



METER
ENVIRONMENT

ATMOS 41—HOW TO CHECK THE PRECIPITATION READING

Use these instructions to check the calibration of the drip counter on the [ATMOS 41](#) all-in-one weather station. The procedure could take one to four hours to complete.

WHAT YOU WILL NEED

- 5-20 mL plastic syringe
- Plastic cups or beakers (2)
- DI water (~200 mL)
- Towel
- Whatman #3 filter paper disc (METER part number 30049, pack of 30)
 - Any filter paper or other (fabric/plastic) insert to control flow will work
- Tweezers
- Pen
- Mechanical pencil or thin gauge wire
- Stopwatch
- ATMOS 41
- Stand/mount for ATMOS 41
- Scale/balance that can measure 5.00 to 50.00 grams
- Data logger

- Cable adapter
- Laptop with software installed:
 - [Zentra Utility](#) for METER data logger
 - LoggerNet for Campbell Scientific data logger
 - [Driver](#) for USB cable adapter

STEPS

1. Clean ATMOS 41 funnel outside and inside, if needed. Directions [here](#).
2. Remove the spring from the funnel.
3. Using a scale/balance, verify that the 20 mL mark on a plastic syringe dispenses close to 20 grams; make a new mark on the syringe if needed.
4. Place ATMOS 41 on a stand/mount.
5. Connect ATMOS 41 to a data logger.
6. Use tweezers to dip one filter paper disc in DI water. Re-wet if needed by dipping the filter in the DI water cup for about two seconds.
7. Place the pre-wetted filter paper disc at the top of the spring hole.
8. Use the back of a round pen to push the filter paper to the bottom of the hole. The purpose of the filter paper disc is to regulate the flow rate of water through the funnel.
9. Poke a very small hole through the middle of the filter paper using a metal wire or fine-point pen/pencil (Figure 1). Exercise caution when poking the filter paper to avoid damaging parts below the funnel.

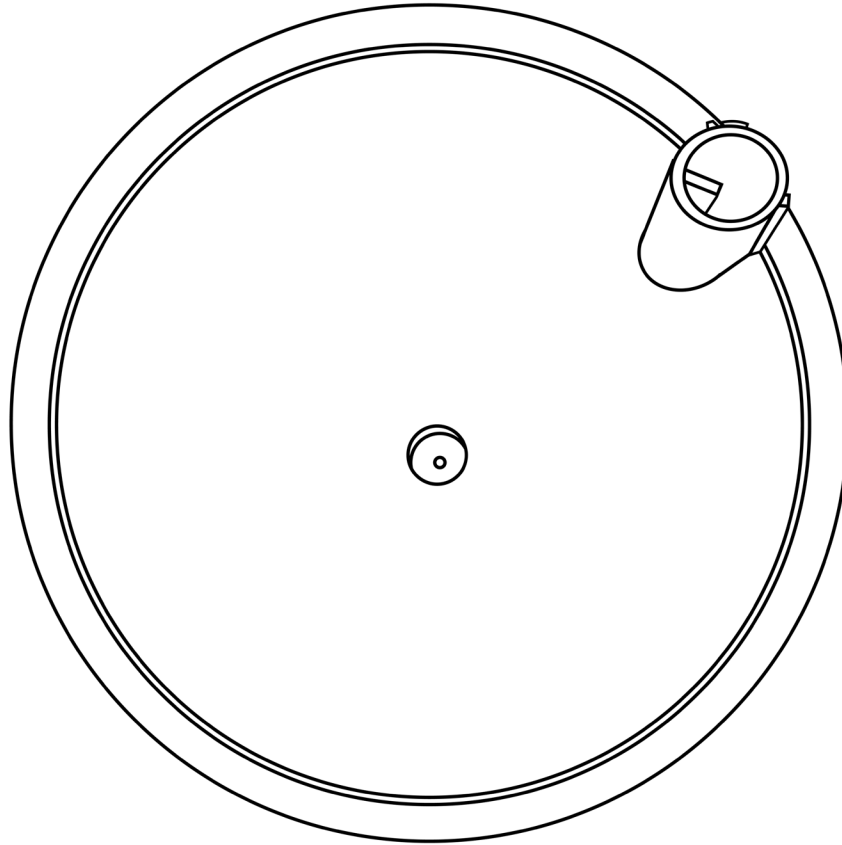


Figure 1. Wetted filter paper disc installed in ATMOS 41 funnel. The small hole is to regulate water flow rate through the funnel.

