IAPMO IGC 373-2025

PUBLIC REVIEW DRAFT

Industry Standard for

Copper Silver Ionization Disinfection Systems -

IAPMO Standard

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Contents

Preface

This is the first edition of IAPMO IGC 373, Copper Silver Ionization Systems.

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.

Notes:

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

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(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.

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- *(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.*

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IAPMO IGC 373-2025
Copper-Silver Ionization Disinfection Systems

1 Scope

1.1 Scope

This Standard covers copper-silver ionization disinfection systems intended for commercial and residential applications and specifies requirements for materials, physical characteristics, performance testing, and markings.

These devices may be used in hot water recirculation systems and cold-water point of entry applications.

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. Notes to tables and figures are considered part of the table or figure and can be written as requirements.

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.

Underwriters Laboratories (UL)
UL-1081 Swimming Pool Pumps, Filters, and Chlorinators (2020)

UL-508 Industrial Control Equipment (2024)
UL 979 Water Treatment Appliances (2025)

American Society of Mechanical Engineers (ASME)
ASME A112.18.1/CSA B125.1 Plumbing Supply Fittings (2018 (R2023))
ASME B1.20.1 Pipe Threads, General Purpose, Inch (2013 (R2018))
ASME B1.20.3 Dryseal Pipe Threads, Inch (1976 (R2023))
ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings (2021)
ASME B16.22 Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings (2021)
ASME B16.51 Copper and Copper Alloy Press-Connect Pressure Fittings (2021)

ASSE International
ASSE LEC 2011 Legionella Reduction and Treatment Devices (2022)
ASSE 1061 Performance Requirements for Push-Fit Fittings (2020)

SAE International
SAE J512 Automotive Tube Fittings (2022)

International Association of Plumbing and Mechanical Officials (IAPMO)
IAPMO Z1117 Standard for Press Connections (2022)

American Society for Testing and Materials International (ASTM)
ASTM F838 Standard Test Method for Determining Bacterial Retention of Membrane Filters Utilized for Liquid Filtration

International Organization for Standardization (ISO)
ISO 11731 Water Quality – Enumeration of Legionella

3 Definitions and Abbreviations

3.1 Definitions

The following definitions shall apply in this Standard:

Copper Silver Ionization Disinfection System — a system that is designed to utilize copper and silver ions to disinfect water used in different plumbing applications.

Flow Cell – water bearing devices that contains the copper and silver alloy electrodes for delivery into the plumbing system

3.2 Abbreviations

The following abbreviations shall apply in this Standard:

HPC - Heterotrophic Plate Count
PBS - Phosphate Buffered Saline

4 General Requirements

4.1 Materials

4.1.1 Flow Cells
Flow cells shall be constructed of non-conducting materials (e.g. PVC) or coated with a non-conducting layer.

If flow cells are coated, verify coating adhesion per Section 5.2 of ASME A112.18.1/CSA B125.1.

4.2 Toxicity

4.2.1 Materials and components of copper-silver ionization disinfection systems intended to convey or dispense water for human consumption through drinking or cooking shall comply with the applicable requirements of NSF/ANSI/CAN 61.

4.2.2 Materials and components of copper-silver ionization disinfection systems intended to convey or dispense water for human consumption through drinking or cooking shall have a maximum average lead content of 0.25% in accordance with the requirements of NSF/ANSI/CAN 372.

4.3 Connections

4.3.1 Pipe threads and other connections to the plumbing supply shall conform to the applicable standards.

(a) Tapered pipe threads shall comply with ASME B1.20.1.
(b) Dry seal pipe threads shall comply with ASME B1.20.3.
(c) Compression assemblies shall comply with SAE J512.
(d) Soldered connections shall comply with ASME B16.18 or ASME B16.22.
(e) Push fit connections shall comply with ASSE 1061.
(f) Press connections shall comply with ASME B16.51 or IAPMO Z1117.

4.3.2 In addition to the performance requirements of this Standard, alternate end connections not specified in this Standard shall comply with dimensional and performance requirements of applicable nationally recognized standards.

4.4 Electrical Requirements

4.4.1 Electrical Components

Copper-silver ionization disinfection systems incorporating electrical components (control unit and water-bearing equipment) or features shall comply with the applicable CSA and UL standards.

4.5 Operating Temperatures

Copper-silver ionization disinfection systems shall operate with water temperatures between 39 °F – 131 ^{o}F (2 - 55°C), or the manufacturer's rated temperature range, whichever is greater.

