IAPMO IGC 419-2025

PUBLIC REVIEW DRAFT

Industry Standard for

Clamp-on Water Submeters

IAPMO Standard

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Published by
International Association of Plumbing and Mechanical Officials (IAPMO)
4755 East Philadelphia Street, Ontario, California, 91761, USA
1-800-854-2766 • 1-909-472-4100

Visit the IAPMO Online Store at: www.IAPMOstore.org
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Printed in the United States of America

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Preface

This is the first edition of IAPMO IGC 419, Clamp-on Water Submeters.

This Standard was developed by the IAPMO Standards Review Committee (SRC) in accordance with the policies and procedures regulating IAPMO industry standards development, Policy S-001, Standards Development Process. This Standard was approved as an IAPMO Industry Standard on Month DD, YYYY.

This Standard draws upon established testing practices used for inline water meters, as documented in AWWA Manual M6, *Water Meters—Selection, Installation, Testing, and Maintenance*. While the procedures in this Standard are adapted for clamp-on submeter applications, reference to M6 is provided to highlight consistency with widely recognized U.S. water meter testing practices. This reference is informative only and does not create a requirement to follow AWWA M6.

Notes:

(1) The use of the singular does not exclude the plural (and vice versa) when the sense allows.

(2) The use of IAPMO Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

(3) This standard was developed using an open process and in accordance with IAPMO Standards Policy S-001, Standards Development Process*, which is available on the IAPMO Standards website (www.IAPMOstandards.org).*

(4) During its development, this Standard was made available for public review, thus providing an opportunity for additional input from stakeholders from industry, academia, regulatory agencies, and the public at large. Upon closing of public review, all comments received were duly considered and resolved by the IAPMO Standards Review Committee.

(5) This Standard was developed in accordance with the principles of consensus, which is defined as substantial agreement; consensus implies much more than a simple majority, but not necessarily unanimity. It is consistent with this definition that a member of the IAPMO Standards Review Committee might not be in full agreement with all sections of this Standard.

(6) Although the intended primary application of this Standard is stated in its scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

(7) IAPMO Standards are subject to periodic review and suggestions for their improvement will be referred to the IAPMO Standards Review Committee. To submit a proposal for change to this Standard, you may send the following information to the International Association of Plumbing and Mechanical Officials, Attention Standards Department, at standards@IAPMOstandards.org or, alternatively, at 4755 East Philadelphia Street, Ontario, California, 91761, and include "Proposal for change" in the subject line:

- *(a) standard designation (number);*
- *(b) relevant section, table, or figure number, as applicable;*
- *(c) wording of the proposed change, tracking the changes between the original and the proposed wording; and*
- *(d) rationale for the change.*

(8) Requests for interpretation should be clear and unambiguous. To submit a request for interpretation of this Standard, you may send the following information to the International Association of Plumbing and Mechanical Officials, Attention Standards Department, at standards@IAPMOstandards.org or, alternatively, at 4755 East Philadelphia Street, Ontario, California, 91761, and include "Request for interpretation" in the subject line:

- *(a) the edition of the standard for which the interpretation is being requested;*
- *(b) the definition of the problem, making reference to the specific section and, when appropriate, an illustrative sketch explaining the question;*
- *(c) an explanation of circumstances surrounding the actual field conditions; and*
- *(d) the request for interpretation phrased in such a way that a "yes" or "no" answer will address the issue.*

(9) IAPMO does not "approve", "rate", or endorse any item, construction, proprietary device, or activity.

(10) IAPMO does not take any position with respect to the validity of any patent rights asserted in connection with any items mentioned in this Standard and does not undertake to insure anyone utilizing this Standard against liability for infringement of any applicable patents, nor assumes any such liability. Users of this Standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their responsibility.

(11) Participation by federal or state agency representative(s) or person(s) affiliated with industry is not to be interpreted as government or industry endorsement of this Standard.

(12) Proposals for amendments to this Standard will be processed in accordance with the standards-writing procedures of IAPMO industry standards development, Policy S-001, Standards Development Process.

