

Paper Proficiency Service Report

February 2012



Prepared by Chris Berry

Smithers Pira
Cleeve Road, Leatherhead
Surrey KT22 7RU, United Kingdom
Telephone: +44 (0) 1372 802000
Fax: +44 (0) 1372 802245
www.smitherspira.com

Registered number: 5761324

This report is made subject to the conditions that it is confidential and may not be disclosed in whole or in part to others without the written consent of Smithers Pira

Contents

	Page
Introduction	
Interpretation of Results	
Air Permeance Tests	1
Bending Stiffness Tests	7
Bursting Tests	13
Compressive Strength Tests	18
Flat Crush Tests	22
Folding Endurance	26
Grammage	28
Scott Internal Bond strength	31
Opacity	33
Puncture Resistance	35
Roughness and Smoothness Tests	37
Tear Resistance	46
Tensile Strength and Stretch	48
Thickness	54
Water Absorption	63
Optical Properties	65

Introduction

This report uses the ISO 5725 standard for the statistical calculation; it also includes Warning and Action limits for the normal deviation to account for tests with fewer participants in them.

The report uses two established methods of identifying laboratories that appear to have a problem with their testing/operators/conditioning from the calculation using the “Grubbs” and “Cochran” statistical tests which are based on the standard deviation and mean values of testing results.

A laboratory that is flagged as an outlier in the “Cochran” tests indicates a problem with the standard deviation of the results (because of this the mean is also excluded). A laboratory that is flagged as an outlier in the “Grubbs” test indicates a problem with the mean value. In either case the reason for this should be investigated.

Should a laboratory be flagged as a straggler for either “Grubb” or “Cochran” the results are included in the report but the laboratory should investigate why they have an issue. The majority of issues are usually caused by a calibration error with the test equipment, a sample preparation error, a test procedure error or an issue with the conditioning of the laboratory or sample.

An important point to take note of is that if a laboratory has not been flagged as an outlier or a straggler the results might still be outside of the Warning and Action limits. This should be checked by all laboratories.

We are committed to the continuous improvement of all the services we offer our customers, we would welcome any suggestions so please feel free to contact me with these or any other question or queries you have. My contact details are shown below.

Chris Berry

Head of Proficiency

Smithers Pira

Cleeve Road

Leatherhead

Surrey

KT22 7RU

Tel: +44 (0)1372 802094

Fax: +44 (0)1372 802245

Email: cberry@smithers.com

Website: www.smitherspira.com

Interpretation of results

ISO 5725:(1994)

Laboratory:

Each laboratory is identified by its own code number, known only to them.

Mean (included/excluded)

The means are checked for outliers using the Grubbs test. Outliers are marked with a double asterisk and excluded from the "Grand Mean". If the SD (standard deviation) of any mean is found to be an outlier then the mean is also excluded from the "Grand Mean". A single asterisk indicates a result is a Straggler and is included in the "Grand Mean".

Standard Deviation (included/excluded):

The standard deviations are checked for outliers using the Cochran test. Outliers are marked with a double asterisk and excluded from the "SD within". If an SD is found to be an outlier then the associated mean is also excluded from the "Grand Mean". If a lab's standard deviation fails the Cochran test then the mean value is automatically excluded. A single asterisk indicates a result is a Straggler and is included in the "Grand Mean".

Coefficient of Variation:

This is the SD divided by the mean, multiplied by 100, it is not included in any of the mean or SD calculations.

Number of labs:

The number of acceptable laboratories after excluding outliers.

Cochran and Grubbs tests:

Results (mean and SD's) are checked using the Cochran and Grubb tests for outliers in accordance with ISO 5725-2:(1994)

Z-score:

The Z-score is calculated by subtracting the Grand Mean from your lab results and dividing by the SD between. It is based on the ISO/IEC Guide 43-1(1996).

Grand Mean:

Overall mean of all acceptable means.

SD Within:

The average of all acceptable SD's.

SD Between:

The SD of the means.

Warning Limits:

Range of warning limits ± 2 SD for tests with more than 10 acceptable results about the Grand Mean and 2.6 for tests with less than 10 acceptable results.

Action Limits:

Range of action limits ± 2.6 SD for tests with more than 10 acceptable results about the Grand Mean and 3.3 for tests with less than 10 acceptable results.

Air permeance - Bendtsen

ISO 5636/3

Sample	A	Units	ml/min				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
			Conditions	23°C 50%rh			
126	145.3	3.84	2.64	10			2.21
143	128.0	13.80	10.78	10			0.57
146	98.0 *	18.00	18.37	10		S	-2.26
179	115.0	11.01	9.57	10			-0.65
229	123.0	17.35	14.11	10			0.10
241 0							
243	117.4	12.14	10.34	10			-0.43
245	126.7	14.35	11.33	10			0.45
321	130.4	14.80	11.35	10			0.80
368	119.8	14.79	12.35	10			-0.21
411	127.0	14.57	11.47	10			0.48
441	113.0	14.00	12.39	10			-0.84
455	124.9	8.71	6.97	10			0.28
484	118.1	13.42	11.36	10			-0.36
485							
503	120.3	18.15	15.09	10			-0.15
516							

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers 0
Number of outliers 0

Statistics

Number of labs 14

Grand mean 121.92
SD Within 13.50
Reproducibility SD 10.59

Warning Limits
Mean - 2.0 SD 100.74
Mean + 2.0 SD 143.10

Action Limits
Mean - 2.6 SD 94.39
Mean + 2.6 SD 149.46

Air permeance - Bendtsen

ISO 5636/3

Sample	B	Units	ml/min				
		Conditions	23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
126	442	10.17	2.30	10			1.46
143	420	10.15	2.42	10			0.44
146	414	16.00	3.86	10			0.15
179							
229	446	11.74	2.63	10			1.65
241 0	405	9.16	2.26	10			-0.26
243	380	9.67	2.55	10			-1.44
245	400	9.53	2.38	10			-0.50
321							
368	411	13.01	3.17	10			0.01
411							
441	425	16.40	3.86	10			0.67
455							
484	419	12.97	3.09	10			0.39
485	398	9.66	2.43	10			-0.62
503	370	9.90	2.67	10			-1.89
516	410	6.75	1.65	10			-0.06

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	13	Warning Limits	
		Mean - 2.0 SD	368
		Mean + 2.0 SD	454
Grand mean	411	Action Limits	
SD Within	11.16	Mean - 2.6 SD	355
Reproducibility SD	21.41	Mean + 2.6 SD	466

Air permeance - Bendtsen

ISO 5636/3

Sample	C	Units	ml/min				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
126							
143							
146							
179	1203	17.03	1.42	10			-0.53
229	1335	33.75	2.53	10			1.47
241 0	1253	14.94	1.19	10			0.23
243	1149	21.32	1.86	10			-1.35
245							
321							
368							
411	1275	26.35	2.07	10			0.56
441							
455	1215	23.66	1.95	10			-0.34
484	1330	25.70	1.93	10			1.40
485	1213	23.87	1.97	10			-0.37
503	1168	23.60	2.02	10			-1.07
516							

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
0

Statistics

Number of labs 9

Grand mean 1238
SD Within 23.36
Reproducibility SD 65.86

Warning Limits

Mean - 2.6 SD 1067
Mean + 2.6 SD 1409

Action Limits

Mean - 3.3 SD 1021
Mean + 3.3 SD 1455

Air resistance - Gurley

ISO 5636/5

Sample	A	Units	sec/100ml				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
			Conditions	23°C 50%rh			
126	12.24	0.41	3.35	10			0.09
134	12.40	0.84	6.80	10			0.37
229	12.82	1.26	9.85	10			1.11
241	12.61	0.69	5.45	10			0.74
243	12.87	0.86	6.67	10			1.19
299	11.94	0.72	6.03	10			-0.43
321	12.05	1.40	11.61	10			-0.24
364 0	11.30	0.93	8.23	10			-1.54
364 2	11.30	1.13	10.00	10			-1.54
368							
420	12.03	1.43	11.89	10			-0.27
437	11.70	0.82	7.04	10			-0.85
485	12.01	1.34	11.13	10			-0.31
506							
509	13.14	0.76	5.79	10			1.66

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers 0
Number of outliers 0

Statistics

Number of labs 13

Grand mean 12.2
SD Within 0.97
Reproducibility SD 0.57

Warning Limits
Mean - 2.0 SD 11.0
Mean + 2.0 SD 13.3

Action Limits
Mean - 2.6 SD 10.7
Mean + 2.6 SD 13.7

Air resistance - Gurley

ISO 5636/5

Sample B Units sec/100ml
Conditions 23°C 50%rh

Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
126	38.0	0.98	2.57	10			0.83
134	30.9	3.73	12.06	10			-2.25
229	39.4	2.69	6.83	10			1.42
241	35.4	1.87	5.27	10			-0.29
243	40.2	3.85	9.59	10			1.77
299	36.1	3.61	10.00	10			0.01
321	35.9	2.45	6.83	10			-0.10
364 0	35.8	3.16	8.83	10			-0.13
364 2	35.2	3.18	9.03	10			-0.39
368	34.1	3.55	10.39	10			-0.85
420	36.4	2.46	6.75	10			0.13
437	35.8	2.97	8.31	10			-0.13
485	37.8	1.93	5.10	10			0.73
506	34.4	0.31	0.90	10			-0.76
509							

Tests for outliers

Cochran-Test O - denotes an outlier
Grubbs-Test S - denotes a straggler
Number of outliers 0
Number of outliers 0

Statistics

Number of labs 14
Warning Limits
Mean - 2.0 SD 31.5
Mean + 2.0 SD 40.7
Action Limits
SD Within 2.62
Reproducibility SD 2.31
Mean - 2.6 SD 30.1
Mean + 2.6 SD 42.1

Air resistance - Gurley

ISO 5636/5

Sample	C	Units					
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
126							
134							
229	86	3.70	4.33	10			1.10
241							
243	70	1.54	2.21	10			-0.25
299							
321							
364 0							
364 2							
368	63	2.18	3.47	10			-0.85
420							
437							
485							
506							
509							

