

Installation and Field Use Guide 2022

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Installation and Field Use for Dendrometer Nodes

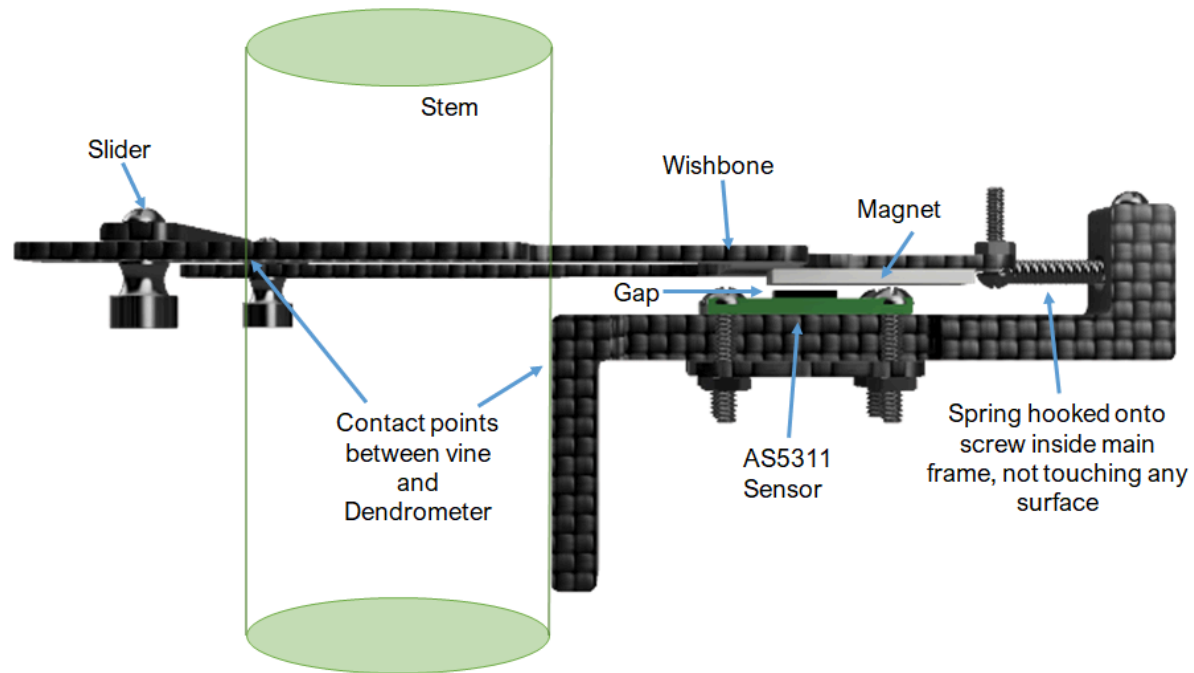


Figure 56: Diagram depicting proper installation and orientation of the dendrometer on a vine or stem.

1. Choose a plant to install the dendrometer on. It should have:
 - a. a vine or stem with a diameter of 23 - 40 mm (or up to 55 mm if using the larger wishbone design)
 - b. enough surrounding space for the dendrometer to sit untouched by other parts of the plant
 - i. remove leaves or other possible obstructions nearby the mounting site if needed
 - c. ~125 mm in height of relatively smooth stem (avoid knots or other anomalies in stem structure) to ensure both the dendrometer and protective covering will fit on the plant.
 - i. The more vertical the orientation of the vine or stem, the better.
2. Remove the bark from where the dendrometer will be taking measurements by peeling and rubbing around the circumference until most of it is gone from that area. There

should be a mostly smooth surface remaining that the frame and slider can be held against.



Figure 001: Dendrometer installed on grapevine trunk with bark removed and trunk orientation is relatively perpendicular to the ground.

3. To secure the dendrometer to the vine, a hose clamp will be used.
 - a. If on, remove one end of the Slider from the Wishbone by unscrewing the thumb nut, squeezing the Wishbone arms, and releasing the screw from inside the slot/groove.
 - b. Orient the device so that the Wishbone is above the body of the Frame (Fig. 56).
 - c. Holding the dendrometer against the vine, tighten the hose clamp around the vine and the leg of the Frame until it is snug. The leg should be flush against the vine, centered with the vine, and the hose clamp holding them firmly together (Fig. A, 57).

