Designation: D 2186 – 05

An American National Standard

Standard Test Methods for Deposit-Forming Impurities in Steam[1]

1. Scope

1.1 These test methods cover the determination of the amount of deposit-forming impurities in steam. Determinations are made on condensed steam samples in all test methods. Test Methods A, B, and C give a measure of the amount of total deposit-forming material present; Test Method D deals with special constituents that may be present. Special precautions and equipment, calculation procedures, and ranges of applicability are described. The following test methods are included:

	Sections
Test Method A (Gravimetric or Evaporative)	6 to 12
Test Method B (Electrical Conductivity)	13 to 19
Test Method C (Sodium Tracer)	20 to 26
Test Method D (Silica and Metals)	27 to 30

1.2 Test Method A is applicable for determining total dissolved and suspended solids in concentrations normally not less than 0.4 mg/L (ppm). It is applicable only to long-time steady-state conditions and is not applicable for transients.

1.3 Test Method B will measure minimum impurity concentrations varying from 3 mg/L (ppm) down to at least 0.005 mg/L (ppm), depending on the means for removing dissolved gases from the steam condensate. The means for removing dissolved gases also affects the storage capacity of steam condensate in the system and, thus, affects the response of the system to transients.

1.4 Because of the high sensitivity of methods for measuring sodium in steam condensate, Test Method C provides the most sensitive measure of impurity content for samples in which sodium is an appreciable percentage of the impurities present. Concentrations as low as 4.0 µg/L (ppb) can be detected by inductively coupled plasma atomic emission spectroscopy, 0.2 µg/L (ppb) by atomic absorption spectrophotometry, 0.1 µg/L (ppb) by graphite furnace atomic absorption spectroscopy, and as low as 0.5 µg/L (ppb) by sodium ion electrode. The apparatus can be designed with low volume, and, therefore, Test Method C is the most responsive to transient conditions.

1.5 Test Method D covers the determination of silica and metals in steam, which are not included in Test Methods B and C and are not individually determined using Test Method A.

1.6 *This standard does not purport to address the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 512 Test Methods for Chloride Ion in Water
D 516 Test Method for Sulfate Ion in Water
D 857 Test Methods for Aluminum in Water
D 859 Test Method for Silica in Water
D 1066 Practice for Sampling Steam[2]
D 1068 Test Methods for Iron in Water
D 1125 Test Methods for Electrical Conductivity and Resistivity of Water
D 1129 Terminology Relating to Water
D 1687 Test Methods for Chromium in Water
D 1688 Test Methods for Copper in Water
D 1886 Test Methods for Nickel in Water
D 1976 Test Method for Elements in Water by Inductively-Coupled Argon Plasma Atomic Emission Spectroscopy
D 2791 Test Method for Continuous Determination of Sodium in Water
D 3082 Test Method for Boron in Water[2]
D 3370 Practices for Sampling Water from Closed Conduits
D 3867 Test Methods for Nitrite-Nitrate in Water
D 4191 Test Method for Sodium in Water by Atomic Absorption Spectrophotometry
D 5542 Test Methods for Trace Anions in High Purity Water by Ion Chromatography
D 5907 Test Method for Filterable and Nonfilterable Matter in Water
D 6071 Test Method for Low Level Sodium in High Purity Water by Graphite Furnace Atomic Absorption Spectroscopy

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[1] These test methods are under the jurisdiction of ASTM Committee D19 on Water and are the direct responsibility of Subcommittee D19.03 on Sampling of Water and Water-Formed Deposits, Analysis of Water for Power Generation and Process Use, On-Line Water Analysis of Water for Power.

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[2] 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. Terminology

3.1 *Definitions*—For definitions of terms used in these test methods, refer to Terminology D 1129.

4. Significance and Use

4.1 Limiting the concentration of deposit-forming impurities in steam is of significance to protect both steam generators and steam turbines from damage or degradation of performance, or both.

4.1.1 Steam entering superheaters and reheaters of steam generators always contains some impurities. If the concentration of impurities is sufficiently low, the impurities are dissolved in superheated steam and are carried out of the steam generator. However, if the steam contains a sufficient amount of any substance to exceed its solubility limit in steam, the substance is likely to form a deposit on the heat-transfer surface. Because heat transfer in superheaters and reheaters in fossil-fueled steam generators is controlled principally by the low heat-transfer coefficient on the gas side, the formation of steam-side deposits will have little effect on the overall heat-transfer rate. However, steam-side deposits will increase the operating temperature of the heat-transfer surface. Such temperature increases can lead to swelling and ultimately to rupture of the tubing. Also, aggressive materials can concentrate under solid deposits of porous materials, such as magnetite (Fe_3O_4), and can cause serious corrosion of the tubing.

