REPORTING QUALITY OBSERVATIONS TO NOAA

Application Note **30**

and other weather observation groups

INTRODUCTION

This document provides guidelines for the setup and installation of your weather station so as to provide the highest quality observations for use by NOAA (National Oceanic and Atmospheric Administration) and other weather groups. Through the Citizen Weather Observer Program (CWOP), NOAA ingests weather data into its weather forecast models at the Forecast Systems Laboratory in Boulder, Colorado. As a Cooperative Observer (COOP), it is possible to supplement the sensor data from the NOAA equipment with data from your weather station. However, it should be noted that no consumer system has been officially approved for COOP use other than the equipment provided by the NWS. Other private media groups also have interest in "backyard" weather station data.

Since the number of "official" real-time observations is limited to the Automated Surface Observing System (ASOS) which has sites primarily at airports and military installations, using private weather stations provides a means to capture more observations without expending substantial resources to acquire, install, and maintain these high-end systems. More observations means better forecast prediction and forecast verification (checking to see if the forecast was correct). However, the quality of observations is also just as important. Since Davis Instruments weather station specifications closely mirror those used by the meteorological community, you can report professional quality observations for just a fraction of the price. Proper siting and installation of the weather station is the primary key here.

As the owner of a Davis Instruments weather station, you can help NOAA improve their forecasts by providing more ground-truth observations. The guidelines here follow recommendations provided by CWOP, NOAA and the National Weather Service (NWS). Data provided to other private weather groups also helps them in a similar manner since they also do their own in-house weather forecasting and forecast verification.

EQUIPMENT NEEDED

You can use any Davis Instruments weather station, but you will also need a PC with Windows 95 or Mac OSX or later, WeatherLink™ software and an Internet Connection to report your data to CWOP. If you have a Weather Wizard III® or Weather Monitor II®, it is highly recommended that you obtain a Radiation Shield (P/N 7714), the reasons for which will be discussed later. Refer to the weather station instruction manual for a list of tools and weather station mounting options. The WeatherLink Help files cover how to set up the software to report your data to CWOP. Additionally, Application Note 26 provides guidelines on choosing an Internet Service Provider (ISP) and setting up your Internet data transfer. This document will cover more information on becoming a member of CWOP or COOP later.

Optionally, you may choose to have your unit NIST certified. In the U.S., the National Institute of Standards and Technology (NIST) develops and maintains the standards of measurement to which all others are ultimately compared and certified. NIST certification is typically required by public agencies that monitor weather conditions, but it is not a requirement for CWOP at this time. If you are a member or want to be a member of COOP, contact your local NWS office to see if NIST traceability is a requirement for your Davis Instruments weather station. For more information about NIST, check out their website at http://www.NIST.gov . If resources allow, you may choose to have your weather station NIST certified. If so, then you have documentation that proves that your system has been compared to a higher-order standard. This may alleviate some concerns about data quality that may arise in the future. To be continually certified, you will need to be certified once every year. Contact Davis Instruments Customer Service for more details about having your station NIST certified.

ASSESSING YOUR ENVIRONMENT

Whether the weather station is installed at a business or at home, the type of building and surrounding environment has a dramatic effect on the values of the weather parameters throughout this location. It is generally best to have plenty of naturally (best) or artificially landscaped ground space that is flat or on a gentle slope away from the building. Also, the location should not be heavily shaded by trees. If you lack sufficient or acceptable ground space on the property, the next best, but not ideal location, is a rooftop location. Cases where a rooftop installations are the only option are generally urban areas including multi-story office buildings, apartments, condominiums, or office space where the ground space is almost entirely paved. Never install a weather station over or near any sort of paved surface regardless of whether it is asphalt or concrete. Try to be at least 100 feet away from any driveway or roadway. If you lack a suitable location, see if you neighbors have an acceptable location and would be willing to allow you to put a weather station on their property. Be sure and tell them it is possible to locate it in an inconspicuous location. If you fail to find an "ideal" location, don't be discouraged. Data can still be of value. In most cases, any data is better than no data.

FINDING AN INSTALLATION LOCATION

If you manage to find an available location on your property or nearby, next determine your exact station location and configuration. Generally and ideally, you should locate the temperature/humidity and rain sensors in the open ground space area and the wind sensor (anemometer) on the building rooftop. If possible, also try to choose a location not visible from the street. Some homeowners association covenants and city ordinances require that systems such as these not be visible to the general public. Generally, this means siting the weather station in a backyard or lot and a rooftop location toward the back of the building away from the street. Finally, make sure the location is easily and safely accessible. One important part of quality data is maintenance, so you should be able to return to the installation location to check, clean, and, if necessary, replace sensors. If you have the resources, professional contractors will, for a fee, install items for you.