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
0

Statistics

Number of labs 3

Grand mean 73
SD Within 2.48
Reproducibility SD 11.67

Warning Limits

Mean - 2.6 SD 42
Mean + 2.6 SD 103

Action Limits

Mean - 3.3 SD 34
Mean + 3.3 SD 111

Bending stiffness - Clark

TAPPI T451

Sample A Units cm
Conditions 23°C 50%rh

Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
229	91.55	1.48	1.62	10			0.71
238	8.70	0.90	10.34	10			-0.71

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
0

Statistics

Number of labs 2

Grand mean 50.1
SD Within 1.19
Reproducibility SD 58.58

Warning Limits

Mean - 2.6 SD -102.2
Mean + 2.6 SD 202.4

Action Limits

Mean - 3.3 SD -143.2
Mean + 3.3 SD 243.5

Bending stiffness - Clark

TAPPI T451

Sample	B	Units	cm				
		Conditions	23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
229	167.1	3.81	2.28	10			0.71
238	16.1	0.90	5.59	10			-0.71

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
0

Statistics

Number of labs 2

Warning Limits

Mean - 2.6 SD -186.0
Mean + 2.6 SD 369.2

Grand mean 91.6
SD Within 2.35
Reproducibility SD 106.77

Action Limits

Mean - 3.3 SD -260.8
Mean + 3.3 SD 444.0

Bending stiffness - Rigidimeter

ISO 5629

Sample	A		Units	mN.m			
			Conditions	23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
229	5.57	0.14	2.46	10			0.00

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	1	Warning Limits	
		Mean - 2.6 SD	5.569
		Mean + 2.6 SD	5.569
Grand mean	5.569	Action Limits	
SD Within	0.000	Mean - 3.3 SD	5.569
Reproducibility SD	0.000	Mean + 3.3 SD	5.569

Bending stiffness - Rigidimeter

ISO 5629

Sample	B	Units	mN.m				
		Conditions	23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
229	39.71	1.18	2.97	10			0.00

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
0

Statistics

Number of labs

1

Warning Limits

Mean - 2.6 SD
Mean + 2.6 SD

39.71
39.71

Grand mean

SD Within

Reproducibility SD

39.71

0.00

0.00

Action Limits

Mean - 3.3 SD

Mean + 3.3 SD

39.71

39.71

Bending stiffness - Taber 15°

ISO 2493 Method 1

Sample	A	Units	Conditions	mN			
				23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
125	33.5	1.02	3.04	10			0.19
134	34.2	1.14	3.32	10			0.58
135	31.0	1.66	5.36	10			-1.15
143	33.4	0.97	2.92	10			0.12
146	36.7	1.34	3.64	10			1.93
229 1	32.9	0.63	1.92	10			-0.12
229 2	34.3	1.64	4.80	10			0.61
229 3	30.5	1.07	3.50	10			-1.45
243	33.0	0.73	2.22	10			-0.06
299	33.1	1.20	3.62	10			-0.02
368	30.6	1.00	3.26	10			-1.38
411	38.4	5.23 **	13.62	10	O		2.85
441	35.0	0.00	0.00	10			1.01
484	31.0	1.41	4.56	10			-1.16
505	34.8	1.62	4.65	10			0.90

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

1
0

Statistics

Number of labs

14

Warning Limits

Mean - 2.0 SD
Mean + 2.0 SD

29.4
36.8

Grand mean

33.1

Action Limits

SD Within

1.10

Mean - 2.6 SD

28.3

Reproducibility SD

1.85

Mean + 2.6 SD

37.9

Bending stiffness - Taber 15°

ISO 2493 Method 1

Sample	B	Units	Conditions				
				mN 23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
125	412	97.22 **	23.60	10	O		-0.08
134	446	7.57	1.70	10			1.11
135	355	6.76	1.90	10			-2.08
143	441	8.81	2.00	10			0.92
146	410	9.12	2.22	10			-0.15
229 1	403	5.32	1.32	10			-0.39
229 2	417	5.87	1.41	10			0.09
229 3	401	9.18	2.29	10			-0.46
243	432	7.40	1.71	10			0.63
299							
368	389	4.62	1.19	10			-0.87
411	399	17.71 **	4.44	10	O		-0.54
441							
484	408	15.50	3.80	10			-0.23
505	455	5.06	1.11	10			1.41

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

2
0

Statistics

Number of labs

11

Warning Limits
Mean - 2.0 SD
Mean + 2.0 SD

357
471

Grand mean
SD Within
Reproducibility SD

414
7.75
28.55

Action Limits
Mean - 2.6 SD
Mean + 2.6 SD

340
489

Burst strength - Board

ISO 2759

Sample	A	Units	Conditions	kPa			
				23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
146	569	14.00	2.46	10			0.48
229	286	35.99 **	12.58	10	O		-12.34
368 0	554	11.36	2.05	10			-0.21
368 1	587	11.75	2.00	10			1.27
506	557	5.29	0.95	10			-0.08
519	526	4.24	0.80	10			-1.45

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

1
0

Statistics

Number of labs

5

Warning Limits

Mean - 2.6 SD
Mean + 2.6 SD

501
616

Grand mean

558

SD Within

9.33

Reproducibility SD

22.09

Action Limits

Mean - 3.3 SD
Mean + 3.3 SD

486
631

Burst strength - Board

ISO 2759

Sample	B	Units	Conditions	Units	Conditions			
				kPa	23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score	
146	829	33.00 *	3.98	10	S		0.59	
229	458 *	20.67	4.51	10		S	-1.50	
368 0	796	18.75	2.36	10			0.40	
368 1	815	18.18	2.23	10			0.51	
506								
519								

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
0

Statistics

Number of labs

4

Warning Limits

Mean - 2.6 SD
Mean + 2.6 SD

262
1188

Grand mean

725

SD Within

22.65

Reproducibility SD

178.03

Action Limits

Mean - 3.3 SD
Mean + 3.3 SD

137
1312

Burst strength - Paper

ISO 2758

Sample	A	Units	Conditions	kPa			
				23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubb test	Z-score
105	148	3.51	2.37	10			1.33
125 0							
125 1							
126	128	10.19	7.96	10			-1.15
134							
146	140	20.42	14.62	10			0.30
229	143	18.70	13.10	10			0.70
241	138	20.44	14.86	10			0.03
243	138	19.16	13.86	10			0.12
285 0	131	10.87	8.28	10			-0.74
299	124	22.61	18.18	10			-1.61
321	128	4.16	3.25	10			-1.14
364 0	128	12.91	10.09	10			-1.15
368	129	21.90	16.95	10			-1.01
400	142	20.80	14.63	10			0.62
437	145	10.87	7.51	10			0.93
441	153	8.30	5.42	10			1.97
451	141	23.80	16.88	10			0.47
475	139	17.76	12.80	10			0.19
485							
486							
487	147	19.31	13.16	10			1.19
488	135	17.28	12.80	10			-0.28
506							
509							
514	131	15.73	12.01	10			-0.79

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers 0
Number of outliers 0

Statistics

Number of labs 19

Grand mean 137
SD Within 15.72
Reproducibility SD 8.01

Warning Limits
Mean - 2.0 SD 121
Mean + 2.0 SD 153

Action Limits
Mean - 2.6 SD 116
Mean + 2.6 SD 158

Burst strength - Paper

ISO 2758

Sample	B	Units	Conditions	kPa			
				23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105							
125 0	424	22.85	5.39	10			0.57
125 1	441	23.28	5.28	10			1.37
126	431	14.91	3.46	10			0.88
134	430	9.42	2.19	10			0.85
146	421	15.74	3.74	10			0.40
229	408	24.27	5.95	10			-0.22
241	402	6.61	1.65	10			-0.50
243	423	21.59	5.11	10			0.50
285 0	410	18.49	4.51	10			-0.11
299	416	21.38	5.14	10			0.19
321	371	18.27	4.92	10			-1.97
364 0	400	12.23	3.06	10			-0.59
368	393	16.85	4.29	10			-0.92
400	386	12.08	3.13	10			-1.24
437	433	16.75	3.87	10			0.98
441	395	8.10	2.05	10			-0.83
451	402	24.66	6.14	10			-0.49
475	422	11.38	2.70	10			0.47
485	408	14.48	3.55	10			-0.23
486	496**	31.97	6.45	10		O	4.02
487	414	27.22	6.58	10			0.08
488	412	24.14	5.86	10			-0.03
506	378	3.75	0.99	10			-1.63
509	464	22.24	4.80	10			2.47
514							

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
1

Statistics

Number of labs 23

Warning Limits

Mean - 2.0 SD 371
Mean + 2.0 SD 454

Grand mean 412
SD Within 16.99
Reproducibility SD 20.81

Action Limits

Mean - 2.6 SD 358
Mean + 2.6 SD 466

Burst strength - Paper

ISO 2758

Sample	C	Units	Conditions	kPa			
				23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105	662	11.70	1.77	10			-0.32
125 0	774	41.8 **	5.40	10	O		3.46
125 1	697	29.96	4.30	10			0.88
126							
134	712	18.13	2.55	10			1.36
146							
229	663	20.69	3.12	10			-0.27
241							
243	691	25.31	3.66	10			0.67
285 0	639	17.08	2.67	10			-1.09
299							
321							
364 0							
368							
400	634	8.82	1.39	10			-1.24
437							
441							
451							
475							
485							
486	780	52.95 **	6.79	10	O		3.66
487							
488							
506							
509							
514							

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	2
	Number of outliers	0

Statistics

Number of labs	7	Warning Limits	
		Mean - 2.6 SD	594
		Mean + 2.6 SD	748
Grand mean	671	Action Limits	
SD Within	18.81	Mean - 3.3 SD	573
Reproducibility SD	29.78	Mean + 3.3 SD	769

Compressive strength - Ring crush

ISO 12192

Sample	A		Units				
Conditions	kN/m 23°C 50%rh						
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
146	0.20	0.02	12.04	10			1.30
229	0.19	0.02	8.07	10			0.58
368	0.15	0.02	14.77	10			-1.35
441	0.17	0.02	11.18	10			-0.34
516	0.17	0.02	10.58	10			-0.19