4.1.2 As steam flows through turbines, its temperature and pressure decrease rapidly. Because the ability of steam to dissolve impurities decreases with decreasing temperature and pressure, impurities in steam may exceed their solubility limit and form deposits on the turbine. Such deposits reduce steam flow area, particularly in the high-pressure portion of the turbine where flow passages are small, and the roughness of deposits and their effect on blade contours result in losses of turbine efficiency. All of these effects lead to reduction of the plant maximum capacity, which appreciably reduces the financial return on the capital investment in the power plant. Furthermore, aggressive materials, such as sodium hydroxide ($NaOH$) and sodium chloride ($NaCl$), may condense and deposit on turbine surfaces. Such deposits occasionally contribute to failure due to cracking of highly stressed turbine blades and rotors. Repairs and outages are extremely costly.

4.1.3 By monitoring the concentration of deposit-forming impurities in steam, a power plant operator can take steps necessary to limit the impurities to tolerable concentrations and thus minimize or eliminate losses due to excessive deposits.

5. Sampling

5.1 Collect the samples in accordance with Practice D 1066 and Practices D 3370 as applicable.

5.2 The concentrations of sodium and silica in steam samples are usually well below 1 mg/L (ppm). Because these materials exist in relative abundance in normal plant and laboratory environments, even in atmospheric dust, extreme caution must be used when collecting and handling samples to avoid contamination. The use of a continuously flowing sample, which eliminates the need for collecting, handling, and storing individual samples, is preferred.

TEST METHOD A—GRAVIMETRIC OR EVAPORATIVE

6. Scope

6.1 The gravimetric test method is recommended for applications for which an average value of impurities over a period of several days or weeks is desired. It is particularly useful for samples in which a large percentage of the impurities are insoluble, do not contain sodium, or do not contribute appreciably to the electrical conductivity of the samples, because the other methods are not satisfactory for these conditions. Examples of such impurities are metals and metal oxides. It is not applicable when short-time trends are of interest or when immediate results are desired. The test method is useful for the determination of concentrations of impurities of 0.25 mg/L (ppm) or greater when a previously collected sample is used and for impurities concentrations of 0.1 mg/L (ppm) or greater when continuous sampling is used. Concentrations less than 0.1 mg/L (ppm) can be determined if a continuously flowing sample is evaporated for an extremely long period of time.

7. Summary of Test Method

7.1 This test method involves the evaporation of a quantity of steam condensate at a temperature below the boiling point and the weighing of the residue to determine the amount of impurities in the sample. The evaporation process may be carried out on a steam condensate sample previously collected, or the sample may be taken continuously as the evaporation process is continued.

8. Interferences

8.1 Possible interferences for this test method are described in Test Methods D 5907.

9. Apparatus

9.1 Apparatus shall be provided in accordance with the applicable test method of Test Methods D 5907.

10. Procedure

10.1 Proceed in accordance with Test Method D 5907 to determine filterable and nonfilterable matter in the sample.

11. Calculation

11.1 Calculate the concentration of impurities in the sample from the sum of the filterable and nonfilterable matter.

11.2 Dissolved matter and total matter are usually of greatest interest in the determination of impurities in steam. The determination of fixed solids after ignition at some temperature greater than 103°C (217°F) may be of more significance than the measurement taken at 103°C, depending on the type of solids in the sample and the maximum temperature to which the steam is to be heated in the application.

12. Precision and Bias

12.1 The precision of the analytical results is given in Test Methods D 5907. Because of the uncertainties involved in sampling steam, it is not possible to state the overall precision of this test method.