First, assess your ground location. If possible, select a location that has a natural ground cover surface. This way, your readings will be "representative" of the natural, local environment. Natural surfaces will have vegetation that grows naturally in the climate in which you live. In semi-arid or arid areas, such surfaces are referred to as "xeriscapes" or dry landscaping that may consist of cactus, scrub brush and be interspersed with sandy areas. You can check with a local landscaping company or supplier for what types of vegetation grows naturally in your area. Otherwise, regularly mowed turf-grass will suffice. Note that all agricultural applications where the calculation of evapotranspiration (ET) is involved, the temperature and humidity sensors need to be installed over well-irrigated, regularly mowed grass. If possible, install all the sensors between two orchards, two vineyards or two row crops. If this is not possible, install the sensors near the edge of the primary crop of interest. Be sure and locate the weather station where a sprinkler system will not directly spray the weather station. This can adversely affect the readings. Choose an area with the gentlest slope possible. Never install on a steep hillside if at all possible unless the entire neighborhood is located on a hillside. The rain collector will need to be installed level regardless of the slope of the landscape. Never install near a body of water such as a pond, lake or swimming pool. Avoid low lying areas that don't drain well, that is, areas that experience a lot of standing water.

It is highly recommended that Weather Wizard III or Monitor II users obtain the Davis Radiation Shield, P/N 7714. If this is prohibitive, the temperature sensor will need to be installed in a shady location. Unfortunately, this is often times on the north side of a building. If you must install your temperature sensor up against a building, avoid locations near heating or air conditioning units, exhaust vents, or other sources of heat. Choose a location that remains in the shade all day long, and if possible, is over a landscaped or dirt surface. Stay away from areas with asphalt, concrete, or brick pavement.

Siting your rain collector in a manner that limits the effect of “rain shadow” or blockage from nearby objects needs to be assessed. Rain shadow occurs when rain, that otherwise might fall into the gauge, is captured or deflected by obstructions upstream. As a rule of thumb, the top edge of the rain collector should be no less than twice the height away from any obstruction such as a fence, tree, or building. Never install a rain collector near a building. For heavily forested areas, site your rain collector in a clearing or meadow. Because temperature/humidity sensors should be installed about 5 feet (1.5 m) above the ground, on a Vantage Pro or Vantage Pro2 Integrated Sensor Suite (ISS, where the rain collector is above the temperature/humidity radiation shield), the rain collector will be about 6 feet (2 m) off the ground. In this case, the distance between a 10 foot (3 m) wall and the ISS can be 8 feet (0.5 m) because the difference in height between the 10 foot wall and the Vantage Pro rain collector is only 4 feet (1 m). If necessary, you can site your rain collector away from your ISS. See Application Note 32 for details.

Next, assess the location for your anemometer. As stated before, the easiest way to get your anemometer up into the wind is to install it on the roof of the building or on a tall antenna tower. If at all possible, install it on a rooftop location. If you cannot, then you should install it as high as possible in the surrounding landscape.

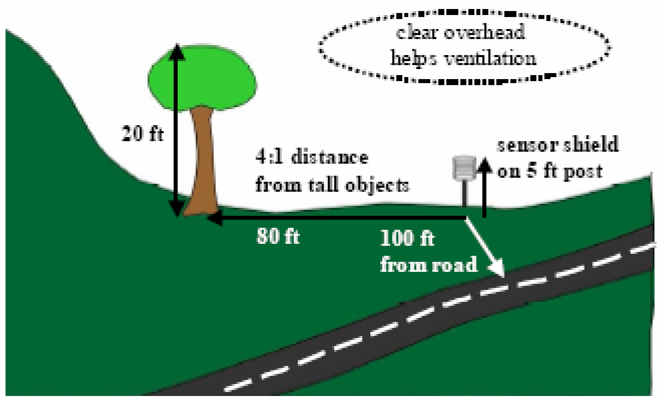
Finally, your barometric pressure readings will also be sent to NOAA if you join the CWOP. The barometric sensor is located inside your display console or Weather Envoy. If at all possible, the console should be located indoors in a dry, indoor location away from outside doors, heating and cooling registers, and direct sunlight. Barometric sensors can be affected by rapid changes in temperature from these sources. Avoid pressurized rooms.

If your weather station location is remote, obtain the Complete System Shelter P/N 7724 to house the console or Envoy. Do not completely seal off the shelter because your system will need exposure to outside air to obtain the true air pressure and to ventilate excessive hot air on hot days. You will also need to connect to the weather station from a phone line and transfer the data to your computer and then to CWOP. Application Note 27 provides guidelines on setting up a remote modem.

