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Committee C11 on Gypsum and Related Building Materials and Systems
Subcommittee C11.01 on Specifications and Test Methods for Gypsum Products

Research Report C11-1001

Interlaboratory Study to Establish Precision Statements for Method B in ASTM C0473-09, Standard Test Methods for Physical Testing of Gypsum Panel Products

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1. Introduction:

Interlaboratory Study 96 was conducted to establish a precision statement for Method B in C0473, Standard Test Methods for Physical Testing of Gypsum Panel Products.

2. Test Method:

The Test Method used for this ILS is C0473-09. To obtain a copy of C0473, go to ASTM's website, www.astm.org, 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 service@astm.org.

3. Participating Laboratories:

The following laboratories participated in this interlaboratory study

1. American Gypsum Company - Bernalillo Plant
1000 North Hill Road
Bernalillo, NM
87004
US
Mr. Larry Malin
505-867-5200, ext. 1

2. CertainTeed Gypsum. - Clearwater
Research & Development Center
14255 49th Street North
Clearwater, FL
33762
US
Mr. Hutch Gwynn
727-538-1969, ext 20
Hutch.Gwynn@bpb-na.com

3. G-P Gypsum Corporation - Decatur
2861 Miller Rd
Decatur, GA
30035
US
Mr. Fabio Esguerra
770-987-5190 x110104
feesguer@GAPAC.com

4. National Gypsum Company - Charlotte
5901 Carnegie Blvd
Charlotte, NC
28209
US
Mr. Keith Poerschke
704-551-5807
kapoerschke@nationalgypsum.com

5. Temple Inland - Cumberland City
150 Temple Drive
Cumberland City, TN
37050
US
Bob Bertolomi
931-827-4547

6. Temple Inland - Fletcher
16850 NE 135th
Fletcher, OK
73541
US
Treasia Leatherbury
580-549-7147

7. Temple Inland - McQueeney
FM 78 Cypress Ridge Rd
McQueeney, TX
78123
US
Will Hatfield
830-401-1026

8. USG - Aliquippa Plant
1 Woodlawn Road
Aliquippa, PA
15001
US
Mr. Mike Kennedy
724-857-4305

9. USG - Rainier Plant
29073 Dike Rd
Rainier, OR
97048
US
Mr. Dan Murphy
503-556-4340

10. USG Corporation - Libertyville
Systems Engineering Laboratory
700 North Highway 45
Libertyville, IL
60048
US
Mr. Chuck Cochran

4. Description of Samples:

There were 5 samples of varying targeted results used for this study. Each sample was supplied, prepared and distributed by Robert Ek of American Gypsum. Below is a list of the samples with the corresponding supplier:

1. 1/2" regular gypsum wallboard

2. 1/4" regular gypsum wallboard

3. 5/8" type X gypsum wallboard

4. Gypsum Sheathing

5. Water-Resistant Gypsum Backing Board

5. Interlaboratory Study Instructions

Laboratory participants were emailed the test program instructions. For a copy of the instructions, please see Annex A.

6. Description of Equipment/Apparatus[1]:

For information on the equipment/apparatus used by each laboratory, please see Annex B.

7. Data Report Forms:

Each laboratory was provided with a data report form for the collection of data. A copy of the data is provided in Annex C.

[1] The equipment listed was used to develop a precision statement for C0473-09. This listing is not an endorsement or certification by ASTM International.

Please note: The laboratories have been randomly coded and cannot be identified herein.

8. Statistical Data Summary:

A summary of the statistics calculated from the data returned by the participating laboratories is provided in Annex D.

9. Precision and Bias Statement:

9.1 The precision of this test method is based on an interlaboratory study of C473-07, Standard Test Methods for Physical Testing of Gypsum Panel Products, conducted in 2007. Ten laboratories tested five different gypsum panel products. Every "test result" represents an individual determination. Participants were asked to submit six replicate test results for each parameter / material combination (twelve replicates for Edge Hardness). Practice E 691 was followed for the design and analysis of the data; the details are given in ASTM Research Report No. C11-1001.

9.1.1 *Repeatability limit (r)* - Two test results obtained within one laboratory shall be judged not equivalent if they differ by more than the "*r*" value for that material; "*r*" is the interval representing the critical difference between two test results for the same material, obtained by the same operator using the same equipment on the same day in the same laboratory.

9.1.1.1 Repeatability limits are listed in Tables 1 – 9 below.

9.1.2 *Reproducibility limit (R)* - Two test results shall be judged not equivalent if they differ by more than the "*R*" value for that material; "*R*" is the interval representing the critical difference between two test results for the same material, obtained by different operators using different equipment in different laboratories.