TEST METHOD B—ELECTRICAL CONDUCTIVITY

13. Scope

13.1 *Ion-Exchange Degasser*—An ion-exchange degasser consists of an ion-exchange resin that exchanges hydrogen ions for all cations in the sample, thereby eliminating all basic dissolved gases, including volatile amines. By converting mineral salts to their acid forms, it also increases the specific conductance of the impurities. As a result, the linear relationship between conductivity and impurity content is extended to a much lower level, depending on the carbon dioxide content. The test method is very useful for measuring low concentrations of impurities, such as condenser cooling water leakage, in steam condensate, and it is especially useful, for indicating small or intermittent changes in impurity content from some normal value. The test method is not satisfactory for the determination of impurities in steam condensate samples that contain acidic gases, such as carbon dioxide, large percentages of insoluble matter, or substances that ionize weakly. The sensitivity and accuracy of the method are decreased for samples in which hydroxides represent an appreciable percentage of the impurities, because hydroxides, which contribute to the formation of deposits, are converted to water by the ion-exchange resin. This characteristic is particularly significant when steam is generated at sufficiently high pressure to cause appreciable vaporization of sodium hydroxide from the boiler water.

13.2 *Mechanical and Ion-Exchange Degasser*—By combining mechanical and ion-exchange degassing of steam or condensed steam, or both, effective elimination of both acidic and basic dissolved gases is attained. This arrangement has the same advantages and limitations as the ion-exchange degasser alone, except that it will remove acidic gases, and the greater sensitivity afforded by measuring the conductance at atmospheric boiling water temperature extends the linear relationship between conductivity and the ionized impurity content down to about at least 0.005 mg/L (ppm). Although the relationship becomes somewhat nonlinear, the conductance is sensitive to concentration changes down to at least 0.005 mg/L (ppm). [3]

14. Summary of Test Method

14.1 Because the concentrations of impurities in steam condensate are usually very low, most impurities are assumed to be completely dissolved and completely ionized. Therefore, the electrical conductivity of the condensate sample is a measure of the concentration of ionized impurities in the sample.

14.2 Most steam contains gases from decomposition of certain substances in boiler feedwater and from the addition of chemicals to boiler water or boiler feedwater for the control of corrosion. These gases dissolve and ionize in the condensed steam samples. Since such gases normally do not form deposits, their contribution to conductivity should be eliminated by degassing the sample before its electrical conductivity is measured. Because mechanical degassing is not completely effective, the amount of residual gases must be determined and the measured conductivity value must be corrected for their effect. Although mechanical degassers may still be used to a limited extent, they are no longer available commercially. The use of mechanical degassers should be considered obsolete.

14.3 Basic dissolved gases, many of which are not effectively removed by mechanical degassing, are converted to water by an ion-exchange degasser. The ion-exchange degasser also converts mineral salts to their acid form by exchanging hydrogen ions for the metallic cations. Since the specific conductance of the acid form is roughly three times that of the original mineral salts at 25°C (77°F), the sensitivity of measurement is increased. If the conductance measurement is made at the atmospheric boiling point (approximately 100°C (212°F)), the specific conductances of the ions are increased and the sensitivity of measurement is improved still further.

15. Interferences

15.1 Residual gases remaining in steam condensate samples after mechanical degassing constitute interference with the conductivity measurement. The concentrations of these gases remaining in the samples shall be determined, and appropriate corrections shall be subtracted from the measured conductivity values.

16. Apparatus

16.1 Apparatus shall be provided in accordance with Test Methods D 1125.

16.2 *Ion-Exchange Degasser*—The ion exchange column shall consist preferably of sulfonated styrenedivinyl-benzene resin in a container of plastic or other corrosion-resistant material. A column of approximately 38-mm (1.5-in.) internal diameter and 305 mm (12 in.) in length, containing about 272 g (0.6 lb) of resin, is satisfactory for most applications. Woven plastic fabric or similar corrosion-resistant material is required at each end of the column to retain the resin and to permit the condensate sample to enter and leave the column. An example of an ion-exchange column, equipped with a conductivity cell, flowmeter, and thermometer, is shown in Fig. 1.

