Designation: ~~C1407 – 98 (Reapproved 2016)~~ C1407 – 23

Standard Practice for Calculating Areas, Volume, and Linear Change of Refractory Shapes[1]

This standard is issued under the fixed designation C1407; 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 practice covers the methods of calculating areas, volumes, and linear changes of irregularly shaped refractory specimens.

1.2 ~~Areas of irregular (both conventional and shaped) specimens are required for determining the creep of certain refractory products.~~The specimens must have a constant cross-sectional area over a length (*L*).

~~1.3 Linear and volume changes or irregularly shaped refractories are required for determining reheat change.~~

1.3 The values stated in SI units are to 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~~safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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]

C20 Test Methods for Apparent Porosity, Water Absorption, Apparent Specific Gravity, and Bulk Density of Burned Refractory Brick and Shapes by Boiling Water

C830 Test Methods for Apparent Porosity, Liquid Absorption, Apparent Specific Gravity, and Bulk Density of Refractory Shapes by Vacuum Pressure

3. Significance and Use

3.1 Fireclay steel-teeming nozzles and sleeves are classified by volume reheat change. Bloating of some refractories results in irregular reheat dimensions, which are difficult to measure. This practice determines the volume without depending upon physical linear measurements.

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[1] This practice is under the jurisdiction of ASTM Committee C08 on Refractories and is the direct responsibility of Subcommittee C08.03 on Physical Properties.

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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.

3.2 Blast furnace checkers that have irregular cross-sections are classified by "creep properties." This practice determines the average cross-sectional ~~area without requiring area measurements.~~area.

4. Procedure

4.1 The test specimens shall have their dry weight (*W*) and volume (V_A) ~~pre-determined~~measured using the standard procedure described in Test Methods C20 or C830.

~~4.2 Dry the specimens to constant weight.~~

~~4.3 Weigh the specimens to the nearest 0.1 g and record as *W*.~~

4.2 ~~If the specimens have parallel faces (such as ground surfaces for applying load for creep data) measure the~~ Measure the length to the nearest 0.02 in. (0.5 mm) and record as *L*.

5. Calculation

5.1 *Area of ~~Creep Specimens (Irregular Cross-Sections):~~ Specimens:*

5.1.1

$$\text{area}\,(A) = \frac{\text{volume}(V)\ (C20\ \text{or}\ C830)\ \text{cm}^3}{\text{length}(L)\ (\text{cm})} = \text{cm}^2\,(10^{-4}\ \text{m}^2) \tag{1}$$

5.1.2

$$\text{volume(V)} = \frac{\text{weight}(W)\ (\text{g})}{\text{bulk density}\ (\text{g/cm}^3)} = \text{cm}^3\,(10^{-6}\ \text{m}^3) \tag{2}$$

5.1.3 *Illustration:*

Weight (W) = 375.2 g
Bulk Density = 2.56 g/cm^3 (Mg/m^3)
~~Length (L) = 10.795 cm (10^{-2} m)~~
Length (L) = 10.80 cm (10^{-2} m)

$$V = \frac{375.2}{2.56} = 146.56\ \text{cm}^3\,(10^{-6}\ \text{m}^3) \tag{3}$$

$$A = \frac{\text{Volume}}{\text{Length}} = \frac{146.56}{10.795\,(10^{-2}\ \text{m})} = 13.58\ \text{cm}^2\,(10^{-4}\ \ \text{m}^2) \tag{4}$$

$$A = \frac{\text{Volume}}{\text{Length}} = \frac{146.56}{10.80\,(10^{-2}\ \text{m})} = 13.58\ \text{cm}^2\,(10^{-4}\ \ \text{m}^2) \tag{4}$$

5.2 *Volume Change of Reheat Specimens:*

$$\%\ \text{volume change}\ (\Delta V) = \frac{V_B - V_A}{V_A} \times 100 \tag{5}$$

where:

V_A = original volume, cm^3 (10^{-6} m^3)
V_B = final reheat volume, cm^3 (10^{-6} m^3), and
ΔV = (V_B - V_A) change in volume from State A to State B (volume obtained from either Test Method C20 or Test Method C830).

5.3 *Converting % Volume Change ΔV to % Linear Change ΔL of Reheat Specimens:*

5.3.1 If volume change is negative (shrinkage) then: