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AWS
Weather Station Maintenance

Description

An Automatic Weather Station (AWS) is a collection of sensors for measuring various meteorological variables including temperature, black globe temperature (BGT), relative humidity, wind speed and direction, solar radiation, barometric pressure, and rainfall. Other variables such as dew point, for example, can be calculated from temperature and relative humidity. A description of the various sensors follows.

Temperature and relative humidity

These sensors are mounted in a semi-open/ventilated enclosure so that the sensors are in contact with the air but protected from direct sunlight, rain, insects and other external interference. As such, the actual sensors are not visible unless the enclosure is disassembled. The main maintenance issues here are leaves, spider webs and other foreign material obstructing any ventilation.

Black Globe Temperature

This sensor consists of a metal sphere, about 150mm in diameter painted matt black. A standard temperature sensor is located at its centre. The purpose of this sensor is to measure the combined heating/cooling effect of solar radiation, air temperature and wind speed. It needs to be mounted in a sunny position (no shadows must fall on it during any part of the day) and away from shiny surfaces that might reflect sunlight onto it. The matt black coat of paint is important as this allows maximum absorption of solar radiation. It must be kept clean of “colourful” effects such as dust, mud, bird droppings.

Wind sensors

These normally consist of separate speed and direction sensors. The speed sensor, or anemometer, is a set (usually three) cups attached to a vertical rotating spindle. The speed of rotation varies with wind speed. The direction sensor, the wind vane, resembles a horizontally mounted arrow that points into the wind. Since these sensors contain moving parts, normal wear and tear will affect operation in time. The cups and vane both should spin freely by hand with very little friction and very little or no noise. The presence of friction and/or noise is usually symptomatic of worn bearings which need to be replaced by the manufacturer or suitably qualified technical personnel.

Another type of wind sensor supplied with a weather station is the ultrasonic wind sensor. These measure wind speed and direction by measuring the speed of sound through the moving air and therefore have no moving parts. The transducers need to be kept clean from insects, webs, nests and other debris such as leaves.

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Solar radiation

These can be constructed from a small Photo-Voltaic element or a pyranometer-like device where the sensing element is a semiconductor diode, transistor or light dependent resistor. Photo-voltaic devices resemble small solar panels, the detecting surface is a flat area and need to be mounted horizontally. The pyranometer-like devices are characterized by a small transparent dome that admits radiation. These also need to be mounted horizontally and usually come with a small level for this purpose.

These need to be kept clean for proper operation.

Solar panels (Photo-Voltaic or 'PV' array) and battery

Power for AWSs can be obtained from the mains supply (provided power leads are available at the AWS site) or by a battery/solar panel combination. The solar panel provides power for the AWS and charges the battery during the day or in times of low sunlight and the battery powers the AWS at night.

The output of a PV varies depending on the amount of sunlight falling on it. The voltage can be a few volts in the evening to about 20 volts in full sunlight, depending of the array configuration. Consequently, the output of the PV array is fed into a regulator, of which is to accept the varying output voltage of the array and deliver a constant voltage to the battery (typically 12 to 13 volts) and other circuitry. These can be easily measured using a multimeter.

Solar panels need to face north (in the Southern Hemisphere) and must be kept clean for maximum efficiency. The orientation of the panel would have been correctly adjusted during installation. Routine maintenance should include inspection of the PV array cover (usually tough clear plastic) for cracking or crazing, leakage of rain around the edges and dirt. If the cover shows signs of cracking or moisture ingress, it needs to be repaired. Consult with the supplier for further advice.

Maintenance

The purchase of a weather station represents a significant investment for a feedlot. The utility of a weather station includes the ability to calculate the level of heat stress in the cattle and, also, the potential to use the data in research towards better heat stress forecast models. Therefore, proper maintenance of your weather station should be taken seriously.

Since the weather station is mounted outside and exposed to the elements, it is subjected to several detrimental effects. These include:

(1) Moisture from rain and condensation

Moisture corrodes metals. This includes the mounting hardware (mast, booms) electrical cables and connectors. In addition, since the moisture conducts electricity, it can create unwanted connections between different conductors, resulting in corruption of data and possible (actually, probable) damage of the weather station electronics if the wrong voltages are introduced into some circuitry. Desiccant may be used to remove moisture/condensation from the air inside enclosures.

(2) Exposure to ultra-violet radiation from the sun

Plastic and rubber items such as electrical cables and seals that are exposed to UV radiation tend to crack, become brittle and powdery. The UV attacks the surface rendering it friable and easily rubbed off. The dust that is rubbed off may find its way into parts where it can do further damage, particularly if mixed with water from condensation or rain. Also, if sufficient insulation is affected, the metallic wires may become exposed.

