



Standard Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blasting Abrasives¹

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1. Scope

1.1 This test method describes a procedure for rapid evaluation of abrasives for the presence of ionic contamination by determining the total concentration of water soluble ionic contaminants by means of a conductivity test.

1.2 This test method does not identify the ionic species present nor provide quantitative results on each species.

1.3 This test method is based on a volume comparison among abrasives of similar sizes. A volume comparison is more closely related to surface area of the abrasives than is a weight comparison.

1.4 *This standard does not purport to address all of 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 1193 Specification for Reagent Water²

E 832 Specification for Laboratory Filter Papers³

2.2 Other Standard:

ISO 11127-6 Preparation of Steel Substrates before Application of Paints and Related Products - Test Methods for Non-Metallic Blast Cleaning Abrasives - Part 6: Determination of Water-Soluble Contaminants by Conductivity Measurement⁴

2.3 Steel Structures Painting Council Standard:

SSPC-AB 1 "Specification for Mineral and Slag Abrasives"⁵

3. Summary of Test Method

3.1 Abrasive and pure water are combined into a slurry that is stirred to leach the soluble salts from the abrasive. This slurry is filtered and conductance of the filtrate is measured.

¹ This specification is under the jurisdiction of ASTM Committee D-1 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.46 on Industrial Protective Coatings.

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² *Annual Book of ASTM Standards*, Vol 11.01.

³ *Annual Book of ASTM Standards*, Vol 14.02.

⁴ Available from American National Standards Institute, 13th Floor, 11 W. 42nd St., New York, NY 10036.

⁵ Available from Steel Structures Painting Council, 40 24th Street, Pittsburgh, PA 15222.

The conductivity, which is related to the concentration of soluble ionic materials contaminating the abrasive surface, is calculated from the conductance and the cell constant.

4. Significance and Use

4.1 By-product abrasives manufactured from slags that are air cooled or quenched with pure water, normally contain low concentrations of ionic materials as do mined mineral abrasives. However, slags quenched with seawater or other contaminated water, contain high amounts of ionic material as does seashore sand. This contamination of the abrasive can transfer to the steel surfaces being blasted, where it may accelerate corrosion. This test is useful in establishing the cleanliness of the abrasive at the jobsite.

4.2 This test method provides a value that indicates the concentration of total water soluble ions in accordance with their electrolytic mobility. Thus, it provides an indication of ionic corrosion potential.

NOTE 1—A typical value of conductivity for a high level of contamination is 500 $\mu\text{mho/cm}$. A typical value for a low level of contamination is 50 $\mu\text{mho/cm}$.

5. Apparatus

5.1 *Conductivity Bridge and Cell*—Any commercial conductivity bridge and conductivity cell having a range of at least 5 $\mu\text{mho/cm}$ to 1 000 000 $\mu\text{mho/cm}$ and temperature compensation capability is satisfactory. Either a dip-type, pipet-type, or cup-type cell may be used. A means of adjusting for temperature or controlling the temperature is essential. While some instruments have an adjustment to compensate for temperature, one means is to use a 25°C constant temperature bath. Another method is to stir the solution with a clean thermometer while the vessel is warmed or cooled by an external source.

NOTE 2—ISO 11127-6 is another method for assessing the level of soluble salt contamination present in an abrasive. It differs from this test method in two major areas:

(1) The ISO method uses a weight to volume ratio between the abrasive and the fluid (deionized water) used to extract soluble salts from the abrasive. The ASTM method allows a user to measure a loose packed volume of abrasive and mix that abrasive with an equal volume of reagent water. The ISO method is well suited to use in a laboratory setting but is poorly suited to use in the field. The ASTM method is well suited for use in the field or laboratory.

(2) The ISO method reports the effect of the level of extracted salts in terms of milliSiemens/m, whereas this test method uses $\mu\text{mho/cm}$. The

ISO method uses strict SI units, this test method reports using SI compliant units.

Method to Method Comparison:

The reader is warned that it is difficult to make direct comparisons between the results of these two different methods of analysis.

Weight/Volume versus Volume/Volume Method Considerations:

In the ASTM Method the weight of the abrasive is not known; this makes it impossible to assess the ratio between conductivity values determined using this test method procedure and those determined using the ISO 11127-6 procedure.

Comparisons Between Reported Units for Each Method:

An independent study by SSPC showed that the relative order of extracted salts using each type of procedure on abrasive materials was identical. The ranked order correlation between the two methods was unity. There was no direct correlation possible between numerical results obtained and reported by the two different methods. Abrasives that showed qualifying extracted salts using the ISO Procedure also showed qualifying extracted salt levels as specified in SSPC-AB 1.

Converting from ISO Reported Units to ASTM Reported Units:

Converting from one unit base to another is not useful as the two methods differ in process. The conversion factor from $\mu\text{mho/cm}$ to milliSiemens/m is as follows:

$$\begin{aligned} & \text{A Micro Mho Per Centimetre} \\ & 1 \mu\text{mho cm}^{-1} (1 \times 10^{-6}) \Omega^{-1} \text{ cm}^{-1} \\ & \text{A MilliSiemen Per Metre} \\ & 1 (\text{MilliSiemen})(\text{m}^{-1}) = (1 \times 10^{-3}) \Omega^{-1} 100 \text{ cm}^{-1} \end{aligned}$$

Thus one milliSiemen/m = ten $\mu\text{mho/cm}$.

