



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F201

Pygmy and Type AA Velocity Meters

Standard Operating Procedure

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Table of contents

1 Purpose	2
2 Scope	2
3 Responsibilities	2
4 Definitions	2
5 Safety and Hazards	3
5.1 Required PPE	3
6 Instrument Specifications	4
6.1 Price Type AA Current Meter	4
6.2 Price Pygmy Current Meter	4
6.3 Choosing Between Meters	4
7 Equipment and Accessories	5
7.1 Maintenance Supplies	5
8 Procedure	5
8.1 Assembly	5
8.2 Pre-Field Spin Test	6
8.3 Cleaning and Oiling (Pre-Season and As Needed)	6
8.4 Annual Maintenance	7
8.5 Pivot Adjustment	7
8.6 Storage	7
9 Rating Tables	7
9.1 Meter Calibration Verification	8
10 Ordering Parts and Supplies	8
10.1 Replacement Parts to Stock	8
11 Troubleshooting	8
12 References	9

13 Related SOPs **9****14 Training Record** **9**

1. Purpose

This SOP describes the specifications, assembly, maintenance, and ordering of replacement parts for the Price Pygmy and Price Type AA mechanical current meters used by the EA Program. These vertical-axis cup-type meters convert water velocity into rotational counts and are the standard instruments for measuring point velocities during stream discharge measurements (Rantz et al., 1982) (see also [SOP-F301 Stream Discharge Measurement](#)).

2. Scope

- **Applies to:** Price Pygmy current meters and Price Type AA current meters owned by the EA Program, including standard cat-whisker and magnetic-head contact chamber variants
- **Does not apply to:** Electronic velocity meters (e.g., Marsh-McBirney, FlowTracker ADV), propeller-type meters (e.g., Ott), or acoustic Doppler instruments
- **Location:** Instruments stored in the EA field equipment room; maintenance performed in SGM 133

3. Responsibilities

Role	Responsibility
Lab PI	Approve purchases, authorize meter retirement
Field Lead	Perform pre-field spin tests, coordinate maintenance
Trained Personnel	Assemble, inspect, and clean meters per this SOP
New Students	Complete training before handling meters

4. Definitions

- **AquaCalc:** A digital flow computer that counts current meter revolutions electronically and converts them to velocity automatically using the stored rating table; eliminates manual timing and reduces transcription error.
- **Cat-whisker contact:** A spring-wire contact element in the Type AA meter's contact chamber; makes electrical contact with a solder bead on the shaft once per revolution (single-revolution contact) or once per five revolutions (penta contact); must be checked for wear and proper contact force before each field season (Rantz et al., 1982).
- **Contact chamber:** The sealed housing on the Type AA meter that contains the electrical contact mechanism (cat-whisker wire and solder bead, or magnetic head); connects to the cable leading to the headset or digital counter.

- **Penta contact:** A gear-reduction contact in the Type AA meter that closes the circuit once every five bucket-wheel revolutions; used at high velocities to reduce the counting rate to a manageable level; not available on the Pygmy meter (Rantz et al., 1982).
- **Pivot:** The tungsten carbide tip at the bottom of the current meter shaft; rides in a hardened bearing cup; the single most wear-sensitive part of a mechanical current meter; must be inspected for burrs, flat spots, and magnetization before each field season (Rantz et al., 1982; U.S. Geological Survey, Office of Surface Water, 2002).
- **Price Pygmy current meter:** A vertical-axis cup-type current meter with a 2-inch (5.1 cm) diameter bucket wheel; designed for shallow streams (depth < 1.0 ft); wading rod suspension only; rated for velocities of 0.1–4.9 ft/s (Rantz et al., 1982).
- **Price Type AA current meter:** The standard USGS vertical-axis cup-type current meter with a 5-inch (12.7 cm) diameter bucket wheel; rated for velocities of 0.1–25 ft/s; can be suspended from a wading rod or cable (Rantz et al., 1982).
- **Rating table:** A lookup table, supplied with each meter by the manufacturer and approved by the USGS, that converts bucket-wheel revolutions per second to velocity in ft/s or m/s; laminated copies must be kept in each meter's carrying case (Rantz et al., 1982).
- **Raising nut:** The nut that controls the vertical position of the shaft and pivot within the yoke; must be tightened to the correct end-play setting (~0.001 in) for accurate measurements; never loosen by holding the nut and spinning the bucket wheel.
- **Spin test:** A field quality control check in which the bucket wheel is given a sharp spin by hand and the time for it to stop is measured; a proxy for bearing condition; minimum acceptable spin times are 40 s (Type AA) and 24 s (Pygmy) at room temperature (Rantz et al., 1982).
- **Wading rod (top-setting):** A graduated aluminum rod used to position the current meter at a known depth fraction (0.6 or 0.2/0.8 of total depth) below the water surface; the depth-setting mechanism is located on the handle, enabling depth changes without removing the meter from the water.

