Designation: C903 – 15$^{\varepsilon 1}$

Standard Practice for Preparing Refractory Specimens by Cold Gunning[1]

This standard is issued under the fixed designation C903; 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.

ε[1] NOTE—Editorial changes were made throughout in April 2016.

1. Scope

1.1 This practice covers a procedure for preparing refractory specimens usually containing calcium aluminate cement with or without metal fibers by cold nozzle-mix gunning. Specimens prepared in accordance with this practice are intended for use in standard ASTM test methods required for evaluating gunned materials.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *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:*[2]

C401 Classification of Alumina and Alumina-Silicate Castable Refractories

C865 Practice for Firing Refractory Concrete Specimens

3. Significance and Use

3.1 The properties of refractories can be affected by their method of installation. This practice attempts to minimize the variables encountered during installation by pneumatic gunning.

3.2 This practice provides parameters to produce gunned specimens for use in other ASTM test methods.

3.3 This practice may be used to produce specimens for acceptance testing, service evaluation, manufacturing control, and research and development.

3.4 Differences between various kinds of equipment and the differences in procedures and operator techniques may result in significant variations in the physical properties of the gunned specimens. It is recommended that the same operator use the same equipment to produce specimens for referee testing agreed to by the involved testing parties. The specific operating parameters should be shown in the report.

3.5 Although this practice is specifically designed for refractories containing calcium aluminate cement, it may be used with minor modifications for gun mixes containing other bond systems.

4. Apparatus

4.1 *Gun,* pneumatic nozzle-mix. At least 50 ft (15.2 m) of hose should be available. Acceptable nozzle diameters range from 1 to 2 in. (25 to 51 mm).

4.2 *Air Compressor,* capable of delivering sufficient pressure and volume to adequately move refractory to the gun. The compressor should be able to supply at least 250 ft^3 (7 m^3)/min.

4.3 *Forms,* suitable nonabsorbent type, which will vary in size in accordance with the number and size of samples being prepared, but are at minimum 12 by 12 by 4 in. (305 by 305 by 100 mm). Forms should be sized to prevent rebound entrapment. The use of ½ inch hardware cloth as sidewalls of the form allows most of the rebound to pass through.

5. Procedure

5.1 Store the refractory to be gunned at 70 to 85°F (20 to 27°C) for 24 h prior to gunning.

5.2 Place the form against a rigid surface at an angle of 80 to 90° to the horizontal.

5.3 If recommended by the supplier, predampen the refractory by mixing with potable water in a paddle mixer for 1 to 5 min or follow manufacturer's specific instructions. In general, regular (dense) refractories require 2 to 4 % of predampening water and lightweight (insulating) refractories require 5 to 8 %.

NOTE 1—Refractories that contain a high-purity cement may benefit by

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

Current edition approved Oct. 1, 2015. Published December 2015. Originally approved in 1979. Last previous edition approved in 2010 as C903 – 10. DOI: 10.1520/C0903-15E01.

[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.

aging for 5 to 10 min after dampening before gunning. This "aging'' procedure should be used if gunning without it produces excessive rebound, dusting, or slumping.

NOTE 2—Treat refractories containing metal fibers in a normal manner. If metal fibers are to be added to the gunning material, add them to the paddle mixer before any water is introduced. The amount of fiber to be added and the methods of reporting this amount shall be agreed upon by the parties involved. To prevent clumping of the fibers they should be added slowly through a suitable screen of ½ in. mesh. Fibers larger than 1 in. may require larger openings. If any predampening water is to be added, dry mix for two to three min before adding water.

5.4 Gun the refractory into the form at a distance of 3 to 4 ft (0.91 to 1.2 m) from gun nozzle. Hold the gun nozzle at 90° to the form. Gunning pressures are suggested to be approximately 40 psi (276 kPa) for regular-weight refractories and approximately 20 psi (138 kPa) for insulating refractories. If more than 50 ft (15 m) of hose is used, it may be necessary to add 5 psi (34 kPa) for each additional 50 ft. These conditions and the amount of potable water used must be adjusted by the nozzleman for acceptable rebound. The gunning pattern involves moving the nozzle in a circular motion, back and forth across the form, beginning at the bottom. Report any unusual dusting, slumping, or other unique characteristics of the refractory. The water, material, and environment temperature shall also be reported.

NOTE 3—For referee tests all participating laboratories should agree on a specific gun pressure and other test parameters to obtain reproducible results. Excessive air pressures and hose lengths may cause changes in properties of the gunned refractory especially in properties of gunned insulating refractories.

5.5 Trim the gunned surface approximately parallel to the back of the form. See Practice C865 for procedures concerning the measurement of specimens.

5.6 Follow the recommended manufacturer's curing instructions. For calcium aluminate bonds, optimum curing temperature is 90 to 95°F (32 to 35°C) for 24 + 0.5 h.

5.7 Cut suitably sized lamination-free specimens from the central section. If excessive tearout of refractory grain occurs while cutting, it may be necessary to dry the panel first before cutting (ex. Low Cement Gun Mix). Cut specimen to exclude the portion nearest the backboard to eliminate trapped rebound. Identify the gunned face or gunning direction on each specimen since it may influence the results of subsequent tests.

5.8 Specimens prepared according to section 5.7 that will be used for further testing shall be placed in a 150°F oven; hold until all specimens have been inserted. Increase temperature at a rate of 50°F/h (28°C/h) maximum from 150°F to between 220 to 230°F (105 to 100°C) and hold for at least 15 h prior to testing or firing in a prescribed manner.

5.9 Determine specific properties by selected test procedures.

6. Report

6.1 Report the following information:

6.1.1 Specific predampening water content and type of mixer,

6.1.2 Premix time,

6.1.3 Temperature of the water, refractory, and environment,

6.1.4 Aging time (if any),

6.1.5 Type of gun, length and diameter of hose,

6.1.6 Gunning pressure employed,

6.1.7 Nozzle size and type,

6.1.8 Size and type of form used,

6.1.9 Type and amount (by weight or volume) of any metal fibers added prior to gunning, and

6.1.10 Curing time, temperature and environment.

6.2 The report may also specify the amount of rebound and any unusual gunning characteristics observed.

6.3 The report may include any other parameters agreed to by the parties involved.

7. Keywords

7.1 gunning; predampening; rebound; specimens