



Designation: D1886 – 14 (Reapproved 2021)^{ε1}

Standard Test Methods for Nickel in Water¹

This standard is issued under the fixed designation D1886; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

^{ε1} NOTE—The WTO caveat was editorially added in November 2021.

1. Scope

1.1 These test methods^{2, 3, 4} cover the atomic absorption determination of nickel in water and wastewaters. Three test methods are given as follows:

	Concentration Range	Sections
Test Method A—Atomic Absorption, Direct	0.1 to 10 mg/L	7 – 16
Test Method B—Atomic Absorption, Chelation-Extraction	10 to 1000 µg/L	17 – 26
Test Method C—Atomic Absorption, Graphite Furnace	5 to 100 µg/L	27 – 36

1.2 Test Methods A, B, and C have been used successfully with reagent grade water and natural waters. Evaluation of Test Method C was also made in condensate from a medium Btu coal gasification process. It is the user's responsibility to ensure the validity of these test methods for other matrices.

1.3 The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversion to inch-pound units that are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* For specific hazards statements, see [Note 5](#), [11.8.1](#), [21.11](#), [23.7](#), and [23.10](#).

1.5 Two former colorimetric test methods were discontinued. Refer to [Appendix X1](#) for historical information.

¹ These test methods are under the jurisdiction of ASTM Committee D19 on Water and are the direct responsibility of Subcommittee D19.05 on Inorganic Constituents in Water.

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² Chilton, J. M., "Simultaneous Colorimetric Determination of Copper, Cobalt, and Nickel as Diethyldithiocarbamates," *Analytical Chemistry*, Vol 25, 1953, pp. 1274–1275.

³ Platte, J. A., and Marcy, V. M., "A New Tool for the Water Chemist," *Industrial Water Engineering*, May 1965.

⁴ Brown, E., Skougstad, M. W., and Fishman, M. J., "Methods for Collection and Analysis of Water Samples for Dissolved Minerals and Gases," *Techniques of Water-Resources Investigations of the U.S. Geological Survey*, Book 5, 1970, p. 115.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:⁵

[D858 Test Methods for Manganese in Water](#)
[D1066 Practice for Sampling Steam](#)
[D1068 Test Methods for Iron in Water](#)
[D1129 Terminology Relating to Water](#)
[D1193 Specification for Reagent Water](#)
[D1687 Test Methods for Chromium in Water](#)
[D1688 Test Methods for Copper in Water](#)
[D1691 Test Methods for Zinc in Water](#)
[D2777 Practice for Determination of Precision and Bias of Applicable Test Methods of Committee D19 on Water](#)
[D3370 Practices for Sampling Water from Flowing Process Streams](#)
[D3557 Test Methods for Cadmium in Water](#)
[D3558 Test Methods for Cobalt in Water](#)
[D3559 Test Methods for Lead in Water](#)
[D3919 Practice for Measuring Trace Elements in Water by Graphite Furnace Atomic Absorption Spectrophotometry](#)
[D4841 Practice for Estimation of Holding Time for Water Samples Containing Organic and Inorganic Constituents](#)
[D5673 Test Method for Elements in Water by Inductively Coupled Plasma—Mass Spectrometry](#)
[D5810 Guide for Spiking into Aqueous Samples](#)
[D5847 Practice for Writing Quality Control Specifications for Standard Test Methods for Water Analysis](#)

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this standard, refer to Terminology [D1129](#).

⁵ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *total recoverable nickel, n*—a descriptive term relating to the nickel forms recovered in the acid-digestion procedure specified in these test methods.

4. Significance and Use

4.1 Elemental constituents in potable water, receiving water, and wastewater need to be identified for support of effective pollution control programs. Test Methods A, B, and C provide the techniques necessary to make such measurements.

4.2 Nickel is considered to be relatively nontoxic to man and a limit for nickel is not included in the EPA National Interim Primary Drinking Water Regulations.⁶ The toxicity of nickel to aquatic life indicates tolerances that vary widely and that are influenced by species, pH, synergistic effects, and other factors.

