



Designation: D 933 – 84 (Reapproved 1999)

Standard Practice for Reporting Results of Examination and Analysis of Water- Formed Deposits¹

This standard is issued under the fixed designation D 933; 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.

1. Scope

1.1 This practice covers the manner in which the results of examination and analysis for inorganic constituents of deposits formed from waters are to be reported.

1.2 While various practices of reporting the analysis of water-formed deposits are in use, this practice is intended as a rational and comprehensive practice for general application. For use in specific industries or individual cases, molecular combinations may be useful and desirable.

1.3 *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:*

D 887 Practices for Sampling Water-Formed Deposits²

D 1129 Terminology Relating to Water³

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁴

3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice reference should be made to Terminology D 1129.

4. Significance and Use

4.1 The results are used to characterize the scale formed and used to evaluate the quality of water used in the unit. Characterizing the scale will assist in the design of the water treatment process to avoid further scale buildup. The use of

modern up-to-date chemical detection units will increase the usefulness of the practice.

5. History of Sample

5.1 Information regarding the source and history of the sample shall be included in the report of the analysis. This information should be that specified in Practices D 887, as follows:

5.1.1 Name of individual or company supplying sample,

5.1.2 Geographic origin of sample,

5.1.3 Date and time of sampling,

5.1.4 Number of sample,

5.1.5 Name and other designation of equipment from which sample was removed,

5.1.6 Precise location from which sample was removed (for example, exactly what turbine blade),

5.1.7 Appearance and extent of deposit prior to removal,

5.1.8 Type of deposit—whether scale, sludge, biological deposit, or corrosion product as defined in Practices D 887,

5.1.9 Exact method that was used in removing the sample and notes concerning any contamination that might have occurred during the process,

5.1.10 Operating temperature and pressure of liquid or vapor in the equipment that contained the deposit,

5.1.11 Type of treatment applied to the water that formed the deposit or to the water that furnished steam to the affected zone,

5.1.12 An account of discrepancies in operating condition that may have contributed to deposition (for example, water starving),

5.1.13 Results of field tests made on the sample or related equipment, and

5.1.14 Signature of sampler.

6. Physical Characteristics

6.1 The report shall include a description of the physical characteristics of the sample, including any peculiarities that may be pertinent in its further examination.

¹ This practice is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.03 on Sampling of Water and Water-Formed Deposits, Surveillance of Water, and Flow Measurement of Water. Current edition approved Sept. 11, 1984. Published November 1984. Originally published 1947. Last previous edition D933 – 50 (1982) ϵ ¹.

² *Annual Book of ASTM Standards*, Vol 11.02.

³ *Annual Book of ASTM Standards*, Vol 11.01.

⁴ *Annual Book of ASTM Standards*, Vol 14.02.

6.2 Characteristics such as the following may be recorded: color, form, (scaly, slimy, drusy, etc.), texture (oily, smooth, friable, gritty, etc.), hardness, magnetic properties (as determined by test with magnet), and structure (amorphous, crystalline, columnar crystals).

7. Completeness and Accuracy of Analysis

7.1 The determinations to be reported in a complete analysis shall be those listed in Table 1. For many practical purposes, a less complete analysis will suffice. In other instances the location or nature of the deposit or a knowledge of the composition of the equipment affected will suggest the need for determinations in addition to those listed.

7.2 The completeness and accuracy of the analysis should be carefully appraised before reporting. In a complete analysis, the summation of all determinations under oxides, acid radicals, ether-extractable matter, carbonaceous matter, and combined water shall total $100 \pm 2\%$.

7.3 A summation in excess of 102 % indicates a positive error in one or more of the determinations (or the calculation of a metal or element as an oxide, or the calculation of a lower oxide as a higher oxide). The converse may be indicated when the summation is below 98 %, or it may be due to the presence of a substance not identified and not determined.

TABLE 1 Constituents of Water-Formed Deposits to Be Reported

Oxides: ^A	Acid Anhydrides: ^B
Iron oxide, ^C Fe ₂ O ₃	Carbonate, CO ₂
Alumina, ^D Al ₂ O ₃	Chloride, Cl
Calcium oxide, CaO	Nitrate, N ₂ O ₅
Magnesium oxide, MgO	Sulfate, SO ₃
Sodium oxide, ^E Na ₂ O	Sulfite, SO ₂
Potassium oxide, ^F K ₂ O	Sulfide, ^F S
Copper oxide, CuO	Phosphate, P ₂ O ₅
Zinc oxide, ZnO	Silica, SiO ₂
Lead oxide, PbO	<i>Miscellaneous:</i>
Titanium oxide, TiO ₂	Ammonia (reported as NH ₃)
Nickel oxide, NiO	Water-soluble matter
Chromium oxide, Cr ₂ O ₃	Ether-extractable matter (oil)
Tin oxide, SnO ₂	Carbonaceous matter ^G
	Combined water
	Moisture
	Total weight of sample (where significant)

^A Expression of analytical results in terms of oxides is an arbitrary procedure sanctioned by long usage and general convenience. Adherence to this convention does not imply that any of the oxides necessarily are present in the sample as such, although this may actually be the case with respect to such items as iron oxide and silica. A metal oxide shall be reported in the form listed in Table 1 unless the form present has been otherwise identified. Any metal definitely identified to be present in the sample in the metallic form shall be reported as such.

