



# Standard Test Method for Determination of the Proportion of Phases in Portland Cement and Portland-Cement Clinker Using X-Ray Powder Diffraction Analysis<sup>1</sup>

This standard is issued under the fixed designation C1365; 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 direct determination of the proportion by mass of individual phases in portland cement or portland-cement clinker using quantitative X-ray (QXRD) analysis. The following phases are covered by this standard: alite (tricalcium silicate), belite (dicalcium silicate), aluminate (tricalcium aluminate), ferrite (tetracalcium aluminoferrite), periclase (magnesium oxide), gypsum (calcium sulfate dihydrate), bassanite (calcium sulfate hemihydrate), anhydrite (calcium sulfate), and calcite (calcium carbonate).

1.2 This test method specifies certain general aspects of the analytical procedure, but does not specify detailed aspects. Recommended procedures are described, but not specified. Regardless of the procedure selected, the user shall demonstrate by analysis of certified reference materials (CRM's) that the particular analytical procedure selected for this purpose qualifies (that is, provides acceptable precision and bias) (see **Note 1**). The recommended procedures are ones used in the round-robin analyses to determine the precision levels of this test method.

**NOTE 1**—A similar approach was used in the performance requirements for alternative methods for chemical analysis in Test Methods **C114**.

1.3 The values stated in SI units shall be regarded as the standard.

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.* For specific hazards, see Section **9**.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee **C01** on Cement and is the direct responsibility of Subcommittee **C01.23** on Compositional Analysis. Current edition approved Dec. 1, 2011. Published May 2012. Originally approved in 1998. Last previous edition approved in 2006 as C1365 - 98 (2006). DOI: 10.1520/C1365-06R11.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

**C114** Test Methods for Chemical Analysis of Hydraulic Cement

**C150** Specification for Portland Cement

**C183** Practice for Sampling and the Amount of Testing of Hydraulic Cement

**C219** Terminology Relating to Hydraulic Cement

**C670** Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

**E29** Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

**E691** Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

## 3. Terminology

3.1 **Definitions:** Definitions are in accordance with Terminology **C219**.

### 3.2 Phases (**1**):<sup>3</sup>

3.2.1 *alite, n*—tricalcium silicate ( $C_3S$ )<sup>4</sup> modified in composition and crystal structure by incorporation of foreign ions; occurs typically between 30 to 70 % (by mass) of the portland-cement clinker; and is normally either the  $M_1$  or  $M_3$  crystal polymorph, each of which is monoclinic.

3.2.2 *alkali sulfates, n*—arcanite ( $K_2SO_4$ ) may accommodate  $Na^+$ ,  $Ca^{2+}$ , and  $CO_3$  in solid solution, aphthitalite ( $K_{4-x}Na_xSO_4$  with  $x$  usually 1 but up to 3), calcium langbeinite ( $K_2Ca_2[SO_4]_3$ ) may occur in clinkers high in  $K_2O$ , and thenardite ( $Na_2SO_4$ ) in clinkers with high Na/K ratios (**1**).

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> The boldface numbers in parentheses refer to the list of references at the end of this standard.

<sup>4</sup> When expressing chemical formulae, C = CaO, S = SiO<sub>2</sub>, A = Al<sub>2</sub>O<sub>3</sub>, F = Fe<sub>2</sub>O<sub>3</sub>, M = MgO,  $\bar{S}$  = SO<sub>3</sub>, and H = H<sub>2</sub>O.