4.3 Nickel is a silver-white metallic element seldom occurring in nature in the elemental form. Nickel salts are soluble and can occur as a leachate from nickel-bearing ores. Nickel salts are used in metal-plating and may be discharged to surface or ground waters.

5. Purity of Reagents

5.1 Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available.⁷ Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

5.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean reagent water conforming to Specification D1193, Type I. Other reagent water types may be used, provided it is first ascertained that the water is of sufficiently high purity to permit its use without lessening the bias and precision of the determination. Type II water was specified at the time of the round-robin testing of this test method.

6. Sampling

6.1 Collect the sample in accordance with Practice D1066 or Practices D3370, as applicable.

6.2 Samples shall be preserved with HNO₃ (sp gr 1.42) to a pH of 2 or less immediately at the time of collection, normally about 2 mL/L. If only dissolved nickel is to be determined, the sample shall be filtered through a 0.45-μm membrane filter

before acidification. The holding time for samples may be calculated in accordance with Practice D4841.

NOTE 1—Alternatively, the pH may be adjusted in the laboratory if the sample is returned within 14 days. However, acid must be added at least 24 hours before analysis to dissolve any metals that adsorb to the container walls. This could reduce hazards of working with acids in the field when appropriate.

TEST METHOD A—ATOMIC ABSORPTION, DIRECT

7. Scope

7.1 This test method covers the determination of dissolved and total recoverable nickel and has been used successfully with reagent water, tap water, river water, lake water, ground water, a refinery effluent, and a wastewater.

7.2 This test method is applicable in the range from 0.1 to 10 mg/L of nickel. The range may be extended upward by dilution of the sample.

8. Summary of Test Method

8.1 Nickel is determined by atomic absorption spectrophotometry. Dissolved nickel is determined by aspirating the filtered sample directly with no pretreatment. Total recoverable nickel is determined by aspirating the sample following hydrochloric-nitric acid digestion and filtration. The same digestion procedure is used for cadmium (Test Methods D3557), chromium (Test Methods D1687), cobalt (Test Methods D3558), copper (Test Methods D1688), iron (Test Methods D1068), lead (Test Methods D3559), manganese (Test Methods D858), and zinc (Test Methods D1691).

9. Interferences

9.1 Sodium, potassium, sulfate, and chloride (9000 mg/L each), calcium, magnesium and iron (4000 mg/L each), nitrate (2000 mg/L), and cadmium, lead, copper, zinc, cobalt, and chromium (10 mg/L each) do not interfere.

NOTE 2—Background correction by techniques such as a continuum source, nonabsorbing lines, or chelation-extraction, may be necessary for low levels of nickel for some types of water. Instrument manufacturer's instructions for use of the specific correction technique should be followed.

10. Apparatus

10.1 *Atomic Absorption Spectrophotometer*, for use at 232.0 nm.

NOTE 3—The manufacturer's instructions should be followed for all instrumental parameters. Wavelengths other than 232.0 nm may be used if they have been determined to be equally suitable.

10.2 *Nickel Hollow-Cathode Lamp*—Multielement hollow-cathode lamps are available and also have been found satisfactory.

10.3 *Pressure-Reducing Valves*—The supplies of fuel and oxidant shall be maintained at pressures somewhat higher than the controlled operating pressure of the instrument by suitable valves.

11. Reagents and Materials

11.1 *Filter Paper*—Purchase suitable filter paper. Typically the filter papers have a pore size of 0.45-μm membrane.

⁶ EPA Publication No. EPA-570/9-76-003 was originally published in 1976, and amended in 1980. Contact the Environmental Protection Agency, 401 "M" ST., S.W., Washington, DC 20406 for availability.

⁷ *ACS Reagent Chemicals, Specifications and Procedures for Reagents and Standard-Grade Reference Materials*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.