^B Organic acid radicals of soaps shall be reported as the anhydride of oleic acid (C₁₇H₃₃O₂), unless the specific acid has been identified.

^C When iron oxides other than Fe₂O₃ are known to be present (Fe₃O₄ and FeO), but determination of the separate oxide forms is considered not to be essential, report as "Iron oxides as Fe₂O₃."

^D If alumina is not separated from iron oxide in the analytical procedure, report as "Iron and aluminum oxides as Fe₂O₃."

^E If sodium and potassium are not separated, report as "Sodium and potassium oxides as Na₂O."

^F Elementary sulfur shall be reported as S.

^G Graphite or other forms of carbon shall be reported as C.

8. Reporting of Chemical Analysis

8.1 All data, except water, shall be reported as percentage by weight of the dry sample. Water shall be reported on the as-received basis.

8.2 For convenience in calculation, values for oxides, acid anhydrides, and combined water may also be expressed on a basis of chemical equivalents. Values for relative equivalents are obtained by dividing each value of percentage by weight by the equivalent weight of the respective oxide, acid radical, or water.

8.3 Quantitative determinations shall be reported to the nearest 0.1 % (8.4). When a quantitative determination is made and a negative result is obtained, it shall be reported as "0.0" with a notation as to the amount of sample used and the method of determination. When a determination has been omitted, but the heading of the determination is carried in a tabulation with determinations of other samples, the absence of a determination for any other specific sample shall be indicated by an entry "no determination" or by a dash. The terms, "nil," "none," and "trace" shall not be used. If the qualitative determination shows presence, and a quantitative determination shows absence, the item shall be reported as "less than 0.1" with a notation that this is a qualitative estimation.

8.4 In so far as applicable, Practice E 29 shall be followed in expressing numerical results.

9. Reporting Results of X-ray Diffraction and Petrographic Examination

9.1 All constituents identified by X-ray diffraction or petrographic examination shall be reported according to the following rules:

9.1.1 *Silicon Compounds*—Report all compounds containing silicon, except the simple alkali silicates, by their trivial name and combined-oxide formula. Example: acmite, Na₂O·Fe₂O₃·4SiO₂.

9.1.2 *Polymorphous Compounds*—Report compounds having more than one crystal form by their trivial name and chemical formula. Examples: calcite, βCaCO₃ and argonite, γCaCO₃.

9.1.3 *Multiple Salts*—Report multiple salts by their trivial name and combined-compound formula. Examples: burkeite, Na₂CO₃·2Na₂SO₄, and malachite, CuCO₃·Cu(OH)₂.

9.1.4 *Other Compounds*—Report compounds not covered by the above rules by their chemical name and chemical formula. Example: sodium chloride, NaCl.

9.1.5 *Controversial Compounds*—Report compounds whose nomenclature is in controversy in accordance with the latest revision of the Powder Diffraction File⁵, subject to conformance with rules (9.1.1 to 9.1.4).

9.1.6 If a compound can be reported by several rules, the rule first listed that covers that compound must prevail.

⁵ This Card Index File may be purchased from the Joint Committee on Powder Diffraction Standards, 1601 Park Lane, Swarthmore, PA 19081.



9.1.7 Free elements must be considered as compounds in applying the above rules.

9.1.8 If the compound does not have a trivial name and the rule calls for a trivial name, the chemical name must be used.

9.1.9 The Greek letter and Roman numeral conventions already adopted in the literature must be accepted as standard.

10. Reporting Results of Spectrochemical Analysis

10.1 Results of spectrochemical analysis shall be reported in terms of elements present.

10.2 The elements may be grouped as major, minor, and trace constituents, with due regard for variation in the sensi-

tivity of the method for the various elements reported. A satisfactory grouping in terms of percentage of the element present is as follows:

	Amount of Element Present, %
Major	over 5
Minor	0.5 to 5
Trace	under 0.5

While the identification of elements is positive, quantitative measurements are only approximations.

11. Keywords

11.1 crystallographic examination; deposits; metal oxides; scale; spectrochemical analysis

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).