



**American Water Works
Association**

Dedicated to the World's Most Important Resource®

ANSI/AWWA B512-15
(Revision of ANSI/AWWA B512-08)

AWWA Standard

Sulfur Dioxide

Effective date: May 1, 2015.
First edition approved by AWWA Board of Directors Jan. 27, 1991.
This edition approved Jan. 24, 2015.
Approved by American National Standards Institute Jan. 28, 2015.



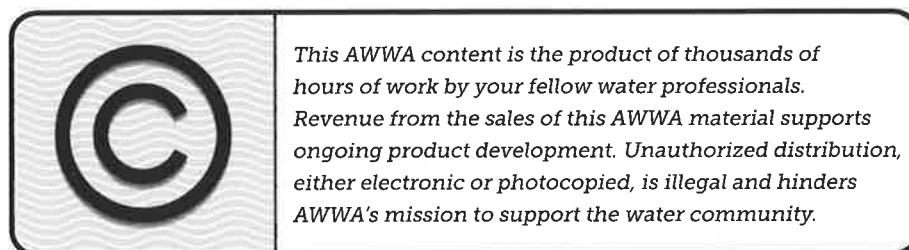
AWWA Standard

This document is an American Water Works Association (AWWA) standard. It is not a specification. AWWA standards describe minimum requirements and do not contain all of the engineering and administrative information normally contained in specifications. The AWWA standards usually contain options that must be evaluated by the user of the standard. Until each optional feature is specified by the user, the product or service is not fully defined. AWWA publication of a standard does not constitute endorsement of any product or product type, nor does AWWA test, certify, or approve any product. The use of AWWA standards is entirely voluntary. This standard does not supersede or take precedence over or displace any applicable law, regulation, or code of any governmental authority. AWWA standards are intended to represent a consensus of the water supply industry that the product described will provide satisfactory service. When AWWA revises or withdraws this standard, an official notice of action will be placed in the Official Notice section of *Journal - American Water Works Association*. The action becomes effective on the first day of the month following the month of *Journal - American Water Works Association* publication of the official notice.

American National Standard

An American National Standard implies a consensus of those substantially concerned with its scope and provisions. An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American National Standard does not in any respect preclude anyone, whether that person has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. American National Standards are subject to periodic review, and users are cautioned to obtain the latest editions. Producers of goods made in conformity with an American National Standard are encouraged to state on their own responsibility in advertising and promotional materials or on tags or labels that the goods are produced in conformity with particular American National Standards.

CAUTION NOTICE: The American National Standards Institute (ANSI) approval date on the front cover of this standard indicates completion of the ANSI approval process. This American National Standard may be revised or withdrawn at any time. ANSI procedures require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of ANSI approval. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036; 212.642.4900; or emailing info@ansi.org.



ISBN-13, print: 978-1-62576-078-4

eISBN-13, electronic: 978-1-61300-332-9

DOI: <http://dx.doi.org/10.12999/AWWA.B512.15>

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information or retrieval system, except in the form of brief excerpts or quotations for review purposes, without the written permission of the publisher.

Copyright © 2015 by American Water Works Association
Printed in USA

Committee Personnel

The AWWA Standards Committee on Taste and Odor Control Chemicals, which reviewed and approved this standard, had the following personnel at the time of approval:

Nathan K. Dunahee, *Chair*

General Interest Members

N.K. Dunahee, Burns & McDonnell, Kansas City, Mo.	(AWWA)
T.E.T. Gillogly, Carollo Engineers, Miami, Fla.	(AWWA)
C.B. Lind, Mauser Corporation, East Brunswick, N.J.	(AWWA)
S.J. Posavec,* Standards Group Liaison, AWWA, Denver, Colo.	(AWWA)
B.H. Wilder, Daytona Beach, Fla.	(AWWA)

Producer Members

J.E. Boll, Carus Chemical Co., Peru, Ill.	(AWWA)
J.M. Gonzalez, South New Berlin, N.Y.	(AWWA)

User Members

M. Ramon, City of Houston, Houston, Texas	(AWWA)
R. Sparks, City Utilities of Springfield, Springfield, Mo.	(AWWA)
P. Zielinski, Pennsylvania American Water, Hershey, Pa.	(AWWA)

* Liaison, nonvoting.

