

Wheat Quality Council
Hard Spring Wheat Technical Committee
2009 Crop



February 16 – 18, 2010



Kansas City, MO

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Wheat Quality Council

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Introduction

Breeders' experimental lines of wheat are evaluated for overall quality before being released for commercial production. The Hard Spring Wheat Technical Committee provides milling and baking quality data on breeders' experimental lines of wheat that are annually submitted to the Wheat Quality Council (WQC). The impact is the commercialization of high quality wheat for production and processing.

Thirteen experimental lines of hard spring wheat were grown at up to five locations in 2009 and evaluated for kernel, milling, and bread baking quality against the check variety Glenn. To avoid any bias in the test procedures, code numbers were assigned to the experimental lines and maintained throughout the growing and harvesting of the plots and the milling and baking trials. Samples of wheat were milled at the USDA Hard Red Spring and Durum Wheat Quality Laboratory (WQL), Fargo, ND. Flour samples were shipped to independent laboratories and tested for bread baking quality.

From this report:

The WQC makes no representation regarding the accuracy or conclusiveness of the data developed by and received from the participating laboratories. The data has been scientifically determined and accurately reported from the perspective of the Hard Spring Wheat Technical Committee.

The results relate only to test samples that were volunteered for testing in the 2009 crop year. Test results from other crop years may differ from those reported herein.

The Hard Spring Wheat Technical Committee, by compilation of data and issuance of this report, does not make or intend any general recommendations or conclusions on its part with respect to the desirability of any wheat included in the tests. Mention of a vendor, product, proprietary product, or procedure does not constitute a guarantee or warranty of the vendor, product, or procedure by the Hard Spring Wheat Technical Committee or by cooperating laboratories, and does not imply its approval to the exclusion of other vendors, products, or procedures that may also be suitable. Data reported herein are not to be used in any publication or literature or for advertising or publicity purposes.

Trait	A	M9 Glenn	M1	W9 Glenn	W1
I. USDA/ARS WQL Data					
1	Wheat Protein (12%mb)	14.8	13.7	16.2	13.3
2	Flour Protein (12%mb)	14.7	12.9	16.2	12.7
3	Market Value (Score 1-6)	4.4	3.5	4.8	3.4
4	Market Value (Score 1-10)	10	7.4	10	5.8
5	Test Weight (lb/bu)	62.8	59.1	62.4	58.6
6	1000 Kernel Weight (g)	32.5	33.1	28.4	27.8
7	Kernel Size % Large	68	74	27	55
8	Kernel Size % Small	5	3	11	7
9	Wheat Moisture (%)	10.1	10.6	9.4	9.7
10	Wheat Ash (14%mb)	1.19	1.33	1.44	1.39
11	Wheat Falling Number (sec)	388	384	464	579
12	SKCS Hardness Index	72.7	73.1	76.6	70.4
13	Vitreous Kernels (%)	71.0	14.2	98.0	26.0
	Flour Extraction (%)				
14	Tempered Wheat Basis (%)	72.9	73.6	70.6	73.5
15	Total Product Basis (%)	75.9	78.0	73.8	77.1
16	Flour /Bu Wheat (lbs)	48.5	46.2	46.8	46.3
17	Flour Color Brightness (L*)	90.0	89.7	90.2	90.6
18	Flour Color Yellowness (b*)	8.1	8.9	8.9	8.9
19	Flour Moisture (%)	13.4	12.1	13.3	12.7
20	Flour Ash (14%mb)	0.433	0.505	0.458	0.470
21	Flour FN (Malted) (sec)	252	254	247	250
Farinograph					
22	Water Absorption (500bu)	66.1	65.5	66.5	61.7
23	Water Absorption (14%mb)	65.4	63.3	65.7	60.2
24	Arrival Time (min)	4.7	3.5	5.8	2.8
25	Peak Time (min)	9.7	6.2	13.7	6.2
26	Dough Stability (min)	11.5	5.2	14.1	9.3
27	MTI (bu)	25.0	48.0	12.0	27.0
28	TTB (min)	15.2	8.9	20.0	12.0
II. Cooperator Results					
29	Bake Absorption (Ave %)	65.2	63.7	65.8	61.3
30	Loaf Volume (% of Check)		88.0		86.7

Trait	II. Cooperator Results	A	M9 Glenn	M1	W9 Glenn	W1
31	Mixing Requirement	5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	3.5	2.8	4.1	3.6
32	Dough Characteristics	5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	4.0	3.1	3.9	3.5
33	Mixing Tolerance	5 Much More Tolerance Than Check 4 More Tolerance Than Check 3 Tolerance Equivalent To Check 2 Less Tolerance Than Check 1 Much Less Tolerance Than Check		1.8		2.4
34	Internal Crumb Color	5 Much Brighter Than Check 4 Brighter Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.7		3.8
35	Internal Grain and Texture	5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		3.4		3.6
	III. Cooperator Evaluation					
	Quality Trait 1-2: Protein	5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.0		1.3
	Quality Trait 3-21: Milling	5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.8		3.1
	Quality Trait 22-35: Baking	5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.0		1.8
	Quality Trait 1-35: Overall Comparison	5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.0		2.3