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
0

Statistics

Number of labs

5

Warning Limits

Mean - 2.6 SD
Mean + 2.6 SD

0.12
0.23

Grand mean

SD Within

Reproducibility SD

0.18
0.02
0.02

Action Limits

Mean - 3.3 SD
Mean + 3.3 SD

0.11
0.24

Compressive strength - Ring crush

ISO 12192

Sample	B	Units	Conditions	Units	Conditions			
				kN/m	23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score	
146	3.55	0.08	2.31	10			1.11	
229	3.39	0.06	1.91	10			0.45	
368	3.20	0.07	2.31	10			-0.36	
441	3.01	0.20	6.64	10			-1.20	
516								

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
0

Statistics

Number of labs

4

Warning Limits

Mean - 2.6 SD
Mean + 2.6 SD

2.68
3.89

Grand mean

3.29

SD Within

0.11

Reproducibility SD

0.23

Action Limits

Mean - 3.3 SD
Mean + 3.3 SD

2.52
4.05

Compressive strength - Short span

ISO 9895

Sample	A	Units	kN/m				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
			Conditions	23°C 50%rh			
146	3.18	0.21	6.61	10			-0.60
229	3.25	0.20	6.10	10			-0.16
368	2.98	0.18	6.11	10			-1.84
400	3.19	0.13	4.22	10			-0.53
441	3.20	0.10	3.13	10			-0.46
451	3.51	0.20	5.78	10			1.52
455	3.49	0.10	2.89	10			1.38
486	3.34	0.19	5.74	10			0.46
487	3.40	0.24	7.19	10			0.80
506	3.15	0.05	1.49	10			-0.79
516	3.31	0.16	4.87	10			0.23

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	11	Warning Limits	
		Mean - 2.0 SD	2.96
		Mean + 2.0 SD	3.59
Grand mean	3.27	Action Limits	
SD Within	0.16	Mean - 2.6 SD	2.86
Reproducibility SD	0.16	Mean + 2.6 SD	3.68

Compressive strength - Short span

ISO 9895

Sample	B	Units	kN/m				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
			Conditions	23°C 50%rh			
146	6.23	0.26	4.17	10			0.03
229	6.11	0.36	5.91	10			-0.53
368	5.98	0.29	4.88	10			-1.15
400	6.06	0.19	3.12	10			-0.77
441							
451	6.59	0.35	5.36	10			1.73
455	6.46	0.13	1.96	10			1.12
486	6.28	0.21	3.37	10			0.26
487	6.08	0.39	6.49	10			-0.69
506							
516							

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
0

Statistics

Number of labs

8

Warning Limits

Mean - 2.6 SD
Mean + 2.6 SD

5.67
6.78

Grand mean

SD Within

Reproducibility SD

6.22

0.27

0.21

Action Limits

Mean - 3.3 SD

Mean + 3.3 SD

5.52

6.92

Flat crush resistance (FCT)

ISO 3035

Sample A Units kPa
Conditions 23°C 50%rh

Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
146	267	14.00	5.24	10			-0.42
229	288	11.20	3.89	10			1.14
285	263	17.43	6.63	10			-0.73

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers 0
Number of outliers 0

Statistics

Number of labs 3

Grand mean 273
SD Within 14.21
Reproducibility SD 13.46

Warning Limits
Mean - 2.6 SD 238
Mean + 2.6 SD 308

Action Limits
Mean - 3.3 SD 228
Mean + 3.3 SD 317

Flat crush resistance (FCT)

ISO 3035

Sample B
 Units kPa
 Conditions 23°C 50%rh

Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
146	427	34.00	7.96	10			-0.58
229	606	36.41	6.01	10			1.15
285	428	46.46	10.85	10			-0.57

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	3	Warning Limits	
		Mean - 2.6 SD	220
		Mean + 2.6 SD	754
Grand mean	487	Action Limits	
SD Within	38.96	Mean - 3.3 SD	148
Reproducibility SD	102.70	Mean + 3.3 SD	826

Flat crush resistance after Lab fluting (CMT)

EN ISO 7263

Sample	A	Units Conditions	N 23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105	188	9.26	4.93	10			1.37
229	178	14.68	8.27	10			0.44
400	175	10.32	5.91	10			0.17
451	172	8.14	4.73	10			-0.06
486	168	6.45	3.84	10			-0.43
487	177	11.31	6.39	10			0.39
516	152	6.38	4.20	10			-1.88

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers 0
Number of outliers 0

Statistics

Number of labs 7

Grand mean 173
SD Within 9.51
Reproducibility SD 11.04

Warning Limits
Mean - 2.6 SD 144
Mean + 2.6 SD 201

Action Limits
Mean - 3.3 SD 136
Mean + 3.3 SD 209

Flat crush resistance after Lab fluting (CMT)

EN ISO 7263

Sample	B	Units Conditions	N 23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105	440	8.97	2.04	10			1.80
229	389	26.15	6.71	10			0.36
400	371	13.72	3.70	10			-0.16
451	343	17.02	4.97	10			-0.97
486	350	14.96	4.27	10			-0.76
487	368	12.81	3.49	10			-0.27
516							

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	6	Warning Limits	
		Mean - 2.6 SD	286
		Mean + 2.6 SD	468
Grand mean	377	Action Limits	
SD Within	15.60	Mean - 3.3 SD	261
Reproducibility SD	35.05	Mean + 3.3 SD	492

Folding Endurance - Schopper

ISO 5626

Sample	A	Units	log ¹⁰ of double fold				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
			Conditions	23°C 50%rh			
229	2.19	0.08	3.88	10			-1.03
241	2.31	0.03	1.36	10			0.06
484	2.40	0.14	5.71	10			0.97
515							

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
0

Statistics

Number of labs 3

Grand mean 2.30
SD Within 0.08
Reproducibility SD 0.11

Warning Limits

Mean - 2.6 SD 2.02
Mean + 2.6 SD 2.58

Action Limits

Mean - 3.3 SD 1.94
Mean + 3.3 SD 2.65

Folding Endurance - Schopper

ISO 5626

Sample	B	Units	log ¹⁰ of double fold				
		Conditions	23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
229	2.67	0.11	4.06	10			-1.36
241	2.81	0.06	2.03	10			-0.03
484	2.92	0.11	3.65	10			0.99
515	2.86	0.13	4.69	10			0.40

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	4	Warning Limits	
		Mean - 2.6 SD	2.55
		Mean + 2.6 SD	3.09
Grand mean	2.82	Action Limits	
SD Within	0.10	Mean - 3.3 SD	2.47
Reproducibility SD	0.10	Mean + 3.3 SD	3.16

Grammage

EN ISO 536

Sample	A	Units	g/m ²				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
			Conditions	23°C 50%rh			
105	52.7	1.51	2.86	10			1.25
126	52.3	1.00	1.91	10			-0.02
143 0	52.2	0.92	1.76	10			-0.18
143 1	51.4	1.26	2.45	10			-2.26
146							
229 0	52.3	0.79	1.52	10			0.01
229 1	52.3	1.13	2.16	10			0.23
229 2	51.8	1.18	2.28	10			-1.21
241	52.7	0.95	1.81	10			1.30
243	52.3	0.93	1.78	10			0.19
245	55.8	9.58 **	17.17	10	O		9.83
299	52.3	0.69	1.32	10			0.21
321	52.4	1.07	2.05	10			0.47
368							
411	52.7	1.39	2.64	10			1.10
437	52.1	1.15	2.22	10			-0.57
441	53.0	0.50	0.94	10			2.06
475 0	52.2	0.37	0.71	10			-0.27
475 1	52.1	0.56	1.07	10			-0.31
475 2	52.0	0.47	0.91	10			-0.63
488	51.8	1.25	2.41	10			-1.18
503	52.2	1.09	2.09	10			-0.20
509							
519							

Tests for outliers

Cochran-Test	O - denotes an outlier	1
Grubbs-Test	S - denotes a straggler	0
	Number of outliers	
	Number of outliers	

Statistics

Number of labs	19	Warning Limits	
Grand mean	52.3	Mean - 2.0 SD	51.5
SD Within	0.96	Mean + 2.0 SD	53.0
Reproducibility SD	0.36	Action Limits	
		Mean - 2.6 SD	51.3
		Mean + 2.6 SD	53.2

Grammage

EN ISO 536

Sample	B	Units	g/m ²				
		Conditions	23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105	93.9	0.58	0.61	10			0.54
126	94.8	0.75	0.79	10			2.02
143 0	92.6	1.19	1.28	10			-1.52
143 1							
146	94.5	1.20	1.27	10			1.55
229 0	93.3	0.76	0.81	10			-0.32
229 1	93.3	1.06	1.13	10			-0.30
229 2	93.0	1.57	1.68	10			-0.83
241	93.0	1.03	1.10	10			-0.86
243	93.7	1.19	1.27	10			0.29
245	94.2	0.84	0.89	10			1.13
299	94.9	0.96	1.01	10			2.21
321	93.1	1.03	1.10	10			-0.68
368	93.6	1.41	1.51	10			0.11
411	92.6	1.19	1.29	10			-1.38
437	93.7	1.16	1.24	10			0.29
441	93.3	0.40	0.43	10			-0.34
475 0	93.0	0.77	0.83	10			-0.85
475 1	94.0	0.69	0.74	10			0.79
475 2	93.1	0.97	1.04	10			-0.69
488	93.5	0.85	0.91	10			-0.09
503	93.1	1.40	1.51	10			-0.73
509	93.4	0.99	1.07	10			-0.21
519	93.4	0.55	0.59	10			-0.12

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
0

Statistics

Number of labs

23

Warning Limits

Mean - 2.0 SD
Mean + 2.0 SD

92
95

Grand mean

SD Within
Reproducibility SD

93.5
0.98
0.63

Action Limits

Mean - 2.6 SD
Mean + 2.6 SD

92
95

Grammage

EN ISO 536

Sample	C	Units					
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105							
126							
143 0	244	0.62	0.25	10			0.06
143 1							
146							
229 0	245	0.60	0.25	10			0.81
229 1	244	1.20	0.49	10			-0.08
229 2	244	1.14	0.47	10			-0.35
241							
243	242	1.41	0.58	10			-1.83
245							
299							
321							
368	246	1.02	0.42	10			1.36
411							
437							
441							
475 0							
475 1							
475 2							
488							
503	244	0.84	0.35	10			0.02
509							
519							

