Slip-Test •1730 Mt. Vernon Road, Suite H, Atlanta GA 30338 •770.671.0090 •info@slip-test.com

TRIBOMETER CERTIFICATION

"Slip-Test Inc. certifies that the Slip-Test Mark IIIB walkway tribometer model has undergone certification procedures described in and in accordance with Practice F2508, as documented by the attached Certification Test Method, Validation Report, Interlaboratory Study Data, and Precision Statement."

Reference: ASTM F2508-13 section 16.3.1.

John Leffler, PE
January 19, 2015 (Revision B: Precision Statement updated)

SLIP-TEST
WALKWAY TRIBOMETERS

F2508 Validation / Calibration / Certification Test Method - 1/13/14 - Mark IIIB

1. Notes regarding use of Certification Test Method for Interlaboratory Study (ILS):
   a. Each combination of tribometer, testfoot & operator must remain together for all testing – this defines each "laboratory". No operator may use multiple tribometers.
   b. Each laboratory during testing will also require a recorder (to write down readings) and an observer (to ensure that this protocol is being followed). Recorders and observers can be interchanged if necessary.
   c. One testing data sheet will be used by each laboratory to record the 48 slip resistance values to be measured.
2. Testfoot preparation (Neolite, obtained from Smithers-Rapra):
   a. Ensure that testfoot identification number is recorded on testing data sheet.
   b. Nominal testfoot dimensions are Neolite width and length of 2.95 +/- 0.05 inches, and thickness (Neolite + plate) of 0.30 +/- 0.03 inches. Testfeet older than 3 years shall not be used. When not in use, store Neolite testfeet in normal home/office ambient conditions.
      i. For ILS: All testfeet must be 0.300 +/- 0.015 inches thick (Neolite + plate), and all testfeet must be from the same Smithers batch of Neolite.
   c. Testfoot sanding:
      i. Ensure that testfoot is completely dry.
      ii. Utilizing surface plate or flat tile (e.g. equivalent to RS-A) and 180-grit 3M wet/dry sandpaper, place testfoot surface on sandpaper.
      iii. Hold testfoot as shown in Figure 1. While ensuring that moderate and even downward force is applied, sand the testfoot four strokes in one direction **parallel** with the groove orientation of the Neolite.
      iv. Hold testfoot as shown in Figure 2. Ensuring that moderate and even downward force is applied, sand the testfoot four strokes in one direction **perpendicular** to the groove orientation of the Neolite.
      v. Using clean compressed air, blow out the grooves in the testfoot. Inspect the testfoot surface and ensure that it has an even appearance, and re-sand per steps 2a(i-iv) if necessary.
      vi. Using a spray bottle of distilled water over a sink or bucket, spray grooved testfoot surface 10+ times to rinse away sanding dust.

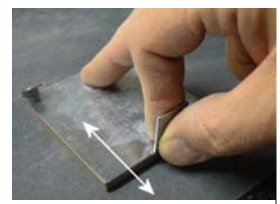


Fig. 1 Parallel sanding

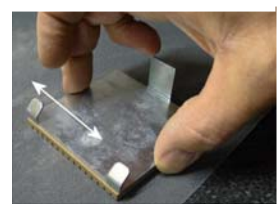
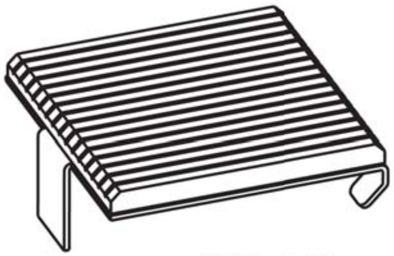