10. Put a cup/beaker under the spout of the drip counter outlet (Figure 2).
 - a. A towel can be put around the setup to soak up water spills/splatters

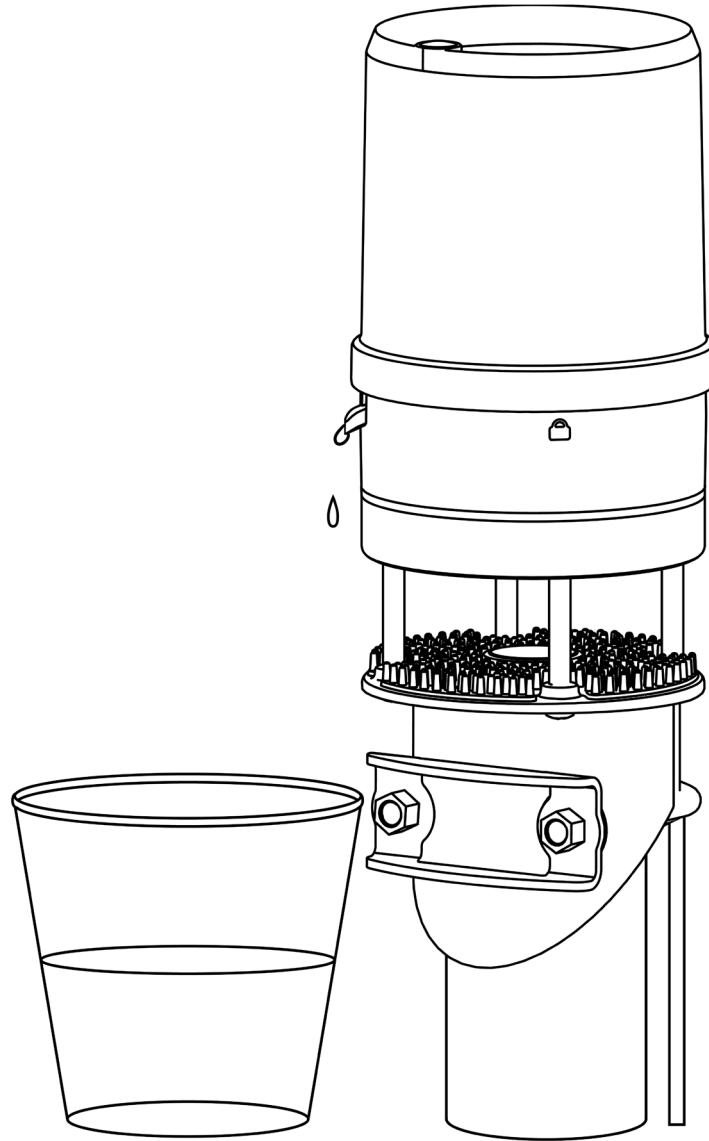


Figure 2. Setup with ATMOS 41, stand, and cup for collecting water exiting the spout

11. Open the data logger software

12. Level the ATMOS 41 and check the X and Y orientation angle (Figure 3). Adjust the level to ± 2.0 degrees of dead level (0, 0). If the sensor is more than ± 2 degrees of dead level (0, 0), then drops can either be missed by the counter or more drop counts could result if the size of the drops change based on the level.

13. Set the measurement/scan interval to 10 minutes (Figure 3). The ATMOS 41 records the accumulated rainfall depth since the last measurement/scan, so setting a longer measurement/scan interval of 10 minutes is important for checking the drip counter.

z6-01984	ZL6	10 minutes			0.0% in use. Approximately 4.2 years until overwriting old data
ATMOS 41 All-in-one Weather Station Port 1	Solar Radiation	Precipitation	Lightning Activity	Lightning Distance	
	3 W/m ²	0.000 mm	0	0 km	
	Wind Direction	Wind Speed	Gust Speed	Air Temperature	
	266°	0.15 m/s	0.15 m/s	72.3 °F	
Vapor Pressure	Atmospheric Pressure	X-axis Level	Y-axis Level		
	1.34 kPa	91.97 kPa	-0.6°	-0.7°	
Max Precip Rate	RH Sensor Temp				
	0.0 mm/h	72.1 °F			
Battery	Battery Percent	Battery Voltage			
	100%	9451 mV			
Barometer	Reference Pressure	Logger Temperature			
	91.87 kPa	73.2 °F			

Figure 3. Zentra Utility software example (for METER data loggers)

