Designation: C 1233 – 03

Standard Practice for
Determining Equivalent Boron Contents of Nuclear Materials[1]

This standard is issued under the fixed designation C 1233; 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 standard details a recommended practice for the calculation of the Equivalent Boron Content (EBC) values for elements that are of potential significance as thermal neutron poisons. The values are determined from a knowledge of the atomic weight of elements and the thermal neutron absorption cross section in barns. This practice is illustrated by using the EBC factors of Table 1 which are based on thermal neutron (2200 m/s) absorption cross sections. Other EBC factors may be used depending upon the actual neutron energy characteristics of the applicable reactor system.

1.2 The following elements do not require to be included in the EBC calculations, as their EBC factors are less than or equal to 0.0001.

aluminum	fluorine	rubidium
barium	lead	silicon
beryllium	neon	tin
bismuth	oxygen	zirconium
carbon	magnesium	
cerium	phosphorus	

Their contribution to the total poison effect is not considered significant.

2. Referenced Documents

2.1 *ASTM Standards:*
C 696 Test Methods for Chemical, Mass Spectrometric, and Spectrochemical Analysis of Nuclear-Grade Uranium Dioxide Powders and Pellets[2]
C 698 Test Methods for Chemical, Mass Spectrometric, and Spectrochemical Analysis of Nuclear-Grade Mixed Oxides ((U,Pu)O$_2$)[2]
C 699 Methods for Chemical, Mass Spectrometric, and Spectrochemical Analysis of, and Physical Tests on, Beryllium Oxide Powder[2]

C 761 Test Methods for Chemical, Mass Spectrometric, Spectrochemical, Nuclear, and Radiochemical Analysis of Uranium Hexafluoride[2]
C 799 Test Methods for Chemical, Mass Spectrometric, Spectrochemical, Nuclear, and Radiochemical Analysis of Nuclear-Grade Uranyl Nitrate Solutions[2]
C 859 Terminology Relating to Nuclear Materials[2]

3. Terminology

3.1 Terms shall be defined in accordance with Terminology C 859.

4. Methods For EBC Determination

4.1 Agreement shall be reached between the buyer and seller as to which elements shall be analyzed for calculation of their EBC. It is recommended that B, Cd, Dy, Eu, Sm, and Gd be included in this calculation. Analytical methods for such elements shall be those given in Methods C 696, C 699, and C 799, and Test Methods C 698 and C 761 as applicable or as otherwise agreed upon between buyer and seller.

4.2 The individual EBC values are calculated using the EBC factors from Table 1 as follows:

$$EBC \ of \ impurity = (EBC \ factor)(\mu g \ of \ impurity/g \ base \ material)$$

where:

$$EBC \ factor = \frac{(atomic \ mass \ boron)(\sigma a \ impurity)}{(atomic \ mass \ impurity)(\sigma a \ boron)}, \quad and$$

σa = atomic neutron absorption cross section in barns.

The values given in Table 1 have been calculated using a value of 764 Barns for the neutron absorption cross section (σa) of boron. This value may vary in nature according to the isotopic composition of the elements. If an alternative value is chosen the EBC factors must be recalculated using the chosen value.

4.3 If the concentration of any of the elements used in the calculation is reported as "less than" values, these values shall be used in calculating the EBC.

4.4 A total EBC value, if required, is determined by the summation of individual EBC values.