01S0263-28		B9	B2	C9	C2	M9	M2
Trait	I. USDA/ARS WQL Data	Glenn		Glenn		Glenn	
1	Wheat Protein (12%mb)	15.5	14.8	14.5	13.6	14.8	14.7
2	Flour Protein (12%mb)	15.2	14.4	14.0	13.3	14.7	14.2
3	Market Value (Score 1-6)	4.8	4.4	4.2	3.0	4.4	4.0
4	Market Value (Score 1-10)	10	8.6	10	7.8	10	9.0
5	Test Weight (lb/bu)	63.3	62.2	63.6	59.7	62.8	61.0
6	1000 Kernel Weight (g)	35.6	33.4	28.3	29.6	32.5	29.7
7	Kernel Size % Large	79	75	47	46	68	57
8	Kernel Size % Small	3	5	9	11	5	8
9	Wheat Moisture (%)	10.8	10.7	10.2	9.8	10.1	9.6
10	Wheat Ash (14%mb)	1.57	1.58	1.54	1.59	1.19	1.30
11	Wheat Falling Number (sec)	400	457	418	371	388	396
12	SKCS Hardness Index	83.7	77.8	88.6	87.4	72.7	64.7
13	Vitreous Kernels (%)	92.0	59.3	90.2	65.6	71.0	5.4
	Flour Extraction (%)						
14	Tempered Wheat Basis (%)	69.9	70.1	69.4	72.4	72.9	73.1
15	Total Product Basis (%)	73.7	73.5	73.1	76.3	75.9	76.8
16	Flour /Bu Wheat (lbs)	46.2	45.7	46.6	45.9	48.5	47.8
17	Flour Color Brightness (L*)	89.8	89.7	89.9	89.1	90.0	89.5
18	Flour Color Yellowness (b*)	8.2	10.3	8.4	10.3	8.1	10.4
19	Flour Moisture (%)	13.3	13.1	12.5	12.5	13.4	12.8
20	Flour Ash (14%mb)	0.518	0.529	0.473	0.615	0.433	0.454
21	Flour FN (Malted) (sec)	251	251	252	258	252	269
Farinograph							
22	Water Absorption (500bu)	68.8	67.6	66.1	63.9	66.1	65.7
23	Water Absorption (14%mb)	68.0	66.6	64.4	62.2	65.4	64.3
24	Arrival Time (min)	3.9	4.2	2.2	3.0	4.7	5.0
25	Peak Time (min)	8.0	6.8	6.2	6.5	9.7	7.8
26	Dough Stability (min)	10.1	7.0	10.5	9.0	11.5	8.7
27	MTI (bu)	26.0	37.0	25.0	28.0	25.0	21.0
28	TTB (min)	13.6	11.3	12.0	11.1	15.2	14.2
II. Cooperator Results							
29	Bake Absorption (Ave %)	66.7	65.6	64.9	63.0	65.2	64.3
30	Loaf Volume (% of Check)		98.3		95.4		98.2

Trait	01S0263-28	B9 Glenn	B2	C9 Glenn	C2	M9 Glenn	M2
31	II. Cooperator Results Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	3.7	2.8	4.0	3.5	3.5	2.9
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	4.0	3.3	3.8	3.4	4.0	3.5
33	Mixing Tolerance 5 Much More Tolerance Than Check 4 More Tolerance Than Check 3 Tolerance Equivalent To Check 2 Less Tolerance Than Check 1 Much Less Tolerance Than Check		2.3		2.9		2.3
34	Internal Crumb Color 5 Much Brighter Than Check 4 Brighter Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.7		2.5		2.6
35	Internal Grain and Texture 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		3.5		3.5		3.7
	III. Cooperator Evaluation Quality Trait 1-2: Protein 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.4		2.2		2.8
	Quality Trait 3-21: Milling 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.8		2.7		2.5
	Quality Trait 22-35: Baking 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.8		2.4		2.8
	Quality Trait 1-35: Overall Comparison 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.7		2.3		2.9

ND811		C9	C3	K9	K3	M9	M3	W9	W3
Trait	I. USDA/ARS WQL Data	Glenn		Glenn		Glenn		Glenn	
1	Wheat Protein (12%mb)	14.5	13.9	14.1	11.1	14.8	14.0	16.2	14.4
2	Flour Protein (12%mb)	14.0	13.5	13.3	10.3	14.7	13.5	16.2	14.0
3	Market Value (Score 1-6)	4.2	4.2	3.7	3.0	4.4	4.0	4.8	3.9
4	Market Value (Score 1-10)	10	8.6	10	6.2	10	8.6	10	7.4
5	Test Weight (lb/bu)	63.6	62.0	64.5	62.3	62.8	60.1	62.4	59.9
6	1000 Kernel Weight (g)	28.3	32.8	33.4	36.0	32.5	34.0	28.4	29.0
7	Kernel Size % Large	47	77	71	83	68	43	27	47
8	Kernel Size % Small	9	5	4	3	5	5	11	8
9	Wheat Moisture (%)	10.2	10.9	9.7	9.6	10.1	10.6	9.4	10.0
10	Wheat Ash (14%mb)	1.54	1.40	1.47	1.49	1.19	1.15	1.44	1.38
11	Wheat Falling Number (sec)	418	454	312	322	388	421	464	479
12	SKCS Hardness Index	88.6	78.8	87.5	83.1	72.7	74.0	76.6	77.3
13	Vitreous Kernels (%)	90.2	65.6	91.2	51.5	71.0	27.3	98.0	88.4
	Flour Extraction (%)								
14	Tempered Wheat Basis (%)	69.4	72.4	68.8	69.2	72.9	72.2	70.6	69.8
15	Total Product Basis (%)	73.1	76.0	72.0	72.7	75.9	75.4	73.8	74.1
16	Flour /Bu Wheat (lbs)	46.6	46.9	47.2	46.0	48.5	45.8	46.8	44.6
17	Flour Color Brightness (L*)	89.9	89.7	90.2	90.0	90.0	89.9	90.2	90.5
18	Flour Color Yellowness (b*)	8.4	9.2	7.5	9.3	8.1	9.4	8.9	9.3
19	Flour Moisture (%)	12.5	13.0	13.2	13.1	13.4	13.5	13.3	11.9
20	Flour Ash (14%mb)	0.473	0.499	0.468	0.484	0.433	0.390	0.458	0.479
21	Flour FN (Malted) (sec)	252	256	259	248	252	250	247	249
	Farinograph								
22	Water Absorption (500bu)	66.1	64.1	68.6	65.4	66.1	65.0	66.5	65.9
23	Water Absorption (14%mb)	64.4	62.9	67.7	64.4	65.4	64.4	65.7	63.5
24	Arrival Time (min)	2.2	3.2	2.0	1.5	4.7	4.2	5.8	3.2
25	Peak Time (min)	6.2	5.7	3.8	2.3	9.7	7.2	13.7	8.2
26	Dough Stability (min)	10.5	7.8	6.1	3.1	11.5	9.7	14.1	11.4
27	MTI (bu)	25.0	31.0	36.0	51.0	25.0	19.0	12.0	29.0
28	TTB (min)	12.0	10.3	8.1	4.5	15.2	14.3	20.0	13.8
	II. Cooperator Results								
29	Bake Absorption (Ave %)	64.9	62.9	66.6	63.2	65.2	64.2	65.8	64.7
30	Loaf Volume (% of Check)		97.7		90.6		96.5		89.8