14. Close the software program and disconnect the cable adapter from the computer.
15. Pretest the filter paper in the funnel by adding about 5 to 20 mL of water.
 - a. When adding water to the funnel, use discretion by directing the water to the wall of the funnel, not directly into the hole.
16. Monitor the water flowing out of the spout. You should see discrete drops exit the spout. A good flow rate check is to see if 5 mL of water flows through in less than one minute (5 mL/min), while still observing discrete drops exit the spout. A flow rate of 30 to 40 mL/min could be too fast for checking the precipitation calibration.
 - a. To know the flow rate of water, repeat the pretest (step 15) and use a known volume of water. Use a stopwatch to time how long it takes a known volume of water to pass through the filter. Divide the volume added by the time in minutes to get flow rate (see appendix).
 - b. If the flow rate is greater than 30 mL/min, then repeat steps 6 to 9 with a new filter paper (remove the wet filter paper first), and make a smaller hole in the new filter paper.
 - c. If the flow rate is less than 0.5 mL/min, make the hole slightly bigger.
17. Add a little more than 20 mL of DI water in the syringe. Tap air bubbles up. Squeeze any air bubbles out.

18. Squeeze water out of the syringe until the water is at the 20 mL mark on the syringe. Squeeze this excess water back into the DI water cup/beaker.

19. One minute after the 10-minute data logger interval (eg., 8:01, 8:11, 8:21, etc), gently squeeze 20 mL of DI water from the syringe into the ATMOS 41 funnel with filter paper.

a. Wait 10 minutes for the water to flow through. You should see discrete drops exit the spout.

b. If water flows too slowly, make the opening in the filter paper slightly bigger using a metal wire or fine-point pen/pencil.

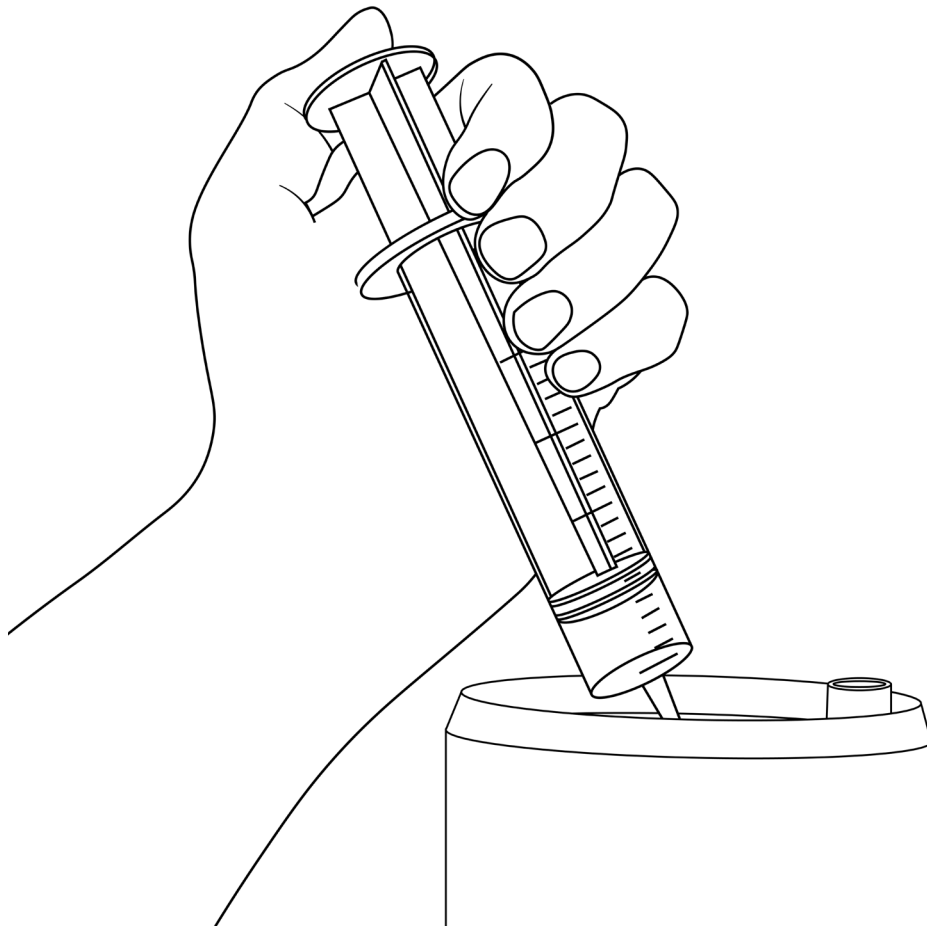


Figure 4. Adding water to ATMOS 41 funnel with filter paper to regulate flow rate