This page intentionally blank.

Contents

All AWWA standards follow the general format indicated subsequently. Some variations from this format may be found in a particular standard.

SEC.	PAGE	SEC.	PAGE
Foreword		2	References2
I	Introduction.....vii	3	Definitions2
I.A	Background.....vii	4	Requirements
I.B	History.....viii	4.1	Physical Requirements.....3
I.C	Acceptance.....viii	4.2	Chemical Requirements3
II	Special Issues.....ix	4.3	Impurities.....3
II.A	Safety and Accidental Release Reporting.....ix	5	Verification
III	Use of This Standardix	5.1	Sampling.....4
III.A	Purchaser Options and Alternativesx	5.2	Laboratory Examination.....5
III.B	Modification to Standardx	5.3	Test Procedures for Sulfur Dioxide, Nonvolatile Residue, Moisture, and Heavy Metals6
IV	Major Revisions.....x	5.4	Basis for Shipment and Acceptance7
V	Commentsx	5.5	Notice of Nonconformance.....8
Standard		6	Delivery
1	General	6.1	Marking.....9
1.1	Scope1	6.2	Packaging and Shipping9
1.2	Purpose.....1	6.3	Affidavit of Compliance10
1.3	Application.....1		

This page intentionally blank.

Foreword

This foreword is for information only and is not a part of ANSI/AWWA B512.*

I. Introduction.

I.A. *Background.* Sulfur dioxide (SO₂), or sulfurous oxide, is a colorless, nonflammable, pungent, suffocating gas. This reducing agent is widely used to remove chlorine and other oxidants from water. Sulfur dioxide is corrosive to mild steel if moisture is present.

Sulfur dioxide is manufactured by burning sulfur in air or from the roasting and smelting of sulfide ores. Generally, sulfur dioxide is purified by using intricate scrubbing methods to remove metal impurities. The sulfur dioxide gas is compressed to form liquid sulfur dioxide, which can then be fed either as a liquid or as a gas. Sulfur dioxide liquid or gas is commercially available at nominally 100 percent strength.

Sulfur dioxide dosage for dechlorination is based on the level of residual chlorine to be removed. The required theoretical dosage for dechlorination is 0.9 mg/L of SO₂ per 1.0 mg/L of residual chlorine (not chlorine dosage). In practice, a ratio of 1:1 is generally used.

Sulfur dioxide mixed with water reacts almost instantaneously with chlorine, converting the chlorine (Cl₂) to chloride (Cl⁻) and the residual sulfur dioxide to sulfate (SO₄²⁻).

When plant capacity is expressed in million gallons per day (mgd), the sulfur dioxide feed rate in pounds per day (lb/d) can be calculated using the following formula:

$$\text{SO}_2 \text{ lb/d} = \text{Cl}_2 \text{ residual ppm} \times 8.34 \times \text{mgd of plant}$$

The following properties of sulfur dioxide (SO₂) may be useful:

Odor	Pungent
Melting point	-99°F (-72.7°C)
Boiling point at atmosphere	14.0°F (-10°C)
Specific gravity of liquid at 0°C (water = 1)	1.434
Specific gravity at 80°F (27°C)	1.363
Critical temperature	314.8°F (174.9°C)
Molecular weight	64.06

For additional information on chemical and physical properties and safety information, refer to the technical information and material safety data sheet/safety data

* American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.

sheet (MSDS/SDS) available from the supplier or manufacturer and the Compressed Gas Association's (CGA's) booklet CGA G-3, Sulfur Dioxide.*

I.B. *History.* The first edition of ANSI/AWWA B512, Sulfur Dioxide, was developed by the AWWA Standards Committee on Taste and Odor Control Chemicals and approved by the AWWA Board of Directors on Jan. 27, 1991, with an effective date of June 1, 1991. Subsequent editions of ANSI/AWWA B512 were approved on June 15, 1997, Jan. 20, 2002, and Jan. 27, 2008. This edition was approved on Jan. 24, 2015.

