Designation: C 1223 – 92 (Reappoved 1998)

Standard Test Method for Testing of Glass Exudation from AZS Fusion-Cast Refractories[1]

This standard is issued under the fixed designation C 1223; 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 a procedure for causing the exudation of a glassy phase to the surface of fusion-cast specimens by subjecting them to temperatures corresponding to glass furnace operating temperatures.

1.2 This test method covers a procedure for measuring the exudate as the percent of volume increase of the specimen after cooling.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 20 Test Methods for Apparent Porosity, Water Absorption, Apparent Specific Gravity, and Bulk Density of Burned Refractory Brick and Shapes by Boiling Water[2]

3. Significance and Use

3.1 This test method was developed for use both by manufacturers as a process control tool for the production of AZS fusion-cast refractories, and by glass manufacturers in the selection of refractories and design of glass-melting furnaces.

3.2 The results may be considered as representative of the potential for an AZS refractory (specifically, in the tested region) to contribute to glass defect formation during the furnace production operation.

3.3 The procedures and results may be applied to other refractory types or applications (that is, reheat furnace skidrail brick) in which glass exudation is considered to be important.

4. Apparatus and Materials

4.1 *Scale*—A laboratory scale rigged for suspension of specimens for dry/wet weight determinations to an accuracy of 0.01 g.

4.2 *Kiln*—An electric kiln to accommodate several 4-in. (102-mm) specimen cores placed vertically on end, and for service at 2750°F (1510°C), with a variation of <10°F (6°C).

4.3 *Foil*—Cups formed from 2¼-in. (56-mm) squares of platinum foil (Pt, 5 % Au alloy, 0.003-in. (0.076-mm) thick). One cup required per specimen.

4.4 *AZS Casting*—A virgin casting having no prior thermal history except that of its own formation, and of a size and casting process equivalent to the intended application (such as an arch block) in which exudation potential is of interest.

5. Test Specimens and Sampling

5.1 Specimens may be removed from the original casting either as drilled cores or as sawed bars, depending on laboratory capability. Specimen cores or bars should be 4-in. (102-mm) long and either 1 in. (25.4 mm) in diameter or 1 by 1 in. (25.4 by 25.4 mm) in cross-section. The length dimension of the specimen should be perpendicular to the surface of the block from which it is removed.

5.2 The dimensions of the prepared specimen core are not critical but should be maintained as specified, with minimal specimen-to-specimen variation. Excessive thickness can prevent isothermal heating within the specimen. Height and width can affect the positioned stability of the specimen in the kiln during heating.

5.3 The size of the original casting may influence the results. Evaluations of the product should be made relative to only the intended application. For example, a conveniently sized bottom paver might not be representative of a larger superstructure casting because (for example) casting mold types and solidification rates may have been different during manufacture.

5.4 The location and depth of specimens within the original casting can influence the results. Regions closely underlying the surface of the casting (particularly near the corners and edges) are thermally quenched and have aligned microstructures that are atypical of more slowly cooled regions. Deeper in

[1] This test method is under the jurisdiction of ASTM Committee C-8 on Refractories and is the direct responsibility of Subcommittee C08.10 on Refractories for Glass.

Current edition approved Dec. 15, 1992. Published February 1993.

[2] *Annual Book of ASTM Standards*, Vol 15.01.

a casting, glass phase pockets and crystal sizes are larger, and certain shifts in chemical stratification exist due to fractional crystallization during solidification. No single point in an AZS casting represents the whole entirely.

5.5 Regular-cast AZS blocks, approximately 8 to 12-in. (203 to 305-mm) thick, such as is typical of furnace superstructure and sidewall sizes, are sampled by drilling or plunge-cutting perpendicularly to the bottom surface (the surface opposite the casting scar).

5.5.1 The location of entry (by drilling or sawing) should be at least 4-in. (102-mm) away from any edge, yet not immediately under the casting scar.

5.5.2 Drill or cut deeper than specified; then break out from the casting and saw square to 4-in. (102-mm) length, retaining the moldskin (original surface of the block) on one end of the specimen by cutting off the end opposite it.

5.5.3 The quantity of specimens per casting is not specified. (Correlation coefficients of 10 to 20 % have been obtained by this procedure on large specimen populations taken from single castings.)

5.6 For smaller regular-cast blocks less than 8-in. (203-mm) thick, specimen length and location are determined by original casting size. That is, the proximity of specimen location to any edge should be no less than half the casting thickness. The specimen length should be approximately half the casting thickness.

5.7 Solid-cast tile (3 in. (76 mm)) should be sampled perpendicularly to a major face, with the proximity to any edge being no less than half the thickness of the casting. The specimen length should be either half the thickness or full surface-to-surface thickness.

5.8 Large, vertically-cast blocks, such as those that are used commonly in high-wear glass-contact applications, may be sampled perpendicularly to any of the four major vertical surfaces, with the following restrictions: sampling should be at least 4 in. (102 mm) from any edge, and the entire bottom region should be avoided up to 8 in. (203 mm) from the bottom (as-cast). This lower region, which often becomes the top "metal-line" region, as when the casting is inverted, has been found to be not representative of the overall casting.

6. Procedure

6.1 Weights must be obtained individually for both the untested specimen cores and the foil squares on which the cores will be placed. This is because each core and its foil will usually be fused together at the end of testing and cannot be separated before weighing without risk of lost exudate. Once paired, each set of core-and-foil must remain together throughout testing and subsequent calculation of data (see Fig. 1).

6.2 To account for the possible presence of surface-connected porosity in specimen cores, the treatments (drying and boiling) as specified by Test Methods C 20 must be applied, as described as follows:

6.3 Dry the specimen cores to constant weight by heating to 220 to 230°F (105 to 110°C), and determine the dry weight (Wd_1) to the nearest 0.01 g.

Casting No.________ ASTM Member____________

Specimen No.________ Date Reported___________

BEFORE EXUDATION

Core Wd_1 = ________ g   Pt Foil PWd_1 = ______ g.

Core Ww_1 = - ________ g.   Pt Foil PWw_1 = ______ g.

Vol_1 = (Wd_1 − Ww_1) = ________ cc.

AFTER EXUDATION

	(Cycle 1)	(Cycle 2)	(Cycle 3)
Core Wd_2 =	________ g.	________ g.	________ g.
Foil PWd_1 =	− ________ g.	− ________ g.	− ________ g.
ECDW =	________ g.	________ g.	________ g.
Core Ww_2 =	________ g.	________ g.	________ g.
Foil PWw_1 =	− ________ g.	− ________ g.	− ________ g.
ECWW =	________ g.	________ g.	________ g.
ECDW − ECWW = Vol_2	________ cc.	________ cc	________ cc
Vol_2 − Vol_1 =	________ cc.	________ cc.	________ cc.

PERCENT EXUDATION

% = $\frac{Vol_2 - Vol_1}{Vol_1}$ =	________ %	________ %	________ %

FIG. 1 Worksheet—Round Robin No. 2 for AZS Exudation