



Protocols for Using the Global Flow Meter in Wadeable Rivers and Streams



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**Bureau of Land and Water Quality
Division of Environmental Assessment
Biomonitoring Program**

**Standard Operating Procedure
Methods for the Global Flow Meter**

- 1. Applicability.** This standard operating procedure (SOP) is used by the Biomonitoring Program to collect flow velocity data (cm/sec) from wadeable rivers and streams in Maine using the Global Flow Meter models FP101-201. Model FP101, which the Biomonitoring unit uses, is expandable from 3' to 6' while Model FP102 is expandable from 5' to 15'.
- 2. Purpose.** This procedure is used to characterize average velocity conditions in wadeable rivers and streams using a Global flow meter.
- 3. Definitions**
 - A. **Globe.** Type of flow meter manufactured by Global Water Instrumentation, and used by the staff of the Biomonitoring Program of the Maine Department of Environmental Protection (MDEP).
 - B. **Probe.** Sensing device with propeller located at the bottom of the meter.
 - C. **Calibration.** Set of procedures established to ensure that the meter is operating properly; a critical quality assurance step in meter preparation prior to use.
- 4. Responsibilities**
 - A. **Training.** It is the responsibility of the team leader to ensure that the individual(s) collecting the velocity data have received training in using Global flow meter.
 - B. **Data recording.** It is the responsibility of the individual collecting the data to record the results and additional qualifying information on standard field sheets obtained from the MDEP Biomonitoring program.
 - C. **Data submission.** It is the responsibility of the team leader or the staff member collecting the data, as appropriate, to place completed field sheets in the appropriate field sheet folder located in the Biomonitoring staff area.



5. Guidelines and Procedures

- A. Sampling period. In the majority of cases, data will be collected concurrently with the sampling of macroinvertebrates or algae.
- B. Flow meter preparation. Not required as meter comes fully operational including calibration.
- C. Data collection
 - (1) Take meter out of case and ensure that propeller moves freely (by blowing on it in direction of flow as indicated by red arrow).
 - (2) Take measurements in a representative section of the stream near sampling area. For details about taking measurements see point (6) below.
 - (3) In 2006, the Program purchased two new meters; these should be used preferentially for doing field work. The old and new meters function slightly differently:
 - (a) New meter (silver head): the active measurement unit (ft/sec – CAL I, or m/sec – CAL II) is indicated by a “I” or “II” in the upper left corner of the display. Make sure it is set to “II”. If it is not, change the unit following the instructions in the manual. Use the bottom button on the head to scroll until “AVGSPEED” appears. If the meter displays a measurement, press the top button for 5 seconds to rezero.
 - (b) Old meter (black head): Press the left button to toggle between measurements in metric (“km”) or standard (“mi”) units. Set to measure in “km”. Press the right button once to check calibration; correct value is “2086” when measuring in “km”. If value is different, adjust value following the instructions in the manual. Press the right button a few more times until the “V” for velocity appears. Push the left button to toggle between maximum (“mx”) and average (“av”) velocity. Set to measure average velocity. If the meter displays a measurement, push the right and left buttons simultaneously and release to rezero.
 - (4) Put the probe at your starting point [see (5)], pointing the prop directly into the flow with the arrow on the bottom of the probe pointing downstream.
 - (5) Taking measurements
 - (a) Macroinvertebrate sampling: collect average velocity from measurements taken around the rock bags/rock baskets. At each location, keep the meter in one spot horizontally but move it slowly up and down for ~20 sec; remove meter from water when moving between locations.
 - (b) Algae Method 1: The purpose of this method is to have a measurement that can be compared to the macroinvertebrate sampling method. Collect average velocity from measurements taken at 5-10 locations representative of the flow regime where rock bags/rock baskets would likely be deployed (e.g., deep run, thalweg). At each location, keep the meter in one spot horizontally but move it slowly up and down for ~20 sec; remove meter from water when moving between locations.



