Designation: D4940 – 15$^{\varepsilon 1}$

Standard Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blast Cleaning Abrasives[1]

This standard is issued under the fixed designation D4940; 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.

ε^1 NOTE—Conversion factor in Note 1 was editorially corrected in July 2016.

1. Scope

1.1 This test method describes a procedure for assessing blast cleaning abrasives for the presence of conductive-potential, ionic contaminants by determining the total concentration of water soluble conductive species using 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 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *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:*[2]

D1193 Specification for Reagent Water

E832 Specification for Laboratory Filter Papers

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 Measurement[3]

2.3 *SSPC: The Society for Protective Coatings:*[4]

SSPC-AB 1 Mineral and Slag Abrasives

SSPC-AB 2 Cleanliness of Recycled Ferrous Metallic Abrasive

SSPC-AB 3 Ferrous Metallic Abrasive

SSPC-AB 4 Recyclable Encapsulated Abrasive Media

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

4. Significance and Use

4.1 Abrasive media may contain ionic contamination naturally (for example, beach sand), from manufacturing (quenching with contaminated water), transportation, storage or use (in the case of abrasive that is reused). Ionic contamination on the abrasive may transfer to the surface during abrasive blast cleaning, resulting in potential osmotic blistering, accelerated underfilm corrosion and premature coating failure.

4.2 This test method describes a shop/field procedure for assessing the level of conductive species on an abrasive.

4.3 Abrasive standards published by SSPC (AB) and ISO 11126 provide tolerance levels for water soluble contaminants of the abrasive.

5. Apparatus

5.1 *Conductivity Bridge and Cell*—Any commercial conductivity bridge and conductivity cell typically having a range of at least 5 µmho/cm to 10,000 µmho/cm with built-in

---

[1] This test method is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.46 on Industrial Protective Coatings.

Current edition approved Dec. 1, 2015. Published December 2015. Originally approved in 1989. Last previous edition approved in 2010 as D4940 – 10. DOI: 10.1520/D4940-15E01.

[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] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from Society for Protective Coatings (SSPC), 40 24th St., 6th Floor, Pittsburgh, PA 15222-4656, http://www.sspc.org.

temperature compensation is satisfactory. A dip-type, pipet-type, or cup-type cell may be used.

5.2 *Filter Paper,* conforming to Specification E832, Type 1, Class C, to keep silt from fouling the surfaces of the conductivity cell.

NOTE 1—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 µmho/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 µmho/cm to milliSiemens/m is as follows:

A Micro Mho Per Centimeter

$$1 \mu\text{mhocm}^{-1} = (1 \times 10^{-6})\ \Omega^{-1}\ \text{cm}^{-1}$$

A MilliSiemen Per Meter

$$1\ (\text{MilliSiemen})(\text{m}^{-1}) = (1 \times 10^{-3})\ \Omega^{-1}\ (1 \times 10^{-2})\ \text{cm}^{-1}$$

Thus one milliSiemen/m = ten µmho/cm.

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.[5] 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 D1193.

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.

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 (weighed after heating 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:

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

where:

C_m = conductance, measured at 25°C (see 10.1), µmho, and
C_s = conductivity, 72 µmho/cm (from Table 1).

NOTE 2—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 use 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 µmho/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 µmho/cm or less.

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

Normality	Heated, Dry KCl/Reagent Water Solution, g/L	KCl Conductivity, µmho/cm
0.0005	0.0373	72
0.001	0.0746	147
0.005	0.3728	718
0.01	0.7455	1414

---

[5] *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.

9.1.5 Rinse the conductivity cell two or three times with the filtrate then determine conductance 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:

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

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 temperature from the conductivity meter.

11.1.3 The material, date, readings, and mean in µmho/cm along with name of person conducting the tests and identification of the apparatus.

12. Precision and Bias[6]

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 blast cleaning abrasives containing ionic 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 µmho/cm.

13. Keywords

13.1 abrasive; blast cleaning; chloride; conductimetric; conductivity; contamination; soluble salts

---

[6] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D01-1061. Contact ASTM Customer Service at service@astm.org.