Designation: E790 – 15

Standard Test Method for Residual Moisture in Refuse-Derived Fuel Analysis Samples[1]

This standard is issued under the fixed designation E790; 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 test method covers the measurement of residual moisture in refuse-derived fuel (RDF) analysis samples. It is used to calculate on a dry basis other determinations performed on analysis RDF samples. It is used with air-dry moisture results to calculate total moisture (Note 1). The total moisture is used to calculate as-received values or other analyses performed on a sample.

NOTE 1—In some instances RDF moisture may change during size-reduction steps of the RDF analysis sample preparation procedure. This moisture change, unless suitable corrections are made, will affect the accuracy of the total moisture value as calculated from the air-dry and residual moisture results.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *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.* For more specific precautionary information see Section 7.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D3173 Test Method for Moisture in the Analysis Sample of Coal and Coke

D5681 Terminology for Waste and Waste Management

E180 Practice for Determining the Precision of ASTM Methods for Analysis and Testing of Industrial and Specialty Chemicals (Withdrawn 2009)[3]

3. Terminology

3.1 For definitions of terms used in this test method, refer to Terminology D5681.

4. Summary of Test Method

4.1 This test method is based on the weight loss of an air-dried analysis RDF sample under rigidly controlled conditions of temperature, time, and air flow.

4.2 The total moisture is calculated from the loss or gain upon sample air drying and the residual moisture as determined by this test method.

5. Significance and Use

5.1 The procedure in this test method for a sample as specified herein is intended for the purpose of determining the residual moisture present in a RDF analysis sample.

5.2 The residual moisture value is used to correct as-determined analysis results such as gross heating value, sulfur, and ash to dry sample basis results.

6. Apparatus

6.1 *Drying Oven:*

6.1.1 *Referee Type*—The oven shall be constructed to have a uniform temperature within the specimen chamber, have a minimum excess air volume, and be capable of constant temperature regulation at 107 ± 3°C. Provision shall be made for renewing the preheated air in the oven at the rate of two to four times the oven air volume a minute, with the intake air dried by passing through a desiccant. An oven similar to the one illustrated in Fig. 1 of Test Method D3173 is suitable.

6.1.2 *Routine Type*—A drying oven of either the mechanical or natural circulation type which is capable of constant uniform temperature within the specimen chamber regulated at 107 ± 3°C.

NOTE 2—Either type of oven may be used for routine determinations. However, the referee-type oven shall be used to resolve differences between determinations.

6.2 *Containers*—Sample ash determinations are made using a porcelain capsule 22 mm in depth and 44 mm in diameter or a fused silica capsule of similar shape. A well-fitting flat aluminum cover is used when ashing samples. Platinum

[1] This test method is under the jurisdiction of ASTM Committee D34 on Waste Management and is the direct responsibility of Subcommittee D34.03 on Treatment, Recovery and Reuse.

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[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] The last approved version of this historical standard is referenced on www.astm.org.

crucibles or glass capsules with ground-glass caps may also be used. They should be as shallow as possible while remaining convenient to handle.

6.3 *Analytical Balance*—Balance capable of weighing with an accuracy of 0.1 mg.

6.4 *Analysis Sample Containers*—Heavy (minimum 4 mil), vapor-impervious bags, properly sealed; or noncorroding cans, glass jars, or plastic bottles with air-tight sealing covers to store RDF samples for analysis. Containers shall be checked for suitability by measuring weight loss or gain of the sample and container stored for 1 week under ambient laboratory conditions. The weight loss or gain should be less than 0.5 % of the sample weight stored in the container.

7. Precautions

7.1 Due to the origins of RDF in municipal waste, precautions should be observed when conducting tests on samples. Recommended safety practices include use of suitable gloves when handling RDF; wearing dust masks (NIOSH-approved type), especially when shredding RDF samples; conducting tests under a negative pressure hood when possible; and washing hands upon completion of activity and before eating or smoking.

7.2 Sample handling shall be performed by trained personnel. All operations shall be done as rapidly as possible to avoid sample moisture changes due to atmospheric exposure.

7.3 Since heavy fine particles tend to segregate rapidly in RDF analysis samples, the analyst should exercise care to assure that the analysis sample is well-mixed prior to performing this determination.

7.4 When residual moisture is to be used for the determination of total moisture, special care shall be taken to minimize any change in sample moisture between the completion of air drying and analysis for residual moisture. It is recommended that the delay between sample preparation and the determination of residual moisture not exceed 72 h.

8. Sampling[4]

8.1 RDF products are frequently inhomogeneous. For this reason, significant care should be exercised to obtain a representative sample from the RDF lot to be characterized.

8.2 The sampling method used to collect samples for this procedure should be based on agreement between the involved parties.

8.3 The laboratory sample must be air-dried and particle size reduced to pass through a 0.5-mm screen for this analysis. This procedure must be performed carefully to preserve the sample's representativeness beyond just particle size while preparing the analysis sample to be analyzed according to this procedure.

[4] ASTM Subcommittee E38.01 is currently in the process of developing procedures for sampling RDF and the preparation of an analysis sample. The chairman of E38.01 should be contacted for details.

9. Procedure

9.1 Heat the empty containers and covers under the same conditions under which the sample is to be dried, place the stopper or cover on the container, cool over a desiccant for about 15 to 20 min, and weigh to 0.1 mg. Mix the sample, if necessary, and take out with a spoon or spatula from the sample bottle approximately 1 g of sample. Put the sample quickly into the container, cover, and immediately to 0.1 mg.

NOTE 3—If weighing bottles with air-tight covers are used, it may not be necessary to preheat the moisture analysis container nor to desiccate it after drying.

9.2 Remove the cover and place in a desiccator. Quickly place the uncovered container into an oven preheated to 107 ± 3°C through which is passed a current of dry air. Close the oven at once and heat for 1 hr. Open the oven, remove, cover the container quickly, and cool to room temperature in a desiccator over desiccant. Weigh the sample and container as soon as they have cooled to room temperature.

10. Calculation (see Note 1)

10.1 Calculate the percent residual moisture, R, in the analysis sample as follows:

$$R = \frac{S - B}{S} \times 100 \quad (1)$$

where:

S = grams of analysis sample used, and
B = grams of sample after heating.

10.2 Calculate the percent total moisture in the laboratory sample, as follows:

$$M = \frac{R\,(100 - A)}{100} + A \quad (2)$$

where:

R = residual moisture, %, and
A = air dry loss determined during preparation of the analysis sample, %.

10.3 To convert other parameters determined on the analysis sample, such as ash, sulfur, and gross calorific value, to a dry sample basis, the following equation can be used:

$$P_{dry} = \frac{P_{ad}\,(100)}{100 - R} \quad (3)$$

where:

P_{ad} = parameter, %" as-determined" on the analysis sample,
R = residual moisture, % (see 10.1), and
P_{dry} = parameter, % expressed on a dry sample basis.

11. Precision and Bias

11.1 *Precision:*

11.1.1 The standard deviations of individual determinations, in percent absolute are as follows:

Typical Average Value	Within Laboratories	Between Laboratories
2.5–4.5 %	0.15 %	0.50 %

11.1.2 The above precision estimates are based on an interlaboratory study conducted in accordance to Practice E180.

11.2 *Bias*—The bias of this test method has not been determined due to a lack of an accepted standard reference material.