5. Safety and Hazards

Hazards

- **Physical:** Pivot points and shaft tips are sharp; handle with care. The bucket wheel can pinch fingers if spun while adjusting the assembly.
- **Chemical:** Instrument oil is a mild skin irritant. Avoid eye contact.

5.1. Required PPE

- ☐ Nitrile gloves (when oiling or cleaning with solvents)
- ☐ Safety glasses (when using compressed air for cleaning)

6. Instrument Specifications

6.1. Price Type AA Current Meter

The Type AA is the standard USGS Price-type current meter for general streamflow measurement (Rantz et al., 1982). The bucket wheel has six conical cups (12.7 cm diameter) rotating on a vertical axis inside a brass yoke. Tungsten carbide bearings are seated in deeply recessed inverted cups that trap air and exclude water and silt. A tailpiece assembly aligns the meter with the current when suspended by cable.

Parameter	Value
Velocity range	0.1–25 ft/s (0.03–7.6 m/s)
Bucket wheel diameter	5 in (12.7 cm)
Number of cups	6
Contact types	Single revolution and penta (every 5 rev)
Suspension	Wading rod or cable with sounding weight
Construction	Brass and stainless steel, chrome plated
Rating	USGS standard rating table (two equations joined at 1 rev/s = 2.2 ft/s) (Rantz et al., 1982)

6.2. Price Pygmy Current Meter

The Pygmy meter is scaled to two-fifths the size of the Type AA, designed for shallow streams (Rantz et al., 1982). The contact chamber is integral to the yoke; single-revolution contact only (no penta gear). The meter has no tailpiece and cannot be used with cable suspension.

Parameter	Value
Velocity range	0.1–4.9 ft/s (0.03–1.5 m/s)
Bucket wheel diameter	2 in (5.1 cm)
Number of cups	6
Contact type	Single revolution only
Suspension	Wading rod only (no cable suspension)
Construction	Brass and stainless steel, chrome plated
Rating	USGS standard rating table (single equation) (Rantz et al., 1982)

6.3. Choosing Between Meters

Condition	Meter to Use
Water depth > 1.0 ft (0.3 m)	Type AA
Water depth 1.0 ft (0.3 m)	Pygmy
Velocities expected > 4.9 ft/s	Type AA
Shallow stream edges (supplemental data)	Pygmy

Condition	Meter to Use
Cable suspension required	Type AA

7. Equipment and Accessories

Item	Used With	Notes
Top-setting wading rod	Both	Graduated in tenths of a foot; depth-setting mechanism on handle
Round wading rod	Both	Simpler design; depth read from rod markings
Headset (earpiece)	Both	For counting clicks manually
AquaCalc or digital flow computer	Both	Automatically counts revolutions and computes velocity
Stopwatch	Both	For timed revolution counts if no digital counter
Sounding weight (Columbus type)	Type AA only	For cable-suspended measurements
Tailpiece assembly	Type AA only	Remove when using wading rod
Electrical cable	Both	Connects meter to counter or headset