I.C. *Acceptance.* In May 1985, the US Environmental Protection Agency (USEPA) entered into a cooperative agreement with a consortium led by NSF International (NSF) to develop voluntary third-party consensus standards and a certification program for direct and indirect drinking water additives. Other members of the original consortium included the Water Research Foundation (formerly AwwaRF) and the Conference of State Health and Environmental Managers (COSHEM). The American Water Works Association (AWWA) and the Association of State Drinking Water Administrators (ASDWA) joined later.

In the United States, authority to regulate products for use in, or in contact with, drinking water rests with individual states.† Local agencies may choose to impose requirements more stringent than those required by the state. To evaluate the health effects of products and drinking water additives from such products, state and local agencies may use various references, including two standards developed under the direction of NSF‡: NSF/ANSI 60, Drinking Water Treatment Chemicals—Health Effects, and NSF/ANSI 61, Drinking Water System Components—Health Effects.

Various certification organizations may be involved in certifying products in accordance with NSF/ANSI 60. Individual states or local agencies have authority to accept or accredit certification organizations within their jurisdictions. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

Annex A, "Toxicology Review and Evaluation Procedures," to NSF/ANSI 60 does not stipulate a maximum allowable level (MAL) of a contaminant for substances not regulated by a USEPA final maximum contaminant level (MCL). The MALs of an unspecified list of "unregulated contaminants" are based on toxicity testing guidelines (noncarcinogens) and risk characterization methodology (carcinogens). Use of Annex A procedures may not always be identical, depending on the certifier.

* Compressed Gas Association, 4221 Walney Road, 5th Floor, Chantilly, VA 20151.

† Persons outside the United States should contact the appropriate authority having jurisdiction.

‡ NSF International, 789 North Dixboro Road, Ann Arbor, MI 48113.

ANSI/AWWA B512 addresses additives requirements in Sec. 4.3.2 of the standard. The transfer of contaminants from chemicals to processed water or to residual solids is becoming a problem of great concern. The language in Sec. 4.3.2 is a recommendation only for direct additives used in the treatment of potable water to be certified by an accredited certification organization in accordance with NSF/ANSI 60, *Drinking Water Treatment Chemicals—Health Effects*. However, users of the standard may opt to make this certification a requirement for the product. Users of this standard should also consult the appropriate state or local agency having jurisdiction in order to

1. Determine additives requirements, including applicable standards.
2. Determine the status of certifications by parties offering to certify products for contact with, or treatment of, drinking water.
3. Determine current information on product certification.

II. Special Issues.

II.A. *Safety and Accidental Release Reporting.* Sulfur dioxide is a colorless, nonflammable, pungent gas or liquid with a vapor density of 2.26. Sulfur dioxide reacts with water or free moisture to form sulfurous acid, which is corrosive.

The odor threshold for sulfur dioxide is usually from 0.3 ppm to 2.5 ppm. Levels of 20 ppm usually cause coughing, while short exposures to 400 ppm to 500 ppm may be fatal. The Occupational Safety and Health Administration (OSHA) has set the permissible exposure level for sulfur dioxide* at 2 ppm as the 8-hr-time weighted average and 5 ppm as the short-term exposure level because sulfur dioxide is irritating to the respiratory system. Sulfur dioxide is corrosive to the eyes and skin and causes burns.

When handling sulfur dioxide, wear chemical safety glasses, rubber gloves, and rubber protective clothing. For additional information, study the supplier's material safety data sheet (MSDS).

Emergency release of sulfur dioxide is reportable under the US Comprehensive Environmental Response Compensation and Liability Act of 1980, Sec. 302.† At present, the reportable quantity of sulfur dioxide is 1 lb.

III. Use of This Standard. It is the responsibility of the user of an AWWA standard to determine that the products described in that standard are suitable for use in the particular application being considered.

* Code of Federal Regulations, Title 29, Part 1910, Superintendent of Documents, US Government Printing Office, Washington, DC 20402.

† Code of Federal Regulations, Title 40, Part 300, Superintendent of Documents, US Government Printing Office, Washington, DC 20402.