4.6 Operating Pressures
Copper-silver ionization disinfection systems shall operate at pressures between 0 – 150 psi, or the manufacturer's rated pressure range, whichever is greater.

4.7 System Structural Integrity
System integrity will be verified through hydrostatic pressure testing in Section 5.4

4.8 Accessibility
Replacement parts should be easily accessible. Inspection and cleaning/descaling of the electrodes shall be done on a monthly basis.

4.9 Rated Service Flow
The manufacturer shall specify the rated service flow for each flow cell in the copper silver ionization disinfection system.

4.10 EPA Registration for Water Treatment of *Legionella Pnuemophila*
All EPA-registered biocides (like copper/silver) must have a U.S. EPA registration number, which consists of a company number and a product number.

4.11 Electrode Composition
Electrode composition shall be comprised of a minimum ratio of 30 percent silver.

4.12 Power Supply and Control Panel
The power system shall be capable of supplying amperage to the electrodes at a minimum of 0.5 amps.
Note: Typically the supply amperage is in the range of 0.5-10 amps.

4.13 Controller
The controller shall be able to measure the increased resistance caused by the scale and automatically compensate by increasing the voltage.

4.14 Flow Meter
A flow meter shall provide input to the controls such that ion dosing is proportionate to the volume of the untreated water introduced into the target water system.

5 Testing Requirements

5.1 General

5.1.1 Test Specimen
The testing agency shall select the appropriate number of systems of each type, model and size for the full test. There is no required testing order. Representative samples may be chosen for testing.

5.1.2 A sufficient number of samples of each type, model and size shall be submitted by the manufacturer to test the requirements of the laboratory.

5.1.3 Test Apparatus

The system shall be installed and calibrated per the manufacturer recommendations.

5.2 *Legionella* Bacteria Reduction Test

5.2.1 Purpose

The purpose of this section is to measure the ability of the device to reduce the concentration of *Legionella pneumophila serogroup 1 (L.p.)* using copper-silver ionization as the means of disinfection. Legionella pneumophila serogroup 1 is used as the challenge microorganism of choice, and the culture may be obtained from the American Type Culture Collection (ATCC) using reference number ATCC 33152.

5.2.2 Procedure

5.2.2.3 Challenge Stock Suspension

Preparation

The below is guidance to prepare the bacterial challenge stock suspension. An alternate procedure for producing microbial challenge stock may be used if it yields homogenous and pure suspension containing >1.0 x 10^9 CFU/mL. The procedure below is based on ISO 11731, and ASTM F838.

1. Change the challenge organism with *Legionella pneumophila* serogroup 1 (ATCC 33152)
2. Change the optimum growth temperature to 95 ± 3.6 F° (35 ± 2°C)
3. Add Buffered Charcoal Yeast Extract (BCYE), Buffered Yeast Extract (BYEB), and de-ionized water to ASTM F838 Section 8, Reagents and Materials. In addition to BCYE, BYEB and sterile DI water, the following are needed: BCYE without L-cysteine (negative growth control media) or Blood Agar Plates (BAP) and sterile Phosphate Buffered Saline (PBS)
4. Prepare stock culture by inoculating BCYE slant with no mineral oil overlay (per ASTM F838 section 9.2.1) or prepare stock culture from reference culture by inoculating BCYE agar plate and incubate for 4-6 days at 95 ± 3.6 °F (35 ± 2 °C) in humidified incubator while maintaining 2-5% carbon dioxide atmosphere.

   The resulting tube and/or plate will serve as the stock culture for studies and as the qualitative positive control for the culture. Maintain stock culture plates in a sealed container at 32 – 46 °F (0-8 °C) for no longer than 30 days. Ensure Challenge Stock Suspension is made from single isolated colony from stock culture plate and/or tube.

5. Prepare Challenge Stock Suspension by either method below:
   BCYE Agar: Apply cells from a single stock culture colony to Buffered Charcoal Yeast Extract (BCYE) agar in petri dish and incubate at 95 ± 3.6 °F (35 ± 2 °C) in humidified incubator while maintaining 2-5% carbon dioxide atmosphere for up to 7 days. Following incubation, add 5-10 mL of sterile PBS or appropriate buffer to each plate and harvest microbial growth with a sterile spreader. Transfer required volume of suspended culture to a sterile centrifuge tube. Centrifuge at >4K x g for 10 minutes. Aspirate supernatant and suspend culture in sterile PBS up to the same volume as prior to centrifugation. Repeat centrifugation, aspirate, and suspend in adequate volume of sterile PBS. Use the purified Challenge Stock Suspension for study within 7 days of preparation.