Fig. 2 Perpendicular sanding

3. Starting height verification:
   a. Set the mast angle at zero on the graduated scale.
   b. Using the aluminum "go/no-go" thickness gauge supplied with the tribometer (5/32" – 7/32"), check the gap between the bottom of the testfoot and a flat surface. This is done by seeing that the thinner end of the gauge can be slipped between the testfoot pivot and the surface and that the thicker end of the gauge will not fit in the same space. If the thinner end of the gauge does not fit, the gap is too small and the three feet on the bottom of the tribometer must each be shimmed using an equal amount of washers. If the thicker end of the gauge will fit then the gap is too large and it must be reduced by removing shims from under the feet.
   c. Check that the articulated strut pivots freely at each of its two ends, and that it just contacts its stop when placed on a level surface.
4. Reference surface preparation
   a. Prior to validation, calibration, or Interlaboratory Study, clean the reference surfaces using the procedure in section 8.2 of ASTM F2508-13. Once cleaned, avoid contacting the reference surface with fingers or other contaminants.
      i. Between ILS test sessions, use the provided 50/50 alcohol-distilled water mixture and white towels to clean the entire top of the subject reference surface prior to beginning the next session of testing. Use spare non-white towels for spill cleanup.

5. Tribometer testing operation – wet
   a. Place the tribometer on the surface to be tested, with the three rubber feet entirely within the perimeter of the reference tile surface, and with the testfoot nominally centered on the tile. Ensure the recorder knows which surface is being tested.
      i. For calibration and for ILS, test the reference surfaces in the following order: RS-B, RS-C, RS-D, RS-A.
   b. Place one 10 pound rubberized hand barbell on each end of the tribometer baseplate as ballast. Lift the top handle so that the strut carriage becomes supported by the trigger.
   c. Using distilled water, apply enough water to provide an unbroken film (i.e. a puddle) under the testfoot. During all tests, it is necessary to ensure this unbroken film (puddle) is under the testfoot prior to triggering.
      i. When testing RS-A only, utilize the provided distilled water/Triton solution.
      ii. When testing an initially-dry RS-D tile, to reduce the tendency of the water to bead up due to surface tension, apply a puddle of water and allow to stand on the RS-D surface for at least 5 minutes prior to testing.
   d. **If the testfoot has just been sanded:** set the mast to an angle expected to result in a slip (RS-A: 0.25, RS-B: 0.35, RS-C: 0.55, RS-D: 0.85), trigger the tribometer and see if it slips – if it does not, increase the mast angle until it is well into the range of the testfoot slipping. Repeat triggering the tribometer into an unbroken puddle of water four additional times, and then proceed with test measurements below.
   e. Set the mast at an angle expected to not result in a slip. Ensure that the mast lock knob is tight before each triggering, and that the front tab on the testfoot is pushed back against the testfoot pivot. Prepare to trigger by pausing for one second to reduce transitional vibrations. Trigger the tribometer. A testfoot slip has occurred when the testfoot rapidly slips all the way to its limits of travel – i.e. when the top handle contacts the rubber bumper. If a slip does not occur, increase the mast angle incrementally, reapply water (or Triton solution for RS-A only) as needed to ensure an unbroken film of liquid, and retest, continuing until slip does occur. If it is apparent that the point of slip is being approached, reduce the incremental changes in mast angle to 0.01 on the tribometer's scale.
   f. Record the value at which slip occurred to two decimal places (e.g. 0.43).
   g. **REPETITION**:
      i. For ILS, repeat steps 5a-f for a total of 3 slips in each of four perpendicular directions (~90º apart) on each reference surface, for a total of 12 slips per surface. Conduct all of the 3 slips in a particular direction sequentially.
      ii. For F2508 calibration, repeat steps 5a-f for a total of 4 slips in each of four perpendicular directions (~90º apart) on each reference surface, for a total of 16 slips per surface. Conduct all of the 4 slips in a particular direction sequentially.
      iii. For F2508 validation, repeat steps 5a-f for a total of 10 slips in each of four perpendicular directions (~90º apart) on each reference surface, for a total of 40 slips per surface. Conduct all of the 10 slips in a particular direction sequentially. Between testing each reference surface, re-sand testfoot per step 2 above.
   h. Repeat steps 5a-g for the remaining reference surfaces.