INSTALLATION GUIDELINES

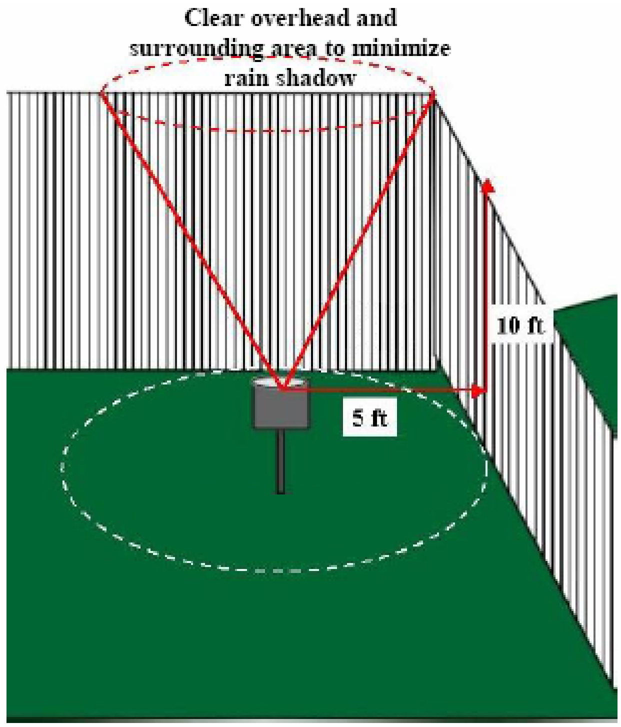
TEMPERATURE AND HUMIDITY

As stated before, the best location for the temperature/humidity sensors is inside a radiation shield located over the ground. Second best is a rooftop location. Either way, the shield should be mounted so that the sensors are about 5 feet (1.5 m) +/-1 foot (0.3 m) above the ground or rooftop (or, for ground installations or flat roof installations, 2 feet (0.6 meters) above the average maximum snow depth, whichever is higher).

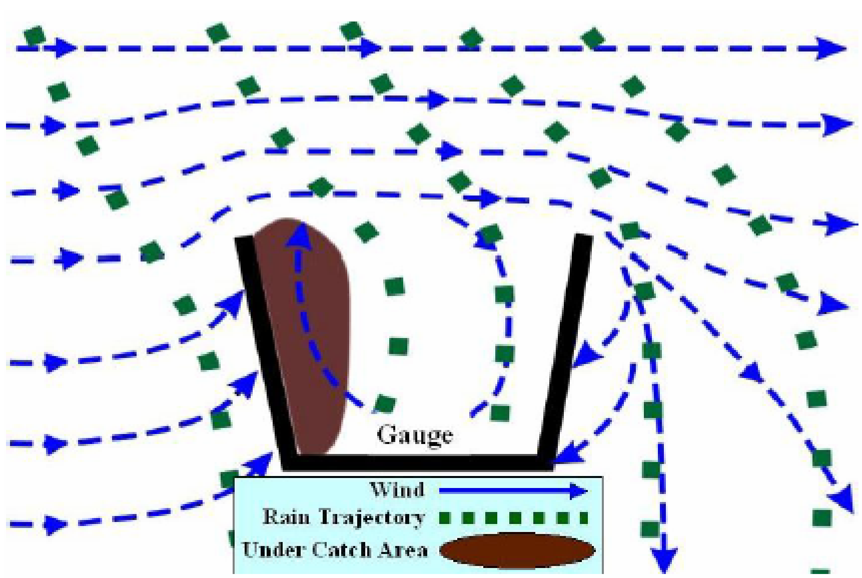


RAIN COLLECTOR

If you have a Vantage Pro or Vantage Pro2 system, your rain collector will be mounted above your temperature/humidity radiation shield since both are included as part of the ISS. If you have a Weather Wizard III or Weather Monitor II, you will need to find a separate location for your rain collector. Generally, the best location will be similar to that of the temperature-humidity sensors. A 2 foot (0.6 m) mounting height for stand-alone gauges is usually best. The area above the gauge should be free of obstructions. Avoid areas where a sprinkler system will produce false rain readings. Make sure the rain collector is a level as possible. Since Davis rain collectors use tipping bucket technology, accuracy degrades significantly if the unit is not level. A T-shaped trough in the base of the rain collector provides a simple way to determine how level the rain collector is. Consult the appropriate instruction manual for more details. The Rain Collector Shelf (Part #: 7704) and Sensor Mounting Arm (Part #: 7702) back plate can be used together to mount a rain collector to a pole.



If you live in an area that receives significant snowfall throughout the year, you should mount the rain collector 2 feet (0.6 meters) above the average maximum snow depth. You will need to obtain a Rain Collector Heater (Part #: 7720) to measure the liquid equivalent of falling snow. Additionally, you may want to consider installing a small fence (the top of which is at the same height as the top edge of the rain collector), particularly if you experience frequent wind driven snow. This will ensure blowing snow falls into the rain collector and doesn't blow around and by it.