BYEB Broth: Inoculate 10 mL of BYEB from a single stock culture colony and incubate shaking at optimal growth temperature for 48 hours per ASTM F838 Section 9.3.1. Transfer 2 mL of BYEB culture to 1 L sterile de-ionized water to make the Challenge Stock Suspension and incubate for 24 hours per ASTM F838 Section 9.3.2 or transfer required volume of BYEB culture to a sterile centrifuge tube. Centrifuge at a minimum of 4K x g for 10 minutes. Aspirate supernatant and suspend culture in sterile PBS; use same volume as the starting transferred culture volume. Repeat centrifugation, aspirate, and suspend in adequate volume of sterile PBS. Use the purified Challenge Stock Suspension for study within 7 days of preparation.
Note: Alternative methods for preparing the Challenge Stock Suspension are acceptable given that they generate a viable culture that maintains a stable concentration prior to use in Challenge water.

6. Store purified challenge water at 39-46 °F (4-8 °C) for up to 7 days. Enumerate purified challenge culture by performing serial ten or one-hundred-fold dilutions in PBS or appropriate dilution buffer. Spread plate each dilution on BCYE agar plates or use other regulatory approved for enumeration of viable *Legionella*. Incubate plates at 95 ± 3.6 °F (35 ± 2 °C) for 4-7 days in a humified incubator while maintaining 2-5% carbon dioxide atmosphere.

7. Verify purity and species identity of the Challenge Stock Suspension. The results of culture will not be available until 4-7 days following plating. If results of purity and species identity are not indicative of *L. Pnuemophila* (*L.p*.), the challenge suspension preparation is invalid and shall be repeated.
Note: *Incubation conditions for Legionella may vary based on specific strain requirements and enumeration method. The incubation conditions may be adjusted throughout the study as per the requirements of the method use or the individual strain requirements.*

5.2.2.4 Identification and Acceptance of Challenge Stock Suspension

1. *L. pneumophila* (*L.p.)* will grow on BCYE agar and will not grow on BCYE agar without Cysteine or BAP. Verify species identity by plating on both media. If growth is observed on BCYE agar without Cystine, discard Challenge Stock Suspension and start production of new stock.

L.p. colonies on BCYE agar are gray-white, convex, complete, complete, and shiny with a blue, pink, or purple iridescence. *L.p*. colonies are from microscopic to pinpoint size at 2-3 days and 2-3 mm in diameter after 5-7 days incubation. Compare resulting colonies to colonies on stock plate (qualitative positive control).

Colonies must match appearance and growth characteristics. If all or some of the resulting colonies do not match in appearance, discard stock appropriately and start production of new stock.

2. Latex agglutination can be used for further identification as well as Direct Fluorescent Antibody (DFA) staining, MALDI-ToF, nucleic acid sequencing or hybridization, PCR, biochemical assay, or other available validated method.

3. The calculated concentration of microbial challenge stock shall be > 1.0×10^9 CFU/mL.

5.2.2.5 General Water Conditions

Challenge Water is general water plus *Legionella pneumophilia* (*L.p.*) (ATCC 33152) at a final diluted concentration of >1.0 x 10^7 CFU/mL. The Challenge Water will include copper and silver ions at manufacturer-recommended levels. The parameters for general water are as below:
Note: A filtered municipal water supply is typically adequate to achieve the requirements below.

Additional parameters:

(a) pH: 7.5 ± 0.5
(b) Copper concentration: Manufacturer-specified dosage
(c) Silver concentration: Manufacturer-specified dosage
(d) Turbidity: <1 NTU
(e) Total Dissolved Solids (TDS): 150-500 mg/L
(f) Hardness: <200 mg/L
(g) Total Organic Carbon (TOC): 0.5-5.0 mg/L
(h) Total Chlorine: <0.04 mg/L
(i) Temperature for hot water: 90-100 °F (32.2-37.8 °C)
(j) Temperature for cold water: 68-77 °F (20-25 °C)
(k) Inlet pressure: The initial dynamic inlet pressure used for testing shall be ± 5% of the manufacturer's recommended working pressure, or 60 ± 3 psi (414 ± 21 kPa), whichever is greater. Flowing pressure shall not be less than 15 psi (103 kPa), or greater than 80 psi (552 kPa). Pressure shall not be adjusted through test progression. Units shall be tested at the flow rate achieved at the initial dynamic inlet pressure.
(l) Heterotrophic Plate Count (HPC) of 10-10,000 CFU/mL
    a. Measure and report. Adjustment is not necessary. The naturally present HPC in dechlorinated water is within the specified range, and therefore the concentration would not need to be adjusted. If absolutely needed, adjustment may be conducted by dilution with membrane filtered water in addition to E. coli bacteria.

5.2.2.6 Unit Challenge and Legionella Reduction Test

1. Assemble the test system according to the manufacturer's instructions
2. Testing shall be conducted to 100% of the manufacturer's recommended service capacity (volume) at the manufacturer's service flow rating. If a rated service capacity is not provided, testing shall be conducted for the minimum 14-day test period. If flow rate is decreased by 75% prior to achieving the recommended service capacity, the test shall be stopped, and a final challenge shall be conducted. If the device passes at the point of 75% flow reduction, and the test capacity has reached at least 50%, the rated capacity of the device shall be the capacity achieved at the point of 75% flow reduction.
3. Test to run a minimum of 14 days including stagnation, laboratory to adjust the cycle length and running hours of duration per day. Cycle duration maximum of 50-on/50-off minimum of 10-on/90-off; exception is for shower filters as they need to be on for a minimum of 10 minutes continuously.
4. Two production units shall be conditioned per the manufacturer's instructions prior to the start of the test using the Challenge Water without the microorganism.
5. Conditioning water samples shall be collected for each test unit after conditioning prior to challenge with test organism. Neutralization of active effluent samples shall be performed if units contain an active agent. Samples are analyzed for the challenge organism and shall not demonstrate presence of challenge microorganisms.
6. In-line units shall be maintained under pressure during no flow conditions.

7. Calibrated flow meters and totalizers shall be used to record flow rate and cumulative volume passed through each unit. Water temperature shall be adjusted for cold or hot water applications per the manufacturer's use instructions. For hot water applications, the water shall be heated to an appropriate temperature prior to being introduced into the units. Sampling ports prior to and following units are used to collect influent and effluent samples, respectively. Microbial suspension shall be injected into influent water during flow to achieve a concentration of >1 x 10^7 CFU/mL at the required sampling points. The thorough homogenization, dilution of challenge suspension, adjustment of challenge suspension rate, and adequate inline mixing following injection of challenge solution are paramount to achieving the required influent concentrations. Alternately, a dedicated reservoir containing sufficient volume of Challenge Water at the desired Legionella concentration may be used as the supply during challenge events. Between sampling points, background levels of microbial HPC shall be 10-10,000 CFU/mL.
8. Challenge Water is introduced into the unit's influent at the beginning of the "on flow" period. A minimum of 10-unit void volumes of the Challenge Water shall pass through the units prior to sampling the effluent. Neutralization of effluent samples is required if the unit contains an active agent. A minimum of 1 L (0.3 gallons) sample volume shall be collected in a sterile container (with neutralizer) for *L.p.* analysis. HPC analysis may be conducted on the collected sample, or a separate sample may be collected in a sterile container for HPC analysis. Active agent samples shall be collected in a separate and appropriate container. Active agent samples shall be stabilized appropriately. Active agent samples may be stored appropriately and analyzed simultaneously following the final sample collection at end of study.
9. Samples for microbial analysis shall be analyzed within 6 hours of collection (see Table 1 for sample schedule). This process shall be repeated for each sampling timepoint. Sufficient volume shall be collected at each sampling point so that each influent and effluent sample is analyzed for *L.p.* in triplicate. Analysis volume shall be adjusted to allow the demonstration of the required percent reduction based on *L.p.* concentration in Challenge Water (influent).
10. Perform microbial challenge sampling at start-up and every 25% of the system rated capacity. Analysis shall be performed by approved methods (ISO, CDC, and/or Standard Methods). Continue water passage using required cycling and repeat challenge at 25%, 50%, 75% and 100% of the system's capacity. A total of 5 challenge events are conducted per test unit.
11. The two stagnation samples shall occur at 40-49% rated capacity, and again between 90-99% rated capacity. Stagnation samples shall be collected after a minimum of 48-hour rest with no flow through the test units. Stagnation samples shall be collected from the first water drawn through the device after the stagnation period.

