



Designation: C 997 – 83 (Reapproved 1993)^{ε1}

Standard Test Methods for Chemical and Instrumental Analysis of Nuclear-Grade Sodium and Cover Gas¹

This standard is issued under the fixed designation C 997; 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—Section 264, Keywords, was added editorially in April 1993.

1. Scope

1.1 These test methods provide instructions for performing chemical, radiochemical, and instrumental analyses of sodium metal and for determining impurities in cover gas.

1.2 The analytical procedures appear in the following order:

	Sections
Bypass Sampling	6-12
Overflow Sampling	13-18
Wire and Foil Equilibration Sampling	19-24
Laboratory Distillation of Sodium	25-31
Hydrogen by Hydrogen-Diffusion Meter	32-37
Carbon by Oxyacidic-Flux Method	38-46
Carbonaceous Gases Released by Acid	47-54
Cyanide by Spectrophotometry	55-64
Oxygen by the Equilibration Method Using Vanadium Wires	65-74
Fluoride by Selective Ion Electrode	75-83
Chloride by Selective Ion Electrode	84-92
Trace Metals by Atomic Absorption or Flame Emission Spectrophotometry	93-101
Cadmium and Zinc by Atomic Absorption Spectrophotometry	102-111
Potassium by Atomic Absorption Spectrophotometry	112-121
Rubidium and Cesium by Flame Spectrometry	122-131
Silicon by Spectrophotometry	132-140
Boron by Spectrophotometry	141-149
Uranium by Fluorimetry	150-157
Oxygen by Oxygen Meter	158-164
Carbon by Equilibration Method	165-172
Hydrogen by Equilibration Method	173-180
Sulfur by Spectrophotometry	181-189
Sodium Purity By Titration	190-199
Plutonium by Alpha Assay	200-209
Gamma Assay of Distillation Residue	210-217
Gamma Assay of Sodium Solution	218-226
Radioactive Iodine by Gamma Counting	227-235
Tritium by Liquid Scintillation Counting	236-245
Particles by Filtration	246-254
Gaseous Impurities in Cover Gas by Gas Chromatography	255-263

2. Referenced Documents

2.1 ASTM Standards:

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products²

C 859 Terminology Relating to Nuclear Materials³

¹ These test methods are under the jurisdiction of ASTM Committee C-26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.05 on Test Methods.

Current edition approved May 27, 1983. Published August 1983.

² *Annual Book of ASTM Standards*, Vol 01.03.

³ *Annual Book of ASTM Standards*, Vol 12.01.

D 1193 Specification for Reagent Water⁴

E 146 Methods for Chemical Analysis of Zirconium and Zirconium Alloys⁵

3. Significance and Use

3.1 Sodium metal is used as a coolant (heat-transfer medium) in nuclear reactors, particularly in fast breeder reactors. An inert gas (argon, nitrogen, or helium) is used to cover sodium within a reactor and during transfer and shipping operations to protect it from oxygen and water. To be suitable for use, the metal and gas must meet specified criteria for purity as determined by analysis.

3.2 During reactor operation, chemical and radiochemical impurities resulting from corrosion and neutron activation must be maintained within specification levels established for the reactor system. The sodium and cover gas must be analyzed periodically to monitor buildup of those impurities.

3.3 These methods are applicable to the analysis of sodium and cover gas for the above purposes.

4. Reagents

4.1 *Purity of Reagents*—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.^{6,7} 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. Safety Precautions

5.1 Sodium is a reactive metal. It reacts vigorously with water and alcohol to form hydrogen, which is easily ignited

⁴ *Annual Book of ASTM Standards*, Vol 11.01.

⁵ Discontinued; see 1991 *Annual Book of ASTM Standards*, Vol 03.05.

⁶ "Reagent Chemicals, American Chemical Society Specifications," Am. Chemical Soc., Washington, D.C. For suggestions on the testing of reagents not listed by the American Chemical Society, see "Reagent Chemicals and Standards," by Joseph Rosin, D. Van Nostrand Co., Inc., New York, NY, and the "United States Pharmacopeia."

⁷ Met-L-X is a tradename for a NaCl-based powder.