The following figure provides an example of a wind shield that professionals use. Some shields use aluminum and others use wood. Either way, it may be possible to build an inexpensive version of your own.

ANEMOMETER (WIND SENSOR)

As stated before, it is easiest to mount your anemometer on your roof to achieve height. The standard mounting height is 33 feet (10 m) for most applications. For agricultural applications when calculating ET, 6 feet (2 m) is the standard mounting height. For two or more story buildings, this can be achieved by installing the anemometer at least 10 feet (3 m) above the highest point on the roof (regardless of height above the ground) to minimize the affects of the roof on the wind. For most single story buildings, you will need to use an already existing, secured TV or radio antenna tower to achieve this height. Seek profession help to install a TV or radio tower. Generally, if you are uncertain about the safety of your proposed task, seek professional help.

If there are obstructions such as trees within 66 feet (20 m) of the anemometer, you should mount your anemometer at least 7 feet (2 m) above these tree tops. Due to stabililty issues, CWOP does not encourage members to install masts longer than 16 feet (5 m), if tripod mounted, or 33 feet (10 m), if ground based mast connected to a building or supported using guy wires. For masts higher than 33 feet (10 m), seek professional installation.

If you decide you cannot mount your anemometer from your rooftop, you should make every attempt to satisfy the siting guidelines. Never install an anemometer near the side of a building. Get as far away from the building as possible. Install the anemometer as high off the ground as possible. If there are no other obstructions such as trees on your property, and you have at least 0.25 acre of property and a one story building, you may be able to use a Mounting Tripod if you place it at least 50 feet (15 m) away from the building. For two or more story buildings, you will probably need to use a tower mount for any ground based installation unless you have approximately 2.5 acres or more. Any property with a lot of large trees with probably require a tower mount. As with a rooftop mounting, if you have trees on your property, you may want to consider installing the anemometer at least 7 feet (2 m) above the height of the tree tops.

Note that the Vantage Pro anemometers are designed to be mounted with the mounting arm facing “true” north. If you live in an area where all the streets run north-south or east-west in a

square-grid pattern, it will be relatively easy to determine which direction is true north. Otherwise, you can use a local map of your area and align the map so that the street or highway near your building on the map and the actual street are parallel to each other. You can also use a magnetic compass, but keep in mind that the compass will have to be corrected to read the true direction. The National Geophysical Data Center (NGDC) has a page that will calculate this correction or "declination" for you:
http://www.ngdc.noaa.gov/seg/geomag/jsp/Declination.jsp .
Here's a link to a declination map for the CONUS (lower 48 states of the U.S.):
http://www.spacecom.com/customer_tools/html/body_mag_dec_map.htm . A GPS receiver can also be used, but they tend to be very inaccurate in determining direction when used in a stationary position. If you decide that you must face the anemometer a different direction, instructions are provided in the manual on how to recalibrate your direction readings. (For the most precise calibration, remove the wind vane, using the numeral direction display turn the wind pot until the unit displays as close to 180° (true south) as possible, and then reinstall the vane with the nose pointing to the south.) Consult the instruction manual for more details.

MOUNTING OPTIONS

Davis Instruments weather equipment is designed so that it can be mounted to either a pole or a post or flat surface. Davis also provides a Mounting Tripod (Part #: 7716) and Mounting Pole Kit (Part #: 7717) to assist in mounting. The provided poles have nearly the same diameter as poles for mounting TV antennas, thus you may also obtain additional accessories for attaching poles to buildings. Application Note 18 provides guidelines on how to use these mounting accessories whenever a user wants to avoid installing lag screws or bolts into a flat roof or mounting surface (e.g., school or office building installations). Roof mounts are used frequently for small satellite dishes, wireless cable dishes and antennas. Many are stocked or can be ordered through local wireless communications equipment suppliers or ham radio stores.

If you find you need to mount all your sensors in the same general location, use a radiation shield for the temperature/humidity sensor (if the installation site is in direct sunlight) if you have a Monitor or Wizard. Follow the guidelines for each parameter to optimize the final location.

SHARING YOUR WEATHER OBSERVATIONS

There are many entities out there who would like you to share your weather data with them. The ones mentioned primarily in this document are under the jurisdiction of the NOAA. NOAA has the highest standards for quality, so the guidelines in this document are more critical than they are for other groups such as Weatherunderground and WeatherBug. Additionally, local newspapers, radio and TV stations also like to receive observations from local observers due to the lack of a substantial number of official NOAA sites available. However, the better quality of data you provide, the more useful it is to the meteorological community at large. So, regardless of who you share your observations with, it is highly recommended that you site your weather station in the best location(s) possible to achieve the highest quality and most representative data for your neighborhood.

