

IAPMO IGC 324-2019

Alternate Water Source Systems for Multi- Family, Residential, and Commercial Use



For IAPMO Staff use only. Distribution Prohibited.

IAPMO Standard

Approval of an IAPMO Industry Standard requires verification by the Standards Review Committee that the standard has been developed in accordance with the policies and procedures for standards development (S-001, *Standards Development Process*, S-008, *Appeals* and S-011, *Operation of the IAPMO Standards Review Committee*). Although IAPMO administers the process and establishes rules to promote fairness in achieving consensus, it does not independently test, evaluate, or verify the content of standards.

Consensus is established when substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

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

The Standards Review Committee has final authority on interpretation of any IAPMO Industry Standard. Moreover, no person save IAPMO designated staff shall have the right or authority to issue an interpretation of an IAPMO Industry Standard in the name of IAPMO. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

CAUTION NOTICE: This IAPMO Industry Standard may be revised or withdrawn at any time. The policies and procedures require that action be taken periodically to reaffirm, revise, or withdraw this standard. Interested stakeholders of IAPMO Industry Standards may receive current information on all standards by [signing up to receive updates and notices](#) at the IAPMO Standards website www.IAPMOstandards.org.

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

Visit the IAPMO Standards website at: www.IAPMOstandards.org

Copyright © 2015-2019 by International Association of Plumbing and Mechanical Officials (IAPMO)
All rights reserved.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without prior written permission of the publisher.

Printed in the United States of America

For IAPMO Staff use only. Distribution Prohibited.

 **Documents**
Document Sharing Hub

Contents

Preface

IAPMO Standards Review Committee

1 Scope

- 1.1 Scope
- 1.2 Alternative Materials
- 1.3 Terminology
- 1.4 Units of Measurement

2 Reference Publications

3 Definitions and Abbreviations

- 3.1 Definitions
- 3.2 Abbreviations

4 General Requirements

- 4.1 Materials
- 4.2 Plumbing Fixture Waste Fittings
- 4.3 Disinfection Systems
- 4.4 Air Gap

5 Testing Requirements

- 5.1 Test Specimen
- 5.2 Hydrostatic Pressure Test for Closed Systems and/or Leakage Test for Open or Non-Pressurized Systems
- 5.3 Overflow Test
- 5.4 Water Quality Test

6 Markings and Accompanying Literature

- 6.1 Markings
- 6.2 Installation Instructions

Preface

This is the Second edition of IAPMO IGC 324, Alternate Water Source Systems for Multi-Family, Residential, and Commercial Use. This Standard supersedes IAPMO IGC 324-2016^{e1}, Alternate Water Source Systems for Single-Family Dwellings. The previous editions of this standard is: December 2015

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 November 18, 2019.

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.*

Foreword

The 2004 EPA Guidelines for Water Reuse (EPA 625-R-04-108) summarizes water reuse guidelines for water reclamation. It is specific to non-potable urban, industrial, and agricultural reuse, as well as augmentation of potable water supplies through indirect reuse. This Standard builds upon that, Water Efficiency Standard (WESstand), and other efforts to give the performance protocols for treating non-potable water (excluding black water) for further non-potable reuse.

IAPMO Standards Review Committee

T. Collings	Building Services & Licensing - Retired Salt Lake City, Utah, USA	<i>Chair</i>
M. Durfee	Chief Building Official Saratoga Springs, Utah, USA	<i>Vice-Chair</i>
M. Antonacci	Plumbing and HVAC Inspector, City of Toronto Toronto, Ontario, CAN	
R. Coffman	Mechanical Inspector, City of Cedar Falls - Retired Cedar Falls, Iowa, USA	
C. Crimmins	MN State Pipe Trades - Retired Champlin, Minnesota, USA	
J. Krahenbuhl	Plumbing and Mechanical Plans Check Specialist, Clark County - Retired Las Vegas, Nevada, USA	
B. Olinger	William Myers & Sons Inc. - Semi-Retired East Hanover, New Jersey, USA	
B. Pfeiffer	Plumbing Inspector Development Services, City of Topeka Topeka, Kansas, USA	
R. Rice	Sr. Mechanical Inspector - Retired Maplewood, Minnesota, USA	
G. Snider	Plumbing Section Supervisor, City of Surrey Surrey, British Columbia, CAN	
K. Thompson	IAPMO Ontario, California, USA	<i>Staff Liaison</i>
G. Istefan	IAPMO Ontario, California, USA	<i>Staff Liaison</i>
H. Aguilar	IAPMO Ontario, California, USA	<i>Secretary</i>

IAPMO IGC 324-2019

Alternate Water Source Systems for Multi-Family, Residential, and Commercial Use

1 Scope

1.1 Scope

This Standard covers alternate water source systems for multi-family, residential, and commercial use intended to process water from alternate water sources such as greywater, rainwater, stormwater air conditioning condensate, cooling tower makeup, vehicle wash and other non-potable reuse applications not specifically listed, for use in subsurface and/or surface irrigation and toilet/urinal flushing applications, and specifies requirements for materials, physical characteristics, performance testing, and markings. This standard does not cover using blackwater as an alternate water source.