REV	REVISIONS	DATE	APPR



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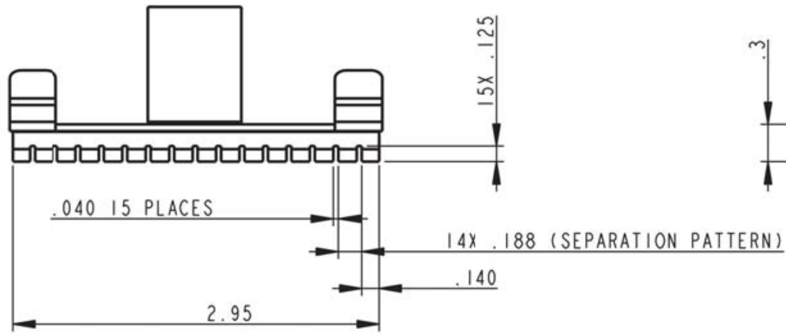

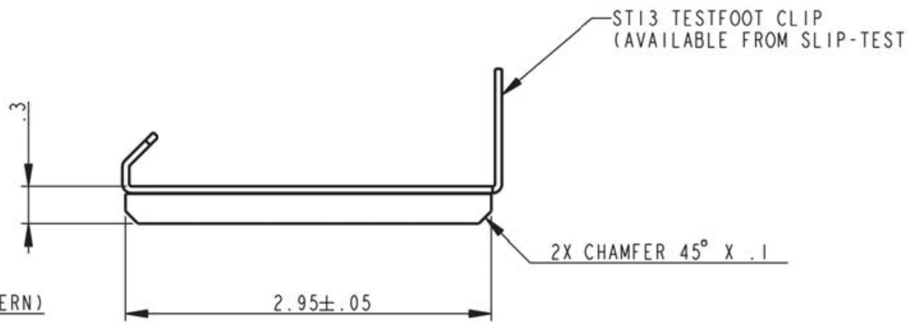

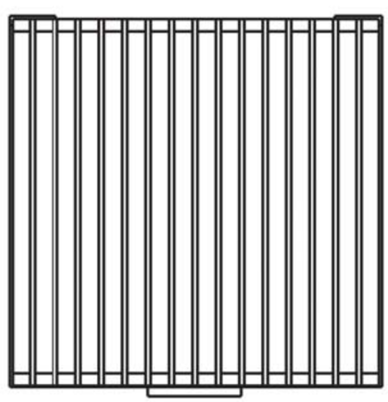

NOTES:
1: ATTACH NEOLITE TO TESTFOOT CLIP USING 3M F9469PC 0.005" THICK TRANSFER TAPE
2. DO NOT OVERHEAT NEOLITE WHEN CUTTING GROOVES - ROTATE CUTTER SLOWLY

	DO NOT SCALE DRAWING	**SLIP-TEST INC.** 1730-H MOUNT VERNON ROAD, ATLANTA GA 30338
	DRAWN BY J LEFFLER	DESCRIPTION GROOVED NEOLITE TESTFOOT ASSEMBLY
	MATERIAL	PART NUMBER ST14_GROOVED_TESTFOOT · REV A
TOLERANCES UOS X.X = ±0.03 X.XX = ±0.01 X.XXX = ±0.005	FINISH	SCALE: 1.000 · SIZE: B · SHEET: 1/1

ASTM F2508 VALIDATION REPORT

Operator: John Leffler
Test address: 8785 Glen Ferry Drive, Alpharetta GA 30022
Test date: January 24, 2014
Test surfaces: F2508ADJ reference surfaces acquired from ASTM in April 2011
Test conditions: 71.6ºF, 45% RH
Tribometer: Slip-Test Mark IIIB #47
Testfoot: Neolite, 15 grooves, polymer manufacturer's shipping date 1/15/2013, 2.95" x 2.95" x 0.290" thick (with plate). Prepared per attached test method. Labeled: 011513C.