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	7	Warning Limits	
		Mean - 2.6 SD	242
		Mean + 2.6 SD	247
Grand mean	244	Action Limits	
SD Within	0.98	Mean - 3.3 SD	241
Reproducibility SD	1.05	Mean + 3.3 SD	248

Internal bond strength - Scott

UNI 9439

Sample	A	Units	J/m ²				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
			Conditions	23°C 50%rh			
105	146.5	6.96	4.75	10			-0.89
126	83.2 **	3.72	4.47	10		O	-2.57
134	238.0	6.32	2.66	10			1.54
135	187.6	23.87	12.73	10			0.20
229	158.1	7.83	4.95	10			-0.58
368	142.9	17.00	11.90	10			-0.98
441							
487	206.5	3.44	1.66	10			0.71
506							

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
1

Statistics

Number of labs 6

Grand mean 180
SD Within 10.90
Reproducibility SD 37.70

Warning Limits
Mean - 2.6 SD 82
Mean + 2.6 SD 278

Action Limits
Mean - 3.3 SD 56
Mean + 3.3 SD 304

Internal bond strength - Scott

UNI 9439

Sample	B	Units	J/m ²	Conditions	23°C	50%rh		
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score	
105	277	13.92	5.03	10			0.81	
126	123 **	4.44	3.61	10		O	-5.00	
134	292	11.60	3.97	10			1.39	
135	408	63.46 **	15.55	10	O		5.78	
229	277	35.17 **	12.70	10	O		0.82	
368	228	15.07	6.61	10			-1.03	
441	229	9.30	4.06	10			-0.99	
487	264	4.45	1.69	10			0.33	
506	242	2.63	1.09	10			-0.51	

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	2
	Number of outliers	1

Statistics

Number of labs	6	Warning Limits	
		Mean - 2.6 SD	186
		Mean + 2.6 SD	324
Grand mean	255	Action Limits	
SD Within	9.50	Mean - 3.3 SD	168
Reproducibility SD	26.43	Mean + 3.3 SD	342

Opacity

Sample	A	Units	%				
		Conditions	23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105	52.0	0.18	0.34	10			-0.47
125	51.9	0.70	1.35	10			-0.58
126	52.2	0.63	1.21	10			0.08
143	51.5	0.39	0.75	10			-1.39
229	53.3	0.62	1.16	10			2.38
241							
243	52.1	0.56	1.08	10			-0.21
245	52.8	0.40	0.77	10			1.24
299	51.7	0.16	0.31	10			-1.05
321	52.2	0.35	0.68	10			-0.03
411	52.6	0.58	1.10	10			0.95
437	52.2	0.47	0.90	10			0.08
441	52.3	0.40	0.76	10			0.27
485	51.7	0.58	1.11	10			-1.06
488	52.1	0.36	0.70	10			-0.21
506							

Lab 125 uses an Eel instrument - correction factor applied ($\times 0.948 + 6.4$)

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers 0
Number of outliers 0

Statistics

Number of labs 14

Warning Limits

Mean - 2.0 SD 51.2
Mean + 2.0 SD 53.1

Grand mean 52.2
SD Within 0.46
Reproducibility SD 0.47

Action Limits

Mean - 2.6 SD 50.9
Mean + 2.6 SD 53.4

Opacity

Sample	B	Units	%				
		Conditions	23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105	90.0	0.20	0.23	10			-1.19
125	90.9**	0.42 *	0.46	10	S	O	5.12
126	89.9	0.21	0.23	10			-1.67
143	90.0	0.21	0.23	10			-0.73
229	90.4	0.30	0.33	10			1.57
241	90.1	0.07	0.08	10			-0.06
243	90.1	0.28	0.31	10			-0.60
245	90.1	0.22	0.25	10			-0.25
299	90.0	0.25	0.28	10			-0.78
321	90.2	0.21	0.23	10			0.53
411	90.2	0.28	0.31	10			0.38
437	90.2	0.17	0.19	10			0.19
441	90.4	0.30	0.33	10			1.72
485	90.1	0.25	0.28	10			-0.40
488	90.4	0.27	0.30	10			1.46
506	90.1	0.19	0.21	10			-0.18

Lab 125 uses an Eel instrument - correction factor applied ($x 0.948 + 6.4$)

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
1

Statistics

Number of labs

15

Warning Limits

Mean - 2.0 SD
Mean + 2.0 SD

89.9
90.4

Grand mean

SD Within

Reproducibility SD

90.1

0.23

0.15

Action Limits

Mean - 2.6 SD

Mean + 2.6 SD

89.8

90.5

Puncture Resistance

ISO 3036

Sample	A		Units	J			
			Conditions	23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
229	6.84	0.31	4.51	8			-0.71
285	9.80	0.32	3.31	8			0.71

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
0

Statistics

Number of labs 2

Grand mean 8.32
SD Within 0.32
Reproducibility SD 2.09

Warning Limits

Mean - 2.6 SD 2.88
Mean + 2.6 SD 13.75

Action Limits

Mean - 3.3 SD 1.42
Mean + 3.3 SD 15.21

Puncture Resistance

ISO 3036

Sample	B	Units	J				
		Conditions	23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
229	13.60	0.21	1.55	8			-0.71
285	19.68	0.38	1.93	8			0.71

Tests for outliers

Cochran-Test	O - denotes an outlier	0
Grubbs-Test	S - denotes a straggler	0
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	2	Warning Limits	
		Mean - 2.6 SD	5.47
		Mean + 2.6 SD	27.81
Grand mean	16.64	Action Limits	
SD Within	0.30	Mean - 3.3 SD	2.47
Reproducibility SD	4.30	Mean + 3.3 SD	30.82

Roughness - Bendtsen

ISO 8791/2

Sample	A	Units	ml/min				
		Conditions	23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
125	9.3	0.67	7.26	10			-1.25
143	13.6	1.35	9.93	10			-0.95
146	17.0	15.0 **	88.24	10	O		-0.70
229	42.5	6.35	14.93	10			1.11
241	17.3	3.37	19.47	10			-0.68
243	15.5	2.17	14.02	10			-0.81
245	48.3	3.89	8.05	10			1.52
299							
364	35.0	14.89 **	42.54	10	O		0.57
368							
410	39.1	3.18	8.13	10			0.87
441	25.0	8.40	33.60	10			-0.14
484	31.6	3.14	9.93	10			0.33
487							
506							

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers 2
Number of outliers 0

Statistics

Number of labs 9

Grand mean 26.9
SD Within 3.61
Reproducibility SD 14.08

Warning Limits
Mean - 2.6 SD -9.7
Mean + 2.6 SD 63.5

Action Limits
Mean - 3.3 SD -19.6
Mean + 3.3 SD 73.4

Roughness - Bendtsen

ISO 8791/2

Sample	B	Units	ml/min				
		Conditions	23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
125	174.2	15.43	8.86	10			-1.21
143	202.8	6.25	3.08	10			0.21
146	152.0	10.00	6.58	10			-2.30
229	204.0	20.66	10.13	10			0.27
241	208.4	8.17	3.92	10			0.48
243	222.5	5.04	2.26	10			1.18
245	210.0	8.53	4.06	10			0.56
299	205.0	12.60	6.14	10			0.32
364	210.0	21.56 *	10.27	10	S		0.56
368	201.3	10.49	5.21	10			0.14
410	194.5	20.88	10.73	10			-0.20
441	198.0	8.40	4.24	10			-0.03
484	165.3	4.55	2.75	10			-1.65
487	204.4	18.16	8.89	10			0.29
506	226.5	3.41	1.50	10			1.38

Tests for outliers

Cochran-Test	O - denotes an outlier	0
Grubbs-Test	S - denotes a straggler	0
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	15	Warning Limits	
		Mean - 2.0 SD	158
		Mean + 2.0 SD	239
Grand mean	199	Action Limits	
SD Within	11.61	Mean - 2.6 SD	146
Reproducibility SD	20.23	Mean + 2.6 SD	251

Roughness - Bendtsen

ISO 8791/2

Sample	C	Units	ml/min				
		Conditions	23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
125	2315	200.1	8.64	10			0.33
143							
146							
229	2315	113.2	4.89	10			0.33
241							
243	2812	121.9	4.33	10			1.45
245							
299							
364							
368	2223	153.5	6.90	10			0.13
410							
441							
484	1792	123.6	6.89	10			-0.84
487	1543	102.4	6.63	10			-1.40
506							

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
0

Statistics

Number of labs 6

Warning Limits

Mean - 2.6 SD 1009
Mean + 2.6 SD 3325

Grand mean 2167
SD Within 135.76
Reproducibility SD 445.45

Action Limits

Mean - 3.3 SD 697
Mean + 3.3 SD 3637

Roughness - Printsurf 10 Kgf/cm2

ISO 8791/4

Sample	A	Units	microns				
		Conditions	23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
229	2.13	0.08	3.55	10			0.71
441	1.60	0.10	6.25	10			-0.71

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	2	Warning Limits	
		Mean - 2.6 SD	0.90
		Mean + 2.6 SD	2.83
Grand mean	1.86	Action Limits	
SD Within	0.09	Mean - 3.3 SD	0.64
Reproducibility SD	0.37	Mean + 3.3 SD	3.09

Roughness - Printsurf 10 Kgf/cm2

ISO 8791/4

Sample B Units microns
Conditions 23°C 50%rh

Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
229	5.99	0.27	4.54	10			0.71
441	4.20	0.10	2.38	10			-0.71

Tests for outliers

Cochran-Test O - denotes an outlier
Grubbs-Test S - denotes a straggler
Number of outliers 0
Number of outliers 0

Statistics

Number of labs 2
Warning Limits
Mean - 2.6 SD 1.81
Mean + 2.6 SD 8.37
Action Limits
Grand mean 5.09
SD Within 0.19
Reproducibility SD 1.26
Mean - 3.3 SD 0.93
Mean + 3.3 SD 9.26