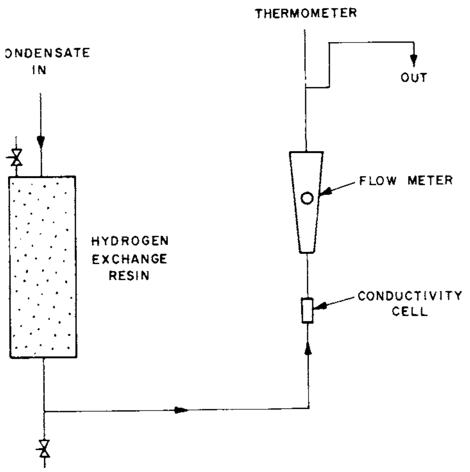

FIG. 1 Larson-Lane Condensate Analyzer

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[3] Lane, R. W., Sollo, F. W., and Neff, C. H., "Conductance Conductivity Monitoring of Anions in High-Purity Water", *Symposium on Power Plant Instrumentation for Measurement of High-Purity Water Quality, ASTM STP 742*, 1981.

16.3 *Mechanical-Ion-Exchange Degasser* —This apparatus consists of a vented condenser in which the steam sample is condensed and mechanically degassed, a cooling coil, a hydrogen ion-exchange bed, and a vented reboil chamber. The vented condenser removes nearly all carbon dioxide and appreciable amounts of other gases. The condensate is cooled in the cooling coil before being transferred to the exchange bed to minimize leaching of the resin (Note 1). The exchange bed exchanges hydrogen ions for all cations in the sample. Thus, hydroxides, ammonia, and alkaline amines are converted to water, carbonates are converted to carbonic acid, and mineral salts are converted to acids. Carbonic acid is driven off as carbon dioxide in the vented reboil chamber. Suitable control valves are required to regulate sample flow rate (Note 2), to adjust cooling water flow rate (Note 3), and to proportion properly the steam sample between the condensing coils in the condenser and in the reboiler. A conductivity cell to measure conductivity of the sample from the reboiler is required (Note 4), and a second conductivity cell to measure conductivity of the effluent from the condenser is helpful in providing an approximation of the amine concentration, in disclosing the need for resin replacement, and in monitoring the proper operation of the apparatus. Also, thermometers to indicate temperatures of effluent cooling water of the sample entering the resin bed, and of the effluent sample from the reboiler are required to control the apparatus properly. A mechanical-ion-exchange degasser is illustrated in Fig. 2.

NOTE 1—Sulfonated styrenedivinylbenzene resin with 8 % cross-linkage has proven to be the most stable type and experiences minimum leaching.

NOTE 2—Commercially available equipment uses the heat from the condensing steam sample to reboil the condensate and to drive off carbon dioxide and other dissolved gases. Such apparatus is designed for a specific condensing pressure which is often considerably less than the pressure of the steam sample. When the steam sample is throttled to condensing pressure, care must be taken to assure that the sample does not become superheated. Even slight superheating can cause deposits of impurities to form at the point of throttling, resulting in a loss of impurity content of the sample. Such superheating can be avoided by providing a sufficiently long uninsulated sampling line before the point of throttling, by providing an auxiliary cooling coil to partially condense the sample upstream of the point of throttling, or by injecting a portion of the condensate sample before the point of throttling. If the condensate injection method is used, the condensate should be obtained from the vented condenser overflow.

NOTE 3—Commercially available apparatus includes a thermostatic valve for controlling cooling water temperature by automatically adjusting cooling water flow rate and manual flow regulating valves to proportion properly the sample steam to the condenser and to the reboiler.

16.3.1 Because conductivity is measured at the constant temperature of atmospheric boiling water, the measuring instrument shall indicate actual conductance at this temperature and shall not include automatic temperature compensation.

17. Procedure

17.1 *Ion-Exchange Degasser*—Operate the condensing and cooling coil for a sufficient length of time to remove contamination. Flush condensate through the ion-exchange column for at least 5 min. Measure the conductivity of the sample in accordance with Test Methods D 1125. If the relationship between conductivity and impurity content is not known, determine the concentration of chloride, sulfate, sulfite, nitrate, and phosphate ions in the boiler water in accordance with Test Methods D 512, D 516, D 5542, D 3867, and D 5542, respectively. Also, determine the total matter in accordance with the sum of the filterable and nonfilterable matter as determined in Test Method D 5907.

