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Committee C01 on Cement Subcommittee C01.27 on Strength

Research Report: C01-1011

Interlaboratory Study to Establish Precision Statements for ASTM C109 - 11 / C109M – 11, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or [50 mm] Cube Specimens)

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1. Introduction:

The original precision statement for C 109 was originally developed in 1975 for portland cements, using results from the Cement and Concrete Reference Laboratory (CCRL) samples 9-36. Precision values for 3- and 7-day mortar strengths were included. Coefficient of variation (CV, or 1s% in some reporting conventions) was identified as the appropriate statistic representing variation in strength data.

The current precision and bias statement in C 109-08 was revised by a 1987 ballot. CCRL portland cement samples 19 - 82 were used to develop the revised precision values. Precision values for blended cements and masonry cements were also added with this ballot. This ballot item, which included a historical summary from which this information was taken, is in the Annex A to this report.

There are two objectives to this report:

1. Examine the trends in precision of portland cement strength test results to determine whether there has been significant change over the 40+ year period represented by CCRL portland cement samples (Annex B);

2. Develop revised statistical parameters for 3- and 7-day test ages for portland cement test results using more recent CCRL data, and develop new estimates of precision for 1- and 28-day test ages.

2. Test Method:

The Test Method used for this ILS was the current version of ASTM C109 available when the CCRL samples used as the basis for this analysis were tested. To obtain a copy of C109/C109M, go to ASTM's website, <u>www.astm.org</u>, or contact ASTM Customer Service by phone at 610-832-9585 (8:30 a.m. - 4:30 p.m. Eastern U.S. Standard Time, Monday through Friday) or by email at <u>service@astm.org</u>.

3. Participating Laboratories:

Laboratories participating in the Cement and Concrete Reference Laboratory (CCRL) proficiency sample program for portland cements for the samples selected for use in this analysis (Annex C) comprised the participating laboratories.

8. Statistical Data Summary:

The data used in the analysis are in Annex C. A summary of the statistics calculated from the data returned by the participating laboratories is provided in Annex D.

9. Precision and Bias Statement:

14.1 *Precision*—The precision statements for this test method are listed in Table 2 and are based on results from the Cement and Concrete Reference Laboratory Reference Sample Program. They are developed from data where a test result is the average of compressive strength tests of

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three cubes molded from a single batch of mortar and tested at the same age. A significant change in precision will not be noted when a test result is the average of two cubes rather than three.

14.2 These precision statements are applicable to mortars made with cements mixed, and tested at the ages as noted. The appropriate limits are likely, somewhat larger for tests at younger ages and slightly smaller for tests at older ages.

14.3 *Bias*—The procedure in this test method has no bias because the value of compressive strength is defined in terms of the test method.

		TABLE 2 Precision		
		Test Age, Days	Coefficient of Variation 1s % ^A	Acceptable Range of Test Results d2s %
Portland Cements				
Constant water-cement				
ratio:		1	2.1	07
Single-lab		3	3.1	10.9
		7	3.9	10.9
		28	3.8	10.6
			3.7	10.4
	Av			
Multi-lab		1	7.3	20.4
		3	6.8	19.0
		7	6.6	18.5
		28	6.5	18.2
	Δν		6.6	18.5
Blended Cements	,			
Constant flow mortar:				
Single-lab		3	4.0	11.3
		/	3.8	10.7
		20	3.4	9.6 10.7
	Av		0.0	
Multi-lab				
		3	7.8	22.1
		28	7.0	20.9
			7.6	21.5
	Av			
Masonry Cements				
Single-lab		7	79	22.3
Siligie-lab		28	7.5	21.2
		-	7.7	21.8
	Av			
Multi-lab		7	11.8	33.4
Multi-Idu		28	12.0	33.9
		-	11.9	33.7
	Av			

^A These numbers represent, respectively, the (1s %) and (d2s %) limits as described in Practice C670.

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