Roughness - Printsurf 20 Kgf/cm2

Sample	A			Units	microns		
			Conditions	23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
229	1.59	0.07	4.22	10			0.71
441	1.20	0.10	8.33	10			-0.71

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	2	Warning Limits	
		Mean - 2.6 SD	0.68
		Mean + 2.6 SD	2.10
Grand mean	1.39	Action Limits	
SD Within	0.08	Mean - 3.3 SD	0.49
Reproducibility SD	0.27	Mean + 3.3 SD	2.29

Roughness - Printsurf 20 Kgf/cm2

Sample	B	Units	microns	Conditions	23°C 50%rh		
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
229	5.29	0.26	5.00	10			0.71
441	3.90	0.20	5.13	10			-0.71

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	2	Warning Limits	
		Mean - 2.6 SD	2.04
		Mean + 2.6 SD	7.15
Grand mean	4.60	Action Limits	
SD Within	0.23	Mean - 3.3 SD	1.35
Reproducibility SD	0.98	Mean + 3.3 SD	7.84

Smoothness - Bekk

ISO 5627

Sample	A	Units	Bekk secs				
		Conditions	23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105	27.01	0.99	3.65	10			1.15
134	25.40	1.17	4.62	10			0.35
143	25.90	1.98	7.63	10			0.60
179							
229	22.40	1.12	4.98	10			-1.14
484	22.76	1.17	5.16	10			-0.96

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
0

Statistics

Number of labs 5

Grand mean 24.7
SD Within 1.29
Reproducibility SD 2.02

Warning Limits

Mean - 2.6 SD 19.4
Mean + 2.6 SD 29.9

Action Limits

Mean - 3.3 SD 18.0
Mean + 3.3 SD 31.4

Smoothness - Bekk

ISO 5627

Sample	B	Units	Bekk secs				
		Conditions	23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105	477 *	21.05	4.41	10		S	-1.94
134	814	38.79	4.77	10			0.51
143	828	57.77 *	6.98	10	S		0.61
179	751	28.19	3.76	10			0.05
229	742	42.21	5.69	10			-0.01
484	853	30.70	3.60	10			0.79

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	6	Warning Limits	
		Mean - 2.6 SD	386
		Mean + 2.6 SD	1102
Grand mean	744	Action Limits	
SD Within	36.45	Mean - 3.3 SD	290
Reproducibility SD	137.69	Mean + 3.3 SD	1198

Tearing resistance - Elmendorf

EN 21974

Sample	A	Units	Conditions	mN			
				23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105	355	14.48	4.08	10			1.36
125 0	468 **	13.98	2.99	10		O	9.01
125 1	353	11.95	3.39	10			1.18
126	344	7.15	2.08	10			0.63
134	299	13.07	4.37	10			-2.44
143	346	15.35	4.44	10			0.73
146	345	9.00	2.61	10			0.67
179	342	12.29	3.59	10			0.47
229	329	11.70	3.56	10			-0.42
241	323	9.28	2.88	10			-0.85
243	323	12.63	3.92	10			-0.85
299	355	13.24	3.74	10			1.31
321	346	14.52	4.20	10			0.71
364 0	334	14.29	4.28	10			-0.08
368	346	13.80	3.99	10			0.74
420	314	0.00	0.00	10			-1.46
437	319	9.51	2.99	10			-1.13
441	349	10.30	2.95	10			0.94
455	342	10.93	3.20	10			0.47
475 0	332	9.10	2.74	10			-0.21
475 1	340	12.30	3.62	10			0.34
485	332	8.33	2.51	10			-0.22
488	334	13.49	4.04	10			-0.06
506	309	5.45	1.76	10			-1.76
514	334	14.71	4.41	10			-0.08

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
1

Statistics

Number of labs

24

Warning Limits

Mean - 2.0 SD
Mean + 2.0 SD

306
365

Grand mean

335

SD Within
Reproducibility SD

11.12
14.75

Action Limits

Mean - 2.6 SD
Mean + 2.6 SD

297
373

Tearing resistance - Elmendorf

EN 21974

Sample	B	Units		mN			
		Conditions		23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105	1095	28.95	2.64	10			1.60
125 0	1118	43.67	3.91	10			1.96
125 1	1023	14.58	1.43	10			0.47
126	979	17.82	1.82	10			-0.23
134	835	25.85	3.10	10			-2.50
143	993	15.28	1.54	10			-0.01
146	1021	21.00	2.06	10			0.44
179							
229	914	25.39	2.78	10			-1.25
241							
243	937	26.28	2.80	10			-0.88
299	1025	28.93	2.82	10			0.50
321	1019	45.36	4.45	10			0.40
364 0	957	27.08	2.83	10			-0.57
368	1014	17.49	1.72	10			0.33
420	921	20.66	2.24	10			-1.13
437	996	24.37	2.45	10			0.04
441	1039	23.80	2.29	10			0.72
455	1013	38.03	3.75	10			0.32
475 0	1029	5.50	0.53	10			0.56
475 1	989	15.88	1.61	10			-0.07
485							
488	949	30.59	3.22	10			-0.70
506							
514							

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	20	Warning Limits	
		Mean - 2.0 SD	866
		Mean + 2.0 SD	1120
Grand mean	993	Action Limits	
SD Within	24.83	Mean - 2.6 SD	828
Reproducibility SD	63.53	Mean + 2.6 SD	1158

Tensile Strength

ISO 1924/2

Sample	A	Units					
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105	3.08	0.27	8.72	10			-0.03
125 0	3.18	0.15	4.75	10			0.81
125 1	3.11	0.16	5.17	10			0.24
126	3.02	0.24	7.95	10			-0.55
134	3.10	0.19	6.08	10			0.12
143	3.13	0.18	5.91	10			0.35
146	3.00	0.21	7.07	10			-0.68
179 0	3.06	0.26	8.38	10			-0.23
179 1	2.92	0.20	6.98	10			-1.37
229	2.98	0.18	5.99	10			-0.87
241	2.98	0.18	5.96	10			-0.86
243	3.16	0.12	3.95	10			0.60
245	3.23	0.20	6.33	10			1.22
299	3.07	0.17	5.63	10			-0.12
321 1	3.06	0.14	4.53	10			-0.20
364 0	3.18	0.30	9.43	10			0.78
364 2	3.15	0.14	4.44	10			0.53
368	3.00	0.15	4.83	10			-0.69
400	3.28	0.18	5.47	10			1.61
410	2.95	0.18	5.93	10			-1.10
420	3.39	0.26	7.80	10			2.49
437	3.23	0.21	6.57	10			1.24
441	2.97	0.20	6.73	10			-0.97
454	3.61 **	0.26	7.20	10		O	4.36
475 0	2.98	0.15	5.01	10			-0.85
475 1	3.01	0.08	2.76	10			-0.65
475 2	2.89	0.13	4.67	10			-1.66
484	2.98	0.17	5.81	10			-0.86
485							
488	3.28	0.21	6.26	10			1.59
506							
514	3.10	0.18	5.69	10			0.12
519							

Tests for outliers

Cochran-Test	O - denotes an outlier	0
Grubbs-Test	S - denotes a straggler	1
	Number of outliers	
	Number of outliers	

Statistics

Number of labs	29	Warning Limits	
		Mean - 2.0 SD	2.85
		Mean + 2.0 SD	3.33
Grand mean	3.09	Action Limits	
SD Within	0.19	Mean - 2.6 SD	2.77
Reproducibility SD	0.12	Mean + 2.6 SD	3.40

Tensile Strength

ISO 1924/2

Sample	B	Units					
		Conditions	kN/m 23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105	5.19	0.16	3.17	10			-0.59
125 0							
125 1							
126							
134	5.45	0.20	3.70	10			0.33
143	5.28	0.24	4.49	10			-0.27
146							
179 0	5.46	0.29	5.33	10			0.35
179 1	5.84	0.22	3.77	10			1.68
229	5.25	0.14	2.75	10			-0.37
241	5.29	0.14	2.72	10			-0.25
243	5.38	0.25	4.68	10			0.09
245	5.52	0.35 *	6.32	10	S		0.57
299							
321 1	5.11	0.19	3.74	10			-0.87
364 0	4.98	0.14	2.81	10			-1.32
364 2	4.90	0.08	1.63	10			-1.62
368							
400	5.60	0.16	2.86	10			0.86
410	4.80	0.50 **	10.42	10	O		-1.96
420	5.68	0.27	4.71	10			1.15
437	5.52	0.16	2.97	10			0.57
441	5.04	0.10	1.98	10			-1.12
454	6.10	0.32	5.27	10			2.60
475 0	5.15	0.14	2.66	10			-0.74
475 1	5.30	0.09	1.70	10			-0.19
475 2	5.10	0.15	2.93	10			-0.92
484							
485	5.34	0.19	3.46	10			-0.06
488	5.39	0.25	4.58	10			0.10
506							
514							
519	0.01 **	0.00	0.00	10		O	-18.83

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

1
1

Statistics

Number of labs 22

Warning Limits

Mean - 2.0 SD 4.79
Mean + 2.0 SD 5.92

Grand mean 5.36
SD Within 0.19
Reproducibility SD 0.28

Action Limits

Mean - 2.6 SD 4.62
Mean + 2.6 SD 6.10

Tensile Strength

ISO 1924/2

Sample	C	Units		kN/m			
		Conditions		23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105							
125 0	8.79	0.27	3.07	10			-0.27
125 1	8.56	0.65 **	7.59	10	O		-1.02
126	8.71	0.39	4.48	10			-0.53
134							
143							
146	8.81	0.31	3.56	10			-0.21
179 0							
179 1							
229	8.93	0.19	2.18	10			0.19
241							
243	9.38 *	0.20	2.15	10		S	1.67
245							
299	8.80	0.21	2.40	10			-0.22
321 1							
364 0							
364 2							
368	8.78	0.18	2.01	10			-0.29
400	9.49 *	0.12	1.23	10		S	2.04
410							
420							
437							
441							
454							
475 0							
475 1							
475 2							
484	8.48	0.23	2.67	10			-1.28
485	8.80	0.40	4.56	10			-0.22
488							
506	8.61	0.16	1.83	10			-0.88
514							
519							