Trait	ND811	C9 Glenn	C3	K9 Glenn	K3	M9 Glenn	M3	W9 Glenn	W3
31	II. Cooperator Results Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	4.0	3.3	3.5	2.4	3.5	3.1	4.1	3.5
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	3.8	3.4	4.0	2.8	4.0	3.5	3.9	3.7
33	Mixing Tolerance 5 Much More Tolerance Than Check 4 More Tolerance Than Check 3 Tolerance Equivalent To Check 2 Less Tolerance Than Check 1 Much Less Tolerance Than Check		2.4		1.6		2.3		2.7
34	Internal Crumb Color 5 Much Brighter Than Check 4 Brighter Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.8		2.2		2.9		3.1
35	Internal Grain and Texture 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		3.3		3.1		3.2		3.5
	III. Cooperator Evaluation Quality Trait 1-2: Protein 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.2		1.2		2.4		2
	Quality Trait 3-21: Milling 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		3.7		2.9		2.7		2.9
	Quality Trait 22-35: Baking 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.5		1.5		2.7		2.3
	Quality Trait 1-35: Overall Comparison 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.7		1.5		2.7		2.7

	CA905-776	C9	C4
Trait	I. USDA/ARS WQL Data	Glenn	
1	Wheat Protein (12%mb)	14.5	14.4
2	Flour Protein (12%mb)	14.0	13.9
3	Market Value (Score 1-6)	4.2	3.5
4	Market Value (Score 1-10)	10	8.8
5	Test Weight (lb/bu)	63.6	61.4
6	1000 Kernel Weight (g)	28.3	29.5
7	Kernel Size % Large	47	55
8	Kernel Size % Small	9	8
9	Wheat Moisture (%)	10.2	10.1
10	Wheat Ash (14%mb)	1.54	1.52
11	Wheat Falling Number (sec)	418	380
12	SKCS Hardness Index	88.6	74.2
13	Vitreous Kernels (%)	90.2	58.4
	Flour Extraction (%)		
14	Tempered Wheat Basis (%)	69.4	70.9
15	Total Product Basis (%)	73.1	74.7
16	Flour /Bu Wheat (lbs)	46.6	45.9
17	Flour Color Brightness (L*)	89.9	89.5
18	Flour Color Yellowness (b*)	8.4	10.7
19	Flour Moisture (%)	12.5	12.6
20	Flour Ash (14%mb)	0.473	0.530
21	Flour FN (Malted) (sec)	252	254
	Farinograph		
22	Water Absorption (500bu)	66.1	65.8
23	Water Absorption (14%mb)	64.4	64.2
24	Arrival Time (min)	2.2	4.7
25	Peak Time (min)	6.2	7.3
26	Dough Stability (min)	10.5	7.7
27	MTI (bu)	25.0	31.0
28	TTB (min)	12.0	12.3
	II. Cooperator Results		
29	Bake Absorption (Ave %)	64.9	64.3
30	Loaf Volume (% of Check)		99.4

Trait	CA905-776	C9 Glenn	C4
II. Cooperator Results			
31	Mixing Requirement	4.0	3.2
	5 Very Long		
	4 Long		
	3 Medium		
	2 Short		
	1 Very Short		
32	Dough Characteristics	3.8	3.5
	5 Bucky-Tough		
	4 Strong-Elastic		
	3 Medium-Pliable		
	2 Mellow-Very Pliable		
	1 Weak-Short or Sticky		
33	Mixing Tolerance		2.7
	5 Much More Tolerance Than Check		
	4 More Tolerance Than Check		
	3 Tolerance Equivalent To Check		
	2 Less Tolerance Than Check		
	1 Much Less Tolerance Than Check		
34	Internal Crumb Color		2.6
	5 Much Brighter Than Check		
	4 Brighter Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		
35	Internal Grain and Texture		3.2
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		
III. Cooperator Evaluation			
	Quality Trait 1-2: Protein		2.9
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		
	Quality Trait 3-21: Milling		2.8
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		
	Quality Trait 22-35: Baking		3.0
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		
	Quality Trait 1-35: Overall Comparison		3.1
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		

SD3948		B9	B5	C9	C5	K9	K5	M9	M5
Trait	I. USDA/ARS WQL Data	Glenn		Glenn		Glenn		Glenn	
1	Wheat Protein (12%mb)	15.5	14.6	14.5	13.7	14.1	13.1	14.8	14.8
2	Flour Protein (12%mb)	15.2	14.3	14.0	13.2	13.3	12.4	14.7	14.0
3	Market Value (Score 1-6)	4.8	4.6	4.2	3.9	3.7	4.2	4.4	4.5
4	Market Value (Score 1-10)	10	9.0	10	9.0	10	8.4	10	10
5	Test Weight (lb/bu)	63.3	62.0	63.6	61.8	64.5	63.2	62.8	61.9
6	1000 Kernel Weight (g)	35.6	35.7	28.3	32.2	33.4	35.7	32.5	34.8
7	Kernel Size % Large	79	81	47	65	71	81	68	78
8	Kernel Size % Small	3	4	9	5	4	3	5	3
9	Wheat Moisture (%)	10.8	10.8	10.2	10.3	9.7	9.6	10.1	10.6
10	Wheat Ash (14%mb)	1.57	1.51	1.54	1.48	1.47	1.46	1.19	1.19
11	Wheat Falling Number (sec)	400	453	418	417	312	399	388	405
12	SKCS Hardness Index	83.7	83.6	88.6	83.0	87.5	81.0	72.7	74.3
13	Vitreous Kernels (%)	92.0	65.0	90.2	41.6	91.2	54.5	71.0	11.4
	Flour Extraction (%)								
14	Tempered Wheat Basis (%)	69.9	71.5	69.4	71.9	68.8	70.5	72.9	72.9
15	Total Product Basis (%)	73.7	74.5	73.1	75.2	72.0	73.7	75.9	75.2
16	Flour /Bu Wheat (lbs)	46.2	46.7	46.6	46.7	47.2	47.3	48.5	47.8
17	Flour Color Brightness (L*)	89.8	90.0	89.9	89.3	90.2	90.1	90.0	89.7
18	Flour Color Yellowness (b*)	8.2	9.0	8.4	9.2	7.5	8.3	8.1	8.7
19	Flour Moisture (%)	13.3	13.6	12.5	13.0	13.2	13.5	13.4	12.9
20	Flour Ash (14%mb)	0.518	0.516	0.473	0.528	0.468	0.478	0.433	0.475
21	Flour FN (Malted) (sec)	251	252	252	259	259	256	252	258
	Farinograph								
22	Water Absorption (500bu)	68.8	66.9	66.1	64.9	68.6	65.1	66.1	64.3
23	Water Absorption (14%mb)	68.0	66.4	64.4	63.7	67.7	64.5	65.4	63.0
24	Arrival Time (min)	3.9	3.5	2.2	2.2	2.0	1.9	4.7	3.7
25	Peak Time (min)	8.0	6.7	6.2	5.8	3.8	3.7	9.7	6.0
26	Dough Stability (min)	10.1	7.1	10.5	6.8	6.1	6.2	11.5	6.4
27	MTI (bu)	26.0	35.0	25.0	39.0	36.0	35.0	25.0	38.0
28	TTB (min)	13.6	10.5	12.0	9.3	8.1	8.2	15.2	10.1
	II. Cooperator Results								
29	Bake Absorption (Ave %)	66.7	65.2	64.9	63.8	66.6	64.1	65.2	63.4
30	Loaf Volume (% of Check)		99.6		95.8		93.2		94.0

