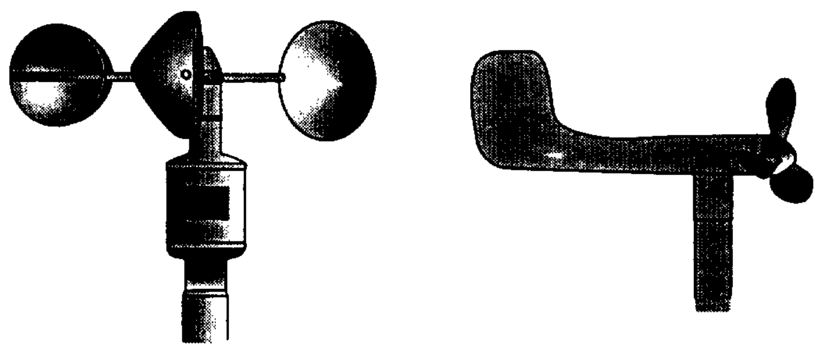


(a) Rotating cup anemometer

(b) Propeller anemometer

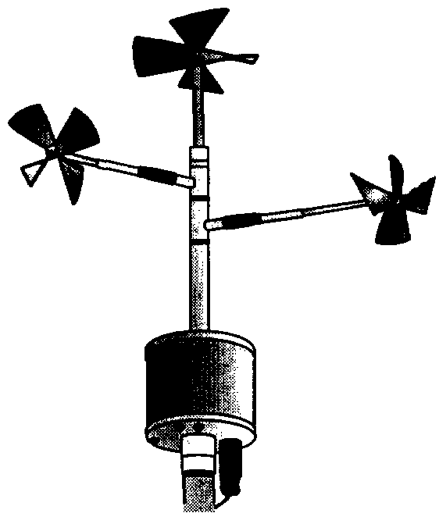
Figure 5-1. Two types of anemometers

Rotating Cup Anemometers

The rotating cup anemometer usually consists of three hemispherical or cone-shaped cups mounted symmetrically about a vertical axis of rotation. The rate of rotation of the cups is essentially linear over the normal range of measurements, with the linear wind speed being about 2 to 3 times the linear speed of a point on the center of a cup, depending on the construction of the cup assembly.

Vane-Oriented and Fixed-Mount Propeller Anemometers

The **vane-oriented propeller anemometer** [Figure 5-1 (b)] usually consists of a two, three or four-bladed propeller which rotates on a horizontal pivoted shaft that is turned into the wind by a vane. There are several propeller anemometers which employ light-weight molded plastic or polystyrene foam for the propeller blades to achieve low starting threshold speeds. Some propeller anemometers are not associated with a moving vane (see Figure 5-2). Rather, two orthogonal fixed-mount propellers are used to determine the vector components (i.e. speed and direction) of the horizontal wind. A third propeller with a fixed mount rotating about a vertical axis may be used to determine the vertical component of the wind if desired.



Fixed mount (uvw) anemometer

Figure 5-2. Fixed mount (uvw) anemometer

Wind Speed Transducers

There are several mechanisms that can be used to convert the rate of the cup or propeller rotations to an electrical signal suitable for recording and/or processing. The selection of the transducer is determined by the nature of the monitoring program—how responsive the instrument needs to be and what type of data readout or recording is needed. The four most commonly used types of transducers are the DC generator, the AC generator, the electrical-contact, and the interrupted light beam. Many **DC** and **AC generator** types of transducers in common use have limitations in terms of achieving low thresholds and quick response times. It is important to use instruments, such as those anemometers that employ miniaturized DC generators, which have low starting thresholds. The AC generator transducers eliminate the brush friction, but the signal conditioning circuitry must be carefully designed to avoid spurious oscillations in the output signal that may be produced at low wind speeds. **Electrical-contact** transducers are used to measure the total passage of the wind (wind-run) instead of instantaneous wind speeds, and may be used to determine the average wind speed over a given time increment. These devices are typically not appropriate for use in air pollutant dispersion studies. The **interrupted light beam** (light chopping) transducer is frequently used in air quality applications because it exhibits less friction and therefore is more responsive to lower wind speeds. This type of transducer uses either a slotted shaft or a slotted disk, a photo emitter and a photo detector. The cup or propeller assembly rotates the slotted shaft or disk, creating a pulse each time the light passes through a slot and falls on the photo detector.

The frequency output from an AC generator or a light chopping transducer may be transmitted through a signal conditioner and converted to an analog signal for various recording devices, such as a continuous strip chart or a multipoint recorder, or through an analog-to-digital (A/D) converter to a microprocessor type of digital recorder. Several modern data-loggers can accept the frequency type signal directly, eliminating the need for additional signal conditioning. The recording and processing of the data needs to be considered in designing a monitoring program.

Wind Direction

Wind direction is generally defined as the orientation of the wind vector in the horizontal. Wind direction for meteorological purposes is defined as the direction from which the wind is blowing, and is measured in degrees clockwise from true north. For example, a westerly wind is blowing from the west, 270° from north. A north wind is blowing from a direction of 360°. Wind direction determines the transport direction of an emitted plume.

Wind Vanes

The most common instrument for measuring wind direction is the **wind vane**. Wind vanes point in the direction from which the wind is blowing. Wind vanes come in many different shapes and sizes: some with two plates joined at their forward edges and spread out at an angle (splayed vanes) and others with a single flat plate or perhaps a vertical airfoil. Vanes are commonly constructed from stainless steel, aluminum, or plastic. As with anemometers, care should be taken in selecting a sensor that has a proper balance of durability and sensitivity for a particular application. Examples of wind vanes are depicted in Figure 5-3.

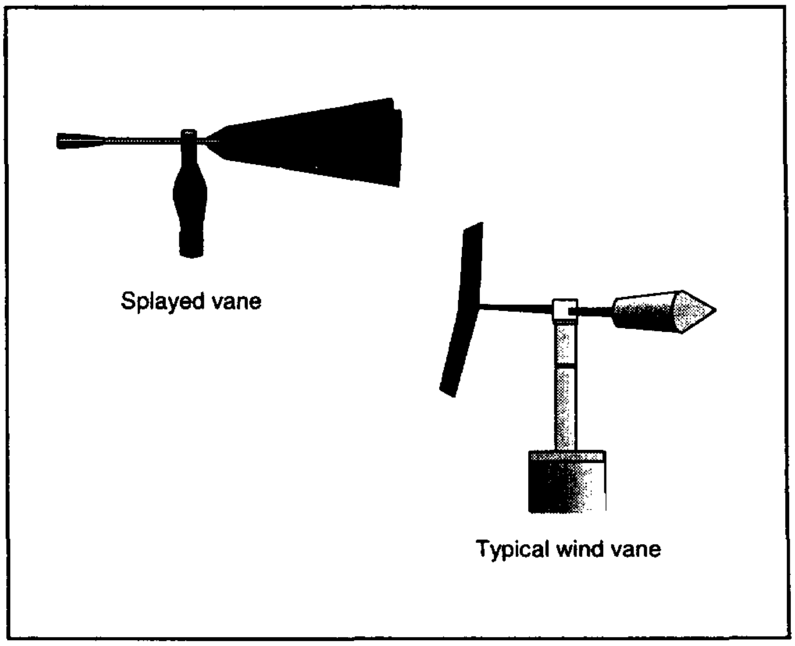


Figure 5-3. Wind vanes

The horizontal (azimuth) and vertical (elevation) components of the wind direction can be measured with a bi-directional wind vane (bivane). The bivane generally consists of either an annular fin or two flat fins perpendicular to each other, counterbalanced and mounted on a gimbal so that the unit can rotate freely both horizontally and vertically.