



**American Water Works  
Association**

The Authoritative Resource on Safe Water®

ANSI/AWWA B512-08  
(Revision of ANSI/AWWA B512-02)

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*AWWA Standard*

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# Sulfur Dioxide



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Approved by American National Standards Institute April 18, 2008.

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

*Advocacy  
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Djanette Khiari, *Chair*

Phillip A. Vella, *Secretary*

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C.A. Blanck, Richmond, Ind.	(AWWA)
C.R. Dugan,* Standards Council Liaison, Bath, Mich.	(AWWA)
D. Khiari, Awwa Research Foundation, Denver, Colo.	(AWWA)
J.S. Kippin, Town of Ipswich Water, Ipswich, Mass.	(NEWWA)
N.E. Otto, Denver, Colo.	(BUREC)
S.J. Posavec,* Standards Group Liaison, AWWA, Denver, Colo.	(AWWA)
M. Siddiqui, University of Utah, Salt Lake City, Utah	(AWWA)
B.H. Wilder, Daytona Beach, Fla.	(AWWA)

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P.A. Vella, Carus Chemical, La Salle, Ill.	(AWWA)
T.R. Walton, Stuart, Fla.	(AWWA)

## *User Members*

J.T. Harvey, Central Arkansas Water, Little Rock, Ark.	(AWWA)
J.J. Parker, Springfield, Mo.	(AWWA)

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# Foreword

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

## I. Introduction.

I.A. *Background.* Sulfur dioxide (SO<sub>2</sub>), 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 SO<sub>2</sub> 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 (Cl<sub>2</sub>) to chloride (Cl<sup>-</sup>) and the residual sulfur dioxide to sulfate (SO<sub>4</sub><sup>2-</sup>).

When plant capacity is expressed in million gallons per day (mgd), the sulfur dioxide feed rate in pounds per day 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 (SO<sub>2</sub>) 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 (MSDS) 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, Standard for 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. ANSI/AWWA B512-97 was approved on June 15, 1997. ANSI/AWWA B512-02 was approved on Jan. 20, 2002. This edition was approved on Jan. 27, 2008.

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 American Water Works Association Research Foundation (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 jurisdiction. 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

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\* 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 N. Dixboro Road, Ann Arbor, MI 48113.

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



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.

ANSI/AWWA B512 addresses additives requirements in Sec. 4.4 of the standard. The transfer of contaminants from chemicals to processed water or the residual solids is becoming a problem of great concern. The language in Sec. 4.4.2 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 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.

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\* *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. 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.

III.A. *Purchaser Options and Alternatives.* The following items 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 (Sec. 4.1).
4. The grade or purity required (see Sec. 4.2, 4.3, and 4.4).
5. 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. 5.4).
6. If required, an affidavit of compliance or certificate of analysis (Sec. 5.4 and 6.3).
7. Size of containers (Sec. 6.2).
8. Quantity required (see Sec. 6.2.1.1).
9. 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.
10. 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, 5.2, and 5.3, demonstrate that the product meets specifications. Failure to meet specifications or the absence of, or irregularities in, seals may be sufficient cause to reject the shipment.

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 a requirement for compliance with the Safe Drinking Water Act and other federal regulations (Sec. 4.1).
2. Inclusion of a requirement for tamper-evident packaging (Sec. 6.2.2 and 6.2.3).

**V. Comments.** If you have any comments or questions about this standard, please call the AWWA Volunteer and Technical Support Group at 303.794.7711, FAX at 303.795.7603, write to the group at 6666 West Quincy Avenue, Denver, CO 80235-3098, or e-mail at [standards@awwa.org](mailto:standards@awwa.org).



**American Water Works  
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ANSI/AWWA B512-08  
(Revision of ANSI/AWWA B512-02)

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*AWWA Standard*

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# Sulfur Dioxide

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## SECTION 1: GENERAL

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### **Sec. 1.1 Scope**

This standard describes sulfur dioxide, a compressed, nonflammable liquified gas, for use in the treatment of municipal and industrial water supplies 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 specifications 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 water supply service applications.