III.A. *Purchaser Options and Alternatives.* The following information should be provided by the purchaser:

1. Standard used—that is, ANSI/AWWA B512, Sulfur Dioxide, of latest revision.
2. Whether compliance with NSF/ANSI 60, Drinking Water Treatment Chemicals—Health Effects, is required.
3. Details of other federal, state or provincial, and local requirements (Section 4).
4. The grade or purity required (see Sec. 4.1, 4.2, and 4.3).
5. Whether the purchaser will reject product from containers or packaging with missing or damaged seals. The purchaser may reject product from bulk containers or packages with missing or damaged seals unless the purchaser's tests of representative samples, conducted in accordance with Sec. 5.1 through Sec. 5.3, demonstrate that the product meets the standard. Failure to meet the standard or the absence of, or irregularities in, seals may be sufficient cause to reject the shipment.
6. If the purchaser desires to sample and analyze shipments received, agreement with the supplier as to the number of samples to be taken is necessary (Sec. 5.1.3.1).
7. If required, an affidavit of compliance or certificate of analysis (Sec. 5.4 and 6.3).
8. Size of containers (Sec. 6.2).
9. Quantity required (see Sec. 6.2.1.1).
10. Whether alternative security measures have been adopted to replace or augment the security measures set out in Sec. 6.2.2 and 6.2.3.

III.B. *Modification to Standard.* Any modification to the provisions, definitions, or terminology in this standard must be provided by the purchaser.

IV. Major Revisions. Major revisions made to the standard in this edition include the following:

1. Inclusion of the use of this material for wastewater and reclaimed water as well as definitions of these terms (Sections 1 and 3).

V. Comments. If you have any comments or questions about this standard, please contact AWWA Engineering and Technical Services at 303.794.7711, FAX at 303.795.7603; write to the department at 6666 West Quincy Avenue, Denver, CO 80235-3098; or email at standards@awwa.org.



**American Water Works
Association**

Dedicated to the World's Most Important Resource®

ANSI/AWWA B512-15
(Revision of ANSI/AWWA B512-08)

AWWA Standard

Sulfur Dioxide

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes sulfur dioxide, a compressed, nonflammable liquefied gas, for use in the treatment of potable water, wastewater, or reclaimed water to remove excess residual chlorine.

Sec. 1.2 Purpose

The purpose of this standard is to provide the minimum requirements for sulfur dioxide, including physical, chemical, sampling, testing, packaging, and shipping requirements.

Sec. 1.3 Application

This standard can be referenced in documents for purchasing and receiving sulfur dioxide and can be used as a guide for testing the physical and chemical properties of sulfur dioxide samples. The stipulations of this standard apply when this document has been referenced and then only to sulfur dioxide used in the treatment of potable water, wastewater, or reclaimed water.

SECTION 2: REFERENCES

This standard references the following documents. In their latest edition, they form a part of this standard to the extent specified within the standard. In any case of conflict, the requirements of this standard shall prevail.

APHA,* AWWA, and WEF.†—*Standard Methods for the Examination of Water and Wastewater*.

CGA‡ G-3—*Sulfur Dioxide*.

CGA P-1—*Safe Handling of Compressed Gases in Containers*.

Code of Federal Regulations,§—Title 49, CFR Parts 100–177 (Transportation).

NSF¶/ANSI** 60—*Drinking Water Treatment Chemicals—Health Effects*.

USEPA††—600/4-79-020—*Methods for Chemical Analysis of Water and Wastes*.

SECTION 3: DEFINITIONS

The following definitions shall apply in this standard:

1. *Day*: A day is defined as a 24-hr period.
2. *Manufacturer*: The party that manufactures, fabricates, or produces materials or products.
3. *Potable water*: Water that is safe and satisfactory for drinking and cooking.
4. *Purchaser*: The person, company, or organization that purchases any materials or work to be performed.
5. *Reclaimed water*: Wastewater that becomes suitable for beneficial use as a result of treatment.
6. *Supplier*: The party that supplies material or services. A supplier may or may not be the manufacturer.

* American Public Health Association, 800 I Street, NW, Washington, DC 20001.

† Water Environment Federation, 601 Wythe Street, Alexandria, VA 22314.

‡ Compressed Gas Association, 4221 Walney Road, 5th Floor, Chantilly VA 20151.

§ US Department of Transportation, Superintendent of Documents, US Government Printing Office, Washington, DC 20402.

¶ NSF International, 789 North Dixboro Road, Ann Arbor, MI 48105.