After you setup your weather station, the next step is to become a part of the volunteer weather observer community. The following paragraphs give general instructions on how to join each network. In many cases, and Internet connection is essential, but not always.

THE COOPERATIVE OBSERVER NETWORK (COOP) (United States Residents Only)

The following website provides guidelines on how to join: http://www.weather.gov/om/coop/become.htm In summary, contact your local NWS office and they will determine whether there is a need for a COOP site in your location. If you are selected for COOP, your local NWS office will provide the "official" equipment for monitoring. Unofficially, many COOP observers supplement their "official" readings with readings from their Davis Instruments weather stations.

THE CITIZEN WEATHER OBSERVER PROGRAM (CWOP)

It is possible there may not be a need for a COOP station in your location. It is possible to provide data to NOAA through the CWOP program. The program is open to anyone who has the equipment listed at the beginning of this document. The following website provides details on how to join: http://www.wxqa.com/SIGN-UP.html . Most of the information in this document is based on the guidelines CWOP has provided.

GLOBE

If you are an educator or member of an educational institution, then you may participate in the GLOBE program. Global Learning and Observations to Benefit the Environment is a worldwide hands-on, primary and secondary school-based education and science program. Teachers and other educators who wish to lead students in GLOBE need to attend special workshops in order to fully participate in the program. Visit the following website for more details: http://www.globe.gov/fsl/html/aboutglobe.cgi?intro&lang=en&nav=1

WEATHER UNDERGROUND

As with CWOP, you only need Internet access to send data to Weather Underground. Contact Weather Underground for the software that will interface with WeatherLink. This software is not compatible with WeatherBug (below). The following website allows you to sign up:

http://www.wunderground.com/signup/signup.asp?mode=pws

WEATHERBUG

WeatherBug offers a co-branded version of Davis Instruments weather stations. These operate just like our weather stations except they have a different name on the box and display console. They also include WeatherBug software that automatically uploads data to their network. This software does not include the Weather Underground feature and may not include the CWOP upload feature. Visit the following website for details: http://www.weatherbug.com/backyard/

LOCAL MEDIA (Newspapers, Radio & TV Stations)

Contact your local media weather departments and ask them if they would be interested in your weather data. Note that one outlet in each TV market will probably have exclusive agreements with other weather station vendors that will not allow you to use a Davis Instruments weather station to send them data. Other than those, they should be happy to receive your data.

MAINTENANCE AND QUALITY CONTROL

In general, the maintenance required for all the sensors will be infrequent and relatively simple. Periodically inspect your sensors to ensure that they are relatively free of dust, leaves, twigs, spider webs, and insect and bird nests. DO NOT remove nesting insects or animals by spraying insecticide because this may damage the plastic and sensors. Generally, if sited properly and well maintained, your Davis Instruments weather station should give you years of quality data and trouble-free performance. However, be sure and keep a periodic eye on your data readings. If they appear suspect, the following section will provide specific guidelines to determine whether you have incorrect readings and if so, how to address them. Although not covered below, missing data (dashes) in readings may indicate a severed cable, loose connection, or poor wireless reception. Consult your instruction manual for troubleshooting suggestions for these types of problems. Also, for CWOP use, be sure you have the latest version of WeatherLink™ software. It will probably have the latest fixes and corrections to the CWOP upload feature. CWOP uses the Automated Position Reporting System (APRS) data protocol text format to transfer data.

TEMPERATURE AND HUMIDITY

NOAA will perform quality control checks on the temperature and humidity data that your weather station reports. However, you should also verify yourself that the data your weather station reports is correct. In addition to following the siting and installation guidelines above, you can use an inexpensive sensor to compare your readings. Make sure the other sensor is properly shaded and located in the same well-ventilated location. If you are a member of COOP, the temperature readings of the MMTS shield and your Davis weather station should agree to within a few degrees if properly sited. You can also check the readings at a nearby airport. When making these comparisons, keep these issues in mind. Differences in elevation will affect temperature (on average 5.5°F (3.0°C) cooling per 1000 feet (300 m) rise in elevation), and subsequently, relative humidity. Differences in your micro-climate will make signficant differences in temperature readings, whether you are located in urban area or the countryside or whether you live in a valley or on top of a ridge. Large differences of 5°F (3°C) in temperature or 10% relative humidity or more between your inexpensive device or MMTS shield and the Davis weather station or differences of 10°F (5°C) or more or 20% relative humidity between your weather station and the nearest airport (if within the 100' elevation difference or less) may indicate either improper siting or sensor malfunction. If it is determined there are no siting issues, following the guidelines below for cleaning and maintenance. If these efforts don't solve the problem, contact Davis Instruments Technical Support.