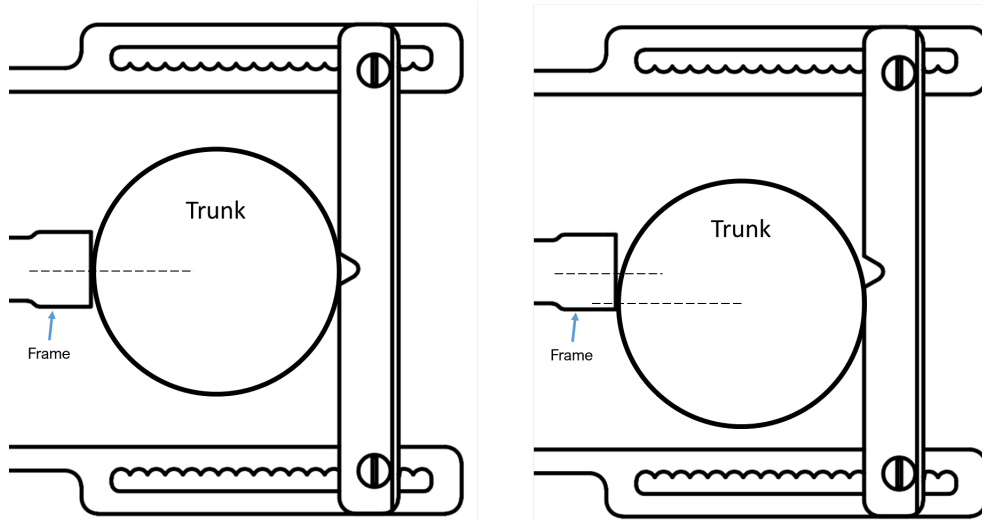


Figure A: Alignment of the frame with the vine. Left: frame and vine are properly aligned, as indicated by the matching centerlines. Right: The frame is off-center relative to the vine.



Figure 57: A hose clamp holds the dendrometer on a stem or vine by wrapping around the leg of the Frame and tightening against the vine.

4. With the vine in between the arms of the Wishbone, gently squeeze together the arms and place the unattached end of the Slider back into the grooves of the Wishbone arm. Screw the thumb nut onto the Slider's 2-56 screw, but do not tighten completely.
5. Adjust the position of the Slider along the grooves in the Wishbone arms by loosening the thumb nuts slightly and squeezing the arms of the Wishbone together. While the

arms are being squeezed, the Slider should move freely along the slots. When the desired position is attained, release the Wishbone arms; the screws on the Slider will be held into the grooves of the slots. Once the Slider is firmly against the vine and is perpendicular to the Wishbone arms, tighten the thumb nuts to clamp the Slider to the Wishbone.

- a. The spring should be engaged a light-to-moderate amount (extending about 1-5mm past equilibrium/rest position) to create tension.
 - i. If the spring must be extended more than 5mm so that the magnet fully covers the black sensor on the AS5311, slide the sensor and magnet magnet to a more appropriate position along the frame; this can be done by loosening the 3-48 hex nuts clamping the AS5311 and sensor mount in place, then retightening the hex nuts once the new position is achieved.
 - ii. The AS5311 should be held tightly in place; if it budes when a medium pressure is applied, the nuts need to be tightened more.
- b. The goal is to position the magnet so that the end closest to the vine is above the region of the AS5311 (green) in between the edge of the board and the end of the magnetic position sensor (raised black rectangular prism) on top of the board. The magnet and magnetic position sensor on the AS5311 should be completely parallel (Fig. 58).
 - i. It is imperative that the magnet does not touch the AS5311 sensor or any of the 3-48 screws from mounting the AS5311 sensor.