** American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.

†† US Environmental Protection Agency, 1200 Pennsylvania Avenue, NW, Washington, DC 20460.

7. *Tamper-evident packaging:* Packaging having one or more indicators or barriers to entry that, if breached or missing, can reasonably be expected to provide visible evidence to the purchaser that tampering has occurred. The tamper-evident features of the packaging shall be designed to remain intact and shall remain intact when handled in a reasonable manner during manufacture, storage, shipment, and delivery to the purchaser. Properly constructed, labeled, and sealed cylinders and tanks constitute effective forms of tamper-evident packaging.

8. *Wastewater:* A combination of the liquid and water-carried waste from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and stormwater that may be present.

SECTION 4: REQUIREMENTS

Materials shall comply with the Safe Drinking Water Act and other federal regulations for potable water, wastewater, and reclaimed water systems as applicable.

Sec. 4.1 Physical Requirements

Sulfur dioxide is a compressed, nonflammable gas containing 99.9 percent or more sulfur dioxide and is also known as *sulfurous oxide* (SO₂) or *sulfurous anhydride*. It has a molecular weight of 64.06 and a boiling point of 14°F (−10°C).

Sec. 4.2 Chemical Requirements

Sulfur dioxide may be available in several grades suitable for water treatment. The assay as SO₂ shall be 99.9 percent or more, by weight, and determined according to Section 5.

Sec. 4.3 Impurities*

4.3.1 *General impurities.* The sulfur dioxide supplied in accordance with this standard shall contain no soluble inorganic or organic substances in quantities capable of producing deleterious or injurious effects on the health of those consuming water that has been properly treated with sulfur dioxide.

4.3.2 *Product certifications.* Sulfur dioxide is a direct additive used in the treatment of potable water. This material should be certified as suitable for contact with, or treatment of, drinking water by an accredited certification organization in accordance with NSF/ANSI 60. Evaluation shall be accomplished in accordance

* See Sec. I.C of the foreword.

with requirements that are no less restrictive than those listed in NSF/ANSI 60. Certification shall be accomplished by a certification organization accredited by the American National Standards Institute.

SECTION 5: VERIFICATION

Sec. 5.1 Sampling

5.1.1 *General.* If the purchaser elects to take a sample at the destination, the purchaser must be familiar with sampling procedures and sampling equipment suitable for safely handling sulfur dioxide. Packaging, marking, shipping, handling, and storage of sulfur dioxide shall conform to all federal, state or provincial, and local applicable laws and regulations.

5.1.2 *Inspection.* All cylinders and portable tanks should be carefully inspected for proper product and container condition. Sulfur dioxide cylinders and 1-ton containers, valves, valve threads, and valve packings shall be in good condition and shall operate normally with a wrench that is no longer than 8 in. (203 mm)*. The container and valve shall conform to recommended practices in the Compressed Gas Association (CGA) pamphlet CGA P-1, *Safe Handling of Compressed Gases in Containers*, or pamphlet CGA G-3, *Sulfur Dioxide*.

5.1.3 *Sampling—numbers and equipment.*

5.1.3.1 Number of cylinder or portable tank shipment samples. When the material is received in individual cylinders or portable tanks, samples shall be taken from the number of cylinders that have been agreed to be representative of the sulfur dioxide supply.

5.1.3.2 Sampling device and container. The sample should be collected and stored in a Type 316 stainless-steel pressure cylinder in conformance with US Department of Transportation (USDOT) regulations for construction, filling, refilling, and shipping as stated in the US Code of Federal Regulations, Title 49, CFR Parts 100–177. The sample cylinder should be equipped with a stainless-steel needle valve on each end. The inlet end should be constructed to be connected with a solid pipe connection to the tank or transfer lines of product to be sampled. Preferably, the sample cylinder should have a water capacity of about 750 mL to provide sufficient sample for complete testing of the sample at least three times.

* Metric conversions given in this standard are direct conversions of US customary units and are not those specified in International Organization for Standardization (ISO) standards.

CAUTION: USDOT regulations state the maximum fill density of sulfur dioxide is 125 percent, by weight, of the sample cylinder's water capacity at 60°F (15.6°C).