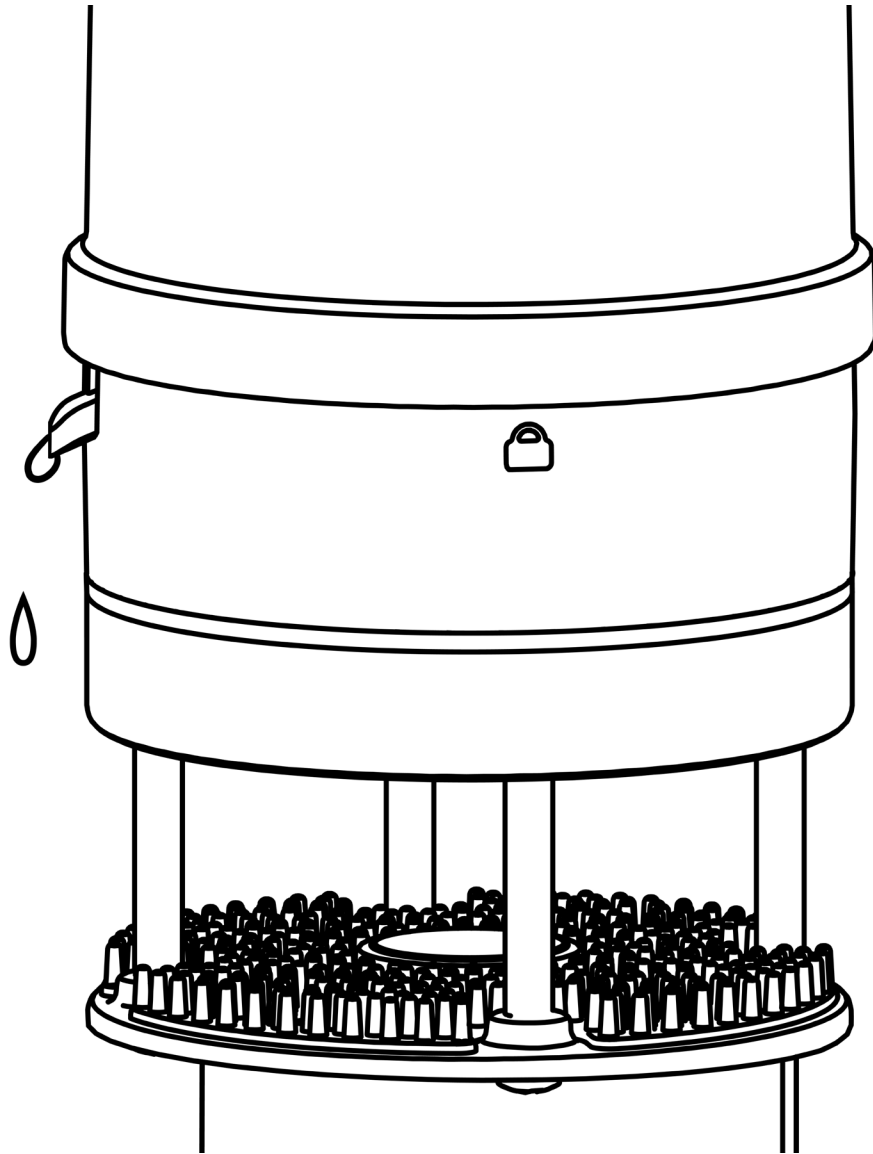


Figure 5. Drips indicating flow rate

20. Repeat steps 17 to 19 three to five times.

21. Open the data logger software, connect, and download the data. Check if the 20 mL volume is close to the expected depth of 2.94 mm.

a. $\pm 5\%$ range is 2.77-3.11 mm

b. $\pm 10\%$ range is 2.65-3.23 mm

NOTE: The precipitation accuracy should fall within 5% for < 50 mm/h rainfall. The more realistic range when testing with a syringe and filter paper is 10%. To check 50 mm/h, add 57 mL of water for a 10-minute interval (~ 8.37 mm).

22. To check other water depths, change the amount of water in the syringe. Calculate the expected depth of precipitation (see Equation 1). The surface area of the ATMOS 41 funnel is 68.08 cm².

$$\text{Water volume} \times \frac{1 \text{ cm}^3}{1 \text{ mL}} / 68.08 \text{ cm}^2 \times \frac{10 \text{ mm}}{1 \text{ cm}} = \text{depth of precipitation (mm)}$$

Equation 1

a. If using 10 mL volume, the expected depth is 1.47 mm.