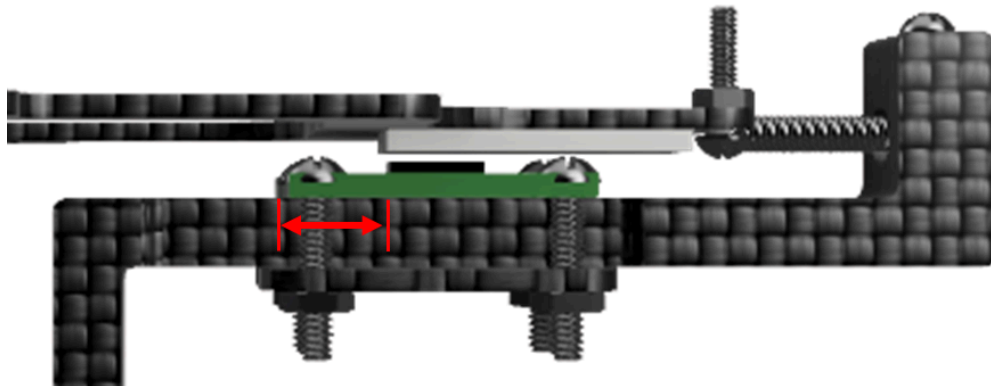


Figure 58: Close up of magnet (gray) and AS5311 sensor (green) initial alignment. Alignment zone is shown in red.

- c. The indent in the Slider marks its center; this end should be against the vine and the indent used to position the Slider on the vine (Fig. E). The edges of the indent will also prevent it from slipping out of place due to winds or plant care. The arms of the Wishbone should not touch the vine.

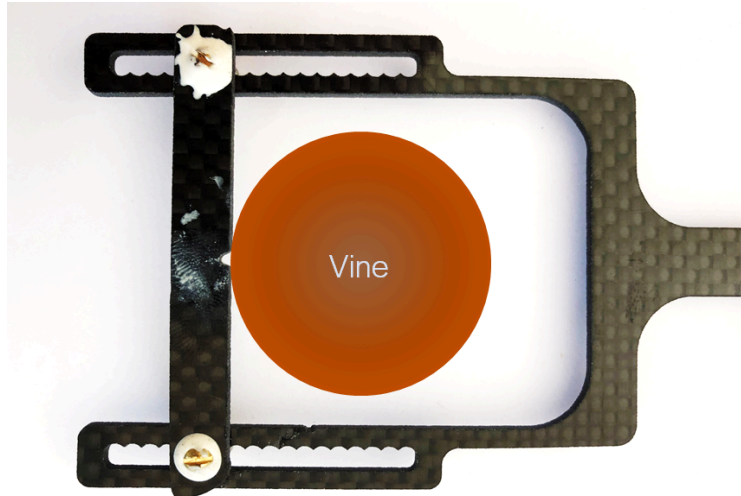


Figure E: The indent on the Slider is centered on the vine, the slider is tightened to the same groove on either arm (and is thus perpendicular to the stem of the wishbone), and neither arm of the wishbone is in contact with the vine.

- d. Achieving the most desirable position may require a few attempts at moving the Slider along the slots within the Wishbone.
6. Open the Pelican Case and plug the battery into the Feather M0.
7. Quickly close the Pelican case and clip it to the trellis wire that runs through the vines with the carabiner on the right side of the case (Fig. T).



Figure T: Pelican Case clipped onto row wire using the carabiner. Dendrometer is installed on blueberry plants at Lewis-Brown Farms in Corvallis, OR.