TEST RESULTS

	RS-A	RS-B	RS-C	RS-D		RS-A - RS-B	RS-B - RS-C	RS-C - RS-D
	GRANITE	PORCELAIN	VCT	CERAMIC				
average	0.15925	0.241	0.33425	0.637	**dm:**	-0.08175	-0.09325	-0.30275
std deviation	0.007298577	0.011502508	0.01393897	0.02747493		0.013566078	0.014030644	0.03137756
std error	0.001154006	0.001818706	0.002203945	0.004344168				
95 %ile high	0.161511853	0.244564664	0.338569731	0.645514569	**t:**	-38.11215095	-42.03404909	-61.0231998
95 %ile low	0.156988147	0.237435336	0.329930269	0.628485431				

- This tribometer passes the F2508 requirement for correct ranking of the references surfaces.
- This tribometer passes the F2508 requirement for statistical differentiation of the reference surfaces.
- This Validation was conducted in accordance with ASTM F2508-13.

TEST #	RS-A GRANITE	RS-B PORCELAIN	RS-C VCT	RS-D CERAMIC		RS-A - RS-B	RS-B - RS-C	RS-C - RS-D
1	0.18	0.26	0.36	0.64		-0.08	-0.1	-0.28
2	0.16	0.25	0.35	0.62		-0.09	-0.1	-0.27
3	0.16	0.24	0.37	0.62		-0.08	-0.13	-0.25
4	0.16	0.24	0.35	0.61		-0.08	-0.11	-0.26
5	0.16	0.24	0.34	0.62		-0.08	-0.1	-0.28
6	0.16	0.24	0.34	0.61		-0.08	-0.1	-0.27
7	0.16	0.24	0.34	0.62		-0.08	-0.1	-0.28
8	0.16	0.24	0.35	0.62		-0.08	-0.11	-0.27
9	0.16	0.24	0.36	0.61		-0.08	-0.12	-0.25
10	0.17	0.24	0.35	0.62		-0.07	-0.11	-0.27
11	0.17	0.25	0.34	0.64		-0.08	-0.09	-0.3
12	0.17	0.24	0.35	0.63		-0.07	-0.11	-0.28
13	0.16	0.24	0.33	0.63		-0.08	-0.09	-0.3
14	0.16	0.23	0.32	0.63		-0.07	-0.09	-0.31
15	0.16	0.23	0.33	0.63		-0.07	-0.1	-0.3
16	0.16	0.23	0.33	0.62		-0.07	-0.1	-0.29
17	0.15	0.23	0.32	0.62		-0.08	-0.09	-0.3
18	0.16	0.23	0.31	0.62		-0.07	-0.08	-0.31
19	0.16	0.23	0.32	0.63		-0.07	-0.09	-0.31
20	0.16	0.23	0.31	0.62		-0.07	-0.08	-0.31
21	0.16	0.28	0.34	0.68		-0.12	-0.06	-0.34
22	0.15	0.26	0.34	0.68		-0.11	-0.08	-0.34
23	0.15	0.26	0.34	0.68		-0.11	-0.08	-0.34
24	0.16	0.25	0.33	0.69		-0.09	-0.08	-0.36
25	0.14	0.25	0.33	0.67		-0.11	-0.08	-0.34
26	0.15	0.25	0.33	0.70		-0.1	-0.08	-0.37
27	0.15	0.25	0.32	0.68		-0.1	-0.07	-0.36
28	0.16	0.25	0.33	0.68		-0.09	-0.08	-0.35
29	0.16	0.25	0.33	0.68		-0.09	-0.08	-0.35
30	0.16	0.25	0.33	0.66		-0.09	-0.08	-0.33
31	0.16	0.24	0.35	0.65		-0.08	-0.11	-0.3
32	0.17	0.24	0.33	0.65		-0.07	-0.09	-0.32
33	0.16	0.23	0.34	0.62		-0.07	-0.11	-0.28
34	0.16	0.23	0.33	0.61		-0.07	-0.1	-0.28
35	0.16	0.23	0.32	0.61		-0.07	-0.09	-0.29
36	0.17	0.23	0.33	0.61		-0.06	-0.1	-0.28
37	0.16	0.23	0.32	0.63		-0.07	-0.09	-0.31
38	0.15	0.23	0.32	0.62		-0.08	-0.09	-0.3
39	0.15	0.23	0.32	0.61		-0.08	-0.09	-0.29
40	0.15	0.23	0.32	0.61		-0.08	-0.09	-0.29
average	0.15925	0.241	0.33425	0.637	**dm:**	-0.08175	-0.09325	-0.30275
std deviation	0.007298577	0.011502508	0.01393897	0.02747493		0.013566078	0.014030644	0.03137756
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95 %ile high	0.161511853	0.244564664	0.338569731	0.645514569	**t:**	-38.11215095	-42.03404909	-61.0231998
95 %ile low	0.156988147	0.237435336	0.329930269	0.628485431				

