Designation: C 987 – 00a

Standard Practice for Vapor Attack on Refractories for Furnace Superstructures[1]

This standard is issued under the fixed designation C 987; 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 describes a procedure for comparing the behavior of refractories in contact with vapors under conditions intended to simulate the environment within a glass melting or other type of furnace when refractories are exposed to vapors from raw batch, molten glass, fuel, fuel contaminants, or other sources. This procedure is intended to accelerate service conditions for the purpose of determining in a relatively short time the interval resistance to fluxing, bloating, shrinkage, expansion, mineral conversion, disintegration, or other physical changes that may occur.

1.2 *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. Significance and Use

2.1 This practice provides a guide for evaluating the resistance of refractories in glass melting furnace superstructures to vapor attack. This test method may also be useful for evaluating refractories in other applications where vapor attack occurs.

2.2 An electric-heated furnace is recommended. Water vapor and other atmospheric components in a gas- or fuel-fired furnace may participate in the chemical and physical reactions being studied. Results may differ, therefore, depending upon the nature and type of firing employed.

2.3 The degree of correlation between this practice and service performance is not fully determinable. This is intended to be an accelerated practice that generates a substantial degree of reaction in a relatively short amount of time. This acceleration may be accomplished by changing the composition and/or concentration of the reactants, increasing temperatures, or by performing the test in an isothermal environment.

2.4 Since the practice may not accurately simulate the service environment, observed results of this practice may not be representative of those found in service. It is imperative that the the user understand and consider how the results of this practice may differ from those encountered in service. This is particularly likely if the reaction products, their nature, or their degree differ from those normally found in the actual service environment.

2.5 It is incumbent upon the user to understand that this is an aggressive, accelarated practice and to be careful in interpreting the results. If, for example, the reaction species have never been found in a real world furnace, then this practice should not necessarily be considered valid to evaluate the refractory in question.

3. Apparatus

3.1 The crucible for containing the reactant shall be a dense alumina or platinum crucible of conical shape with dimensions of 43 mm in diameter at top, 33 mm in diameter at bottom, and 53 mm high.

3.2 The crucible-cover assembly (Fig. 1) may be supported within a suitable refractory holding crucible (Fig. 2) such as mullite to maintain the position of the cover, if an excessive amount of glass phase reaction product is anticipated.

3.3 The electric heating chamber shall be of sufficient size to accommodate at least three assemblies for comparative evaluation. The temperature control system shall be capable of maintaining a desired holding temperature with a tolerance of ±3°C.

4. Specimen Preparation

4.1 The test specimen shall conform to the following dimensions with major faces cut or ground parallel and flat to form a tight seal with top of crucible:

4.1.1 Length, 55 ± 2 mm,

4.1.2 Width, 55 ± 2 mm, and

4.1.3 Thickness, 20 ± 1.0 mm.

4.2 *Selection*—Use specimens that are free of defects such as cracks, fissures, and voids. Where obvious defects in specimens appear after testing is completed, disregard the results and repeat the test.

4.3 Three specimens of a refractory brand shall constitute a test.

5. Procedure

5.1 The reactant shall be selected such that the vapor generated during the test is similar to the vapor encountered in service. Some reactants that have been found suitable for this purpose are: carbonates, sulphates, borates, and halides.

5.2 For comparative evaluations, a consistent weight of reactant is to be used. The level of the reactant is not to exceed 40 % of the depth of the crucible in order to avoid contact

[1] This practice is under the jurisdiction of ASTM Committee C08 on Refractories and is the direct responsibility of Subcommittee C08.10 on Refractories for Glass.