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

1
0

Statistics

Number of labs 11

Warning Limits

Mean - 2.0 SD 8.26
Mean + 2.0 SD 9.48

Grand mean 8.87
SD Within 0.24
Reproducibility SD 0.30

Action Limits

Mean - 2.6 SD 8.08
Mean + 2.6 SD 9.66

Tensile Stretch at break

ISO 1924/2

Sample A Units %
Conditions 23°C 50%rh

Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105	6.41	0.49	7.63	10			0.03
125 0	4.56 **	0.20	4.39	10		O	-4.96
125 1	7.62	0.49	6.42	10			3.28
126	6.66	0.41	6.16	10			0.69
134	6.29	0.31	4.94	10			-0.30
143	6.38	0.31	4.80	10			-0.07
146	6.05	0.39	6.45	10			-0.95
179 0	6.64	0.42	6.32	10			0.64
179 1	6.20	0.27	4.43	10			-0.54
229	6.54	0.39	6.03	10			0.37
241	5.82	0.58	9.98	10			-1.58
243	6.31	0.32	5.10	10			-0.25
245	6.38	0.16	2.51	10			-0.07
299	6.68	0.20	3.03	10			0.75
321 1	6.30	0.46	7.33	10			-0.27
364 0	6.29	0.45	7.15	10			-0.30
364 2	6.55	0.18	2.75	10			0.40
368	6.28	0.36	5.66	10			-0.32
410	6.23	0.55	8.89	10			-0.46
420	6.29	0.21	3.40	10			-0.32
437	5.95	0.45	7.50	10			-1.21
441	6.90	0.60	8.70	10			1.34
454	6.44	0.35	5.45	10			0.10
475 0	6.30	0.27	4.34	10			-0.27
475 1	6.14	0.33	5.31	10			-0.70
475 2	6.21	0.32	5.12	10			-0.52
484	6.13	0.28	4.49	10			-0.74
485							
488	6.07	0.33	5.48	10			-0.89
506							
514	7.20	0.34	4.77	10			2.15
519							

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers 0
Number of outliers 1

Statistics

Number of labs 28

Warning Limits

Mean - 2.0 SD 5.66
Mean + 2.0 SD 7.14

Grand mean 6.40
SD Within 0.37
Reproducibility SD 0.37

Action Limits

Mean - 2.6 SD 5.44
Mean + 2.6 SD 7.37

Tensile Stretch at break

ISO 1924/2

Sample	B	Units	Conditions	%			
				23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105	1.63	0.09	5.74	10			-0.35
125 0							
125 1							
126							
134	1.62	0.06	3.90	10			-0.44
143	1.53	0.11	7.11	10			-1.30
146							
179 0	1.94 *	0.12	6.05	10		S	2.49
179 1	1.70	0.12	6.79	10			0.29
229	1.72	0.10	5.89	10			0.47
241	1.61	0.09	5.45	10			-0.57
243	1.55	0.11	6.88	10			-1.08
245	2.04	0.48 **	23.53	10	O		3.40
299							
321 1	1.63	0.10	6.30	10			-0.34
364 0	1.69	0.10	5.92	10			0.20
364 2	1.60	0.07	4.38	10			-0.62
368							
410	1.50	0.27 **	18.00	10	O		-1.53
420	1.70	0.06	3.71	10			0.27
437	1.58	0.09	5.96	10			-0.82
441	1.90 *	0.10	5.26	10		S	2.12
454	1.78	0.13	7.26	10			0.98
475 0	1.61	0.08	4.81	10			-0.50
475 1	1.61	0.08	5.08	10			-0.53
475 2	1.59	0.08	5.16	10			-0.72
484							
485	1.71	0.11	6.54	10			0.39
488	1.56	0.09	5.59	10			-0.99
506							
514							
519	1.78	0.12	6.81	10			1.05

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers 2
Number of outliers 0

Statistics

Number of labs 21

Warning Limits

Mean - 2.0 SD 1.45
Mean + 2.0 SD 1.89

Grand mean 1.67
SD Within 0.10
Reproducibility SD 0.11

Action Limits

Mean - 2.6 SD 1.38
Mean + 2.6 SD 1.95

Tensile Stretch at break

ISO 1924/2

Sample	C	Units	Conditions				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105							
125 0	1.97 **	0.09	4.57	10		O	-6.69
125 1	3.29	0.30 **	9.12	10	O		6.08
126	2.75	0.18	6.55	10			0.85
134							
143							
146	2.59	0.13	5.02	10			-0.69
179 0							
179 1							
229	2.86	0.14	4.78	10			1.95
241							
243	2.57	0.08	3.03	10			-0.87
245							
299	2.75	0.12	4.36	10			0.89
321 1							
364 0							
364 2							
368	2.63	0.12	4.62	10			-0.30
410							
420							
437							
441							
454							
475 0							
475 1							
475 2							
484	2.60	0.14	5.30	10			-0.59
485	2.56	0.20 *	7.92	10	S		-0.96
488							
506	2.63	0.10	3.79	10			-0.29
514							
519							

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers 1
Number of outliers 1

Statistics

Number of labs 9

Grand mean 2.66
SD Within 0.13
Reproducibility SD 0.10

Warning Limits
Mean - 2.6 SD 2.39
Mean + 2.6 SD 2.93

Action Limits
Mean - 3.3 SD 2.32
Mean + 3.3 SD 3.00

Thickness 1 sheet

EN 20 534

Sample	A	Units	microns				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105	72.9	1.10	1.51	10			0.78
125 0	69.0	2.11	3.06	10			-0.95
125 1	74.3	1.34	1.80	10			1.40
126	72.4	1.27	1.75	10			0.56
134							
135							
143	73.8	1.69	2.29	10			1.18
146							
229	71.8	2.04	2.85	10			0.29
241	72.8	1.83	2.52	10			0.71
243	70.3	0.95	1.35	10			-0.37
245	73.7	1.27	1.72	10			1.11
299	71.0	1.95	2.75	10			-0.07
321	17.7 **	0.48	2.71	10		O	-23.64
364	72.0	3.06 *	4.25	10	S		0.38
368	72.2	2.20	3.05	10			0.47
411	66.6	1.51	2.26	10			-2.01
437	70.9	1.66	2.35	10			-0.11
441	70.1	0.48	0.68	10			-0.46
485							
488	68.1	1.86	2.73	10			-1.34
519	67.6	0.97	1.43	10			-1.57

Tests for outliers

Cochran-Test	O - denotes an outlier	0
Grubbs-Test	S - denotes a straggler	1
	Number of outliers	
	Number of outliers	

Statistics

Number of labs	17	Warning Limits	
Grand mean	71.1	Mean - 2.0 SD	66.6
SD Within	1.61	Mean + 2.0 SD	75.7
Reproducibility SD	2.26	Action Limits	
		Mean - 2.6 SD	65.3
		Mean + 2.6 SD	77.0

Thickness 1 sheet

EN 20 534

Sample	B	Units		microns			
		Conditions		23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105	104.0	1.56	1.50	10			0.60
125 0	101.0	3.16 *	3.13	10	S		-0.60
125 1	106.2	2.04	1.92	10			1.48
126	102.4	0.82	0.80	10			-0.04
134	101.6	1.73	1.70	10			-0.38
135	106.3	5.10 **	4.80	10	O		1.52
143	104.0	2.04	1.96	10			0.61
146	104.5	2.50	2.39	10			0.80
229	102.1	2.42	2.37	10			-0.16
241	104.3	1.08	1.04	10			0.72
243	100.3	0.95	0.95	10			-0.87
245	104.1	2.14	2.06	10			0.62
299	104.2	1.15	1.10	10			0.69
321	25.5 **	0.52	2.04	10		O	-30.74
364	101.0	2.18	2.16	10			-0.60
368	102.7	1.42	1.38	10			0.08
411	97.1	1.79	1.85	10			-2.15
437	101.4	1.17	1.16	10			-0.44
441	105.0	0.00	0.00	10			1.00
485	104.6	1.10	1.05	10			0.82
488	97.0	2.19	2.26	10			-2.21
519							

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	1
	Number of outliers	1

Statistics

Number of labs	19	Warning Limits	
		Mean - 2.0 SD	97.5
		Mean + 2.0 SD	107.5
Grand mean	102.5	Action Limits	
SD Within	1.66	Mean - 2.6 SD	96.0
Reproducibility SD	2.50	Mean + 2.6 SD	109.0

Thickness 1 sheet

EN 20 534

Sample	C	Units	microns				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
105							
125 0							
125 1							
126							
134	210	1.82	0.87	10			-0.24
135	218	2.45	1.12	10			1.36
143							
146							
229	210	1.84	0.87	10			-0.07
241							
243							
245							
299							
321							
364							
368							
411							
437							
441							
485							
488	205	2.06	1.01	10			-1.05
519							

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	4	Warning Limits	
Grand mean	211	Mean - 2.6 SD	197
SD Within	2.04	Mean + 2.6 SD	225
Reproducibility SD	5.49	Action Limits	
		Mean - 3.3 SD	193
		Mean + 3.3 SD	229

Thickness 5 sheets

Sample	A	Units	microns	Conditions	23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score	
105	355	1.32	0.37	10			1.05	
125 0	342	4.22	1.23	10			-2.21	
125 1	352	1.16	0.33	10			0.40	
126	351	1.20	0.34	10			0.03	
134								
135								
143	354	3.70	1.04	10			0.90	
146								
229	352	2.92	0.83	10			0.36	
241	351	3.53	1.01	10			0.00	
243	351	1.30	0.37	10			-0.02	
245	352	3.29	0.93	10			0.28	
299	352	3.84	1.09	10			0.39	
368	351	3.06	0.87	10			-0.05	
411	347	2.47	0.71	10			-0.96	
437	351	2.05	0.59	10			0.02	
441	357	2.04	0.57	10			1.61	
519	344	2.43	0.71	10			-1.78	

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	15	Warning Limits	
Grand mean	351	Mean - 2.0 SD	343
SD Within	2.57	Mean + 2.0 SD	359
Reproducibility SD	3.93	Action Limits	
		Mean - 2.6 SD	340
		Mean + 2.6 SD	361