17.2 *Mechanical-Ion-Exchange Degasser*—Place the apparatus in operation with a sample flow rate of 189 to 567 g/min (25 to 75 lb/h) and adjust the cooling water control valve to provide a constant cooling water effluent temperature of 40 to 70°C (104 to 158°F). During initial operation, the condensate cooling coil is by-passed and the condensate leaving the resin is maintained at near boiling water temperature. Operation at this temperature cleans the resin more quickly. The throttling valve between the condensing chamber and the resin chamber should be adjusted so that 19 to 45 g/min (2½ to 6 lb/h) flow from the condensing chamber overflow (Note 4). In order to provide a definite plume of steam from the reboil chamber vent and to provide a condensate effluent temperature of approximately 99°C (210°F), open the outlet-reboil-chamber-steam valve completely and throttle the inlet-reboil-chamber-steam valve accordingly. After operating the apparatus for a sufficient length of time, indication that contamination has been completely removed will be shown by a constant conductivity value of about 1.6 micromhos/cm (Note 5). Then, cooling of the condensate entering the resin chamber should be initiated by opening the cooling water valves to the condensate cooler and by closing the bypass valve. It is possible that the cooling water control valve setting may require adjustment to provide an outlet temperature of the resin chamber condensate of 25 to 40°C (77 to 104°F) and to provide a cooling water effluent temperature of 40 to 70°C. Readjustment of the reboil chamber steam valves will likely be required. Opening the inlet-reboil-chamber-steam valve completely and gradually closing the outlet-reboil-steam valve, until a definite steam plume is obtained at the reboil chamber vent, is suggested. Measure the electrical conductivity of the sample in accordance with Test Methods D 1125, except that the conductivity shall not be corrected to 25°C. The conductivity shall be determined at the temperature of the sample with no correction. If the relationship between conductivity and impurity content is not known, determine the composition of the boiler water and the total matter in the boiler water in accordance with 17.1.

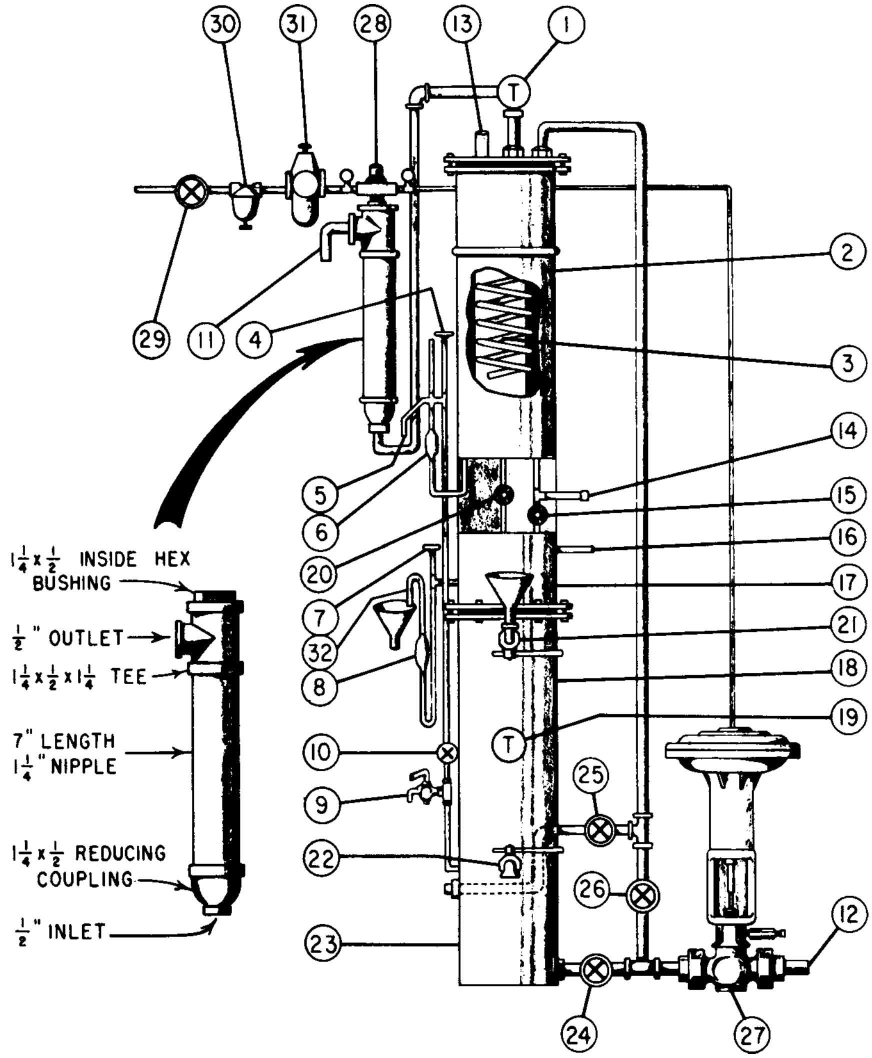
NOTE 4—If condensate is injected into the steam sample before the point of throttling, the condensate should be obtained from the vented condenser overflow. In this case, the flow rate into the instrument should be increased by opening the sample regulating valve; and the throttling valve between the condensing chamber and the resin chamber should be adjusted to provide the additional amount of condensate required for de-superheating in addition to the overflow rate of 19 to 45 g/min (2½ to 6 lb/h).