Tribometer:	Mark IIIB #47	Temp:	71.6
Testfoot:	011513C	RH:	45%

PRECISION AND BIAS STATEMENT

SLIP-TEST MARK IIIB TRIBOMETER

Revision B - Updated January 19, 2015

The precision of the attached "F2508 Validation / Calibration / Certification Test Method" dated 1/13/2014 is based on an InterLaboratory Study (hereafter "ILS") of one set of ASTM F2508 Adjunct reference tiles RS-A, RS-B, RS-C, and RS-D. The tiles were purchased from ASTM in April 2011. The Certification Test Method conforms to ASTM F2508-13 *Standard Practice for Validation, Calibration, and Certification of Walkway Tribometers Using Reference Surfaces*[1]. The ILS was conducted on January 15, 2014 in Lake Buena Vista, Florida. The eight different operators used eight different Slip-Test Mark III "B" series tribometers, each equipped with one of eight different testfeet – each unique combination of operator, tribometer, and testfoot comprised a "laboratory". The ILS Coordinator was John Leffler, PE, lead engineering consultant to Slip-Test.

The Mark IIIB series of tribometers are conceptually and functionally identical to the original Slip-Test Brungraber Mark III tribometers but differ significantly in materials and manufacturing. As such, this precision statement is applicable only to Slip-Test Mark IIIB tribometers[2].

Each of the eight operators tested the four different F2508 Adjunct reference tiles in four nominally perpendicular directions, and recorded three test results in each direction. Ambient test conditions were 72.6ºF and 48% RH. As prescribed for "Certification" within ASTM F2508, ASTM E691 *Standard Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method*[3] was utilized for analysis of the ILS data. The data and calculations are attached at the end of this Statement.

TERMINOLOGY

A glossary of terminology follows the Precision and Bias statements below.

ILS NOTES

The testfoot starting height requirements of Certification Test Method step 3 were verified through the use of a digital caliper and metal straightedge in addition to the specified go/no-go gauge, and the different testfoot starting heights of the 8 tribometers were found to be within 0.015" of each other.

As has been noted by others involved in tribometer testing on other F2508 reference tiles, the tiles tended to shed water to varying extents. At times, it was necessary to apply a lot of distilled water to the reference tile to ensure that a continuous unbroken film (puddle) of water remained under the testfoot before each test was triggered. Variability in the achievable thickness of the water puddle was more pronounced with RS-C (VCT) and RS-D (ceramic tile). This may have contributed to the generally higher reproducibility standard deviation of the results for RS-C and RS-D, as compared to RS-A and RS-B.