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IAPMO IGC 419-20yy
Clamp-on Water Submeters

1 Scope

1.1 Scope

This Standard covers clamp-on water submeters designed for installation on the exterior of existing piping systems without pipe penetration or modification. These submeters are intended for secondary water measurement applications where sub-billing based on usage allocation, or non-billing monitoring, is required beyond the point of primary metering.

The Standard establishes minimum requirements for materials, supported pipe types and sizes, accuracy classifications, performance testing, data accessibility, environmental operating conditions, and product marking.

This Standard does not apply to inline or insertion-style water meters, which serve as primary meters for utility billing.

Devices that only output instantaneous flow rate do not meet the requirements of this Standard.

1.2 Supported Pipe

The manufacturer shall specify the device supported pipes and sizes. Supported Pipe may include, but is not limited to:

(a) Metal
   a. Copper: Type K, L, M
   b. Brass
   c. Stainless Steel
(b) Plastic
   a. PEX per ASTM F876
   b. PVC/CPVC per ASTM F1785
   c. PE/HDPE per ASTM D3350

1.3 Size Range

This Standard applies to clamp-on water submeters intended for use on pipes up to and including 3 inches nominal diameter.

1.4 Terminology

In this Standard,

(a) “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy to comply with the Standard;
(b) “should” is used to express a recommendation, but not a requirement;
(c) “may” is used to express an option or something permissible within the scope of the Standard; and
(d) “can” is used to express a possibility or a capability.

Notes accompanying sections of the Standard do not specify requirements or alternative requirements; their purpose is to separate explanatory or informative material from the text. Notes to tables and figures are considered part of the table or figure and can be written as requirements.

1.5 Units of Measurement

Volume-based totalized water usage shall be the primary basis for measurement and evaluation in this Standard. While devices may display flow rate, the required output shall be accumulated water usage over time to support sub-billing through usage allocation.

SI units are the primary units of record in global commerce. In this Standard, the inch/pound units are shown in parentheses. The values stated in each measurement system are equivalent in application, but each unit system is to be used independently. All references to gallons are to U.S. gallons.

2 Reference Publications

This Standard refers to the following publications and, where such reference is made, it shall be to the current edition of those publications, including all amendments published thereto.

AWWA (American Water Works Association)

AWWA Manual M6 (2018)
Water Meters – Selection, Installation, Testing, and Maintenance

CSA (Canadian Standards Association)

CSA C22.2 No. 14-18 (R2022)
Industrial control equipment

CSA C22.2 No. 15:15 (R2020)
Adhesive Labels

CSA C22.2 No. 68-18 (R2023)
Motor-operated appliances (household and commercial)

CSA C22.2 No. 223:15 (R2020)
Power supplies with extra-low-voltage class 2 outputs

FCC (Federal Communications Commission)

FCC Title 47 CFR Part 15 (2025)
Radio Frequency Devices

IEC (International Electrotechnical Commission)

ANSI/IEC 60529-2020
Degrees of Protection Provided by Enclosures (IP Code)

IEC TR 61000-2-3:1992
Electromagnetic compatibility (EMC) - Part 2: Environment - Section 3: Description of the environment - Radiated and non-network-frequency-related conducted phenomena

IEC 61000-4-3:2020
Electromagnetic compatibility (EMC) - Part 4-3 : Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test

UL (Underwriters Laboratories)

UL 969-2025
Marking and Labeling Systems

UL 1310-2018
Class 2 Power Units

UL 1951-2011
Electrical Plumbing Accessories

3 Definitions and Abbreviations

3.1 Definitions

The following definitions shall apply in this Standard:

Clamp-on Water Submeter — A non-invasive, externally mounted device that measures volumetric water flow through a pipe using ultrasonic technology and outputs totalized volume for sub-billing or monitoring purposes.

Flow Meter Body — An assembly that includes the electronics necessary to obtain flow measurements. This could be attached or separated from the Transducer Assembly.

Transducer Assembly — The physical component that ensures proper placement of ultrasonic sensors on both upstream and downstream sides of the pipe.