Trait	B	M9 Glenn	M6	W9 Glenn	W6
I. USDA/ARS WQL Data					
1	Wheat Protein (12%mb)	14.8	12.8	16.2	12.9
2	Flour Protein (12%mb)	14.7	11.8	16.2	12.0
3	Market Value (Score 1-6)	4.4	3.4	4.8	3.4
4	Market Value (Score 1-10)	10	6.4	10	6.2
5	Test Weight (lb/bu)	62.8	59.8	62.4	59.4
6	1000 Kernel Weight (g)	32.5	29.6	28.4	26.8
7	Kernel Size % Large	68	46	27	25
8	Kernel Size % Small	5	10	11	13
9	Wheat Moisture (%)	10.1	10.1	9.4	9.7
10	Wheat Ash (14%mb)	1.19	1.17	1.44	1.36
11	Wheat Falling Number (sec)	388	407	464	495
12	SKCS Hardness Index	72.7	66.2	76.6	61.2
13	Vitreous Kernels (%)	71.0	6.7	98.0	7.5
	Flour Extraction (%)				
14	Tempered Wheat Basis (%)	72.9	73.4	70.6	70.8
15	Total Product Basis (%)	75.9	76.6	73.8	74.3
16	Flour /Bu Wheat (lbs)	48.5	46.5	46.8	44.4
17	Flour Color Brightness (L*)	90.0	90.0	90.2	90.8
18	Flour Color Yellowness (b*)	8.1	8.5	8.9	8.6
19	Flour Moisture (%)	13.4	12.9	13.3	12.3
20	Flour Ash (14%mb)	0.433	0.490	0.458	0.476
21	Flour FN (Malted) (sec)	252	251	247	241
Farinograph					
22	Water Absorption (500bu)	66.1	61.3	66.5	59.8
23	Water Absorption (14%mb)	65.4	60.0	65.7	57.9
24	Arrival Time (min)	4.7	2.8	5.8	1.8
25	Peak Time (min)	9.7	5.8	13.7	7.2
26	Dough Stability (min)	11.5	7.6	14.1	17.1
27	MTI (bu)	25.0	33.0	12.0	18.0
28	TTB (min)	15.2	10.5	20.0	16.6
II. Cooperator Results					
29	Bake Absorption (Ave %)	65.2	60.5	65.8	60.2
30	Loaf Volume (% of Check)		89.5		86.2

Trait	II. Cooperator Results	B	M9 Glenn	M6	W9 Glenn	W6
31	Mixing Requirement	5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	3.5	2.4	4.1	4.2
32	Dough Characteristics	5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	4.0	2.7	3.9	3.4
33	Mixing Tolerance	5 Much More Tolerance Than Check 4 More Tolerance Than Check 3 Tolerance Equivalent To Check 2 Less Tolerance Than Check 1 Much Less Tolerance Than Check		1.9		3.0
34	Internal Crumb Color	5 Much Brighter Than Check 4 Brighter Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.6		3.2
35	Internal Grain and Texture	5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.9		3.3
	III. Cooperator Evaluation					
	Quality Trait 1-2: Protein	5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		1.3		1.5
	Quality Trait 3-21: Milling	5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.3		2.4
	Quality Trait 22-35: Baking	5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.0		2.0
	Quality Trait 1-35: Overall Comparison	5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		1.9		2.1

Trait	ND810	C9 Glenn	C7	K9 Glenn	K7	W9 Glenn	W7
I. USDA/ARS WQL Data							
1	Wheat Protein (12%mb)	14.5	14.4	14.1	13.9	16.2	14.5
2	Flour Protein (12%mb)	14.0	13.7	13.3	13.0	16.2	14.0
3	Market Value (Score 1-6)	4.2	4.1	3.7	4.3	4.8	3.9
4	Market Value (Score 1-10)	10	9.6	10	9.6	10	7.0
5	Test Weight (lb/bu)	63.6	61.7	64.5	63.0	62.4	60.2
6	1000 Kernel Weight (g)	28.3	28.6	33.4	32.1	28.4	25.7
7	Kernel Size % Large	47	49	71	71	27	22
8	Kernel Size % Small	9	9	4	5	11	17
9	Wheat Moisture (%)	10.2	9.6	9.7	9.3	9.4	9.8
10	Wheat Ash (14%mb)	1.54	1.47	1.47	1.41	1.44	1.33
11	Wheat Falling Number (sec)	418	479	312	431	464	477
12	SKCS Hardness Index	88.6	81.8	87.5	87.0	76.6	81.7
13	Vitreous Kernels (%)	90.2	61.4	91.2	50.7	98.0	89.1
	Flour Extraction (%)						
14	Tempered Wheat Basis (%)	69.4	70.3	68.8	68.1	70.6	70.0
15	Total Product Basis (%)	73.1	73.6	72.0	71.2	73.8	73.8
16	Flour /Bu Wheat (lbs)	46.6	46.3	47.2	45.9	46.8	44.9
17	Flour Color Brightness (L*)	89.9	89.0	90.2	89.6	90.2	89.9
18	Flour Color Yellowness (b*)	8.4	8.5	7.5	7.7	8.9	9.0
19	Flour Moisture (%)	12.5	12.9	13.2	13.3	13.3	12.8
20	Flour Ash (14%mb)	0.473	0.504	0.468	0.476	0.458	0.471
21	Flour FN (Malted) (sec)	252	253	259	276	247	264
Farinograph							
22	Water Absorption (500bu)	66.1	67.0	68.6	69.1	66.5	66.9
23	Water Absorption (14%mb)	64.4	65.7	67.7	68.3	65.7	65.5
24	Arrival Time (min)	2.2	2.8	2.0	2.5	5.8	4.6
25	Peak Time (min)	6.2	5.7	3.8	4.9	13.7	8.9
26	Dough Stability (min)	10.5	7.2	6.1	5.2	14.1	8.3
27	MTI (bu)	25.0	40.0	36.0	50.0	12.0	39.0
28	TTB (min)	12.0	9.6	8.1	7.7	20.0	13.1
II. Cooperator Results							
29	Bake Absorption (Ave %)	64.9	65.3	66.6	66.4	65.8	65.5
30	Loaf Volume (% of Check)		95.6		93.5		90.8