1. ±5% range is 1.40 to 1.54 mm

2. ±10% range is 1.32 to 1.62 mm

z6-00946	Port 1			
Records: 5	ATMOS 41 All-in-one Weather Station			
Timestamp	mm Precipitation			
9/20/2018 11:10	1.498			
9/20/2018 11:20	1.498			
9/20/2018 11:30	1.498			
9/20/2018 11:40	1.515			
9/20/2018 11:50	1.532			

Figure 6. ZENTRA Utility software example for METER data loggers (10 mL of water was added every 10 minutes)

b. If using 50 mL volume, the expected depth is 7.34 mm.

1. ±5% range is 6.98 to 7.71 mm

2. ±10% range is 6.61 to 8.08 mm

z6-00946	Port 1			
Records: 5	ATMOS 41 All-in-one Weather Station			
Timestamp	mm Precipitation			
9/20/2018 13:10	7.379			
9/20/2018 13:20	7.072			
9/20/2018 13:30	7.328			
9/20/2018 13:40	7.191			
9/20/2018 13:50	7.413			

Figure 7. Zentra Utility software example for METER data loggers (50 mL of water was added every 10 minutes)

23. Use tweezers to remove the filter paper.

24. Insert the spring by pushing firmly down and twisting to get the spring reinstalled.

25. Install ATMOS 41 in the field. See the ATMOS 41 quick start guide for installation tips.

APPENDIX:

Effect of flow rate through the filter paper

Dark blue = 5% accuracy range

Light blue = 10% accuracy range

Medium blue > 10% accuracy range

z6-00946	Port 1	Port 2	Port 6			
Records: 33	ATMOS 41 All-i	ATMOS 41 All-i	ATMOS 41 All-in-one Weather Station			
Timestamp	mm Precipitati	mm Precipitati	mm Precipitation			
10/1/2018 13:20	2.855	2.991	0.749			
10/1/2018 13:30	2.821	2.974	0.732			
10/1/2018 13:40	2.787	3.009	0.715			
10/1/2018 13:50	2.821	3.060	0.766			
10/1/2018 14:00	2.838	2.974	0.749			
10/1/2018 14:10	2.889	3.043	0.783			
10/1/2018 14:20	2.872	2.991	0.766			
10/1/2018 14:30	2.889	3.009	0.766			
Flow rate	2 mL/min	2 mL/min	2 mL/min			
Water added	20 mL	20 mL	5 mL			

Trial 1. Two mL/min flow rate for 20 mL and 5 mL water volume. See Equation 1 for precipitation calculation.

z6-00946	Port 1	Port 2	Port 3	Port 4	Port 5	Port 6
Records: 8	ATMOS 41 All-	ATMOS 41 All-	ATMOS 41 All-in	ATMOS 41 All-in-o	ATMOS 41 All-i	ATMOS 41 All-in-o
Timestamp	mm Precipitat	mm Precipitat	mm Precipitatio	mm Precipitation	mm Precipitati	mm Precipitation
10/1/2018 16:40	2.396	2.311	2.923	2.923	0.698	0.749
10/1/2018 16:50	2.413	2.549	3.009	2.974	0.681	0.732
10/1/2018 17:00	2.549	2.549	2.957	3.009	0.681	0.715
Flow rate	40 mL/min	30 mL/min	8 mL/min	8 mL/min	10 mL/min	10 mL/min
Water added	20 mL	20 mL	20 mL	20 mL	5 mL	5 mL
	Higher flow rate is too fast?					

Trial 2. Eight to 40 mL/min for 20 mL and 5 mL water volume. See Equation 1 for precipitation calculation.

z6-00946	Port 1	Port 2	Port 3	Port 6
Records: 7	ATMOS 41 A	ATMOS 41 A	ATMOS 41 A	ATMOS 41 All-
Timestamp	mm Precipit	mm Precipit	mm Precipit	mm Precipitat
10/2/2018 9:50	3.094	2.872	2.940	2.923
10/2/2018 10:00	2.906	2.940	2.906	2.991
10/2/2018 10:40	2.770	2.940	2.923	2.974
Flow rate	40 mL/min	10 mL/min	30 mL/min	5 mL/min
Water added	20 mL	20 mL	20 mL	20 mL

Trial 3. Ten to 40 mL/min for 20 mL water volume. See Equation 1 for precipitation calculation.

Explore which [weather station](#) is right for you.