1.2 Alternative Materials

The requirements of this Standard are not intended to prevent the use of alternative materials or methods of construction provided such alternatives meet the intent and requirements of this Standard.

1.3 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. Captions and footnotes to tables and figures are considered part of the table or figure and are normative.

1.4 Units of Measurement

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.

ASME International (The American Society of Mechanical Engineers)

ASME A112.1.2

Air Gaps in Plumbing Systems (for Plumbing Fixtures and Water-Connected Receptors)

ASME A112.1.3

Air Gap Fittings for use with Plumbing Fixtures, Appliances, and Appurtenances

ASME A112.18.2/CSA B125.2

Plumbing Waste Fittings

ASTM International

ASTM F409

Standard Specification for Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings

CFR (Code of Federal Regulations)

40 CFR 141.720

Inactivation toolbox components

EPA (Environmental Protection Agency)

EPA 815-R-99-014

Alternative Disinfectants and Oxidants Guidance Manual

EPA 815-R-06-009

Membrane Filtration Guidance Manual

ISO (International Organization for Standardization)

ISO 12103-1

Road Vehicles – Test Contaminants for Filter Evaluation – Part 1: Arizona Test Dust

NSF International

NSF/ANSI 55

Ultraviolet Microbiological Water Treatment Systems

NSF/ANSI 350

Onsite Residential and Commercial Water Reuse Treatment Systems

3 Definitions and Abbreviations

3.1 Definitions

The following definitions shall apply in this Standard:

Alternate Water Source — Non-potable source of water that includes but not limited to graywater, on-site treated non-potable water, rainwater, atmospheric generated water, air conditioning condensate and reclaimed (recycled) water.

Blackwater — Wastewater containing bodily or other biological wastes, as from toilets, dishwashers, kitchen sinks and utility sinks.

Graywater — Untreated waste water that has not come into contact with toilet waste, kitchen sink waste, dishwasher waste or similarly contaminated sources. Gray water includes waste water from bathtubs, showers, lavatories, clothes washers and laundry tubs. Also known as grey water, graywater, and greywater

Rainwater — Natural precipitation that lands on a man-made, impervious above ground surface and can be collected on-site for beneficial uses.

Single Pass Flow — Non-circulating flow where a chemical is injected into a new body of water.

Stormwater — Natural precipitation that has contacted a surface at grade, below grade, or above ground parking surfaces.

3.2 Abbreviations

The following abbreviations apply in this Standard:

ORP — Oxidation Reduction Potential

UV — Ultraviolet

4 General Requirements

4.1 Materials

Materials shall comply with local codes.

4.2 Plumbing Fixture Waste Fittings

Plumbing fixture waste fittings shall comply with the requirements of ASME A112.18.2/CSA B125.2 or ASTM F409.

4.3 Disinfection Systems

A disinfection system shall include a combination of treatment processes that complement each other in order to achieve the combined log reductions specified in Table 1

4.3.1 Ultraviolet Disinfection Systems

Ultraviolet (UV) disinfection systems shall comply with:

- (a) NSF/ANSI 55 as Class A systems. UV systems shall deliver a minimum of 40 mJ/cm² at the minimum intensity specified by the manufacturer at the flow rates specified for the application; or
- (b) A system verified to comply with EPA UV Guidance Manual.

Note: See Appendix A (Table A.2) for pathogen log reduction values.

4.3.2 Ozone Systems

Ozone systems shall be equipped with an airflow switch monitored by a controller as well as an Oxidation Reduction Potential (ORP) sensor. Ozone systems shall deliver a minimum of 18 g/hr of ozone per 100 gal/min of single pass flow of water. The ORP reading of water should be ≥ 500 mV near the exit point of the system.

Note: This Section assumes a 15-minute contact time and 60% transfer efficiency. See Appendix A (Table A.3) for disinfection contact time values.

4.3.3 Chlorine disinfection systems

Chlorine disinfection systems shall be equipped with ORP sensors or equivalent to determine the concentration of free available chlorine.