5.1.4 *Sampling procedure.*

5.1.4.1 General sampling procedure. The sample should be collected at the liquid phase for analysis. To obtain a sample, first flush the sample cylinder with clean, dry air to remove any sulfur dioxide remaining from the last sample. With both needle valves closed, attach the inlet end by solid pipe connection to the tank or lines to be sampled. Attach a rubber hose to the outlet end of the cylinder, which is submersed in a container of either dilute caustic solution or water. Open the inlet and then the outlet needle valves to allow for replacement of all air with liquid sulfur dioxide. Release from 200 mL to 300 mL of liquid sulfur dioxide. Close the outlet needle valve, then close the inlet needle valve, and disconnect the sample cylinder from the supply tank or lines. Weigh the filled cylinder and bleed off the excess liquid above the permitted fill density. Each sample must be clearly marked and identified with the lot or shipment number sampled.

5.1.4.2 Cylinder sampling method. Because a 150-lb cylinder is not equipped for liquid withdrawal, carefully lay the cylinder on its side so that liquid will flow from the valve. Proceed with sample withdrawal per Sec. 5.1.4.1.

5.1.4.3 Portable 1-ton tank sampling. Portable 1-ton tanks are equipped for liquid withdrawal. Proceed with sampling per Sec. 5.1.4.1.

5.1.4.4 Bulk shipment sampling. Samples shall be representative of the sulfur dioxide supply and taken during the unloading or transferring operation sufficient to be representative of the sulfur dioxide being delivered. Samples should be withdrawn per Sec. 5.1.4.1.

Sec. 5.2 Laboratory Examination

Laboratory examination by the purchaser of the sample collected according to Section 5 shall be completed within 10 days after receipt of the shipment. The remainder of the sample must be retained for 30 days from receipt of shipment in case of nonconformance and handled according to Sec. 5.5.

5.2.1 *Test samples.* Test samples shall be obtained from a clean, filled sample cylinder delivered to the laboratory.

5.2.2 *Sample retention.* Each sample cylinder shall be retained for at least 30 days after date of receipt before it is discarded.

Sec. 5.3 Test Procedures for Sulfur Dioxide, Nonvolatile Residue, Moisture, and Heavy Metals

5.3.1 *Sampling.* For sample solution for determination of sulfur dioxide assay, nonvolatile residues, and heavy metals, measure 100 mL (144 g) of sulfur dioxide from the sample cylinder (Sec. 5.1.3) into a 125-mL Erlenmeyer flask that has been previously volume marked and weighed to the nearest 0.0001 g.

Determine the sample weight by loss in weight of the sample cylinder to the nearest 0.01 g.

5.3.2 *Nonvolatile residue.* Evaporate the sample to dryness on a steam bath that is properly hooded and vented to capture the sulfur dioxide. After the liquid has evaporated, displace the sulfur dioxide vapors from the flask with dry air. Wipe the flask dry, place it in a desiccator to cool for 30 min, and then reweigh. Save the sample for heavy metal analysis (see Sec. 5.3.5).

5.3.2.1 Calculations.

$$\text{percent nonvolatile residue} = \frac{\text{difference in weight in grams} \times 100}{144 \text{ g (sample weight)}}$$

5.3.3 *Water—Karl Fischer titrimetric method.**

5.3.3.1 Reagents and equipment. Karl Fischer equipment and reagents are as follows:

- Karl Fischer reagent diluent (catalog number SK5-1)
- Karl Fischer reagent stabilized (catalog number SK3-1)
- Automatic burette assembly[†] (catalog number 03-845AA)
- Absolute methanol

Karl Fischer reagent is prepared by diluting (1:1) volumes of the Karl Fischer diluent with the Karl Fischer reagent stabilized. Transfer the resulting dilute stabilized reagent to the bottle supplied with the automatic burette assembly.

5.3.3.2 Standardization of Karl Fischer reagent. Titrate 10 mL of absolute methanol with the Karl Fischer reagent and mark as "Titration A," then add 1.25 mL of water to a 250-mL volumetric flask and dilute to mark with absolute methanol. Titrate 10 mL of this solution with the reagent, and mark as "Titration B."

* The following method is based on using equipment and reagents from Fisher Scientific International, www.fisher-sci.com. Others may be used as agreed to with the purchaser.

