



Designation: C1656 – 13 (Reapproved 2023)

Standard Guide for Measuring the Reactivity of Hydraulic Refractory Castables Using Exothermic Profile¹

This standard is issued under the fixed designation C1656; 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 guide applies to all castables with a reactive binder system that produces a measurable heat profile during the setting and hardening process. The majority of these systems will have calcium aluminate cement as one component of the binder system.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.3 *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

C71 [Terminology Relating to Refractories](#)

C401 [Classification of Alumina and Alumina-Silicate Castable Refractories](#)

[C862 Practice for Preparing Refractory Concrete Specimens by Casting](#)

3. Terminology

3.1 *Definitions:*

3.1.1 *EP—exothermic profile, n*—the curve generated by plotting temperature of the embedded thermocouple versus time.

3.1.2 *LCC, n*—low-cement castable.

¹ This guide is under the jurisdiction of ASTM Committee C08 on Refractories and is the direct responsibility of Subcommittee C08.09 on Monolithics.

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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.

4. Significance and Use

4.1 The heat of hydration of a calcium aluminate-based castable is liberated over a short period of time (as compared to portland cement). This makes it easy to measure the heat profile using off-the-shelf thermocouple equipment.

4.2 The heat profile can be used to make inferences about the setting and strength gain behavior of a castable and sometimes the working time of a castable.

4.3 Factors that should be controlled when comparing two castables include: size, shape, and mass of cast object, start temperature of the mix, temperature of environment, and the thermal conductivity of the environment. If these factors are held constant, then the two castables' heat profiles can be compared.

4.4 The temperature increase created by the castable exothermic reaction shall be at least 2.0 °C more than the normal fluctuation of the laboratory temperature so that the time of this increase is easily discernible to the user.

4.5 Varying the amount of cement in the castable, the amount of water, the type and quantity of admixtures, and so forth, will change the shape, maximum temperature, and time to maximum temperature of the curve.

4.6 Following is an example of a curve generated for an LCC (see [Fig. 1](#)) that does exhibit two peaks, the first one marking the end of working time. In this curve, one could also infer that the start temperature of the mix was 24 °C and also that the hydraulic strength gain reaction was significantly started, but not completed by 6 h.

5. Apparatus

5.1 Mixing equipment as prescribed in Practice [C862](#).

5.2 Type T thermocouple. (Type J, E, or K is also acceptable but not preferred due to range of sensitivity. Other types cannot be used.) Wire ends should be joined by solder or welding. Simple twisting is not recommended due to the potential for inaccurate readings.

5.3 Thermocouple sheathing (optional).

5.4 Voltmeter, data acquisition card, or some other instrument to read the thermocouple mV value.