9.1.2.1 Reproducibility limits are listed in Tables 1 – 9 below.

9.1.3 The above terms (repeatability limit and reproducibility limit) are used as specified in Practice E 177.

9.1.4 Any judgment in accordance with statements 9.1.1 and 9.1.2 would normally have an approximate 95% probability of being correct, however not all of the precision statistics obtained in this ILS may be treated as definitive mathematical quantities, applicable to all circumstances and uses. The limited number of replicates tested and laboratories reporting results for some analyses guarantees that there will be times when differences greater than predicted by these ILS results will arise, sometimes with considerably greater or smaller frequency than the 95%

probability limit would imply. The repeatability limits and the reproducibility limits for those analyses should be considered as general guides, and the associated probability of 95% as only a rough indicator of what can be expected.

Table 1. Parallel Flexural Strength (*lbf*)
5 labs / 81 data points

Panel	Average [1] $\bar{x}$	Standard Deviation of the Sample Averages $s_{\bar{x}}$	Repeatability Standard Deviation s_r	Reproducibility Standard Deviation s_R	Repeatability Limit r	Reproducibility Limit R
A	49.4871	6.3911	11.9766	12.6641	33.5344	35.4593
B	85.2847	5.4871	16.3279	16.3279	45.7180	45.7180
C	35.6045	4.3757	6.3969	7.2970	17.9112	20.4316

Table 2. Perpendicular Flexural Strength (*lbf*)
7 labs / 117 data points

Panel	Average [1] $\bar{x}$	Standard Deviation of the Sample Averages $s_{\bar{x}}$	Repeatability Standard Deviation s_r	Reproducibility Standard Deviation s_R	Repeatability Limit r	Reproducibility Limit R
A	138.1732	3.8219	6.2402	6.8598	17.4725	19.2075
B	206.7995	7.4186	8.8020	10.9361	24.6457	30.6212
C	80.0015	1.9580	1.5868	2.4356	4.4431	6.8196

Table 3. Humidified Deflection (*inches*)
10 labs / 176 data points

Panel	Average [1] $\bar{x}$	Standard Deviation of the Sample Averages $s_{\bar{x}}$	Repeatability Standard Deviation s_r	Reproducibility Standard Deviation s_R	Repeatability Limit r	Reproducibility Limit R
A	0.1566	0.0826	0.0397	0.0902	0.1112	0.2525
B	0.1143	0.0487	0.0644	0.0763	0.1802	0.2137
C	0.5952	0.3575	0.0829	0.3655	0.2323	1.0233

Table 4. Core Hardness (*lbf*)
10 labs / 71 data points

Panel	Average [1] $\bar{x}$	Standard Deviation of the Sample Averages $s_{\bar{x}}$	Repeatability Standard Deviation s_r	Reproducibility Standard Deviation s_R	Repeatability Limit r	Reproducibility Limit R
A	22.4517	3.6610	1.0726	3.7896	3.0032	10.6110
B	24.4100	1.4329	1.2323	1.8218	3.4505	5.1010
C	25.4926	N/A	0.6774	0.6774	1.8968	1.8968

Table 5. End Hardness (*lbf*)
10 labs / 60 data points

Panel	Average [1] $\bar{x}$	Standard Deviation of the Sample Averages $s_{\bar{x}}$	Repeatability Standard Deviation s_r	Reproducibility Standard Deviation s_R	Repeatability Limit r	Reproducibility Limit R
A	27.2263	N/A	0.6353	0.6353	1.7790	1.7790
B	24.5387	1.8854	1.0977	2.1351	3.0737	5.9784

Table 6. Edge Hardness (*lbf*)
10 labs / 120 data points

Panel	Average [1] $\bar{x}$	Standard Deviation of the Sample Averages $s_{\bar{x}}$	Repeatability Standard Deviation s_r	Reproducibility Standard Deviation s_R	Repeatability Limit r	Reproducibility Limit R
A	60.3630	N/A	9.3561	9.3561	26.1970	26.1970
B	60.7652	5.5456	7.6803	9.2100	21.5047	25.7880

Table 7. Nail Pull Resistance (*lbf*)
10 labs / 180 data points

Panel	Average [1] $\bar{x}$	Standard Deviation of the Sample Averages $s_{\bar{x}}$	Repeatability Standard Deviation s_r	Reproducibility Standard Deviation s_R	Repeatability Limit r	Reproducibility Limit R
A	76.7023	3.9561	2.8870	4.7536	8.0837	13.3100
B	87.5646	4.1139	2.6243	4.7606	7.3479	13.3296
C	59.3105	5.1849	2.6658	5.7275	7.4642	16.0371