Measurement Interface – The system, physical or digital, used to configure or retrieve data from the submeter. This may include buttons, indicator lights, a dedicated app, or Bluetooth-enabled features.

Ingress Protection (IP) Rating — A code that classifies the degree of protection provided against intrusion of solids and liquids, as defined in IEC 60529. For outdoor submeters, a minimum rating of IP67 is required.

Totalized Usage — The accumulated volume of water measured over time, typically expressed in gallons or liters. Totalized usage is the required output of clamp-on water submeters under this Standard.

Calibration Certificate — Documentation provided by the manufacturer that verifies the device has been calibrated in accordance with the manufacturer's specifications.

Accuracy Class — A performance classification defining allowable measurement error across flow ranges. This Standard defines two classes:

- **Class 1:** ±5% at normal/intermediate flow, ±10% at low flow
- **Class 2:** ±10% at normal/intermediate flow, ±20% at low flow

3.2 Abbreviations

The following abbreviations apply in this Standard:

ADC — Analog to Digital Conversion

FPS — Feet per Second

GPM — Gallons per Minute

IP — Ingress Protection

UFM — Ultrasonic Flow Meter

4 General Requirements

4.1 Materials

Clamp-on water submeters covered by this standard shall be free of defects and suitable for prolonged exposure to the intended environmental conditions.

4.2 Orientation and Installation Limitations

If there are limitations with proper orientation, the limitations shall be specified in the instructions. Acceptable pipe conditions and straight run requirements shall also be disclosed.

4.3 Measurement Output Requirements

Clamp-on water submeters shall output totalized volumetric water usage suitable for usage allocation billing.

4.4 Sample rate

The device shall take flow measurements at a minimum sample rate of once per second.

4.5 Measurement Interface

Each device shall include a local interface to access totalized usage data for testing. This interface may be physical (e.g., display or buttons), digital (e.g., Bluetooth), or app-based. A traditional 2-wire output is not required.

4.6 Electrical Requirements

Clamp-on Water Submeters with electrical features or components shall comply with the applicable CSA or UL standards (e.g., CSA C22.2 No. 14, CSA C22.2 No. 68, or UL 1951), except when powered by a:

(a) Direct plug-in Class 2 power supply that complies with the applicable CSA or UL standards (e.g., CSA C22.2 No. 223 or UL 1310)

(b) Low-voltage circuit (i.e., a circuit involving a peak open-circuit potential of not more than 42.4V supplied by a battery or by a direct plug-in Class 2 power supply); or

(c) Battery.

4.6.1 Electromagnetic Compatibility (EMC) Documentation

Clamp-on water submeters shall meet the requirements of one of the following:

- IEC 61000-2-3 (Radiated RFI emissions)
- IEC 61000-4-3 (RF field immunity)
- FCC Title 47 CFR Part 15, if applicable

4.7 Battery Specifications

4.7.1 Battery Replacement

If the submeter includes replaceable batteries, the replacement battery type shall be specified in the product documentation.

4.7.2 Battery Life

The manufacturer shall specify the expected battery life under normal operating conditions.

4.7.3 Low Battery Notification

Devices shall include a low battery indication or notification feature.

4.8 Environmental Conditions

4.8.1 Operating Temperature

Devices shall operate at temperatures between 0°C and 60°C (32°F to 140°F).

4.8.2 Ingress Protection

Devices intended for outdoor use shall have a minimum rating of IP67 in accordance with IEC 60529.

4.9 Calibration Certificate

Each device shall be accompanied by a calibration certificate, verifying that the unit has been calibrated according to the manufacturer's specifications.

The certificate shall include the unique serial number or traceable device ID.

The calibration certificate shall reference the method used and confirm consistency with the manufacturer's production calibration process.

4.10 Data Retention and Continuity

Clamp-on water submeters shall retain totalized usage data for a minimum of 30 days in the event of power loss or network communication failure.

In the case of temporary network disconnection, devices shall continue measuring and storing totalized usage data locally until connectivity is restored. Data must remain retrievable through the local interface during the outage period.

