



Standard Practice for Oxidation-Reduction Potential of Water ¹

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1. Scope

1.1 This practice covers the apparatus and procedure for the electrometric measurement of oxidation-reduction potential (ORP) in water. It does not deal with the manner in which the solutions are prepared, the theoretical interpretation of the oxidation-reduction potential, or the establishment of a standard oxidation-reduction potential for any given system. The practice described has been designed for the routine and process measurement of oxidation-reduction potential.

1.2 *This standard does not purport to address all of the safety problems, 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 1129 Terminology Relating to Water ²

D 1193 Specification for Reagent Water ²

D 3370 Practices for Sampling Water from Closed Conduits ²

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *oxidation-reduction potential*—the electromotive force, E_m , developed between a noble metal electrode and a standard reference electrode. This oxidation-reduction potential (ORP) is related to the solution composition by:

$$E_m = E^o + 2.3 \frac{RT}{nF} \log A_{ox}/A_{red}$$

where:

E_m	= ORP,
E^o	= constant that depends on the choice of reference electrodes.
F	= Faraday constant,
R	= gas constant,
T	= absolute temperature, °C + 273.15,

n = number of electrons involved in process reaction, and

A_{ox} and A_{red} = activities of the reactants in the process.

3.2 For definitions of other items used in this practice, refer to Terminology D 1129.

4. Summary of Practices

4.1 This is a practice designed to measure the ORP which is defined as the electromotive force between a noble metal electrode and a reference electrode when immersed in a solution. The practice describes the electronic equipment available to make the measurement and describes how to determine the sensitivity of the electrodes as well as the calibration of equipment to solutions having a known potential. The ORP electrodes are inert and measure the ratio of the activities of the oxidized to the reduced species in the process reactions.

5. Interferences

5.1 The ORP electrodes reliably measured ORP in nearly all aqueous solutions and in general are not subject to solution interference from color, turbidity, colloidal matter, and suspended matter.

5.2 The ORP of an aqueous solution is sensitive to change in temperature of the solution, but temperature correction is rarely done due to its minimal effect and complex reactions. Temperature corrections are usually applied only when it is desired to relate the ORP to the activity of an ion in the solutions.

5.3 The ORP of an aqueous solution is almost always sensitive to pH variations even to reactions that do not appear to involve hydrogen or hydroxyl ions. The ORP generally tends to increase with an increase in hydrogen ions and to decrease with an increase in hydroxyl ions during such reactions.

5.4 Reproducible oxidation-reduction potentials cannot be obtained for chemical systems that are not reversible. Most natural and ground waters do not contain reversible systems, or may contain systems that are shifted by the presence of air. The measurement of end point potential in oxidation-reduction titration is sometimes of this type.

5.5 If the metallic portion of the ORP electrode is sponge-like, materials absorbed from solutions may not be washed away, even by repeated rinsings. In such cases, the electrode may exhibit a memory effect, particularly if it is desired to detect a relatively low concentration of a particular species immediately after a measurement has been made in a relatively

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² Annual Book of ASTM Standards, Vol 11.01.