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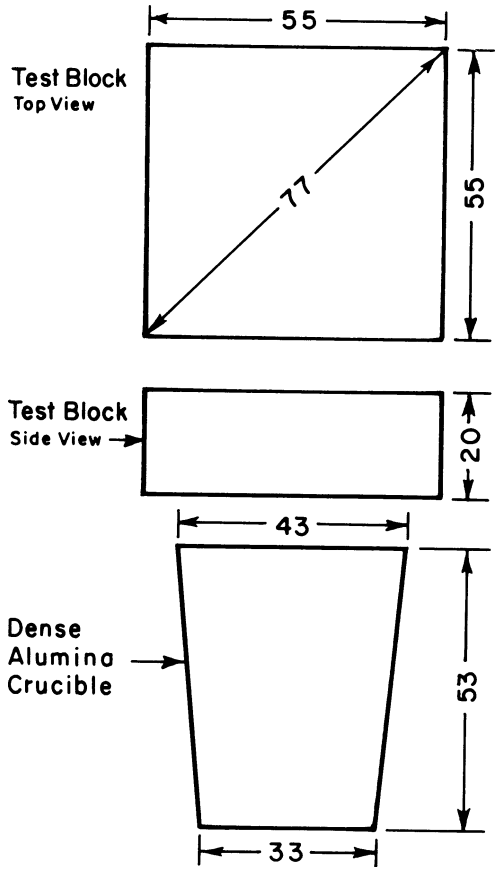

FIG. 1 Crucible-Cover Assembly

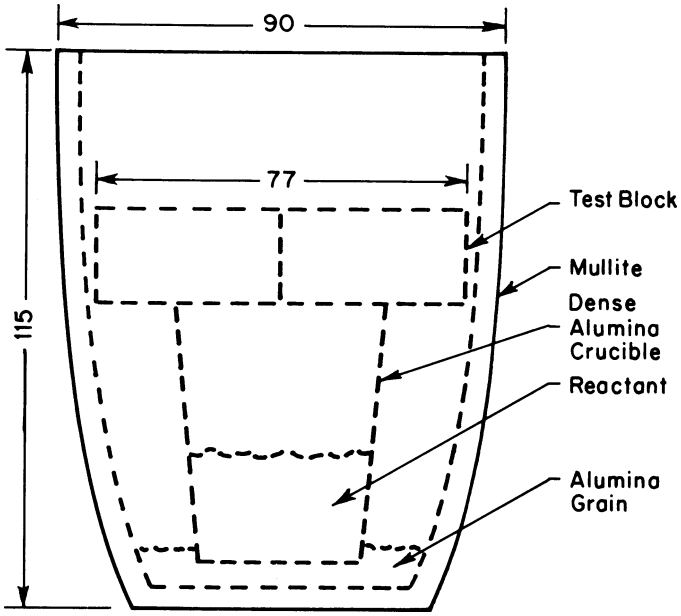

FIG. 2 Refractory Holding Crucible

between the molten reactant and the specimen. An example of a suitable quantity of reactant is 12.5 g of technical grade sodium carbonate.

5.2.1 Use molar equivalents for alternative reactants providing that the level of this reactant does not exceed 40 % of the crucible depth.

5.2.2 The test temperature shall be appropriate to the reactant and the environment to be simulated. For example, a temperature of 1370°C has been found to give measurable results when using a sodium carbonate reactant.

5.3 Place a weighed amount of reactant in a crucible.

5.4 Assemble the crucible and the specimen, and place it on a level furnace hearth. An assembly having a test specimen with a silica content greater than 50 % should be placed in a holding crucible to prevent disorientation by glass phase development (see Fig. 2).

5.5 A consistent heating rate of 2 to 8 h to test temperature and a duration of 24 h at temperature shall constitute the test. Allow the crucible assembly to cool in a manner that prevents thermal shock.

5.6 Separate the sample from the reactant crucible after cooling.

6. Report

6.1 Report the following information:

6.1.1 Materials tested,

6.1.2 Test temperature,

6.1.3 Type and quantity of reactant(s), and

6.1.4 Observations as to the condition of the specimens after testing. It may be desirable to cut the specimens in half and expose a cross-sectional view.

6.1.4.1 These observations may be, but are not limited to: photographs, written comments, change of weight of specimens, change of dimensions of specimens, change of flatness of specimens, change of mineralogy, and development of cracks in specimens.

7. Precision and Bias

7.1 *Precision*—No justifiable statement of precision is possible since the results of this test method are word descriptions rather than numerical values.

7.2 *Bias*—No justifiable statement of bias is possible since a true value of refractory attack by vapor cannot be established by an accepted reference sample.

8. Keywords

8.1 corrosion; glass; refractories; superstructures; vapor attack