5 Testing Requirements

5.1 Data Acquisition, Test Specimen, and Test Apparatus

5.1.1 Data Acquisition for Test Agency

Manufacturer to provide all tools and/or software for purposes of data acquisition.

5.1.2 Test Samples

The manufacturer shall provide at least three (3) separate clamp-on water submeters.

Testing of three specimens shall be conducted on each nominally supported pipe size. For each size, testing shall be performed on:

- One representative plastic pipe sample
- One representative metallic pipe sample

These pipe samples may be selected by the manufacturer based on the most common use cases for that size.

The manufacturer shall specify Accuracy Class 1 or Class 2.

5.1.3 Test Apparatus

Testing shall follow the type testing methodology described below.

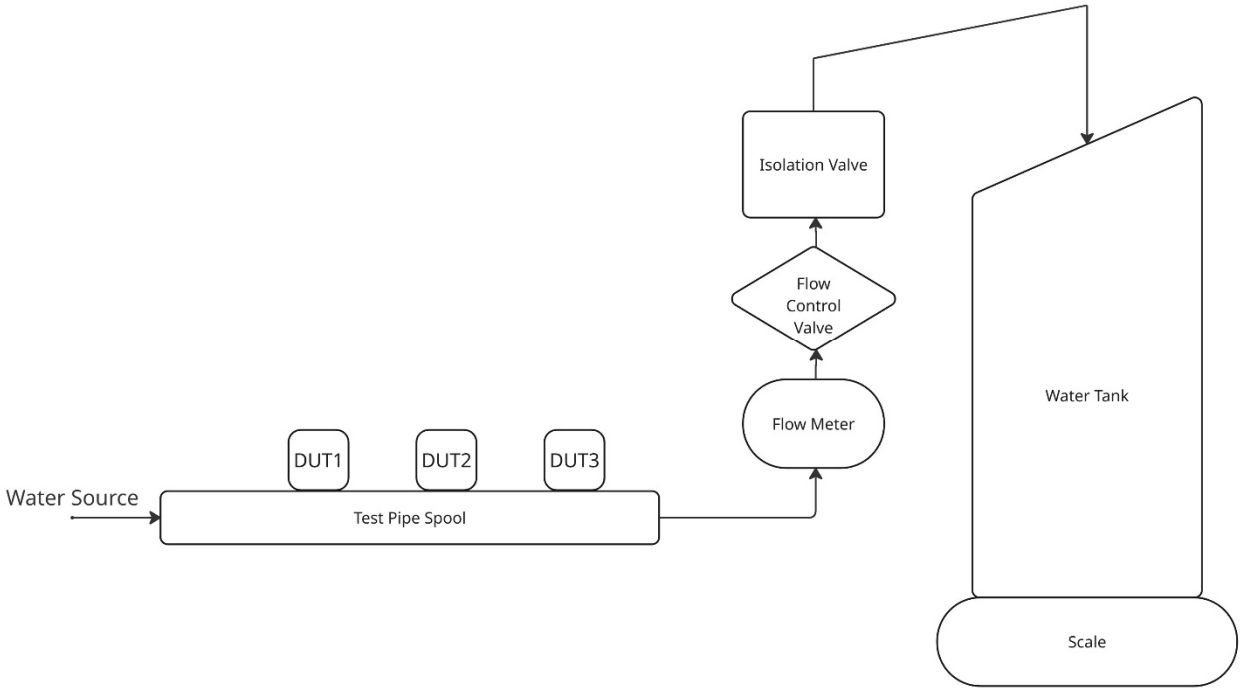
The proving method shall be either:

- Gravimetric: Using a collection tank and calibrated weighing device to determine volume by weight; or
- Volumetric: Using a calibrated volumetric prover to determine collected volume.

The apparatus shall include:

- A controlled water source capable of maintaining target flow rates for the full test duration.
- Flow stabilization apparatus to ensure steady-state conditions prior to measurement.
- A means to compare the totalized usage from the submeter under test to the reference gravimetric or volumetric measurement.