During testing, one droplet of fugitive lubricant/water residue fell from the fine-adjustment quick release nut of one tribometer, onto RS-D. The droplet fell to the side of the tile, outside the area of the tile being tested, and was noticed immediately by the lab personnel. The droplet was promptly soaked up with a paper towel, and though no visible residue remained, RS-D was re-scrubbed with SLS solution (and rinsed) per ASTM F2508 sections 8.2.1.2 through 8.2.1.4. It was then sprayed with 50% alcohol / 50% water mixture and wiped with a clean white terrycloth towel, prior to resuming testing.

Referring to the glossary definition below (from ASTM E177) for "reproducibility conditions", for the subject ILS it was determined that utilizing a common location was acceptable; most entities that own tribometers do not have the sophisticated climate control (temperature/humidity) systems in their laboratory facilities that would be necessary to equalize this aspect of the ILS test conditions. Additionally, several of the tribometer operators were employed by the same entity and (at work) had the same supervisor – but this ILS was supervised by the ILS Coordinator.

PRECISION RESULTS

[Revision B update: results formerly were split by test direction] All data and calculations are attached following this Precision & Bias statement. The calculation worksheet references formulas by number from ASTM E691-11.

		RS-A	*RS-B*	*RS-C*	*RS-D*
average of lab averages	$\bar{\bar{x}}$	0.136042	0.244167	0.408854	0.677083
repeatability standard deviation	s_r	0.008704	0.011323	0.016620	0.027890
reproducibility standard deviation	s_R	0.011783	0.019433	0.03146	0.042007
repeatability limit	r	0.024371	0.031706	0.046537	0.078091
reproducibility limit	R	0.032992	0.054413	0.088087	0.11762

In accordance with E691, the above repeatability limits and reproducibility limits have an approximately 95% probability of being correct.

BIAS STATEMENT

At this time of this ILS, there was no walkway tile available that provided a "known" accepted reference value for traction; any such determination would be subject to the operational influences of the particular apparatus and method used to measure that traction.

GLOSSARY

The following definitions from ASTM E177 *Standard Practice for Use of the Terms Precision and Bias in ASTM Test Methods*[4] are applicable. See E177 for additional discussion of these terms, which are numbered here as in that standard..

3.1.3 Bias, n—the difference between the expectation of the test results and an accepted reference value.

3.1.10 Precision, n—the closeness of agreement between independent test results obtained under stipulated conditions.

3.1.11 Repeatability, n—precision under repeatability conditions.

3.1.12 Repeatability conditions, n—conditions where independent test results are obtained with the same method on identical test items in the same laboratory by the same operator using the same equipment within short intervals of time.

3.1.13 Repeatability limit (r), n—the value below which the absolute difference between two individual test results obtained under repeatability conditions may be expected to occur with a probability of approximately 0.95 (95%).

3.1.13.1 Discussion—The repeatability limit is 2.8 (~1.96√2) times the repeatability standard deviation. This multiplier is independent of the size of the interlaboratory study.

3.1.14 Repeatability standard deviation (s_r), n—the standard deviation of test results obtained under repeatability conditions.

3.1.15 Reproducibility, n—precision under reproducibility conditions.

3.1.16 Reproducibility conditions, n—conditions where test results are obtained with the same method on identical test items in different laboratories with different operators using different equipment.

3.1.16.1 {excerpt} Discussion—A different laboratory of necessity means a different operator, different equipment, and different location and under different supervisory control.

3.1.17 Reproducibility limit (R), n—the value below which the absolute difference between two test results obtained under reproducibility conditions may be expected to occur with a probability of approximately 0.95 (95%).

3.1.17.1 Discussion—The reproducibility limit is 2.8 (~1.96√2) times the reproducibility standard deviation. The multiplier is independent of the size of the interlaboratory study (that is, of the number of laboratories participating).

3.1.18 Reproducibility standard deviation (s_R), n—the standard deviation of test results obtained under reproducibility conditions.

Prepared by ILS Coordinator: John Leffler, PE

REFERENCES

[1] ASTM F2508-13, *Standard Practice for Validation, Calibration, and Certification of Walkway Tribometers Using Reference Surfaces*, ASTM International, West Conshohocken PA, 2013

[2] Slip-Test Mark IIIB tribometers can be identified as serial numbers 40 and 43-on.

