Sensitivity Training

Nine sensors make up the complete package of measuring devices present in both an AWOS or ASOS. They are: 1) rain gauge, known affectionately at the tipping bucket; 2) hygrothermometer for temperature and dew point; 3) LED weather identifier to report the type of precipitation; 4) vaned rotating anemometer cups for wind speed, direction and gusts; 5) laser beam ceilometer to measure cloud height; 6) freezing rain sensor; 7) thunderstorm sensor; 8) visibility sensor; and 9) barometer. Data from all of the weather sensors are processed by the data collection package (DCP), which then transfers the data to the acquisition control unit (ACU).

Why should pilots care about sensors, DCPs and ACUs, as if we do not have enough to worry about? The bottom line is that if we understand how the weather sensors work, and what are their capabilities and limitations, and failure modes, we might be more inclined to use ASOS and AWOS to our advantage. So, let's take a quick glance at each sensor in turn, all the while trying to minimize the pain of close examination.

1. RAIN GAUGE

This device is formally named the Liquid Precipitation Accumulation Sensor (I am not making this up). The device consists of an open top measuring about one foot in diameter. Rain falls into the upper portion, logically called the collector, which is heated to melt any frozen precipitation (snow, hail). Collected water is funneled into a tipping bucket, designed to measure in increments of 0.01 inches. When water accumulates, the bucket fills to the point of tipping over, which serves to empty the bucket and to momentarily close a switch to signal another 0.01 inches of accumulation. This action readies the bucket to measure the next 0.01 inches. The DCP keeps count of the accumulation. To prevent spurious measurements caused by winds, the gauge is protected by a 48-inch diameter shield to reduce updrafts and streamlines that could alter the trajectory of the rain.


Temperature/dew point sensor

2. TEMPERATURE/DEW POINT SENSOR

Using what is known as the "chilled mirror method," the hygrothermometer measures both the temperature and dew point of ambient air. As all pilots know, dew point is the temperature at which air must be cooled for water vapor to condense. In this case, a mirror is cooled to the point where a thin film of condensed water forms on the mirror's surface. The temperature at which this occurs is the dew point. The trick is to detect the condensate and measure the mirror's surface temperature. This feat is accomplished by circuits using an optical feedback loop that cool the tiny mirror to maintain the surface exactly at the temperature at which the mirror is slightly clouded by condensed water vapor, detected by reflecting infrared light off the mirror's surface.

The mirror can get contaminated with dirt, sand, and spider webs, which would of course create false readings. In seriously cold conditions, the heater used to clear the mirror may not do a complete job, leaving ice contamination on the surface.

3. PRECIPITATION IDENTIFICATION SENSOR

As the name implies, the unit detects if precipitation is in the form of rain or snow, or is of some "undetermined" type. In addition, the precipitation's intensity is measured as either light, moderate or heavy. The technology is based on a "weather-particle-induced optical scintillation of an infrared emitter diode system." For those of us speaking English, that means a light emitting diode detects the presence of precipitation by shining an infrared beam towards a receiver about one meter away. A passing particle of rain or snow creates a shadow that changes the frequency of the light at the receiver, depending on the size and speed of the particle. When only snow or only rain are present, the device typically performs well. The picture is less pretty, though, when mixed rain and snow, drizzle or snow or ice pellets rear their ugly heads. During these events the unit may give false readings of precipitation type or report "unknown. Sophisticated algorithms can sometimes extract useful information from a complicated mixture of precipitation, but with the current state of technology, the results are not always reliable. This is one area where pilots must beware.

4. WIND SENSOR

Not as simple as one might suspect, this device measures speed, gusts, direction and variable direction of the wind. Data are taken across five-second averages. Wind speed is measured using the familiar three-cup device to capture wind. Once the unit is spinning, a number of methods can be used to measure speed, for example, by interrupting a light beam with each rotation.


Wind sensor