Trait	ND810	C9 Glenn	C7	K9 Glenn	K7	W9 Glenn	W7
II. Cooperator Results							
31	Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	4.0	2.9	3.4	2.1	4.1	3.4
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	3.8	3.2	4.0	2.7	3.9	3.8
33	Mixing Tolerance 5 Much More Tolerance Than Check 4 More Tolerance Than Check 3 Tolerance Equivalent To Check 2 Less Tolerance Than Check 1 Much Less Tolerance Than Check		2.3		2.4		2.2
34	Internal Crumb Color 5 Much Brighter Than Check 4 Brighter Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		3.3		3.0		3.5
35	Internal Grain and Texture 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		3.5		3.1		3.1
III. Cooperator Evaluation							
	Quality Trait 1-2: Protein 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.8		2.7		2.2
	Quality Trait 3-21: Milling 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.9		2.8		2.3
	Quality Trait 22-35: Baking 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.8		2.3		2.2
	Quality Trait 1-35: Overall Comparison 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.7		2.6		2.5

	CA905-780	B9	B8
Trait	I. USDA/ARS WQL Data	Glenn	
1	Wheat Protein (12%mb)	15.5	15.1
2	Flour Protein (12%mb)	15.2	14.5
3	Market Value (Score 1-6)	4.8	4.2
4	Market Value (Score 1-10)	10	8.8
5	Test Weight (lb/bu)	63.3	60.2
6	1000 Kernel Weight (g)	35.6	33.9
7	Kernel Size % Large	79	69
8	Kernel Size % Small	3	5
9	Wheat Moisture (%)	10.8	10.5
10	Wheat Ash (14%mb)	1.57	1.60
11	Wheat Falling Number (sec)	400	423
12	SKCS Hardness Index	83.7	67.9
13	Vitreous Kernels (%)	92.0	57.6
	Flour Extraction (%)		
14	Tempered Wheat Basis (%)	69.9	72.7
15	Total Product Basis (%)	73.7	75.6
16	Flour /Bu Wheat (lbs)	46.2	45.8
17	Flour Color Brightness (L*)	89.8	89.9
18	Flour Color Yellowness (b*)	8.2	8.7
19	Flour Moisture (%)	13.3	13.3
20	Flour Ash (14%mb)	0.518	0.579
21	Flour FN (Malted) (sec)	251	252
	Farinograph		
22	Water Absorption (500bu)	68.8	64.7
23	Water Absorption (14%mb)	68.0	63.9
24	Arrival Time (min)	3.9	3.6
25	Peak Time (min)	8.0	4.7
26	Dough Stability (min)	10.1	4.8
27	MTI (bu)	26.0	37.0
28	TTB (min)	13.6	8.9
	II. Cooperator Results		
29	Bake Absorption (Ave %)	66.7	63.4
30	Loaf Volume (% of Check)		94.5

Trait	CA905-780	B9 Glenn	B8
II. Cooperator Results			
31	Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	3.7	1.6
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	4.0	1.7
33	Mixing Tolerance 5 Much More Tolerance Than Check 4 More Tolerance Than Check 3 Tolerance Equivalent To Check 2 Less Tolerance Than Check 1 Much Less Tolerance Than Check		1.7
34	Internal Crumb Color 5 Much Brighter Than Check 4 Brighter Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.5
35	Internal Grain and Texture 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.7
III. Cooperator Evaluation			
	Quality Trait 1-2: Protein 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.3
	Quality Trait 3-21: Milling 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.7
	Quality Trait 22-35: Baking 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		1.7
	Quality Trait 1-35: Overall Comparison 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.1

MN03196		B9	B10	C9	C10	K9	K10	M9	M10
Trait	I. USDA/ARS WQL Data	Glenn		Glenn		Glenn		Glenn	
1	Wheat Protein (12%mb)	15.5	14.8	14.5	14.3	14.1	13.8	14.8	14.3
2	Flour Protein (12%mb)	15.2	14.6	14.0	13.7	13.3	13.4	14.7	13.6
3	Market Value (Score 1-6)	4.8	4.6	4.2	4.1	3.7	4.1	4.4	4.3
4	Market Value (Score 1-10)	10	9.0	10	9.6	10	9.6	10	9.4
5	Test Weight (lb/bu)	63.3	62.6	63.6	62.1	64.5	64.0	62.8	62.3
6	1000 Kernel Weight (g)	35.6	33.1	28.3	28.8	33.4	30.8	32.5	33.3
7	Kernel Size % Large	79	71	47	53	71	57	68	67
8	Kernel Size % Small	3	7	9	10	4	9	5	7
9	Wheat Moisture (%)	10.8	10.2	10.2	9.6	9.7	9.6	10.1	10.4
10	Wheat Ash (14%mb)	1.57	1.54	1.54	1.57	1.47	1.38	1.19	1.24
11	Wheat Falling Number (sec)	400	445	418	461	312	406	388	410
12	SKCS Hardness Index	83.7	89.6	88.6	85.1	87.5	87.9	72.7	78.7
13	Vitreous Kernels (%)	92.0	82.7	90.2	82.8	91.2	82.6	71.0	67.2
Flour Extraction (%)									
14	Tempered Wheat Basis (%)	69.9	70.0	69.4	70.6	68.8	70.6	72.9	71.8
15	Total Product Basis (%)	73.7	73.5	73.1	73.6	72.0	74.0	75.9	75.0
16	Flour /Bu Wheat (lbs)	46.2	45.9	46.6	46.9	47.2	47.9	48.5	47.3
17	Flour Color Brightness (L*)	89.8	89.7	89.9	89.6	90.2	90.0	90.0	89.8
18	Flour Color Yellowness (b*)	8.2	8.6	8.4	8.9	7.5	8.7	8.1	8.5
19	Flour Moisture (%)	13.3	13.2	12.5	13.2	13.2	13.0	13.4	13.0
20	Flour Ash (14%mb)	0.518	0.539	0.473	0.497	0.468	0.450	0.433	0.441
21	Flour FN (Malted) (sec)	251	258	252	255	259	267	252	267