- (c) Algae Method 2: The purpose of this method is to get an average measurement that represents the variety of flows within a reach where algae samples are collected. This method will often result in a lower velocity than the other method. Collect average velocity measurements at 5-10 locations across a stream reach. Try to represent the range of velocities found where samples were collected. Avoid stream edges. At each point, hold the probe perpendicular to the flow and slowly move the probe up and down for ~20 seconds, making sure that the probe stays at each point in the flow for approximately the same amount of time. Remove meter from water when moving between locations.
- (6) If the probe gets fouled by algae or debris, remove probe, clean propeller and start over from number (5) above.
- (7) Remove the probe. The average velocity will freeze once the prop stops turning. Write down value on field sheet. Note that the old meter displays velocity 10x too low so the decimal point needs to be shifted one place to the right to obtain velocity as cm/sec (e.g., meter says '2.23', but write down '22.3'). The new meter displays velocity 100x too low so the decimal point needs to be shifted two places to the right to obtain velocity as cm/sec (e.g., meter says '0.23', but write down '23').
- (8) Check that the propeller is clean, turn meter off by holding down both buttons until display clears (old model only, new model turns itself off automatically), and return meter to protective case.
- (9) Allow the case and meter to air-dry at the end of each day by propping the lid open. When contents are very wet, remove the contents and spread out to facilitate drying.

D. Quality Control

- (1) Staff from the biomonitoring unit must check the precision of measurements amongst the meters once a year at the beginning of the field season (May or early June). For this purpose, the average flow velocity in a location with visible flow will be measured with all three meters. To ensure that the same location is used for all three meters, staff will mark the spot with a meter stick; to ensure that measurements are taken at the same height in the water column, flagging tape will be tied to the meter stick to indicate the location of the top of the propeller housing. Information about the precision check will be recorded in the file "Tracking flow meter checking" in the Biomonitoring/SOP-QAPP/ folder. The acceptable precision level is $\pm 15\%$. If this level is not achieved and none of the Trouble Shooting methods indicated in the manual solves the problem, the flow meter must be returned to the manufacturer for repair.
- (2) At the beginning of each field season, all MDEP staff or field personnel who will use the meter covered under this SOP will have a training/refresher session to (re)familiarize themselves with the contents of this SOP and the particulars of the meter. Attendance at the training session will be recorded in the "Tracking staff training" file located in the "Biomonitoring/SOP-QAPP/" folder.



6. Equipment Care

A. Start of field season

- (1) Use new batteries at the start of each sampling season. See manufacturer's instructions for correct battery replacement procedures.
- (2) Each meter must have in its case the following items for dealing with minor problems in the field:
 - (a) Replacement head for old meter;
 - (b) An extra set of appropriate size batteries; and
 - (c) Screw driver for removing back of old meter head to replace batteries (back of new meter can be opened with coin).

B. End of field season

- (1) Completely dry meter and case and all items in the case before storing.
- (2) Remove batteries.
- (3) Keep meter dry and at room temperature to prevent corrosion of electronic parts.
- (4) Label the meter and case as 'WINTERIZED, (date)' in an obvious manner (so users will know the current status of the unit).

7. Specifications

- A. Meter detection limit: 10 cm/sec.
- B. Resolution: for instantaneous velocity, 9 cm/sec; for average velocity, 0.9 cm/sec.
- C. Accuracy: 9 cm/sec.