7.1. Maintenance Supplies

Item	Notes
Instrument oil (light machine oil)	Supplied with meter; for pivot bearings
Lint-free cloth	For cleaning and drying
Cotton swabs (pointed)	For cleaning pivot bearing recesses
Small flat-head screwdriver	For contact chamber adjustments
Magnifying glass or loupe	For inspecting pivot points for burrs
Paper clip	For checking pivot magnetization
Bulk magnetic tape eraser	For demagnetizing pivots
Soft-bristle brush	For removing debris from cups
Compressed air (filtered)	For drying internal components

8. Procedure

8.1. Assembly

Type AA on a wading rod:

1. Remove the tailpiece assembly (used for cable suspension only).

2. Slide the meter yoke onto the wading rod and secure with the thumbscrew.
3. Connect the electrical cable from the binding posts on the contact chamber to the AquaCalc or headset.
4. For penta contact, connect to the penta binding post; for single-revolution counting, use the single-revolution binding post.

Pygmy on a wading rod:

1. Slide the pygmy yoke directly onto the wading rod and secure with the thumbscrew.
2. Connect the electrical cable to the binding post. The Pygmy has only a single-revolution contact.

8.2. Pre-Field Spin Test

Perform a spin test before every field outing (Rantz et al., 1982). Conduct with the meter level, shaft vertical, in a location with no air currents.

1. Hold the meter steady and use your finger or a pencil to give the bucket wheel a sharp, single spin.
2. Immediately start a stopwatch.
3. Stop the stopwatch when the wheel completely stops rotating.
4. Record the spin time in the field notebook.

Minimum acceptable spin times (Rantz et al., 1982):

Meter	Minimum Spin Time	Optimum Spin Time
Type AA	40 s	60–120 s
Pygmy	24 s	40–80 s

If the spin time falls below the minimum, clean and oil the pivot before proceeding (§7.3). If the spin time remains low after cleaning and oiling, replace the pivot.

8.3. Cleaning and Oiling (Pre-Season and As Needed)

1. **Inspect the pivot.** Remove the raising nut and carefully withdraw the shaft. Examine the pivot tip under a magnifying glass. A good pivot is highly polished, with no flat spots, pits, or scratches. Replace a damaged pivot immediately.
2. **Check for magnetization.** Hold the pivot near a paper clip. If the clip is attracted to the pivot, the pivot is magnetized and will cause erroneously high velocity readings. Demagnetize using a bulk magnetic tape eraser.
3. **Oil the bearings.** Apply one small drop of instrument oil to the upper shaft bearing and one drop to the pivot. Do not over-oil; excess oil attracts grit.
4. **Inspect the bucket wheel.** Spin the wheel slowly and watch for wobble. If the upper hub wobbles more than the lower, the shaft is bent and must be replaced.

5. **Inspect the contact chamber.** For cat-whisker contacts, check that the wire makes clean contact with the solder bead on each revolution. For magnetic-head contacts, verify the counter registers properly during the spin test.

 Raising Nut Caution

Never loosen the raising nut by holding the nut and spinning the bucket wheel. This will bend the shaft. Always hold the bucket wheel still and unscrew the nut (U.S. Geological Survey, Office of Surface Water, 2002).

8.4. Annual Maintenance

1. Disassemble the meter completely: remove bucket wheel, shaft, and pivot.
2. Clean all parts with a lint-free cloth dampened with instrument oil.
3. Inspect the shaft for straightness by rolling on a flat surface.
4. Replace worn or damaged parts.
5. Reassemble and adjust the pivot per the manufacturer's instructions.
6. Perform a spin test to verify performance.
7. Record maintenance date, parts replaced, and spin test results in the instrument log (U.S. Geological Survey, Office of Surface Water, 2002).

8.5. Pivot Adjustment

1. Hold the meter inverted with the pivot pointing up.
2. Release the keeper screw and unscrew the pivot-adjusting nut a few turns.
3. Advance the pivot-adjusting nut until it touches the yoke.
4. Set end play to approximately 0.001 in – the shaft should have just barely perceptible vertical play detectable by feel.
5. Tighten the keeper screw to lock the adjustment.