[3] ASTM E691-11 *Standard Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method,* ASTM International, West Conshohocken PA, 2011

[4] Reprinted, with permission, from ASTM E177-13 *Standard Practice for Use of the Terms Precision and Bias in ASTM Test Methods*, copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

	DATA				eq 1	x bar (cell avg)			eq 2	s (cell std deviation)			eq 6	sr (repeatability std dev)			eq 4	d (cell deviation)		
LAB #	*RS-A*	*RS-B*	*RS-C*	*RS-D*	*RS-A*	*RS-B*	*RS-C*	*RS-D*	*RS-A*	*RS-B*	*RS-C*	*RS-D*	*RS-A*	*RS-B*	*RS-C*	*RS-D*	*RS-A*	*RS-B*	*RS-C*	*RS-D*
1	0.15	0.24	0.38	0.67	0.140000	0.225833	0.406667	0.658333	0.004264	0.007930	0.019695	0.010299	0.008704	0.011323	0.016620	0.027890	0.003958	-0.018333	-0.002188	-0.018750
1	0.14	0.22	0.39	0.65																
1	0.13	0.22	0.39	0.65																
1	0.14	0.23	0.39	0.68																
1	0.14	0.22	0.39	0.66																
1	0.14	0.22	0.39	0.67																
1	0.14	0.23	0.42	0.65																
1	0.14	0.22	0.43	0.65									eq 10	r (repeatability limit)						
1	0.14	0.22	0.42	0.66									0.024371	0.031706	0.046537	0.078091				
1	0.14	0.24	0.43	0.65																
1	0.14	0.23	0.43	0.65																
1	0.14	0.22	0.42	0.66									eq 11	R (reproducibility limit)						
2	0.15	0.25	0.41	0.66	0.139167	0.245000	0.430833	0.673333	0.005149	0.007977	0.015050	0.024246	0.032992	0.054413	0.088087	0.11762	0.003125	0.000833	0.021979	-0.00375
2	0.14	0.25	0.41	0.65																
2	0.14	0.24	0.41	0.66									eq 7	sR (reproducibility std dev)						
2	0.14	0.26	0.43	0.70									0.011783	0.019433	0.03146	0.042007				
2	0.14	0.25	0.43	0.70																
2	0.14	0.24	0.42	0.69																
2	0.14	0.25	0.44	0.70																
2	0.14	0.25	0.45	0.70																
2	0.14	0.23	0.45	0.68																
2	0.14	0.24	0.44	0.66																
2	0.13	0.24	0.44	0.64																
2	0.13	0.24	0.44	0.64																
3	0.14	0.25	0.43	0.65	0.125	0.234167	0.440833	0.675833	0.006742	0.0079296	0.010836	0.0167649					-0.011042	-0.010000	0.031979	-0.00125
3	0.13	0.24	0.44	0.67																
3	0.12	0.24	0.42	0.67																
3	0.13	0.24	0.44	0.68																
3	0.13	0.23	0.44	0.68																
3	0.12	0.23	0.44	0.65																
3	0.13	0.24	0.45	0.70																
3	0.12	0.23	0.43	0.69																
3	0.12	0.22	0.44	0.70																
3	0.12	0.23	0.45	0.66																
3	0.12	0.23	0.45	0.68																
3	0.12	0.23	0.46	0.68																
4	0.16	0.24	0.37	0.63	0.1325	0.239167	0.385000	0.694167	0.0105529	0.0066856	0.009045	0.0524765					-0.003542	-0.005000	-0.023854	0.017083
4	0.14	0.24	0.38	0.62																
4	0.13	0.24	0.38	0.61																
4	0.13	0.25	0.39	0.68																
4	0.13	0.24	0.38	0.67																
4	0.12	0.23	0.38	0.69																
4	0.14	0.25	0.40	0.75																