[†] Any burette apparatus may be used if it adequately excludes atmospheric moisture and allows for determination of the end-point.

NOTE: The standardization should be carried out by titrating through a one-hole rubber stopper inserted into the titrating flask. This prevents atmospheric moisture from entering the flask, resulting in a low titer value.

$$\text{titer} = \frac{0.05}{B - 0.995A} = \text{g water/mL of Fischer reagent}$$

5.3.3.3 Procedure for sulfur dioxide sample. Transfer by loss of weight 100 mL (144 g) of sulfur dioxide sample from the sample cylinder into a clean, dry Erlenmeyer flask, and titrate to the brown end-point with Karl Fischer reagent.

NOTE: The sample for analysis for moisture should be withdrawn and analyzed as soon as possible after collecting the sample because the vaporization and loss of sulfur dioxide will increase the amount of moisture found. Sulfur dioxide vaporization will keep the atmospheric moisture swept out of the flask and prevent it from interfering with the titration.

5.3.3.4 Calculation for moisture residual.

$$\text{percent water} = \frac{\text{mL Fischer reagent} \times \text{titer} \times 100}{144 \text{ g (sample weight)}}$$

5.3.4 *Sulfur dioxide assay.* Determine assay by subtracting the percentage of nonvolatile residue and moisture from 100.

5.3.5 *Heavy metal determination.* Take sample of nonvolatile residue saved in Sec. 5.3.2. Add 3 mL of nitric acid and 10 mL of water to the dry flask. Warm gently for 15 min on a hotplate. Transfer the sample content to a 100-mL volumetric flask, dilute it to the 100-mL mark with water, and mix. Depending on the level of impurities to be determined, further quantitative dilution may be needed.

To analyze for heavy metals, use the methods currently accepted by the US Environmental Protection Agency (USEPA).^{*} When no USEPA method is provided, analyses may be performed according to *Standard Methods for the Examination of Water and Wastewater*.

Sec. 5.4 Basis for Shipment and Acceptance

5.4.1 *Authorization for shipment.*[†] The purchaser may authorize shipment on the basis of either (1) the supplier's certification of quality or (2) a test of the

^{*} Methods for Chemical Analysis of Water and Wastes, USEPA Report 600/4-79-020.

[†] Purchasers should become familiar with the problem of collecting and maintaining a reference sample for SO₂.

retained sample at loading by the supplier or by a suitable independent laboratory to confirm compliance.

5.4.2 *Sampling and testing after delivery of shipment.* The purchaser may elect to collect a representative sample of the material after delivery. The procedure used shall be in accordance with Sec. 5.1.1. Purchasers who will be off-loading SO₂ to bulk storage tanks and then running on-site quality analysis are cautioned that this sequence may result in an altered quality of the product that is already stored in the bulk storage facility. Testing after delivery of a shipment should be required only if proper on-site controls and analytical equipment are available.

5.4.3 *Acceptance.* The purchaser may elect to accept the material on the basis of (1) the manufacturer's certified test report and accompanying certification as to the quality of the material to be shipped; (2) the purchaser's tests of the reference sample collected at loading and the certification of the quality of the material to be shipped; or (3) the purchaser's test of the representative sample collected according to Section 5 after receipt of shipment, showing compliance with the standard.

Sec. 5.5 Notice of Nonconformance

If the sulfur dioxide delivered to the purchaser does not meet the chemical, physical, safety, or security requirements of this standard, a notice of nonconformance shall be provided by the purchaser to the supplier within 10 days after receipt of the shipment at the point of destination. The results of the purchaser's tests shall prevail unless the supplier notifies the purchaser that a retest is desired within 5 days after receipt of the notice of nonconformance. On receipt of the request for a retest, the purchaser shall forward one of the sealed samples taken according to Sec. 5.1.4 to the supplier. In the event the test results obtained by the supplier do not agree with the test results obtained by the purchaser, another sealed sample shall be forwarded, unopened, for analysis to a referee laboratory agreed on by both parties. The results of the referee analysis shall be accepted as final.

Material not complying with the requirements of this standard and the purchaser's documents may be rejected. Replacement and retesting shall be accomplished in accordance with the purchaser's documents.