To remove dust build-up from the temperature/humidity sensor, using a clean, dry toothbrush, gently brush the gold-colored mesh cloth. (If you have a Monitor II system, you will need to remove the lower portion of the temperature/humidity sensor cover by loosening the two screws.) Clean the white plastic cover with water and a mild liquid detergent, and rinse thoroughly before replacing. Depending upon the vintage of your humidity sensor, it may need to be recalibrated once every five years. Contact Technical Support with your manufacturing code and station model type to determine whether your humidity sensor supports calibration. Also, both the temperature and humidity readings can be manually adjusted through settings on the display console or in the WeatherLink software.

The outer portion of the plates of the radiation shield should be cleaned when there is excessive dirt and build up on them. Use a damp cloth to clean the outer edge of each ring. The effectiveness of the radiation shield will be reduced if the surfaces of the shield become dusty or dirty. A buildup of material inside the shield reduces its effectiveness and may lead to inaccurate temperature and humidity readings. Keep areas between radiation shield plates free of debris that may obstruct air flow. This type of maintenance will probably need to be done on an annual basis, or more often during drier times of the year when regular rains do not wash dust off the radiation shield. Consult the appropriate instruction manual for details on how to disassemble and reassemble the radiation shield.

RAIN COLLECTOR

Determining if your rainfall measurements are correct is more difficult. Precipitation can be highly variable over very short time and distance. For this reason, NOAA does not yet have quality control algorithms to verify the accuracy of rainfall readings. So, maintaining rainfall accuracy is up to you. In addition to following the siting guidelines earlier in this document, use the maintenance guidelines below to ensure the most accurate readings.

For greatest accuracy, clean several times a year. Dust and debris can accumulate on the tipping bucket, affecting its operation. Spiders and insects can make their homes in the base, and birds have been known to nest in the funnel. To clean the rain collector, remove the funnel from the base. Gently clean the tipping bucket and the funnel with water and a mild liquid detergent. Rinse thoroughly.

If you use the Rain Collector Heater, only use the device during periods when freezing weather is expected. The heat generated by the heater is enough to cause evaporation of rain water when used during liquid precipitation events. As a general guideline, leave it turned off during the summer months.

To check the accuracy of the rain collector, compare the Davis Rain Collector with a tube type "manual" rain gauge. Use a rain gauge with an opening diameter of at least 4 inches. If you are a COOP member, you can safely use this type of gauge for comparison provided it is located near your weather station. Rain gauges with openings smaller than 4 inches (1.5 cm) will not be sufficiently accurate or precise. Make sure there are no cracks in the rain gauge. In areas that experience freezing weather, plastic gauges can crack and develop leaks. Place the tube type rain gauge directly next to the Davis rain collector. If using the device to measure frozen precipitation, remove the funnel and center tube and melt the catch. Use the center tube for measurement. Compare the totals on three storms. Based on this, develop an average for how far off the readings are. There are adjustment screws under the rain collector bucket that are designed to fine tune readings. Use at least three rain storms to determine the appropriate adjustment. DO NOT compare rainfall readings to reading obtained from television, radio, newspapers, or the neighbors. Due the wide variation in rainfall over small distances, such readings are not an accurate measurement of the weather readings taking place at your site. The rain collector is carefully tested and calibrated at the Davis Instruments factory to conform to its stated specifications.

Additionally, the NWS WSR-88D Doppler radar measures storm precipitation amounts (to the nearest 0.25 inch). Check the storm total precipitation amount over your location from the WSR-88D total precipitation product for a gross check (generally good in non-winter precipitation events). Doppler radar precipitation reports are available on your local NWS Weather Forecast Office web page, which can be found by going to the NWS national page and clicking on your location on the map: http://www.weather.gov/ .

ANEMOMETER (WIND SENSOR)

Generally, if you mounted your anemometer at an ideal height and either pointed it in the correct direction or calibrated it to report correctly, your wind speed readings should be correct. You can validate your wind direction by monitoring your winds against area airport winds to see if your wind direction is consistent with their data. Complete your wind direction validation on an afternoon that is the day before or the day after a cold frontal passage. Use the readings on your display console, don't look at the unit on the roof. The roof device will always point into the wind regardless of the calibration setting. Ideally you want moderate, but not overly gusty, winds where flow is relatively uniform in speed and direction throughout your region. If wind direction is consistently off by more than 30 degrees from your reference station, apply a correction to your direction so it is consistent with area wind direction. This can be done on a Vantage Pro system using your weather station display console. A Monitor II or Wizard III unit will have to be manually calibrated on the roof.