Thickness 5 sheets

Sample	B	Units	microns	Conditions	23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score	
105	515	0.94	0.18	10			1.14	
125 0	503	4.83	0.96	10			-0.90	
125 1	511	2.38	0.46	10			0.51	
126	509	1.12	0.22	10			0.09	
134	504	1.83	0.36	10			-0.78	
135	498	5.23 **	1.05	10	O		-1.75	
143	507	2.44	0.48	10			-0.25	
146	509	2.40	0.47	10			0.19	
229	504	1.84	0.37	10			-0.81	
241	506	2.85	0.56	10			-0.37	
243	504	1.64	0.33	10			-0.75	
245	520	67.16 **	12.92	10	O		1.99	
299	513	1.36	0.27	10			0.74	
368	510	1.90	0.37	10			0.36	
411	503	4.97	0.99	10			-0.96	
437	503	0.93	0.18	10			-0.90	
441	524 *	1.71	0.33	10		S	2.67	
519								

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers 2
Number of outliers 0

Statistics

Number of labs

15

Warning Limits

Mean - 2.0 SD 497
Mean + 2.0 SD 520

Grand mean

508

Action Limits

SD Within
Reproducibility SD

2.21
5.88

Mean - 2.6 SD 493
Mean + 2.6 SD 524

Thickness 5 sheets

Sample	C	Units	microns				
		Conditions	23°C 50%rh				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubb test	Z-score
105							
125 0							
125 1							
126							
134	1058	5.64	0.53	10			-0.16
135	1066	14.59	1.37	10			1.07
143							
146							
229	1053	2.92	0.28	10			-0.91
241							
243							
245							
299							
368							
411							
437							
441							
519							

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	3	Warning Limits	
		Mean - 2.6 SD	1042.17
		Mean + 2.6 SD	1075.23
Grand mean	1059	Action Limits	
SD Within	7.72	Mean - 3.3 SD	1037.71
Reproducibility SD	6.36	Mean + 3.3 SD	1079.69

Thickness 10 sheets

Sample	A	Units	microns	Conditions	23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score	
105	706	1.18	0.17	4			0.49	
125 0	688	7.15 **	1.04	4	O		-2.56	
125 1	703	2.06	0.29	4			0.10	
126	703	1.81	0.26	4			0.00	
134								
135								
143	704	3.22	0.46	4			0.23	
146								
229	703	3.13	0.45	4			-0.02	
241	704	4.83 *	0.69	4	S		0.14	
243	701	0.50	0.07	4			-0.34	
245	702	4.25	0.61	4			-0.16	
299	702	2.44	0.35	4			-0.09	
368	702	2.50	0.36	4			-0.19	
437	705	1.29	0.18	4			0.31	
441	715	2.58	0.36	4			2.14	
519	688 *	2.99	0.43	4		S	-2.61	

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers 1
Number of outliers 0

Statistics

Number of labs 13

Grand mean 703
SD Within 2.52
Reproducibility SD 5.73

Warning Limits

Mean - 2.0 SD 691
Mean + 2.0 SD 714

Action Limits

Mean - 2.6 SD 688
Mean + 2.6 SD 718

Thickness 10 sheets

Sample	B	Units	microns	Conditions	23°C 50%rh			
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score	
105	1023	1.20	0.12	4			1.49	
125 0	1009	5.68	0.56	4			-0.47	
125 1	1019	4.19	0.41	4			0.95	
126	1017	2.41	0.24	4			0.60	
134	1005	4.06	0.40	4			-1.07	
135	1008	5.26	0.52	4			-0.68	
143	1012	2.98	0.29	4			-0.05	
146	1016	3.50	0.34	4			0.47	
229	1006	3.80	0.38	4			-0.93	
241	1014	4.30	0.42	4			0.25	
243	1003	2.22	0.22	4			-1.27	
245	1008	3.23	0.32	4			-0.62	
299	1024	2.55	0.25	4			1.62	
368	1020	3.86	0.38	4			1.06	
437	1003	1.71	0.17	4			-1.34	
441	1047 **	3.70	0.35	4		O	4.81	
519								

Tests for outliers

Cochran-Test	O - denotes an outlier	0
Grubbs-Test	S - denotes a straggler	1
	Number of outliers	
	Number of outliers	

Statistics

Number of labs	15	Warning Limits	
		Mean - 2.0 SD	998
		Mean + 2.0 SD	1027
Grand mean	1012	Action Limits	
SD Within	3.40	Mean - 2.6 SD	994
Reproducibility SD	7.20	Mean + 2.6 SD	1031

Thickness 10 sheets

Sample	C	Units	microns				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubb test	Z-score
105							
125 0							
125 1							
126							
134	2121	6.95	0.33	4			-0.71
135	2152	5.73	0.27	4			0.71
143							
146							
229							
241							
243							
245							
299							
368							
437							
441							
519							

Tests for outliers

Cochran-Test	O - denotes an outlier	
Grubbs-Test	S - denotes a straggler	
	Number of outliers	0
	Number of outliers	0

Statistics

Number of labs	2	Warning Limits	
		Mean - 2.6 SD	2078
		Mean + 2.6 SD	2195
Grand mean	2136	Action Limits	
SD Within	6.34	Mean - 3.3 SD	2063
Reproducibility SD	22.38	Mean + 3.3 SD	2210

Water absorption - Cobb (60secs)

EN 20535 (ISO 535)

Sample	A	Units	g/m ²				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
126	20.0	0.34	1.70	8			-0.38
146							
229	20.9	0.26	1.25	8			0.90
241							
243							
245	20.3	0.57 *	2.79	8	S		0.07
299	20.4	0.32	1.58	8			0.12
321	20.5	0.43	2.10	8			0.33
368	20.6	0.23	1.10	8			0.41
437	20.1	0.24	1.22	8			-0.30
484	21.5	0.36	1.65	8			1.81
506	19.1	0.24	1.28	8			-1.60
519	19.3	0.40	2.07	8			-1.35

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

0
0

Statistics

Number of labs

10

Warning Limits

Mean - 2.0 SD
Mean + 2.0 SD

18.9
21.7

Grand mean

SD Within
Reproducibility SD

20.3
0.34
0.70

Action Limits

Mean - 2.6 SD
Mean + 2.6 SD

18.4
22.1

Water absorption - Cobb (60secs)

EN 20535 (ISO 535)

Sample	B	Units	g/m ²				
Lab no	Mean	Standard Deviation	Coefficient of Variation	Number of replicates	Cochran test	Grubbs test	Z-score
			Conditions	23°C 50%rh			
126	22.6	0.23	1.02	8			-0.80
146	26.2	0.40	1.54	8			2.06
229	24.9	0.33	1.32	8			1.07
241	22.2	0.05	0.25	8			-1.11
243	27.0	1.39 **	5.15	8	O		2.72
245	23.3	0.61	2.63	8			-0.23
299	23.6	0.86 **	3.64	8	O		0.03
321	24.6	0.52	2.09	8			0.84
368	22.8	0.18	0.80	8			-0.59
437	23.2	0.39	1.69	8			-0.30
484	23.3	0.38	1.65	8			-0.24
506	22.7	0.21	0.92	8			-0.70
519							

Tests for outliers

Cochran-Test
Grubbs-Test

O - denotes an outlier
S - denotes a straggler
Number of outliers
Number of outliers

2
0

Statistics

Number of labs 10

Warning Limits

Mean - 2.0 SD 21.0
Mean + 2.0 SD 26.1

Grand mean 23.6
SD Within 0.33
Reproducibility SD 1.26

Action Limits

Mean - 2.6 SD 20.3
Mean + 2.6 SD 26.8

R457	Paper 1	Paper 2	Paper 3	Paper 4	Paper 5 black	Paper 6	Paper 7
Labs.	Result	Result	Result	Result	Result	Result	Result
Smithers Pira	80.01	74.23	70.89	63.82	6.19	66.87	77.12
105	80.88	74.84	70.91	64.75	6.07	66.86	76.55
146	80.46	74.65	70.74	65.03	6.14	67.07	77.16
241	79.96	73.91	70.54	64.19	6.02	66.70	76.59
299	80.25	74.21	70.55	64.49	6.13	67.02	76.79
321							
410	80.38	74.66	70.92	65.48	6.10	67.40	77.02
437	80.32	74.41	70.91	65.06	6.10	67.34	77.14
441	80.11	74.74	71.24	64.57	6.24	67.49	77.54
126							
Statistics							
No.of labs.	8	8	8	8	8	8	8
Mean	80.30	74.46	70.84	64.67	6.12	67.09	76.99
sd between	0.29	0.32	0.23	0.53	0.07	0.29	0.33
Warning limits							
Mean -2.00 sd	79.71	73.82	70.38	63.62	5.99	66.52	76.33
Mean +2.00 sd	80.89	75.10	71.29	65.73	6.26	67.67	77.65
Action limits							
Mean -2.6 sd	79.53	73.62	70.24	63.30	5.95	66.35	76.13
Mean +2.6 sd	81.06	75.29	71.43	66.04	6.30	67.84	77.85

Outliers in Red

R457	Paper 1	Paper 2	Paper 3	Paper 4	Paper 5 black	Paper 6	Paper 7
Labs.	Result	Result	Result	Result	Result	Result	Result
Smithers Pira	80.09	74.18	70.92	63.84	6.17	66.64	76.63
105	81.02	75.05	71.04	64.85	6.07	67.27	77.12
146	80.40	74.54	70.64	64.95	6.13	66.85	76.86
241	80.02	73.88	70.53	64.19	6.01	66.49	76.45
299	80.18	74.14	70.47	64.43	6.12	66.83	76.55
321	79.84	74.00	70.43	64.33	6.03	66.39	76.44
410	80.31	74.67	70.94	65.47	6.12	67.29	77.03
437	80.26	74.29	70.81	64.99	6.11	67.13	76.88
441	80.03	74.71	71.21	64.46	6.25	67.29	77.28
126	79.49	73.86	70.40	64.35	6.10	66.42	76.44
Statistics							
No.of labs.	10	10	10	10	10	10	10
Mean	80.16	74.33	70.74	64.59	6.11	66.86	76.77
sd between	0.40	0.40	0.28	0.47	0.07	0.37	0.31
Warning limits							
Mean -2.00 sd	79.37	73.54	70.17	63.64	5.97	66.13	76.15
Mean +2.00 sd	80.96	75.13	71.31	65.53	6.25	67.59	77.39
Action limits							
Mean -2.6 sd	79.13	73.30	70.00	63.35	5.93	65.91	75.97
Mean +2.6 sd	81.20	75.36	71.48	65.82	6.29	67.81	77.57