Farinograph

22	Water Absorption (500bu)	68.8	69.8	66.1	64.0	68.6	66.4	66.1	67.6
23	Water Absorption (14%mb)	68.0	68.9	64.4	63.1	67.7	65.2	65.4	66.4
24	Arrival Time (min)	3.9	3.9	2.2	3.3	2.0	2.8	4.7	4.7
25	Peak Time (min)	8.0	7.0	6.2	7.2	3.8	7.7	9.7	7.5
26	Dough Stability (min)	10.1	7.3	10.5	9.0	6.1	10.6	11.5	7.4
27	MTI (bu)	26.0	37.0	25.0	31.0	36.0	25.0	25.0	33.0
28	TTB (min)	13.6	11.2	12.0	12.1	8.1	12.9	15.2	11.9

II. Cooperator Results

29	Bake Absorption (Ave %)	66.7	67.1	64.9	63.4	66.6	65.1	65.2	65.7
30	Loaf Volume (% of Check)		97.6		96.3		95.7		95.7

BZ903-504		M9	M11
Trait	I. USDA/ARS WQL Data	Glenn	
1	Wheat Protein (12%mb)	14.8	14.4
2	Flour Protein (12%mb)	14.7	13.5
3	Market Value (Score 1-6)	4.4	4.1
4	Market Value (Score 1-10)	10	8.8
5	Test Weight (lb/bu)	62.8	60.4
6	1000 Kernel Weight (g)	32.5	37.9
7	Kernel Size % Large	68	81
8	Kernel Size % Small	5	3
9	Wheat Moisture (%)	10.1	10.4
10	Wheat Ash (14%mb)	1.19	1.19
11	Wheat Falling Number (sec)	388	391
12	SKCS Hardness Index	72.7	70.4
13	Vitreous Kernels (%)	71.0	53.6
	Flour Extraction (%)		
14	Tempered Wheat Basis (%)	72.9	71.5
15	Total Product Basis (%)	75.9	75.1
16	Flour /Bu Wheat (lbs)	48.5	45.8
17	Flour Color Brightness (L*)	90.0	89.9
18	Flour Color Yellowness (b*)	8.1	8.7
19	Flour Moisture (%)	13.4	13.0
20	Flour Ash (14%mb)	0.433	0.434
21	Flour FN (Malted) (sec)	252	266
Farinograph			
22	Water Absorption (500bu)	66.1	66.0
23	Water Absorption (14%mb)	65.4	64.8
24	Arrival Time (min)	4.7	4.0
25	Peak Time (min)	9.7	7.2
26	Dough Stability (min)	11.5	7.7
27	MTI (bu)	25.0	34.0
28	TTB (min)	15.2	11.4
II. Cooperator Results			
29	Bake Absorption (Ave %)	65.2	64.5
30	Loaf Volume (% of Check)		96.2

BZ903-504		M9	M11
Trait	II. Cooperator Results	Glenn	
31	Mixing Requirement	3.5	2.9
	5 Very Long		
	4 Long		
	3 Medium		
	2 Short		
	1 Very Short		
32	Dough Characteristics	4.0	3.2
	5 Bucky-Tough		
	4 Strong-Elastic		
	3 Medium-Pliable		
	2 Mellow-Very Pliable		
	1 Weak-Short or Sticky		
33	Mixing Tolerance		2.1
	5 Much More Tolerance Than Check		
	4 More Tolerance Than Check		
	3 Tolerance Equivalent To Check		
	2 Less Tolerance Than Check		
	1 Much Less Tolerance Than Check		
34	Internal Crumb Color		3.0
	5 Much Brighter Than Check		
	4 Brighter Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		
35	Internal Grain and Texture		3.1
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		
III. Cooperator Evaluation			
Quality Trait 1-2: Protein			2.3
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		
Quality Trait 3-21: Milling			2.9
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		
Quality Trait 22-35: Baking			2.6
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		
Quality Trait 1-35: Overall Comparison			2.6
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		

ND808		C9	C12	K9	K12	M9	M12	W9	W12
Trait	I. USDA/ARS WQL Data	Glenn		Glenn		Glenn		Glenn	
1	Wheat Protein (12%mb)	14.5	14.3	14.1	12.2	14.8	13.9	16.2	15.3
2	Flour Protein (12%mb)	14.0	13.8	13.3	11.7	14.7	13.1	16.2	14.7
3	Market Value (Score 1-6)	4.2	4.0	3.7	3.9	4.4	4.0	4.8	4.0
4	Market Value (Score 1-10)	10	8.8	10	7.4	10	8.2	10	8.2
5	Test Weight (lb/bu)	63.6	60.6	64.5	63.0	62.8	60.6	62.4	58.7
6	1000 Kernel Weight (g)	28.3	33.4	33.4	37.7	32.5	39.2	28.4	30.3
7	Kernel Size % Large	47	70	71	87	68	83	27	47
8	Kernel Size % Small	9	6	4	3	5	3	11	9
9	Wheat Moisture (%)	10.2	9.6	9.7	9.7	10.1	9.9	9.4	9.5
10	Wheat Ash (14%mb)	1.54	1.51	1.47	1.31	1.19	1.18	1.44	1.35
11	Wheat Falling Number (sec)	418	460	312	336	388	373	464	466
12	SKCS Hardness Index	88.6	79.7	87.5	76.0	72.7	67.5	76.6	73.7
13	Vitreous Kernels (%)	90.2	57.2	91.2	92.4	71.0	10.8	98.0	80.0
	Flour Extraction (%)								
14	Tempered Wheat Basis (%)	69.4	72.4	68.8	73.2	72.9	74.7	70.6	73.0
15	Total Product Basis (%)	73.1	76.1	72.0	76.8	75.9	78.4	73.8	76.4
16	Flour /Bu Wheat (lbs)	46.6	47.0	47.2	49.0	48.5	48.3	46.8	45.7
17	Flour Color Brightness (L*)	89.9	89.6	90.2	90.3	90.0	89.8	90.2	90.2
18	Flour Color Yellowness (b*)	8.4	7.4	7.5	6.7	8.1	7.2	8.9	7.1
19	Flour Moisture (%)	12.5	13.0	13.2	13.2	13.4	12.7	13.3	12.8
20	Flour Ash (14%mb)	0.473	0.525	0.468	0.452	0.433	0.456	0.458	0.454
21	Flour FN (Malted) (sec)	252	253	259	252	252	251	247	231