8. To adjust the orientation of the sensor and the magnet so that the alignment is sufficient for the AS5311 sensor to make accurate measurements, the LED indication system will be employed. The distance between the sensor and the magnet must be 0.2 - 0.4mm according to the AS5311 datasheet [14]; the Frame is designed so that if the Wishbone is exactly parallel to the face of the AS5311 board on the Frame, this distance will be achieved. However, given the precision required, this can still be challenging; the LED indication system can be used to make slight adjustments of the magnet and Slider/Wishbone positions. Once the battery is plugged into the Feather M0 (step 7), the LED will turn on after 30-60 seconds. The dendrometer will not begin recording data until the correct distance is achieved, in which case the LED will blink green three times. If alignment requirements are not met upon first try, the LED will be red (or yellow in rare cases). Adjust until the LED is green (note that the color change might take a few seconds to appear), then leave it in that position. The button does not need to be used upon initial startup of the dendrometer. This completes the process of setting up the dendrometer. See below for more details on using the LED Indication System.
 - a. This is the most finicky part of the set up and will likely require some patience and possibly a few small adjustments/tests. Placing a 0.2 - 0.35mm feeler gauge between the magnet and AS5311 sensor might be helpful.
 - b. To adjust, begin by moving the Slider vertically along the vine. You may find it necessary to move the Slider forwards or back along the grooves in the Wishbone slots to satisfy the requirements outlined in step 5.



Figure 59: Dendrometer successfully installed on a blueberry bush at Lewis-Brown Farm in Corvallis, OR.

*Short-version checklist of **requirements** for proper use of the dendrometer*

1. Wishbone arms are not touching the plant
2. Magnet is coaxial with magnetic sensor
3. Magnet is not resting on any of the screws; it is “free floating”
4. Bark is actually rubbed away / removed
5. Hose clamp is tight around the branch
 - a. Dendrometer does not budge with a light - moderate tap
6. AS5311 is tightly held against the frame
 - a. Does not move unless applying moderate - significant force

Data Collection from Node

To collect data from the dendrometer, open the Pelican case and remove the microSD card from the Hypnos board. Using a microSD adapter chip, plug in the SD card to your computer and upload the data file. Eject the microSD from the computer and place it back into the Hypnos board.

1. Do not delete the data file from the SD card unless the battery is unplugged from the Feather M0 prior to removing the microSD. If the file is removed and the dendrometer is not reset, there will no longer be a data file for the program to write to and no data will be collected.

2. The battery does not need to be unplugged while the microSD is removed. However, it is recommended that the battery be unplugged if the SD is removed for longer than 30 minutes in order to preserve battery life.
3. If the battery has been unplugged (and you're not done using the dendrometer for the season), plug the battery back into the Feather M0 and refer to steps 7 and 8 in order to restart operation. Note that doing this will create a new data file on the microSD card for data to be written to.

LED Indication System

The LED Indication System is implemented to easily check that the dendrometer is actively collecting data. When the button is pushed, the device will check the distance between the magnet and sensor to see if it is still within the required range of 0.2 - 0.4mm. If it is, the LED will turn **green** for a few seconds; this indicates that the dendrometer is still accurately recording data. If the LED turns **red**, something may have caused the magnet to shift relative to the sensor, in which case the data may no longer be valid during the previous testing period (when looking at the data, you will likely be able to see a jump when the misalignment event occurred). If this happens, use the LED indication system to adjust the magnet and Sandwich Grip until the LED is green when the button is pushed. Alternatively, open the Pelican Case and hit the 'Reset' button on the Hypnos board, then refer back to step 7 of the setup process to get everything up and running again. This approach will create a new data file on the SD for the coming measurements. In rare cases, the LED will appear **yellow**; this means that the alignment is still in range but is on the very edge. This could impact the precision of the measurements; it is recommended that the same procedures for adjustment be followed as when the LED is red. However, if yellow, the data trends can be expected to still be valid, although slightly less accurate.

Installation of Protective Covering

The protective cover can be attached to the plant using a hose clamp. It is essential that the cover surround the dendrometer but not touch it. There should be at least 2cm of space between the arms of the wishbone and the cover at every point. The protective cover should be installed before final alignment and power-on of the dendrometer device to avoid bumping the device and skewing the data. Furthermore, the rubber flaps should be adjusted or taped such that they do not drape down with the potential to bump the wishbone or direct rainfall onto the dendrometer.



Figure XX: Dendrometer installed with protective covering. The cover does not touch the device and duct tape has been applied to keep the rubber flaps in place.

Installation and Field Use for Hub

The hub should be installed within a 1km of all devices. The installation will be site-dependent but can be done on a stake or most wood poles. The orientation of the solar panel should be such that it is most favorable for capturing sunlight throughout the day.