Generally, if you mounted your anemometer at an ideal height, your wind speed readings should be correct. Wind speed will be difficult to validate using local airport data due to the large fluctuations in wind speed over time. Obstructions surrounding your anemometer may also decrease your wind speed significantly relative to your local airport's wind speed. Use the Beaufort Scale below for wind speed (land version) to determine whether you wind speed readings are in the "ballpark". Observe the motion of tree leaves, twigs, and chimney smoke plumes to estimate wind speed at the elevation of the anemometer.

Beaufort Code	Speed (mph)	Speed (km/hr)	Wind Category Description	Effects on the Environment
0	< 1	< 1	calm	smoke rises vertically
1	2 - 3	1 - 5	light air	smoke drifts slowly
2	4 - 7	6 - 11	light breeze	leaves rustle, wind can be felt, wind vanes move
3	8 - 12	12 - 19	gentle breeze	leaves and twigs on trees move
4	13 - 18	20 - 29	moderate breeze	small tree branches move, dust is picked up from the ground surface
5	19 - 24	30 - 38	fresh breeze	small trees move
6	25 - 31	39 - 51	strong breeze	large branches move, telephone and power overhead wires whistle
7	32 - 38	51 - 61	near gale	trees move, difficult to walk in the wind
8	39 - 46	62 - 74	gale	twigs break off from trees
9	47 - 54	75 - 86	strong gale	branches break off from trees, shingles blown off roofs
10	55 - 63	87 - 101	whole gale	trees become uprooted, structural damage on buildings
11	64 - 74	102 - 120	storm	widespread damage to buildings and trees
12	> 75	> 120	hurricane	severe damage to buildings and trees

Another method for checking anemometer performance is to use a less-expensive, separate hand-held anemometer such as the Davis Wind Scribe (Part # 276), Wind Wizard (Part #281), or Turbo Meter (Part # 271). Taking a series of comparisons between the hand-held anemometer and your weather station anemometer readings will help validate your anemometer's readings. Bear in mind that you will need to take these measurements at or near the same location as the anemometer itself. DO NOT attempt this method if the anemometer is in a difficult to reach location and/or if winds are currently in excess of 25 mph or if you are uncertain about the safety of going on your roof.

Your anemometer should provide years of trouble-free service. However, spiders and insects can affect its operation. If wind speed seems low, use an Allen wrench to loosen the set-screw on the side of the wind cups. Remove the wind cups, and clean the exposed portion of the shaft with a damp cloth or cotton swab. Clean the wind cups with water and a mild liquid detergent. Rinse thoroughly before replacing. *Do not use or add grease, oil, or a spray lubricant of any kind.* After replacing the wind cups and tightening the setscrew, check to make sure that the wind cups spin freely. If they do not, the bearings may be worn and need factory-replacement. To ensure accurate wind direction readings, check the orientation of the wind vane annually. Consult the instruction manual for details.

BAROMETER (ALTIMETER SETTING)

CWOP prefers to receive barometer data in the form of altimeter. Altimeter is the CWOP pressure standard because it is the simplest pressure reduction format that most CWOP members can reliably deliver. The National Meteorological Services use this information to determine the uncorrected pressure value at your location, called station pressure. Altimeter uses only elevation to determine a sea-level pressure value. Sea-level pressure is determined from temperature and humidity also, making it more difficult to determine station pressure. Davis Instruments weather stations normally report sea-level pressure.

WeatherLink versions 5.7 and later automatically convert Vantage Pro and Vantage Pro2 barometer data to altimeter. Monitor II data is reported as is. Vantage Pro barometers only need the elevation to be set once to report properly. Monitor II barometers require a user offset calibration to be entered whenever powered up. The following procedure is the CWOP guidelines for checking barometric pressure tailored specifically for Davis weather stations. To ensure you are reporting the correct value, the following procedure is highly recommended. For Vantage Pro systems, you should get your CWOP/APRS upload working before beginning this procedure.

1. Select a nearby (within 20 miles or 28 km) airport weather station to provide your reference or calibrated pressure. Data online is available through the following website if you know your airports 4-letter identifier (in the US, it is the 3-digit code with a K at the beginning: e.g., Chicago O'Hare's identifier is KORD): http://weather.noaa.gov/weather/metar.shtml . Otherwise, you can go to your local National Weather Service website http://www.weather.gov/ , click on the map for your location, and scroll down to Current Conditions. The link to "Other Local Obs" will provide a list of other nearby weather reports. Be sure to select an airport and not a CWOP station (indicated by call letters, rather than a name).
2. Vantage Pro users should set their correct elevation in the setup procedure and configure their WeatherLink APRS upload feature for frequent uploads. If not feasible at this time, set the elevation to zero and use the on-screen displayed value.