Farinograph

22	Water Absorption (500bu)	66.1	65.9	68.6	65.9	66.1	66.2	66.5	64.9
23	Water Absorption (14%mb)	64.4	64.7	67.7	65.0	65.4	64.7	65.7	63.5
24	Arrival Time (min)	2.2	3.2	2.0	2.1	4.7	3.8	5.8	3.5
25	Peak Time (min)	6.2	5.7	3.8	3.8	9.7	5.9	13.7	7.4
26	Dough Stability (min)	10.5	6.7	6.1	6.2	11.5	6.6	14.1	11.0
27	MTI (bu)	25.0	36.0	36.0	37.0	25.0	34.0	12.0	22.0
28	TTB (min)	12.0	9.8	8.1	7.9	15.2	10.1	20.0	13.0

II. Cooperator Results

29	Bake Absorption (Ave %)	64.9	64.5	66.6	64.2	65.2	64.4	65.8	64.1
30	Loaf Volume (% of Check)		97.3		94.1		95.1		96.9

ND808		C9	C12	K9	K12	M9	M12	W9	W12
Trait	II. Cooperator Results	Glenn		Glenn		Glenn		Glenn	
31	Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	4.0	2.7	3.5	2.8	3.5	2.7	4.1	3.6
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	3.8	3.2	4.0	3.3	4.0	3.2	3.9	3.9
33	Mixing Tolerance 5 Much More Tolerance Than Check 4 More Tolerance Than Check 3 Tolerance Equivalent To Check 2 Less Tolerance Than Check 1 Much Less Tolerance Than Check		2.4		2.7		2.0		2.9
34	Internal Crumb Color 5 Much Brighter Than Check 4 Brighter Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		3.5		3.7		3.3		4.0
35	Internal Grain and Texture 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		3.4		3.3		3.4		3.6
	III. Cooperator Evaluation								
	Quality Trait 1-2: Protein 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.8		1.4		2.1		2.4
	Quality Trait 3-21: Milling 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		3.4		3.9		3.5		3.3
	Quality Trait 22-35: Baking 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.8		2.6		3.0		2.9
	Quality Trait 1-35: Overall Comparison 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.8		2.7		2.6		3.0

	SD4011	B9	B13
Trait	I. USDA/ARS WQL Data	Glenn	
1	Wheat Protein (12%mb)	15.5	15.5
2	Flour Protein (12%mb)	15.2	15.2
3	Market Value (Score 1-6)	4.8	4.2
4	Market Value (Score 1-10)	10	8.8
5	Test Weight (lb/bu)	63.3	59.8
6	1000 Kernel Weight (g)	35.6	34.1
7	Kernel Size % Large	79	76
8	Kernel Size % Small	3	4
9	Wheat Moisture (%)	10.8	10.5
10	Wheat Ash (14%mb)	1.57	1.53
11	Wheat Falling Number (sec)	400	447
12	SKCS Hardness Index	83.7	71.4
13	Vitreous Kernels (%)	92.0	62.3
	Flour Extraction (%)		
14	Tempered Wheat Basis (%)	69.9	72.3
15	Total Product Basis (%)	73.7	74.5
16	Flour /Bu Wheat (lbs)	46.2	45.3
17	Flour Color Brightness (L*)	89.8	89.8
18	Flour Color Yellowness (b*)	8.2	8.3
19	Flour Moisture (%)	13.3	12.9
20	Flour Ash (14%mb)	0.518	0.507
21	Flour FN (Malted) (sec)	251	257
	Farinograph		
22	Water Absorption (500bu)	68.8	69.2
23	Water Absorption (14%mb)	68.0	68.0
24	Arrival Time (min)	3.9	4.5
25	Peak Time (min)	8.0	7.4
26	Dough Stability (min)	10.1	7.6
27	MTI (bu)	26.0	28.0
28	TTB (min)	13.6	13.1
	II. Cooperator Results		
29	Bake Absorption (Ave %)	66.7	66.9
30	Loaf Volume (% of Check)		97.4

SD4011		B9	B13
Trait	II. Cooperator Results	Glenn	
31	Mixing Requirement	3.7	2.6
	5 Very Long		
	4 Long		
	3 Medium		
	2 Short		
	1 Very Short		
32	Dough Characteristics	4.0	2.4
	5 Bucky-Tough		
	4 Strong-Elastic		
	3 Medium-Pliable		
	2 Mellow-Very Pliable		
	1 Weak-Short or Sticky		
33	Mixing Tolerance		2.2
	5 Much More Tolerance Than Check		
	4 More Tolerance Than Check		
	3 Tolerance Equivalent To Check		
	2 Less Tolerance Than Check		
	1 Much Less Tolerance Than Check		
34	Internal Crumb Color		2.6
	5 Much Brighter Than Check		
	4 Brighter Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		
35	Internal Grain and Texture		3.1
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		
III. Cooperator Evaluation			
Quality Trait 1-2: Protein			3.0
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		
Quality Trait 3-21: Milling			3.0
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		
Quality Trait 22-35: Baking			2.4
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		
Quality Trait 1-35: Overall Comparison			2.7
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		
	1 Much Poorer Than Check		