8. References. Instruction manuals for Global Flow meter models FP101-201 (old and new).



Addendum - List of edits to existing SOP

SOP section	Old text	New text
<i>Edited in November 2006</i>		
1. Applicability	... Global Flow Meter models FP101/201.	... Global Flow Meter models FP101-201. Model FP101, which the Biomonitoring unit uses, is expandable from 3' to 6' while Model FP102 is expandable from 5' to 15'.
5. Guidelines and Procedures, A. Sampling Period	In the majority of cases, data will be collected concurrently with the sampling of macroinvertebrates (in rock bags or baskets) or periphyton (on periphytometer or natural substratum) during summer low-flow conditions.	In the majority of cases, data will be collected concurrently with the sampling of macroinvertebrates or algae.
5. Guidelines and Procedures, C. Data collection, subsections (3) and (4)	(3) Push the left button to toggle between measurements in metric ("km") or standard ("mi") units. Set to measure in "km". Press the right button once to check calibration; correct value is "2086" when measuring in "km". If value is different, wait until small arrow to the right of the number flashes in the direction the value needs to go (up or down), then push and hold down left button until correct value is reached. (4) Press the right button a few more times until the "V" for velocity appears. Push the left button to toggle between maximum ("mx") and average ("av") velocity. Set to measure average velocity.	<i>Note: subsections (3) and (4) were combined and a distinction between 'New meter' and 'Old meter' was made. The following text was inserted at the start of subsection (3):</i> In 2006, the Program purchased two new meters; these should be used preferentially for doing field work. The old and new meters function slightly differently: <i>Subsection (a) was inserted:</i> (a) New meter: (see text in SOP) <i>Subsection, (b) was combined from previous subsections 3. and 4:</i> (b) Old meter: (see text in SOP)
5. Guidelines and Procedures, C. Data collection, subsection (8) [previously, now (7)]	Remove the probe. The average velocity will freeze once the prop stops turning. Write down value on field sheet. Note that the meter displays velocity 10x too low so the decimal point needs to be shifted one place to the right to obtain velocity as cm/sec (e.g., meter says '2.23', but write down '22.3').	... Write down value on field sheet. Note that the old meter displays velocity 10x too low so the decimal point needs to be shifted one place to the right to obtain velocity as cm/sec (e.g., meter says '2.23', but write down '22.3'). The new meter displays velocity 100x too low so the decimal point needs to be shifted two places to the right to obtain velocity as cm/sec (e.g., meter says '0.23', but write down '23').



<p>5. Guidelines and Procedures, C. Data collection, subsection (9) [previously, now (8)]</p>	<p>Check that the propeller is clean, turn meter off by holding down both buttons until display clears, and return meter to protective case.</p>	<p>Check that the propeller is clean, turn meter off by holding down both buttons until display clears (old model only, new model turns itself off automatically), and return meter to protective case.</p>
<p>5. Guidelines and Procedures, D. Quality Control, subsection (1)</p>	<p>Staff from the biomonitoring unit must calibrate the meter once a year at the beginning of the field season (May or early June) using a current meter with a vertical axis rotor with cups, a standard USGS model. For calibration, point measurements of average flow velocity will be taken with the two meter types held side by side at a similar height above the bottom in a stream with measurable flow. Information about the calibration will be recorded in the file "Tracking flow meter calibration" in the Biomonitoring/SOP-QAPP" folder. Acceptable accuracy level compared with USGS model is $\pm 15\%$. If this level is not achieved and none of the Trouble Shooting methods indicated in the manual solves the problem, the Global flow meter must be returned to the manufacturer for repair.</p>	<p>Staff from the biomonitoring unit must check the precision of measurements amongst the meters once a year at the beginning of the field season (May or early June). For this purpose, the average flow velocity in a location with visible flow will be measured with all three meters. To ensure that the same location is used for all three meters, staff will mark the spot with a meter stick; to ensure that measurements are taken at the same height in the water column, flagging tape will be tied to the meter stick to indicate the location of the top of the propeller housing. Information about the precision check will be recorded in the file "Tracking flow meter checking" in the Biomonitoring/SOP-QAPP" folder. The acceptable precision level is $\pm 15\%$. If this level is not achieved and none of the Trouble Shooting methods indicated in the manual solves the problem, the flow meter must be returned to the manufacturer for repair.</p>
<p>6. Equipment care, A. Start of field season, subsection (2) (a)</p>	<p>Replacement head for meter;</p>	<p>Replacement head for old meter;</p>
<p>6. Equipment care, A. Start of field season, subsection (2) (c)</p>	<p>Screw driver for removing back of meter head to replace batteries.</p>	<p>Screw driver for removing back of old meter head to replace batteries (back of new meter can be opened with coin).</p>
<p>8. References</p>	<p>Instruction manuals for Global Flow meter model FP101/201.</p>	<p>Instruction manuals for Global Flow meter models FP101-201 (old and new).</p>
<p><i>Edited in May 2010</i></p>		
<p>Title Page</p>	<p>Tom Danielson, Maine Department of Environmental</p>	<p>Beth Connors, Maine Department of Environmental</p>



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