



Designation: E791 – 08 (Reapproved 2022)

Standard Test Method for Calculating Refuse-Derived Fuel Analysis Data from As-Determined to Different Bases¹

This standard is issued under the fixed designation E791; 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 gives equations to enable analytical data from the application of RDF analysis procedures to be expressed on various different bases in common use. Such bases are: as-received; dry; dry, ash-free; and others.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

D5681 Terminology for Waste and Waste Management

3. Terminology

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

3.2 *Symbols:*

3.2.1 The symbols used in this test method are as follows:

M = moisture, weight %,

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.

M_{ar} = moisture as-received (total moisture), weight %,
 M_{ad} = moisture as-determined (residual moisture), weight %,
 ADL = air-dry loss, weight %,
 P = any analysis parameter listed in 5.1, weight % (except gross calorific value in Btu/lb),
 H = hydroxygen, weight %,
 O = oxygen, weight %, and
 A = ash, weight %.

3.2.2 Subscripts used in this test method are as follows:

ad = as-determined,
 ar = as-received,
 d = dry, and
 daf = dry, ash-free (equivalent to moisture and ash-free, maf).

4. Significance and Use

4.1 This test method is available to producers and users of RDF to use in converting laboratory data from one basis to another.

5. Applicable Parameters

5.1 The calculation procedures defined in 7.1.3, 7.2.2, and 7.3.2 are applicable to the following analysis parameters when expressed as a weight percent (except gross calorific value as Btu/lb).

- 5.1.1 Ash,
- 5.1.2 Carbon,
- 5.1.3 Chloride, water-soluble,
- 5.1.4 Chlorine, total,
- 5.1.5 Calorific value (gross),
- 5.1.6 Fixed carbon,
- 5.1.7 Nitrogen,
- 5.1.8 Sulfur, and
- 5.1.9 Volatile matter.

6. Sampling

6.1 Sampling techniques are not directly applicable to this test method. However, sampling procedures are identified in the respective methods of analysis.



7. Methods for Calculating Data

7.1 Converting from the as-determined analysis sample basis to the as-received basis:

7.1.1 Moisture:

$$M_{ar} = [M_{ad} \times (100 - ADL)/100] + ADL \quad (1)$$

7.1.2 *Hydrogen and Oxygen*—Inasmuch as hydrogen and oxygen values may be reported on the basis of containing or not containing the hydrogen and oxygen in water (moisture) associated with the sample, alternate conversion procedures are defined as follows:

7.1.2.1 Hydrogen and oxygen reported include hydrogen and oxygen in water:

$$H_{ar} = \left[(H_{ad} - 0.1119 M_{ad}) \times \frac{100 - M_{ar}}{100 - M_{ad}} \right] + 0.119 M_{ar} \quad (2)$$

$$O_{ar} = \left[(O_{ad} - 0.8881 M_{ad}) \times \frac{100 - M_{ar}}{100 - M_{ad}} \right] + 0.881 M_{ar} \quad (3)$$

where:

0.1119 = ratio of the weight of hydrogen in water to the molecular weight of water, and

0.8881 = ratio of the weight of oxygen in water to the molecular weight of water.

7.1.2.2 Hydrogen and oxygen reported do not include hydrogen and oxygen in water:

$$H_{ar} = (H_{ad} - 0.1119 M_{ad}) \times \frac{100 - M_{ar}}{100 - M_{ad}} \quad (4)$$

$$O_{ar} = (O_{ad} - 0.881 M_{ad}) \times \frac{100 - M_{ar}}{100 - M_{ad}} \quad (5)$$

7.1.3 *Other Parameters*—The following equation is applicable to all parameters, P , listed in 5.1:

$$P_{ar} = P_{ad} \times \frac{100 - M_{ar}}{100 - M_{ad}} \quad (6)$$

7.2 Converting from the as-determined analysis sample basis to the dry basis:

7.2.1 Hydrogen and Oxygen:

$$H_d = (H_{ad} - 0.1119 M_{ad}) \times \frac{100}{100 - M_{ad}} \quad (7)$$

$$O_d = (O_{ad} - 0.881 M_{ad}) \times \frac{100}{100 - M_{ad}} \quad (8)$$

7.2.2 *Other Parameters*—The following equation is applicable to all parameters, P , listed in 5.1:

$$P_d = P_{ad} \times 100/(100 - M_{ad}) \quad (9)$$

7.3 Converting from the as-determined analysis sample basis to the dry, ash-free basis (see Note 1):

7.3.1 Hydrogen and Oxygen:

$$H_{daf} = (H_{ad} - 0.1119 M_{ad}) \times \frac{100}{100 - M_{ad} - A_{ad}} \quad (10)$$

$$O_{daf} = (O_{ad} - 0.8881 M_{ad}) \times \frac{100}{100 - M_{ad} - A_{ad}} \quad (11)$$

7.3.2 *Other Parameters*—The following equation is applicable to all parameters, P , listed in 5.1:

$$P_{daf} = P_{ad} \times \frac{100}{100 - M_{ad} - A_{ad}} \quad (12)$$

NOTE 1—It may not always be practical to report some parameters on a dry, ash-free basis due to oxidation of constituents as well as some elements being retained in the ash. The data calculated are to a theoretical base of no moisture or ash present in the sample.

8. Conversion Chart

8.1 To convert any of the analysis values for the parameters listed in 5.1 from one basis to another, multiply the given value by the value shown in the appropriate column in Table 1.

8.2 Hydrogen and oxygen on the as-determined basis include hydrogen and oxygen in free water (moisture) associated with the analysis sample. However, hydrogen and oxygen values reported on other moisture-containing bases may be reported either as containing or not containing the hydrogen and oxygen in water (moisture) reported on that basis. Conversion procedures are shown in Table 2.

9. Sample Calculations

9.1 An example of analysis data tabulated for a hypothetical RDF on various bases is shown in Table 3.

TABLE 1 Conversion Chart

NOTE 1—To convert any of analysis values for the parameters listed in 5.1 from one basis to another, multiply the given value by the value shown in the appropriate column.

To convert from	Conversion Factor			
Multiply by	As-Determined (ad)	As-Received (ar)	Dry (d)	Dry, Ash-Free (daf)
As-determined (ad)	...	$\frac{100 - M_{ar}}{100 - M_{ad}}$	$\frac{100}{100 - M_{ad}}$	$\frac{100}{100 - (M_{ad} - A_{ad})}$
As-received (ar)	$\frac{100 - M_{ad}}{100 - M_{ar}}$	...	$\frac{100}{100 - M_{ar}}$	$\frac{100}{100 - (M_{ar} - A_{ar})}$
Dry (d)	$\frac{100 - M_{ad}}{100}$	$\frac{100 - M_{ar}}{100}$	...	$\frac{100}{100 - A_d}$
Dry, ash-free (daf)	$\frac{100 - (M_{ad} - A_{ad})}{100}$	$\frac{100 - (M_{ar} - A_{ar})}{100}$	$\frac{100 - A_d}{100}$	...