Because the exact concentration of the active ingredient in specific shipments of some materials can vary within an acceptable range (thereby conforming to the standard), the purchase documents between purchaser and supplier should address treatment of concentration variation.

SECTION 6: DELIVERY

Sec. 6.1 Marking*

6.1.1 *Required.* Each container of material shall be identified as to product, grade, net weight, name and address of the manufacturer, and the brand name. Containers shall show a lot number and identification of manufacturer. All markings on containers shall conform to applicable laws and regulations, including requirements established by the US Occupational Safety and Health Administration (OSHA). Sulfur dioxide is classified as a nonflammable, compressed gas by USDOT.

6.1.2 *Optional.* The package may also bear the statement: "Guaranteed by (name of manufacturer) to meet American Water Works Association Standard B512 for Sulfur Dioxide."

Sec. 6.2 Packaging and Shipping

Sulfur dioxide in individual returnable compressed gas cylinders, in portable 1-ton tanks, or in bulk shipments shall be in containers acceptable to USDOT[†] for nonflammable compressed or liquified gases.

6.2.1 *Package shipments.* Sulfur dioxide may be shipped in 150-lb cylinders or 1-ton portable tanks. Containers must pass the specified hydrostatic test and pressure test and include safety relief devices to protect against unsafe container pressure. Information on storage and handling of cylinders can be found in CGA P-1 and CGA G-3.

6.2.1.1 *Net weight.* The net weight of a cylinder or portable tank shipment shall not deviate from the weight ordered by more than 5 percent, plus or minus. Objections to the weight of the material received shall be based on a certified unit weight of not less than 10 percent of the cylinders or portable tanks shipped, selected at random from the entire shipment.

* Governmental packaging, marking, and shipping references reflect US requirements. Users of ANSI/AWWA B512 outside the United States should verify applicable local and national regulatory requirements. Because of frequent changes in these regulations, all parties should remain informed of possible revisions. Provisions of the purchaser's documents should not preclude compliance with applicable regulations.

† Code of Federal Regulations, Title 49, CFR Parts 100–177 (Transportation), Superintendent of Documents, US Government Printing Office, Washington, DC 20402.

6.2.1.2 *Weight certification.* Bulk shipments shall be accompanied by weight certificates of certified weighers, if specified by the purchaser; or the weights may be checked by certified weighers for the purchaser on delivery.

6.2.2 *Security requirements for nonbulk shipments.* Packaged product shall be stored, shipped, and delivered in tamper-evident packaging as defined in Section 3, item 7, or an alternative method or methods may be agreed on by the manufacturer and purchaser that provide a reasonable assurance of protection against tampering.

6.2.3 *Security requirements for bulk shipments.* Bulk quantities of product shall be secured employing one of the following security measures (or a combination of measures):

6.2.3.1 *Seals.* Bulk quantities of product may be sealed with a uniquely numbered tamper-evident seal(s). The seal numbers shall be recorded and disclosed on shipping documents, such as the bill of lading. Seals shall be inspected on receipt of product by the purchaser, and evidence of tampering or removal should be reported to the carrier and supplier.

6.2.3.2 *Chain of custody.* A continuous chain of custody may be maintained between the manufacturer and the purchaser during storage and shipment if so specified by the purchaser.

6.2.3.3 *Alternative method.* An alternative method or methods agreed on by the manufacturer and purchaser may be used that provide reasonable assurance of protection against tampering.

Sec. 6.3 Affidavit of Compliance

The purchaser may require either (1) an affidavit from the manufacturer or supplier that the material provided complies with the applicable requirements of this standard, or (2) a certified analysis of the material at the time of delivery detailing the desired items.

This page intentionally blank.

This page intentionally blank.

This page intentionally blank.



American Water Works Association

6666 West Quincy Avenue
Denver, CO 80235-3098
T 800.926.7337
www.awwa.org

Dedicated to the world's most important resource, AWWA sets the standard for water knowledge, management, and informed public policy. AWWA members provide solutions to improve public health, protect the environment, strengthen the economy, and enhance our quality of life.

1P-2M 42512-2015 (04/15) IW



Printed on Recycled Paper

ISBN 978-1-62576-078-4



9 781625 760784