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## SECTION 2: REFERENCES

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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.

ASME\* Boiler and Pressure Vessel Code.

*Code of Federal Regulations*,<sup>†</sup> Title 49, CFR Parts 100–177 (Transportation).

CGA<sup>‡</sup> G-3, *Sulfur Dioxide*.

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

NSF<sup>§</sup>/ANSI<sup>¶</sup> 60—Drinking Water Treatment Chemicals—Health Effects.

*Standard Methods for the Examination of Water and Wastewater*. APHA,<sup>\*\*</sup> AWWA, WEF.<sup>††</sup>

USEPA<sup>‡‡</sup> 600/4-79-020—Methods for Chemical Analysis of Water and Wastes.

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## SECTION 3: DEFINITIONS

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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. *Purchaser*: The person, company, or organization that purchases any materials or work to be performed.
4. *Supplier*: The party that supplies material or services. A supplier may or may not be the manufacturer.
5. *Tamper-evident packaging*: Packaging having one or more indicators or barriers to entry which, if breached or missing, can reasonably be expected to provide visible evidence to the purchaser that tampering has occurred.

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\* ASME International, Three Park Avenue, New York, NY 10016.

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

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

§ NSF International, 789 N. Dixboro Road, Ann Arbor, MI 48105.

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

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

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

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

The tamper-evident features of the packaging shall be designed to, 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 two forms of tamper-evident packaging.

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## SECTION 4: REQUIREMENTS

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### Sec. 4.1 Materials

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

### Sec. 4.2 Physical Requirements

Sulfur dioxide is a compressed, nonflammable gas containing 99.9 percent or more sulfur dioxide and is also known as sulfurous oxide (SO<sub>2</sub>) or sulfurous anhydride. It has a molecular weight of 64.06 and a boiling point of 14°F (-10°C).

### Sec. 4.3 Chemical Requirements

4.3.1 *General.* Sulfur dioxide may be available in several grades suitable for water treatment. The assay as SO<sub>2</sub> shall be 99.9 percent or more, by weight, and determined according to Section 5.

### Sec. 4.4 Impurities\*

4.4.1 *General impurities.* The sulfur dioxide supplied in accordance with this standard shall contain no 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.

4.4.2 *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 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.

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\* See Sec. I.C of the foreword.

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## SECTION 5: VERIFICATION

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### 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).<sup>\*</sup> 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 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 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.

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).

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<sup>\*</sup> 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.

#### 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 either a container of 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. One-ton portable 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. 5.4.4.

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.* 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 SK 5
Karl Fischer reagent stabilized	catalog number SK 3
Automatic burette assembly <sup>†</sup>	catalog number 03-845A
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.

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.

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

\* The following method is based on using equipment and reagents from Fisher Scientific International, Liberty Lane, Hampton, NH 03842. 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.



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.* 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).<sup>\*</sup> 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, Acceptance, and Notice of Nonconformance

5.4.1 *Authorization for shipment.*<sup>†</sup> The purchaser may authorize shipment on the basis of either (1) the supplier's certification of quality or (2) on a test of the 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 SO<sub>2</sub> to bulk storage tanks and then running on-site quality analysis are cautioned that

<sup>\*</sup> Methods for Chemical Analysis of Water and Wastes, USEPA Rept. 600/4-79-020.

<sup>†</sup> Purchasers should become familiar with the problem of collecting and maintaining a reference sample for SO<sub>2</sub>.

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.

5.4.4 *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 five 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, the other 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.

The supplier shall provide to the purchaser an adjustment that is agreed on between the supplier and the purchaser reflecting the diminished quality of the product.

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## SECTION 6: DELIVERY

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### Sec. 6.1 **Marking**<sup>\*</sup>

6.1.1 *Required.* Each container shall be marked to clearly identify the contents and shall bear the current proper labeling and precautionary information

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\* 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.

required by the USDOT, USEPA, and other applicable regulatory agencies. 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, 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.

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 5, 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 upon

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

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 an affidavit from the manufacturer or supplier that the material provided complies with all applicable requirements of this standard.



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