3. If making an adjustment or correction, wait for optimal weather conditions to conduct a series of comparisons; these conditions are:
   - High pressure is nearly overhead
   - Wind is less than 5 mph (3 m/s), preferably calm
   - Outside air temperature should relatively stable or slowly changing
   - The best time to conduct pressure comparisons is in the early afternoon; if the winds are light, then you are reasonably certain high pressure is in the area

   If starting up the weather station new or new to CWOP, simply use the readings you have regardless of the weather conditions.
4. For Vantage Pro users, take a series of four pressure measurements using the altimeter setting from the airport and your APRS altimeter value in the View Log file (or on-screen value if unavailable); each comparison should be at least be 15 minutes apart (see procedure below for obtaining airport observations).
   For Monitor II users, take a series of four pressure measurements using the altimeter setting from the airport and your on-screen displayed barometer reading; each comparison should be at least be 15 minutes apart (see procedure below for obtaining airport observations). If the unit is newly in use, use the first reading to adjust your Monitor II to match, for an initial working value. Consult the instruction manual on details on how to set the barometer.

Notes:
   - Some airports only report every hour on the hour, so you will have to take 4 hourly comparisons in this case.
   - Check that the time of your weather station reading and the airport reading are within 5 minutes of each other.

5. After completing the four comparisons noting your altimeter and the reference airport pressure simultaneously; sum the differences between the comparisons and divide by 4 (the number of comparisons) to get a mean difference.
6. If the mean difference between your station and the reference station is more than ±0.03 inches (±1.0 mb) add (or subtract) the difference from the on-screen barometer reading and use that value to correct the appropriate reading. Let the pressure settle for at least 15 minutes and try another series of comparisons to see if you get within ±0.03 inches (±1.0 mb). Repeat the procedure until you achieve the goal a pressure difference of less than ±0.03 inches (±1.0 mb).
7. Stop the comparison series when the mean difference is less than or equal to ±0.03 inches (±1.0 mb).
8. Barometers occasionally will “drift” requiring re-calibration. Therefore, do barometer comparisons at least once every 3 months.
9. Keep a record of your comparisons to monitor performance over time.

It is also possible to check the readings you send to CWOP online. This is recommended because the data you see on your display console may not match the data that gets sent to CWOP. If it doesn’t match, make sure the elevation you report to CWOP is correct and matches what you entered into your Vantage Pro system, if applicable. You can get direct access to station data by simply replacing the callsign in the URL: http://repeater.aprsfl.net/find.cgi?call=CW0001 . If you have a Vantage Pro or Vantage Pro2, you view the data WeatherLink sends to CWOP in the View Log file.

Finally, if your unit is NIST certified, it does not guarantee that the unit could be damaged or fail within the year long certification period. NIST is mainly an indication that if your unit appears to be reporting information that is within “ball-park” expectations, it probably is reporting the correct value. If your readings are in question, but your system appears to be functioning normally, double-check to make sure the sensors have not been unintentionally moved. You may also want to reconsider your sensor siting especially if your original installation was less than ideally located. NIST certification on the temperature and humidity sensors certifies that the sensors will read within specifications within the environment they are exposed to, but does not guarantee the radiation shield's effectiveness in blocking various forms of radiation. It is up to you to install the sensors within the radiation shield correctly according to the directions in the instruction manual. As with all sensors, it is your responsibility to locate them according to the guidelines in this document since NIST only certifies that the sensors will properly report the readings of the environment to which they are exposed.

Davis Instruments weather stations are designed to meet specifications. If you believe your unit to need repair or replacement, we have a fully staffed Support and Repairs team available to help you address your problem. (For residents outside the U.S. and Canada, most countries have a local Davis service center available to help. Contact our Customer Service department for the service center in your country.) Call our Tech Support department and our fully knowledgeable, friendly and helpful staff will listen to your problem and offer suggestions to rectify your problem. If they recommend a repair, they will provide you with the necessary information to get your unit fixed and returned in a timely fashion. If your readings are critical, you can shorten the total time the unit is out of service by shipping it to us via next day delivery and requesting that we return the unit to you the same way. Depending on where you are located, this can shorten the time the unit spends in transit by two weeks or more. We must, of course, charge you for the cost of returning the unit to you by next day delivery, whether it is under warranty or not. We will also send you a replacement part with the repair charge in exchange for returning the original part. This way, you do not have to wait for the unit to be repaired. Failure due to a power surge or lightning damage is not covered by our one year warranty and may not be repairable. In such cases, you may have to pay the full price to replace your unit. Repairs or replacement items have a 90 day warranty period.

REFERENCE

CWOP Weather Station Siting, Performance, and Data Quality Guide, March 2005

Federal Standards for Siting Meteorological Sensors at Airports, August 1994, Julian M. Wright, Jr., Federal Coordinator

Weather Station Siting and Installation Tools, 1997, Campbell Scientific, Inc.

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