4	0.13	0.23	0.39	0.73																
4	0.13	0.24	0.40	0.73																
4	0.13	0.24	0.39	0.76																
4	0.13	0.24	0.38	0.74																
4	0.12	0.23	0.38	0.72																
5	0.14	0.27	0.38	0.68	0.1325	0.2475	0.364167	0.7125	0.0086603	0.0128806	0.009003	0.0338781					-0.003542	0.003333	-0.044688	0.035417
5	0.15	0.26	0.37	0.67																
5	0.14	0.25	0.36	0.66																
5	0.14	0.25	0.37	0.70																
5	0.13	0.25	0.35	0.71																
5	0.12	0.23	0.37	0.70																
5	0.13	0.26	0.35	0.71																
5	0.13	0.25	0.36	0.73																
5	0.13	0.23	0.36	0.76																
5	0.12	0.25	0.37	0.77																
5	0.13	0.23	0.37	0.74																
5	0.13	0.24	0.36	0.72																
6	0.15	0.25	0.37	0.61	0.128333	0.2325	0.400000	0.615833	0.0119342	0.0086603	0.020000	0.0178164					-0.007708	-0.011667	-0.008854	-0.06125
6	0.15	0.24	0.41	0.61																
6	0.13	0.24	0.36	0.61																
6	0.12	0.24	0.40	0.62																
6	0.13	0.23	0.39	0.62																
6	0.11	0.22	0.39	0.60																
6	0.12	0.23	0.41	0.66																
6	0.12	0.23	0.41	0.64																
6	0.12	0.23	0.43	0.61																
6	0.13	0.23	0.42	0.61																
6	0.13	0.23	0.40	0.60																
6	0.13	0.22	0.41	0.60																
7	0.17	0.28	0.41	0.73	0.151667	0.278333	0.440000	0.7175	0.0119342	0.0158592	0.022962	0.0252713					0.015625	0.034167	0.031146	0.040417
7	0.14	0.26	0.44	0.73																
7	0.15	0.28	0.42	0.72																
7	0.16	0.31	0.44	0.71																
7	0.17	0.29	0.44	0.75																
7	0.16	0.27	0.44	0.76																
7	0.16	0.30	0.43	0.74																
7	0.15	0.28	0.42	0.71																
7	0.14	0.26	0.42	0.70																
7	0.14	0.28	0.48	0.68																
7	0.14	0.26	0.48	0.69																
7	0.14	0.27	0.46	0.69																
8	0.15	0.26	0.38	0.67	0.139167	0.250833	0.403333	0.669167	0.0066856	0.0172986	0.019695	0.0197523					0.003125	0.006667	-0.005521	-0.007917
8	0.15	0.25	0.38	0.67																
8	0.14	0.23	0.38	0.64																
8	0.14	0.29	0.40	0.68																
8	0.13	0.27	0.39	0.68																
8	0.14	0.26	0.39	0.68																

8	0.14	0.25	0.41	0.68
8	0.14	0.24	0.42	0.70
8	0.14	0.24	0.42	0.69
8	0.14	0.25	0.42	0.65
8	0.13	0.24	0.41	0.64
8	0.13	0.23	0.44	0.65

		RS-A	RS-B	RS-C	RS-D
average of lab averages	$\bar{\bar{X}}$	0.136042	0.244167	0.408854	0.677083
repeatability standard deviation	s_r	0.008704	0.011323	0.016620	0.027890
reproducibility standard deviation	s_R	0.011783	0.019433	0.03146	0.042007
repeatability limit	r	0.024371	0.031706	0.046537	0.078091
reproducibility limit	R	0.032992	0.054413	0.088087	0.11762

eq 3	x doublebar (avg of cell avgs)		
0.136042	0.244167	0.408854	0.677083

eq 5	s xbar (stdev of cell avgs)		
0.00833	0.016128	0.027138	0.032428