5.2 *Filter Paper*, conforming to Specification E 832, Type 1, Class C, to keep silt from fouling the surfaces of the conductivity cell.

6. Reagents and Materials

6.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available.⁶ 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.

6.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean reagent water as defined by Type IV of Specification D 1193.

6.3 *Potassium Chloride* (KCl or 0.02 N KCl solution).

7. Sampling

7.1 Sampling shall be as follows unless otherwise agreed upon between the purchaser and the seller. Take two 1-L samples of abrasive at random from different packages of each lot, batch, day's pack, or other unit of production in the shipment. When no markings distinguishing between units of production appear, take samples from the different packages in the ratio of two samples for each 5000 kg, except that for shipments of less than 5000 kg, take two samples. Test the samples separately.

⁶ *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

8. Calibration and Standardization

8.1 Determination of Cell Constant:

8.1.1 The conductivity cell will come with a predetermined constant. This constant should be checked periodically, one method being as follows:

8.1.1.1 Prepare a standard solution such as a 0.0005 N solution of KCl by diluting a 0.02 N KCl solution with water or by dissolving 0.0372 g of KCl (heated before weighing for 1 h at 105°C) in water, followed by dilution to 1 L. Cool and measure the conductance at 25°C as described in Section 9. Calculate the cell constant, K_{25} , as follows:

$$K_{25} = (C_s/C_m) \tag{1}$$

where:

C_m = conductance, measured at 25°C (see 10.1), μmho , and

C_s = conductivity, 72 $\mu\text{mho/cm}$ (from Table 1).

NOTE 3—In general the cell constant is not greatly affected by variations in the strength of the KCl solution, but, for greater accuracy, measurements should be made at or near the specific conductivity of the solution to be measured and at values that utilize the middle range of the scale of the conductivity bridge, using the same multiplier tap.

8.1.2 Table 1 gives values of specific conductivities for corresponding KCl solution concentrations which are useful for abrasive testing.

9. Procedure

9.1 Preparation of a Slurry Filtrate:

9.1.1 Rinse beakers, stirring rods, and funnels with reagent water until tests show the rinse water has a conductivity of 5.0 $\mu\text{mho/cm}$ or less.

9.1.2 Add 300 mL of water to 300 mL of abrasive and stir for 1 min with a stirring rod. Let stand for 8 min and then stir again for 1 min.

9.1.3 Filter sufficient supernatant liquid for tests, discarding the first 10 mL of the filtrate. The amount of supernatant liquid filtered shall be sufficient to cover the cell.

9.1.4 Rinse the conductivity cell in reagent water until the rinse water is a cleanliness of 5.0 $\mu\text{mho/cm}$ or less.

9.1.5 Rinse the conductivity cell two or three times with the filtrate then determine conductance at 25°C in accordance with the operating instructions of the instrument. Use successive portions of the sample until a constant value is obtained.

10. Calculation

10.1 Calculate the specific conductivity of the abrasive as follows:

$$C_s = C_m \times K_{25} \tag{2}$$

TABLE 1 Specific Conductivities for Potassium Chloride (KCl) Concentrations at 25°C

Normality	Heated, Dry KCl/Reagent Water Solution, g/L	KCl Conductivity, $\mu\text{mho/cm}$
0.0005	0.0373	72
0.001	0.0746	147
0.005	0.3728	718
0.01	0.7455	1414

11. Report

11.1 Report the following information:

11.1.1 The calibration value of the cell constant (both as measured and as predetermined and supplied with the conductivity cell), the date, and the name of the person checking the calibration.

11.1.2 The material, date, readings, and mean in $\mu\text{mho/cm}$ along with name of person conducting the tests and identification of the apparatus.

12. Precision and Bias ⁷

12.1 *Precision*—On the basis of five replicate interlaboratory tests of this test method in which three operators in three laboratories analyzed, in duplicate, six blasting abrasives containing ionogenic contamination, the within-laboratory coefficient of variation after rejecting results from one set of replicate tests as outliers, was found to be 1.7 % with 20 degrees of freedom (df) and the between-laboratory standard deviation coefficient of variation was found to be 7.4 % with 15 df. Based on these coefficients, the following criteria should be used for judging the acceptability of results at the 95 % confidence level:

12.1.1 *Repeatability*—Two results, each the mean of two runs obtained by the same operator should be considered suspect if they differ by more than 5 % relative.

12.1.2 *Reproducibility*—Two results, each the mean of two runs, obtained by operators in different laboratories should be considered suspect if they differ by more than 22 % relative.

12.2 *Bias*:

12.2.1 Bias can be present because of the mobility of various ions. The hydrogen ion has a much greater mobility than the hydroxyl ion or other ions so that at low pH's the conductivity will be relatively higher than at high pH's for the same ionic concentration. However, the bias introduced by this factor is in the proper direction. That is, high conductivity due to a lower pH of the contamination would normally indicate greater corrosion potential.

12.2.2 A bias may be introduced by extraneous contamination or from reduced sensitivity of instruments for low levels of contamination in the range of conductivity between 0 and 30 $\mu\text{mho/cm}$.

13. Keywords

13.1 ionogenic; contamination; steel surfaces; abrasive; blasting; conductimetric; analysis; interlaboratory testing; precision; chloride; conductivity; salts.

⁷ Supporting data available from ASTM Headquarters. Request RR: D01-1061.

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