



## Standard Practice for Reporting Results of Examination and Analysis of Water-Formed Deposits<sup>1</sup>

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 Deposits<sup>2</sup>

D 1129 Terminology Relating to Water<sup>3</sup>

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications<sup>4</sup>

### 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.

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

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 11.02.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 11.01.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 14.02.

**TABLE 1 Constituents of Water-Formed Deposits to Be Reported**

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

<sup>A</sup> 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 I 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.

<sup>B</sup> Organic acid radicals of soaps shall be reported as the anhydride of oleic acid (C<sub>17</sub>H<sub>33</sub>O<sub>2</sub>), unless the specific acid has been identified.

<sup>C</sup> When iron oxides other than Fe<sub>2</sub>O<sub>3</sub> are known to be present (Fe<sub>3</sub>O<sub>4</sub> and FeO), but determination of the separate oxide forms is considered not to be essential, report as "Iron oxides as Fe<sub>2</sub>O<sub>3</sub>."

<sup>D</sup> If alumina is not separated from iron oxide in the analytical procedure, report as "Iron and aluminum oxides as Fe<sub>2</sub>O<sub>3</sub>."

<sup>E</sup> If sodium and potassium are not separated, report as "Sodium and potassium oxides as Na<sub>2</sub>O."

<sup>F</sup> Elementary sulfur shall be reported as S.

<sup>G</sup> Graphite or other forms of carbon shall be reported as C.

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 ± 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.

## 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, Na<sub>2</sub>O·Fe<sub>2</sub>O<sub>3</sub>·4SiO<sub>2</sub>.

9.1.2 *Polymorphous Compounds*—Report compounds having more than one crystal form by their trivial name and chemical formula. Examples: calcite, βCaCO<sub>3</sub> and argonite, γCaCO<sub>3</sub>.

9.1.3 *Multiple Salts*—Report multiple salts by their trivial name and combined-compound formula. Examples: burkeite, Na<sub>2</sub>CO<sub>3</sub>·2Na<sub>2</sub>SO<sub>4</sub>, and malachite, CuCO<sub>3</sub>·Cu(OH)<sub>2</sub>.

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 File<sup>5</sup>, 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.

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 sensitivity 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

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

Trace

under 0.5

**11. Keywords**

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

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

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