Note: when required by the AHJ a free chlorine meter needs to be added.

4.3.4 Alternative disinfection systems

Any alternate disinfection chemical or process shall be equipped with a feedback sensor connected to the controller to gage and monitor its performance.

4.4 Air Gap

Make up potable water supplied to the system shall be provided through:

- (a) an air gap that complies with ASME A112.1.2;
- (b) an air gap fitting that complies with ASME A112.1.3; or
- (c) an approved backflow prevention device that complies with the local code requirements.

5 Testing Requirements**5.1 Test Specimen**

The test specimen shall consist of a complete alternate water source system assembled in accordance with the manufacturer's installation instructions.

5.2 Hydrostatic Pressure Test for Closed Systems and/or Leakage Test for Open or Non-Pressurized Systems)

5.2.1 Test Procedure for Pressurized Systems

The hydrostatic pressure test for pressurized systems shall be conducted as follows:

- (a) Fill the test specimen with water and purge all the air.
- (b) Block the test specimen outlet.
- (c) Apply a hydrostatic pressure of 1.5 times the maximum system static pressure.
Note: This can be achieved using a secondary booster pump to exceed the existing line pressure or integral pump static pressure.
- (d) Maintain the pressure for not less than 15 min.

Exemption: Components and pressure vessels that comply with local codes are exempt from this test.

5.2.2 Test Procedure for Non-Pressurized Systems

This test is for systems that are vented to atmosphere at all times.

The hydrostatic pressure test for non-pressurized systems shall be conducted as follows:

- (a) Block the test specimen outlet;
- (b) Fill the test specimen with water to appropriate fill level;
- (c) Allow unit to sit for not less than 60 min.

5.2.3 Performance Requirements

There shall be no leakage or cracking during or after the test.

5.3 Overflow Test

5.3.1 Test Procedure

The overflow test shall be conducted as follows:

- (a) Eliminate the demand for water from the system (e.g. close the outlet from the system or completely fill the downstream reservoir so there is no draw from the system).
- (b) Block the system's bypass if applicable.
- (c) Fill the storage tank or reservoir.
- (d) Supply the system with water at the manufacturer's specified maximum flow rate for 15 min.
- (e) Verify that system is operating to allow the excess water to drain down waste system.

Note: The purpose of this test is to ensure that when the system is full, that any additional influent does not cause a flood or damage.

5.3.2 Performance Requirements

The system shall:

- (a) divert the excess water to the system overflow connected to the drain waste system;
- (b) not leak or crack during or after the test
- (c) not breach the air gap between reclaimed water and supply water; and
- (d) not overflow the reservoir.

5.4 Water Quality Test

Tests shall be conducted in sequential order. Log reduction credits may be used in lieu of the final bacteria challenge test in Section 5.4.3 using Appendix A as a guideline.

5.4.1 Failure Mode Effects Analysis (FMEA)

5.4.1.1 Validation Of FMEA

The test time can be reduced in the logic for the purpose of demonstrating the principle.

- (a) For pH; Add a sufficient amount of acids or bases upstream of the pH sensor to cause an alarm condition (i.e., it reads out of specification.) Maintain the pH until the system shutdown set time is reached.
- (b) For Turbidity; Inject a slurry of A2 Fine Arizona dust per ISO 12103-1 or equivalent to cause an alarm condition from the turbidity sensor. Maintain the turbidity until the system shutdown set time is reached.
- (c) For UV intensity; Inject sufficient Humic Acid to reduce the UV intensity sensor output (as a result of a reduction in UV transmittance) below the value specified in Table 2. Ensure that the alarm is activated. Maintain this condition until the system shutdown set time is reached.
Note: An example source for humic acid is Cropmaster® Super Hume® from UAS of America, 534 CR 529A, Lake Panasoffkee FL 33538
- (d) For Ozone systems / Chlorine systems / Iodine or any other oxidizer; If equipped with ORP sensor, defeat the injection of the oxidizer then inject a urea solution until the ORP drops out of spec. Ensure that the alarm comes on. Maintain this condition until the system shutdown set time is reached.

5.4.1.2 Performance Requirements

In each case for steps (a) through (d) of Section 5.4.1.1, the system shall alarm when the measured parameter reads out of the specification per Table 2. The alarm timer shall reset when the parameter returns to specification before the shutdown time is reached. If any of the critical parameters (e.g. pH, Turbidity disinfection) causes an alarm condition, the system shall alarm for a period not to exceed 8 h (i.e. the system shutdown time) after which the system shall go into shutdown and divert the flow to the waste discharge.