NOTE 5—The "mho" is used in this standard as the unit of electrical conductance until such time as the equivalent SI unit, the siemens (symbol S) is accepted by the committee having jurisdiction.

18. Calculation

18.1 *Ion-Exchange Degasser*:

18.1.1 If the relationship between conductivity and impurity content is known, divide the measured conductivity value by



1—Cooling water effluent thermometer
2—Condensing chamber
3—Condensing coil
4—Alternate location for thermometer (top chamber effluent)
5—Condensing chamber overflow
6—Location for second conductivity cell (top chamber effluent)
7—Effluent thermometer
8—Effluent conductivity cell
9—Sampling cock and drain
10—Throttling valve
11— 1 / 2 -in. NPT cold water outlet
12— 1 / 2 -in. NPT cold water inlet
13—Steam vent
14—Steam inlet
15—Inlet reboil chamber steam valve
16—Reboil chamber vent
17—Reboil chamber
18—Resin chamber
19—Resin chamber condensate temperature
20—Outlet reboil chamber steam valve
21—Resin inlet valve
22—Resin outlet valve
23—Condensate cooler
24—Cooling water inlet valve
25—Cooling water outlet valve
26—Cooling water by-pass valve
27—Cooling water control valve
28—Cooling water temperature sensing bulb, well, and air pressure gages
29—Air supply
30—Air filter
31—Air pressure reducing valve and gages
32—Condensate effluent

FIG. 2 Larson-Lane Steam Purity Analyzer

the ratio of conductivity (in acid form) to impurity content to determine the concentration of impurities in the sample.

18.1.2 If the relationship between conductivity and impurity content is not known, it shall be determined from the composition of the boiler water, as follows:[4]

$$E = \frac{12.0\,(Cl^{-})+8.9\,(SO_4^{--})+9.9\,(SO_3^{--})+12.0\,(PO_4^{---})+6.8\,(NO_3^{-})}{T}$$

where:

E = ratio of conductivity (in acid form) to impurity content at 25°C (77°F),

Cl^{-}, SO_4^{--}, etc., = concentrations of these anions in the boiler water, mg/L (ppm), and

T = total solids in the boiler water determined by evaporation, mg/L (ppm).

18.2 *Mechanical-Ion-Exchange Degasser*:

18.2.1 Subtract 0.81 micromho/cm, the theoretical conductivity of pure water at 98.5°C (209.3°F), from the measured conductivity. (Although the sea-level boiling point of water is 100°C (212°F), a temperature of 98.5°C is assumed to account for reasonable altitudes above sea level and heat losses from the sample as it flows from the reboil chamber to the conductivity cell.)

18.2.2 If the relationship between conductivity and impurity content is known, divide the corrected conductivity determined in accordance with 18.2.1 by the ratio of conductivity to impurity content to determine the concentration of impurities in the sample.

18.2.3 If the relationship between conductivity and impurity content is not known, it shall be determined from the composition of the boiler water, as follows:[4]

$$C = \frac{17.0\,(Cl^{-})+13.6\,(SO_4^{--})+9.6\,(NO_3^{-})+4.8\,(PO_4^{---})}{T}$$

where:

C = the ratio of conductivity (in acid form) to impurity content at 98.5°C (209.3°F),

Cl^{-}, SO_4^{--}, etc., = concentration of these anions in the boiler water, mg/L (ppm), and

T = total solids in the boiler water determined by evaporation, mg/L (ppm).

19. Precision and Bias

19.1 The precision of the analytical results is given in Test Methods D 1125. Because of the uncertainties involved in sampling steam, it is not possible to state the overall precision of the test method.