Table 1

Sampling Timepoint[1]	Test Water Type	*L.p.* Challenge Inoculation	Sampling and Analysis			
			Active Agent Residual[2]	Influent Background[3]	HPC	*L.p.*
Start (Day 1)	Challenge	X	X	X		
Run device with general test water including background bacteria						
25% (Day 4)	Challenge	X	X		X	X
Run device with general test water including background bacteria						
49% (Day 7) Following 48h stagnation #1	General		X	X	X	X
50% (Day 7)	Challenge	X	X		X	X
Run device with general test water including background bacteria						
75% (Day 11)	Challenge	X	X		X	X
Run device with general test water including background bacteria						
99% (Day 14) Following 48h stagnation #2	General		X	X	X	X
100% (Day 14)	Challenge	X	X		X	X

1 Percent of estimated capacity or number of calendar days required for test completion.
2 Active agent levels should not exceed US EPA Federal Drinking Water standards or NSF/ANSI/CAN 600
3 Shall be 10-10,000 CFU/mL of the HPC.

5.2.3 Criteria

1. Systems for drinking water shall demonstrate at least 99.9999% reduction (6-$\log_{10}$ reduction) of challenge bacteria species at every test point.
2. Alternatively, systems not intended for drinking water (e.g., shower water) shall be certified to the manufacturer's specific percent reduction claim, or 3$\log_{10}$, whichever is greater.
3. Challenge microorganism following stagnation periods shall be calculated as the geometric mean of the influent concentration used in previous challenge points. Challenge microorganisms following stagnation periods shall be less than 6-$\log_{10}$.

5.3 System Structural Integrity Hydrostatic Pressure Test

The following procedure shall be used for hydrostatic pressure testing. A representative model of flow cell may be used to account for similar construction materials and techniques.

5.3.1 Test Procedure

(a) Install the device per manufacturer's instructions.
(b) Set the water temperature to 45 - 85 °F (7.2 - 29.4 °C) for devices intended for use in cold water.
Set the water temperature to 120 - 140 °F (48.9 - 60 °C) for devices intended for use in hot water.
(c) Purge the system or component of air. Seal any ports to prevent leaking.
(d) d. Pressurize the system or component to 1.5 times its stated working pressure or 300 psi (2069 kPa), whichever is greater.
    a. For systems greater than or equal to 18 in (45.7 cm) in diameter or larger, pressure shall be increased no faster than 10 psi (68.9 kPa) per second.
    b. For systems less than 18 in (45.7 cm) in diameter, pressure shall be increased no faster than 1 psi (6.89 kPa) per second.
(e) Maintain pressure for 15 minutes.

5.3.2 Criteria

Breaks and cracks in the product that cause spraying from the system or component shall constitute a failure. There shall be no leakage.

6 Markings and Accompanying Literature

6.1 Markings

Copper-silver disinfection systems complying with this Standard shall be marked with the:

(a) Name of manufacturer or trademark; and
(b) model number of the device; and

6.2 Visibility

Markings shall be permanent, legible, and visible after installation. The markings shall be either etched, cast, stamped or engraved on the body of the device or on a plate made of a corrosion resistant material securely attached to the device with corrosion resistant means.

6.3 Installation Instructions

Manufacturers of copper-silver disinfection systems shall maintain and provide documentation of an installation, care, and maintenance plan to the end user or certified installer. The plan must address the following key areas:

(a) Company Name and contact information
(b) Model number
(d) General operation and maintenance requirements including, but not limited to, suggested frequency of consumables replacement or service to the device, user responsibility, and parts and service availability
(f) Service Flow rate
(g) Rated pressures and temperatures
(h) Minimum and Maximum Operating pressures
(j) Statement noting the device and installation shall comply with applicable federal, state, and local regulations
(k) A statement of the percent or log reduction of Legionella
(m) Conditioning instructions, if applicable
(n) How to service and maintain the product (i.e. such as electrode replacement and descaling)

6.4 Ongoing Maintenance Plan

Manufacturers shall have a documented maintenance and recalibration plan that aligns with system performance requirements and complies with applicable regulatory standards. The plan should be available upon request for review by regulatory authorities or certified installers.

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Devices for Detection, Monitoring of