8.6. Storage

- Store meters in their waterproof carrying cases.
- Loosen the raising nut to relieve pressure on the pivot.
- Ensure meters are clean and lightly oiled.
- Store in a dry location away from dust and vibration.
- If a meter will not be used for more than 3 months, remove the bucket wheel assembly and store separately.

9. Rating Tables

Each meter ships with a USGS-approved standard rating table that converts bucket-wheel revolutions per second to velocity in ft/s or m/s (Rantz et al., 1982; Turnipseed & Sauer, 2010). Keep a laminated copy in each meter's carrying case and a digital copy on the lab shared drive.

- Type AA rating table: <https://prph2o.com/usgs-type-aa-current-meter/>
- Pygmy rating table: <https://prph2o.com/usgs-pygmy-current-meter/>

9.1. Meter Calibration Verification

USGS studies have found that approximately 35% of Type AA meters and 20% of Pygmy meters in routine field use fail to meet standard rating criteria, typically because of worn pivots, bent shafts, or damaged contacts (Rantz et al., 1982). The spin test (§7.2) is the primary field check.

10. Ordering Parts and Supplies

Primary supplier for USGS-type Price AA and Pygmy current meters and replacement parts:

Performance Results Plus, Inc. Website: <https://prph2o.com>

10.1. Replacement Parts to Stock

Part	Qty to Stock	Fits
Pivot (tungsten carbide tip)	2	Both
Shaft	1 per type	AA or Pygmy
Bucket wheel assembly	1 per type	AA or Pygmy
Bucket wheel hub nut	2	Both
Raising nut	1 per type	AA or Pygmy
Cat-whisker wire and solder bead	2 sets	AA
Instrument oil	1 bottle	Both
Pivot bearing	2	Both

11. Troubleshooting

Problem	Probable Cause	Corrective Action
Spin time below minimum	Dirty or worn pivot; bent shaft; dry bearings	Clean pivot; inspect for burrs; oil bearings; replace pivot or shaft if damaged
Counter not registering	Loose cable; worn cat-whisker; dead counter battery	Check cable; replace contact wire; replace battery
Bucket wheel wobbles	Bent shaft or frame	Replace shaft; if hub wobbles, replace bucket wheel assembly

Problem	Probable Cause	Corrective Action
Meter reads high	Magnetized pivot; worn bearing	Demagnetize pivot; replace pivot bearing
Meter reads low	Excessive friction; over-oiled	Clean and re-oil; replace pivot if burred

12. References

- Rantz et al. (1982)
- Turnipseed & Sauer (2010)
- U.S. Geological Survey, Office of Surface Water (2002)

Rantz, S. E. et al. (1982). *Measurement and computation of streamflow: Volume 1. Measurement of stage and discharge* (Water-Supply Paper 2175). U.S. Geological Survey. <https://pubs.usgs.gov/wsp/wsp2175/>

Turnipseed, D. P., & Sauer, V. B. (2010). *Discharge measurements at gaging stations* (Techniques and Methods 3-A8). U.S. Geological Survey. <https://doi.org/10.3133/tm3A8>

U.S. Geological Survey, Office of Surface Water. (2002). *Maintenance of Price type AA current meters*. U.S. Geological Survey. <https://water.usgs.gov/osw/pubs/9906attachments.pdf>

13. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Required prerequisite
F007	Field Decontamination	Between-site equipment cleaning
F202	SonTek Acoustic Velocity Meters	Acoustic alternative
F301	Stream Discharge Measurement	Primary application of this instrument

14. Training Record

Before handling or using current meters independently, personnel must:

1. Read this SOP in full
2. Complete [SOP-F001 Field Safety](#) training
3. Observe a trained operator assemble, spin-test, and clean both meter types
4. Successfully perform assembly and spin test under supervision
5. Read [SOP-F301](#) before using meters in the field
6. Be signed off by the PI or designated trainer