser has only a targeting function. In this way, it is easier to determine the exact location from which the temperature is measured [4].

A thermocouple is an electrical device consisting of two dissimilar electrical conductors forming an electrical junction. A thermocouple produces a temperature-dependent voltage as a result of the thermoelectric effect, and this voltage can be interpreted to measure temperature. Thermocouples are a widely used type of temperature sensor.

Thermocouples are widely used in science and industry. Applications include temperature measurement for kilns, gas turbine exhaust, diesel engines, and other industrial processes. Thermocouples are also used in homes, offices and businesses as the temperature sensors in thermostats, and also as flame sensors in safety devices for gas-powered appliances [5].

The advantage of thermocouples is their relatively short delay time, i.e. they react very quickly to changes in temperature. Due to the relatively small measuring tip, thermocouples can also measure temperatures of very small objects [6].

Today specialized thermometers are used for a variety of purposes. A cryometer measures very low temperatures, for instance. Cryometers are used to measure temperatures in space.

Astronomers use infrared thermometers to measure temperatures in space, for instance. Infrared thermometers

detect infrared radiation at great distances and correlate it to a specific surface temperature. In 1965, an infrared thermometer detected radiation with a temperature of 3 kelvins (-270 degrees Celsius/-454 degrees Fahrenheit) in all directions in space [2].

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