5.4.2 Long Term Monitoring

5.4.2.1 Test Procedure

The system shall operate in situ for 12 weeks during which the schedule referenced in Table 3 of sampling shall occur. Draw effluent samples near the exit point of the treatment process. If any of the samples do not meet the values in Table 4, the test shall be prolonged 1 week assuming there is a proper justification for the failure.

5.4.2.2 Performance Requirements

The effluent parameters shall meet the values in Table 4. Any 3 failing points shall constitute a test failure. Corrective action shall be implemented and the test procedure in Section 5.4.2 shall be repeated until the system complies. NSF/ANSI 350 monitoring results may be used in lieu of section 5.4.2.

5.4.3 Final Bacteria Challenge Test**5.4.3.1 Test Setup**

Evaluation shall be performed in the field, where the system is installed. The influent challenge water used shall be the site water as long as it meets the minimum criteria in Table 5. If not, add the following additional ingredients:

- (a) For TSS / Turbidity: A2 Fine Arizona test dust ISO 12103-1, approximately 50 gm per 100 liters of flow per minute
- (b) For Coliform and E. Coli: 25922 or Equivalent

5.4.3.2 Test Procedure

Take three influent samples upstream of the treatment system and downstream of the point of injecting the challenge. Confirm that the average of the three influent samples meets the criteria in Table 5.

Allow sufficient time (done by calculating the volumes and flow rates) for the challenge water to pass through all elements of the treatment system before collecting the first effluent sample. Collect 5 effluent samples taken 5 minutes apart at a point downstream of the treatment system.

Calculate the log reduction for each of the effluent samples using Equation 1.

Equation 1

$$\log = \text{Abs}\left(\frac{\text{Effluent concentration } \frac{\text{cfu}}{100 \text{ ml}}}{\text{Average Concentration of 3 influent Samples } \frac{\text{cfu}}{100 \text{ ml}}}\right)$$

5.4.3.3 Test Report

The test report shall at a minimum contain:

- (a) The list of major components of the system (i.e. Carbon Filter/UV/Chlorine);
- (b) A table for each sample analysis showing the:
 - (i) date and time of the sample draw if applicable;
 - (ii) allowable water quality of each parameter in accordance with Table 2; and,
 - (iii) actual quality of the sample determined through analysis.
- (c) The time required for each draw from the system's RO unit component, if applicable.

5.4.3.4 Performance Requirements

Effluent samples collected in accordance with Section 5.4.3.2, shall each meet the criteria in Table 4.

Effluent samples per the schedule in Table 3 shall each comply with the criteria in Table 4, If any of the critical parameters (e.g. pH, Turbidity) causes an alarm condition, the system shall alarm for a period not to exceed 8 h (i.e. the system shutdown time) after which the system shall go into shutdown and divert the flow to the waste discharge.

6 Markings and Accompanying Literature

6.1 Markings

6.1.1 Alternate water source systems complying with this Standard shall be marked with the:

- (a) manufacturer's name or trademark; and
- (b) Maximum flow rate capability of the system;

6.1.2 Each surge tank shall have its rated capacity permanently marked on the unit with a sign stating "GRAY WATER, DANGER — UNSAFE WATER" permanently marked on the holding tank. Each letter shall be a minimum ½" in size and the statement a minimum of 8" in length.

6.2 Installation Instructions

Alternate water source systems shall be accompanied by instructions for their installation, care and maintenance, and repair.

Table 1
Log Reduction Requirements
(See Section 4.3)

Alternate Water Use Scenario	Enteric Viruses	Parasitic Protozoa	Enteric Bacteria
Graywater			
Outdoor Use	5.5	4.5	3.5
Indoor Use	6.0	4.5	3.5
Stormwater or Foundation Drainage			
Outdoor Use	3.0	2.5	2.0
Indoor Use	3.5	3.5	3.0
Rainwater			
Outdoor Use	NA	NA	3.5
Indoor Use	NA	NA	3.5

Note: Table A-4 in Appendix A maybe used as a guide for combining treatment processes to achieve the desired log credits.

Table 2
Sensor Parameters
(See Sections 5.4.1.1, 5.4.1.2, and 5.4.3.3)

Parameter	Value
Turbidity	≤ 2 NTU
pH	$6.0 \leq \text{Value} \leq 9.0$
ORP (if equipped)	≥ 500 mV
UV intensity	≥ 40 mJ/cm ²

Table 3
Sampling Schedule
(See Sections 5.4.2.1, and 5.4.3.4)

Weeks	Sample
1 and 2	Twice per week
3 through 12	Once per week