TEST METHOD C—SODIUM TRACER

20. Scope

20.1 The principal advantages of the sodium tracer test method are the freedom from interferences, the ability to measure extremely small concentrations of impurities, and the rapid response to transient conditions because of the absence of large stagnant sample volumes, such as reboil chambers. Either of two procedures may be employed for the sodium determination, as follows: Precise control of sample temperature is not required for the flame photometry test method. If the impurities are principally sodium compounds, impurity concentrations as low as 0.6 µg/L (ppb) may be detected by the flame photometry method and as low as 0.5 µg/L (ppb) by the sodium ion electrode test method. The sodium tracer test method is not recommended for samples having large percentages of impurities that do not contain sodium.

21. Summary of Test Method

21.1 This test method utilizes the element sodium as a tracer material to determine the amount of impurities in steam. It is assumed that the ratio of concentrations of sodium-to-impurities in steam is equal to the corresponding ratio in boiler water.

22. Interferences

22.1 The types of materials found in steam and their extremely low concentrations render this method free of interferences under ordinary circumstances. Possible interferences in the alternate sodium detection methods are given in Test Methods D 1976, D 2791, D 4191, and D 6071.

23. Apparatus

23.1 Apparatus shall be provided in accordance with Test Methods D 1976, D 4191, D 6071, or D 2791.

24. Procedure

24.1 Determine the sodium content of both steam and boiler water samples.

24.1.1 When the flame photometric test method is employed, determine the sodium concentration of steam either from a continuously flowing sample or from at least ten separately collected samples taken under steady-state conditions. When several separate samples are taken, compare their sodium concentrations to assure that steady-state conditions existed during the sampling period. Samples having sodium contents considerably higher than other samples are generally assumed to be contaminated and shall be discarded. A continuously flowing sample must be employed for the sodium ion electrode test method.

24.1.2 Since the sodium content of boiler water samples may be quite high, exceeding 100 mg/L (ppm), add a sufficient amount of sodium-free water to the samples to dilute their sodium contents to this level or less before analysis by Test Methods D 1976, D 4191, or D 6071. Measure the amount of water added to each sample and the amounts of the original samples to enable calculation of the sodium ion concentrations of the original samples. It is possible that the electrode method could be employed as a static test; however, this procedure apparently is not available in the literature and would have to be developed by the analyst.

24.2 Determine the total matter in boiler water samples from the sum of filterable and nonfilterable matter as determined in Test Method D 5907.

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[4] Lane, R. W., Neff, C. H., and Larson, T. E., "A New Method for Increasing the Sensitivity of the Conductivity Measurement of Steam Purity," *Proceedings of the American Power Conference*, Vol XXIII, 1961, pp. 550–558.

25. Calculation

25.1 Calculate the impurity concentration of the steam samples, as follows:

$$S_t = S_s(W_t/W_s)$$

where:

S_t = concentration of impurities in steam, mg/L,

S_s = concentration of sodium in steam, mg/L,

W_t = concentration of total matter in boiler water, mg/L, and

W_s = concentration of sodium in boiler water, mg/L.

26. Precision and Bias

26.1 The precision of the analytical results are given in Test Methods D 1976, D 2791, D 4191, and D 6071. Because of the uncertainties involved in sampling steam, it is not possible to state the overall precision of the test method.

TEST METHOD D—SILICA, METALS, AND METAL OXIDES

27. Scope

27.1 Silica and various metals are impurities that are occasionally found in steam and have definite tendencies to form deposits. Since these substances are not isolated when using Test Method A and are not detected when using Test Methods B and C, it is advisable to determine their concentrations separately when they are present in significant quantities.

28. Summary of Test Method

28.1 Consult the appropriate ASTM test method for a summary.

29. Procedure

29.1 Proceed in accordance with the applicable ASTM test methods, as follows:

D 857—Aluminum in Water,
D 859—Silica in Water,
D 1068—Iron in Water,
D 1687—Chromium, Total, in Water,
D 1688—Copper in Water,
D 1886—Nickel in Water, and
D 3082—Boron in Water.

30. Precision and Bias

30.1 The precision of the analytical results is stated in the appropriate test methods listed in Section 29. Because of the uncertainties involved in sampling steam, it is not possible to state the overall precision of the test method.

31. Keywords

31.1 deposit-forming; electrical conductivity; evaporate; gravimetric; impurities; Larsen-Lane; sodium tracer; steam