(3) Damage from insects that build nests in the weather station

Insects, particularly ants, build nests in the shelters provided by the various enclosures and other weather station hardware. With insects comes moisture, dirt, foodstuffs and other foreign matter that can interfere with operation of electronic and mechanical systems.

(4) Damage from birds (parrots), mowers, etc.

Parrots have been known to attack cables, wind vanes and anemometers and, to a lesser extent, other sensors. Cables can also be accidentally cut with mowers, weed trimmers and other vegetation control equipment. Reports have been received of cables being gnawed by rodents such as rabbits !

(5) Physical damage and normal wear and tear and deterioration

For equipment that has moving parts, these parts are subject to wear just from normal operation. In addition, moving parts can be affected by ingress of debris such as dust, insects and plant matter. Corrosion/abrasion (as distinct from normal wear and tear) can also impair operation.

Here we can also include the condition of the battery. Although it has no moving parts, the internal components deteriorate through the normal chemical action of charging and discharging. To check the battery, disconnect it from the AWS and measure the voltage across the terminals. This should be close to the nominal battery voltage that is stamped on the battery case. For sealed lead-acid units this can be either 6V or 12V.

If the battery is nearing the end of its life it may not be able to store sufficient charge to power the AWS for the entire night, even though the terminal voltage would indicate otherwise. In this circumstance, the AWS will operate normally during the day and stop sometime during the night.

While the battery is disconnected, measure the output voltage of the PV array. In full sunlight, it should be greater than the battery voltage.

If after the above checks, there are any concerns, contact the manufacturer for further advice.

Maintenance of specific items

(1) Mounting hardware – mast/tripod, booms, brackets

* Check for rusted parts, loose footings, cracks, bends and other signs of fatigue.
* Check for loose nuts, bolts and brackets.
* Check all poles are in the correct orientation (e.g., vertical or horizontal).
* Check cable ties and clamps for deterioration (rust, corrosion, UV attack).

(2) Enclosures

* Check for deterioration of seals around doors, door hinges and latches.
* Ensure that doors close and seal properly.
* Check seals where cables enter enclosures.
* Check for ingress of moisture, insects.

(3) Sensors

* Check that the sensors are not visibly damaged, worn, deteriorated.
* Check that sensors are clean - not clogged with leaves, insects, mud.
* Check that the electrical wires and cables are not pinched or sharply twisted and the insulation is in good condition.
* Check that connectors are in good condition (clean, free of insects and not corroded).

(4) Solar panels (Photo-Voltaic or 'PV' array) and battery

The output of a PV array varies depending on the amount of sunlight falling on it, consequently, the array needs to be kept clean for maximum efficiency. In full sunlight, this voltage should be greater than the battery voltage. Also, the battery voltage should not drop below its nominal value at any time.

Inspection Schedule

The majority of potential problems can be identified by a simple visual inspection of the equipment. Equally important is the inspection of the data recorded by the AWS; for example, if the temperature recorded by the AWS differs significantly from the temperature reported by the Bureau of Meteorology or other AWS readings, then further checks/investigations may be required.

Below is a suggested schedule of maintenance.

Daily

* Ensure that readings recorded by the AWS are reasonable/realistic and agree with your observations and with other sources of weather information; carry out further checks or seek assistance if in doubt.

Weekly or fortnightly

* Carry out a visual inspection of mounting hardware, enclosures and sensors. Replace or repair damaged hardware. This includes rusty/corroded poles, booms, nuts and bolts and brackets.

* Make sure all fasteners are tight – tighten or replace if necessary.

* Make sure all cables/wires are in good condition (not frayed, pinched, crushed, deteriorated)

* Make sure all seals are in good condition (not frayed, pinched, crushed, deteriorated).

* Check inside enclosures for signs of moisture and insects (a flashlight is useful here). Replace desiccant if required.

* Check inside enclosures for signs of corrosion near plugs, connectors and electronic components.

* Check the solar panel for moisture ingress and corrosion. Clean if required with clean water and a cloth.

Every three months and before the start of the hot season (early September)

In addition to the weekly checks:

* Check that the wind sensors (anemometer and wind vane) spin freely and without any noise. Consult with the supplier if damage is suspected.

* If any problem is suspected with the battery, consult with the supplier and/or replace.

* If any problem is suspected with the output of the solar panel, this should be checked by a suitably qualified technician or sent back to the manufacturer.

Scheduled maintenance

Some sensors will require calibration at regular intervals. This interval may range from several months to several years, depending on the sensor. Check with the documentation provided with the weather station to determine when to schedule any such maintenance.