Figure 1
Example Volumetric Test Bench



Note: *The procedures and apparatus described in this section were developed to maintain similarity with practices described in AWWA Manual M6, Water Meters—Selection, Installation, Testing, and Maintenance. This reference is informative only and does not create a requirement to follow AWWA M6.*

5.2 Flow Measurement Accuracy Test

5.2.1 Test Procedure

Each test shall be performed at three distinct flow rates — low, intermediate, and high — as defined below for each pipe size in Table 1.

1. Install the clamp-on submeter on the test pipe per the manufacturer's instructions, ensuring proper alignment and coupling.
2. Purge the system of air; ensure the pipe is completely full of water. Set the flow to the required flow rate per Table 1. Stop the flow using the isolation valve.
3. For each flow point (low, intermediate, high):
    a. Record initial readings on both the clamp-on meter and reference system with no flow. Open the isolation valve to begin flowing water.
    b. Pass the required test quantity of water through the system, per Table 1.
    c. Stop flow and Measure collected volume using either gravimetric or volumetric methods per Section 5.1.3.
    d. Calculate the percent registration.
        a. Percent Registration = (Meter Indication/Reference Volume) x 100

Table 1

Nominal Pipe Size (inches)	Low		Intermediate		High	
	Flow Rate (GPM)	Quantity (gallons)	Flow Rate (GPM)	Quantity (gallons)	Flow Rate (GPM)	Quantity (gallons)
½	0.5	5	2	10	8	50
¾	0.5	5	4	10	25	150
1	0.75	10	6	25	40	300
1 ½	1.5	15	8	25	100	500
2	2	20	12	50	150	750
2 ½"	3	30	20	75	250	1000
3	4	40	30	100	350	1500

5.2.2 Performance Requirement by Accuracy Class

Devices shall be evaluated against one of two accuracy classifications, using the percent registration tolerances listed below:

Accuracy	Normal/Intermediate Flow	Low Flow
Class 1	100 ± 5%	100 ± 10%
Class 2	100 ± 10%	100 ± 20%

Each sample is evaluated against the manufacturer specified class.

Failure Criteria:

- A device fails at a given flow point if the measured error exceeds the specified tolerance for its accuracy class.
- A device is deemed to have failed the overall test if it fails at any of the required flow points for either pipe material type.
- If one or more devices fail at the specified flow rates, the product model under test for that pipe size is considered non-compliant.

5.3 Cutoff Threshold Validation

5.3.1 Test Procedure

1. Install the clamp-on submeter on the test pipe per the manufacturer's instructions, ensuring proper alignment and coupling.
2. Purge the system of air; ensure the pipe is completely full of water.
3. To validate the low-flow cutoff:
   (a) Initiate flow 0.5 GPM above the manufacturer specified expected cutoff threshold.
   (b) Gradually decrease flow by 0.1 GPM at a time until the submeter stops registering usage.
   Note: *The submeter is considered to have stopped registering usage when there is zero flow for 10 seconds.*
   (c) Record the actual cutoff point.

5.3.2 Performance Requirement

The actual cutoff point shall be less than or equal to the manufacturer's published cutoff threshold.

6 Markings and Accompanying Literature

6.1 Product Markings

Clamp-on water submeters complying with this Standard shall be permanently marked with the following:

- Manufacturer's name or trademark
- Model number
- Flow direction indicator
- Standard designation: "IAPMO IGC 419"
- Unique serial number or traceable device ID

6.2 Visibility

Markings shall be permanent, legible, and visible after installation.

Adhesive labels that comply with CSA C22.2 No. 0.15 or UL 969 shall also be considered permanent when placed on a surface that is not normally submerged in water.

6.3 Installation and User Documentation

Each submeter shall be accompanied by installation and user documentation including:

- Acceptable pipe types and sizes
- Placement/orientation requirements (e.g., vertical/horizontal, clamp spacing)
- Minimum straight-run length requirements
- Surface condition/preparation requirements (e.g., paint, rust, condensation)
- Low-flow cutoff threshold
- Battery replacement (if applicable)
- Environmental limitations (e.g., indoor/outdoor use, IP rating)
- Data retention behavior (e.g., storage duration during power/network loss)
- Reference to calibration certificate and accuracy class

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