Outliers in Red

Rx	Paper 1	Paper 2	Paper 3	Paper 4	Paper 5 black	Paper 6	Paper 7
Labs.	Result	Result	Result	Result	Result	Result	Result
Smithers Pira	90.67	86.41	74.08	67.45	6.25	84.57	79.22
105	90.78	86.54	74.08	67.73	6.14	84.90	79.27
146	90.68	86.47	73.81	67.85	6.18	84.66	79.14
241	90.41	86.10	73.62	66.89	6.07	84.33	78.85
299	90.36	86.08	73.57	67.01	6.17	84.49	78.79
321	90.27	86.06	73.53	66.97	6.09	84.26	78.83
410	90.54	86.46	73.83	68.09	6.15	84.59	79.03
437	90.64	86.32	73.77	67.81	6.12	84.67	78.96
441	90.53	86.63	74.21	67.65	6.33	84.85	79.62
126	90.38	86.09	73.47	66.95	6.14	84.30	78.84
Statistics							
No.of labs.	10	10	10	10	10	10	10
Mean	90.53	86.32	73.80	67.44	6.16	84.56	79.05
sd between	0.17	0.22	0.26	0.45	0.08	0.22	0.26
Warning limits							
Mean -2.00 sd	90.19	85.88	73.28	66.54	6.01	84.12	78.53
Mean +2.00 sd	90.86	86.75	74.31	68.34	6.32	85.00	79.58
Action limits							
Mean -2.6 sd	90.09	85.75	73.13	66.28	5.96	83.99	78.37
Mean +2.6 sd	90.96	86.88	74.47	68.60	6.36	85.14	79.74

Outliers in Red

Ry	Paper 1	Paper 2	Paper 3	Paper 4	Paper 5 black	Paper 6	Paper 7
Labs.	Result	Result	Result	Result	Result	Result	Result
Smithers Pira	89.25	84.44	74.06	72.25	6.22	82.17	80.33
105	89.46	84.72	74.07	72.50	6.12	82.66	80.32
146	89.29	84.58	73.73	72.55	6.15	82.38	80.09
241	89.02	84.16	73.59	71.69	6.05	82.07	79.89
299	88.99	84.17	73.51	71.78	6.14	82.23	79.78
321	88.90	84.16	73.50	71.74	6.07	81.99	79.83
410	89.26	84.67	73.87	72.85	6.14	82.43	80.15
437	89.26	84.4	73.74	72.56	6.1	82.42	80.04
441	89.13	84.72	74.16	72.34	6.30	82.53	80.62
126	88.97	84.15	73.43	71.75	6.12	82.01	79.85
Statistics							
No.of labs.	10	10	10	10	10	10	10
Mean	89.15	84.42	73.77	72.20	6.14	82.29	80.09
sd between	0.18	0.24	0.26	0.43	0.07	0.23	0.27
Warning limits							
Mean -2.00 sd	88.80	83.93	73.24	71.35	6.00	81.83	79.55
Mean +2.00 sd	89.51	84.91	74.29	73.05	6.29	82.75	80.63
Action limits							
Mean -2.6 sd	88.69	83.78	73.08	71.09	5.95	81.69	79.39
Mean +2.6 sd	89.62	85.05	74.45	73.31	6.33	82.89	80.79

Outliers in Red

Rz	Paper 1	Paper 2	Paper 3	Paper 4	Paper 5 black	Paper 6	Paper 7
Labs.	Result	Result	Result	Result	Result	Result	Result
Smithers Pira	79.68	73.7	70.64	62.65	6.18	66.44	76.45
105	80.70	74.60	70.75	63.51	6.06	67.08	76.63
146	80.05	74.08	70.37	63.57	6.13	66.64	76.42
241	79.66	73.42	70.25	62.83	6.01	66.26	75.98
299	79.84	73.70	70.21	63.06	6.13	66.61	76.10
321	79.46	73.54	70.14	62.96	6.03	66.16	75.97
410	79.92	74.19	70.65	64.12	6.13	67.10	76.56
437	79.88	73.83	70.54	63.63	6.11	66.91	76.43
441	79.67	74.29	70.97	63.25	6.26	67.11	76.85
126	79.09	73.40	70.13	62.98	6.11	66.20	75.98
Statistics							
No.of labs.	10	10	10	10	10	10	10
Mean	79.79	73.87	70.46	63.26	6.11	66.65	76.34
sd between	0.42	0.40	0.29	0.45	0.07	0.38	0.31
Warning limits							
Mean -2.00 sd	78.96	73.07	69.89	62.36	5.97	65.89	75.71
Mean +2.00 sd	80.63	74.68	71.04	64.15	6.26	67.41	76.96
Action limits							
Mean -2.6 sd	78.71	72.83	69.72	62.09	5.93	65.66	75.53
Mean +2.6 sd	80.88	74.92	71.21	64.42	6.30	67.64	77.15

Outliers in Red

L*	Paper 1	Paper 2	Paper 3	Paper 4	Paper 5 black	Paper 6	Paper 7
Labs.	Result	Result	Result	Result	Result	Result	Result
Smithers Pira	95.48	93.42	88.89	88.19	30.04	92.31	91.86
105	95.59	93.54	88.91	88.33	29.70	92.50	91.82
146	95.52	93.49	88.77	88.37	29.83	92.40	91.76
241	95.37	93.27	88.67	87.92	29.53	92.25	91.61
299	95.42	93.32	88.68	88.01	29.80	92.35	91.62
321							
410	95.49	93.48	88.80	88.47	29.70	92.42	91.72
437	85.5	93.41	88.77	88.36	29.67	92.42	91.72
441	95.49	93.53	88.96	88.27	30.08	92.44	91.98
126	95.36	93.30	88.65	87.99	29.70	92.22	91.63
Statistics							
No.of labs.	9	9	9	9	9	9	9
Mean	94.36	93.42	88.79	88.21	29.78	92.37	91.75
sd between	3.32	0.10	0.11	0.20	0.18	0.09	0.12
Warning limits							
Mean -2.00 sd	87.71	93.22	88.56	87.82	29.43	92.18	91.50
Mean +2.00 sd	101.00	93.62	89.01	88.60	30.14	92.55	91.99
Action limits							
Mean -2.6 sd	85.72	93.15	88.50	87.70	29.32	92.13	91.42
Mean +2.6 sd	103.00	93.68	89.08	88.72	30.25	92.61	92.07

Outliers in Red

a*	Paper 1	Paper 2	Paper 3	Paper 4	Paper 5 black	Paper 6	Paper 7
Labs.	Result	Result	Result	Result	Result	Result	Result
Smithers Pira	-0.63	-0.2	-1.17	-12.08	0.15	-0.68	-3.15
105	-0.53	-0.23	-1.19	-11.98	0.08	-0.94	-3.06
146	-0.57	-0.24	-1.09	-11.84	0.13	-0.89	-2.89
241	-0.61	-0.21	-1.16	-12.03	0.15	-0.91	-3.09
299	-0.57	-0.21	-1.12	-11.97	0.19	-0.90	-2.98
321							
410	-0.78	-0.42	-1.28	-11.82	0.09	-1.03	-3.17
437	-0.64	-0.22	-1.13	-11.88	0.15	-0.89	-3.08
441	-0.58	-0.15	-1.05	-11.74	0.17	-0.67	-2.92
126	-0.72	-0.27	-1.15	-12.03	0.14	-0.89	-3.05
Statistics							
No.of labs.	9	9	9	9	9	9	9
Mean	-0.63	-0.24	-1.15	-11.93	0.14	-0.87	-3.04
sd between	0.08	0.08	0.07	0.12	0.03	0.12	0.10
Warning limits							
Mean -2.00 sd	-0.78	-0.39	-1.28	-12.16	0.07	-1.10	-3.24
Mean +2.00 sd	-0.47	-0.09	-1.02	-11.70	0.21	-0.63	-2.85
Action limits							
Mean -2.6 sd	-0.83	-0.43	-1.32	-12.23	0.05	-1.17	-3.29
Mean +2.6 sd	-0.42	-0.04	-0.98	-11.63	0.23	-0.56	-2.79

Outliers in Red

b*	Paper 1	Paper 2	Paper 3	Paper 4	Paper 5 black	Paper 6	Paper 7
Labs.	Result	Result	Result	Result	Result	Result	Result
Smithers Pira	7.12	8.29	2.92	9.23	0.23	12.32	3.23
105	6.44	7.79	2.85	8.72	0.22	12.34	3.19
146	6.80	8.06	2.84	8.65	0.07	12.33	2.99
241	6.95	8.28	2.85	8.62	0.14	12.41	3.24
299	6.78	8.10	2.84	8.52	0.09	12.30	3.06
321							
410	6.86	8.05	2.75	8.38	0.02	12.06	3.08
437	6.9	8.1	2.7	8.59	-0.01	12.13	2.95
441	7.05	8.03	2.71	8.71	0.12	12.02	3.08
126	7.37	8.34	2.83	8.58	0.08	12.44	3.21
Statistics							
No.of labs.	9	9	9	9	9	9	9
Mean	6.92	8.12	2.81	8.67	0.11	12.26	3.11
sd between	0.26	0.17	0.07	0.23	0.08	0.15	0.11
Warning limits							
Mean -2.00 sd	6.41	7.78	2.66	8.20	-0.06	11.96	2.90
Mean +2.00 sd	7.43	8.45	2.96	9.14	0.27	12.57	3.33
Action limits							
Mean -2.6 sd	6.25	7.67	2.62	8.06	-0.10	11.86	2.84
Mean +2.6 sd	7.59	8.56	3.00	9.28	0.32	12.66	3.39

Outliers in Red