	CA905-781	W9	W14
Trait	I. USDA/ARS WQL Data	Glenn	
1	Wheat Protein (12%mb)	16.2	15.8
2	Flour Protein (12%mb)	16.2	15.8
3	Market Value (Score 1-6)	4.8	4.2
4	Market Value (Score 1-10)	10	8.8
5	Test Weight (lb/bu)	62.4	59.4
6	1000 Kernel Weight (g)	28.4	31.7
7	Kernel Size % Large	27	50
8	Kernel Size % Small	11	8
9	Wheat Moisture (%)	9.4	9.8
10	Wheat Ash (14%mb)	1.44	1.46
11	Wheat Falling Number (sec)	464	479
12	SKCS Hardness Index	76.6	62.8
13	Vitreous Kernels (%)	98.0	82.1
	Flour Extraction (%)		
14	Tempered Wheat Basis (%)	70.6	72.2
15	Total Product Basis (%)	73.8	75.8
16	Flour /Bu Wheat (lbs)	46.8	45.5
17	Flour Color Brightness (L*)	90.2	89.9
18	Flour Color Yellowness (b*)	8.9	8.2
19	Flour Moisture (%)	13.3	13.1
20	Flour Ash (14%mb)	0.458	0.472
21	Flour FN (Malted) (sec)	247	249
	Farinograph		
22	Water Absorption (500bu)	66.5	64.2
23	Water Absorption (14%mb)	65.7	63.2
24	Arrival Time (min)	5.8	3.9
25	Peak Time (min)	13.7	9.3
26	Dough Stability (min)	14.1	16.0
27	MTI (bu)	12.0	16.0
28	TTB (min)	20.0	20.0
	II. Cooperator Results		
29	Bake Absorption (Ave %)	65.8	64.1
30	Loaf Volume (% of Check)		99.4

Trait	CA905-781	W9 Glenn	W14
31	II. Cooperator Results Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	4.1	4.0
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	3.9	4.1
33	Mixing Tolerance 5 Much More Tolerance Than Check 4 More Tolerance Than Check 3 Tolerance Equivalent To Check 2 Less Tolerance Than Check 1 Much Less Tolerance Than Check		3.3
34	Internal Crumb Color 5 Much Brighter Than Check 4 Brighter Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		3.6
35	Internal Grain and Texture 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		3.2
	III. Cooperator Evaluation Quality Trait 1-2: Protein 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		2.8
	Quality Trait 3-21: Milling 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		3.3
	Quality Trait 22-35: Baking 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		3.1
	Quality Trait 1-35: Overall Comparison 5 Much Better Than Check 4 Better Than Check 3 Equivalent To Check 2 Poorer Than Check 1 Much Poorer Than Check		3.4

Glenn Checks 2009, 2008, 2007 Crop Years

	2009 Hard Spring Wheat Crop				2008 Hard Spring Wheat Crop				2007 Hard Spring Wheat Crop			
	Bake	Loaf	Mixing	Dough	Bake	Loaf	Mixing	Dough	Bake	Loaf	Mixing	Dough
Watertown Cooperator	Absorption	Volume	Requirement	Characteristic	Absorption	Volume	Requirement	Characteristic	Absorption	Volume	Requirement	Characteristic
1	61.0	2750	4	4	58.0	2725	4	3	58.0	2850	5	5
2	65.0	2850	3	3	62.0	2900	3	4	60.7	2700	2	3
3	64.0	1033	5	4	62.0	967	4	5	61.0	887	2	4
4	66.0	3045	5	5	65.0	3015	5	5	63.0	3104	5	5
5	70.0	3075	3	3	65.9	2950	2	5	64.8	2925	2	3
6	65.0	2750	4	3	63.0	3000	3	3	62.0	2450	2	3
7	67.3	1035	3	4	63.9	915	4	3	61.3	870	4	4
8	70.4	1050	4	5	63.7	710	5	2	65.5	778	4	3
9	67.2	1035	3	4	64.4	835	3	4	65.8	725	3	5
10	71.1	1002	3	5								
Average	66.7		3.7	4.0	63.1		3.7	3.8	62.5		3.2	3.9
± 1 Std Dev	3.2		0.8	0.8	2.3		1.0	1.1	2.6		1.3	0.9
Casselton Cooperator	Absorption	Volume	Requirement	Characteristic	Absorption	Volume	Requirement	Characteristic	Absorption	Volume	Requirement	Characteristic
1	60.0	3000	5	5	59.0	2725	3	3	62.0	2975	5	5
2	61.5	2800	3	3	62.0	3150	4	5	62.9	3400	3	2
3	64.0	1060	5	4	64.0	975	4	3	64.0	998	4	4
4	65.0	3000	5	5	66.0	2956	5	5	63.0	2986	5	5
5	66.4	2825	3	3	68.0	2675	2	5	66.0	3075	3	3
6	63.0	2900	4	4	64.0	2750	3	3	64.0	2850	3	3
7	64.6	1025	3	4	65.5	950	3	3	62.5	1005	4	4
8	70.7	1015	5	3	64.7	915	3	4	67.2	918	5	3
9	65.1	960	3	4	66.0	960	3	4	66.7	800	3	4
10	68.7	1010	4	3								
Average	64.9		4.0	3.8	64.4		3.3	3.9	64.3		3.9	3.7
± 1 Std Dev	3.2		0.9	0.8	2.6		0.9	0.9	1.9		0.9	1.0
Crookston Cooperator	Absorption	Volume	Requirement	Characteristic	Absorption	Volume	Requirement	Characteristic	Absorption	Volume	Requirement	Characteristic
1	59.0	2900	4	4	60.0	3000	4	4	61.0	3000	5	5
2	64.5	2800	3	3	60.0	2900	4	5	64.3	3350	3	3
3	63.0	950	4	4	64.0	1075	4	4	62.0	923	3	4
4	66.0	3104	5	5	65.0	2986	5	5	66.0	2986	5	5
5	69.7	2900	2	4	66.3	3125	4	3	68.1	3300	3	4
6	65.0	2700	2	3	63.0	3000	4	4	64.0	2450	4	4
7	67.1	950	4	4	63.6	1030	3	3	64.6	1045	3	4
8	73.0	900	4	5	66.7	1020	2	2	69.8	983	4	5
9	67.2	875	3	4	64.1	885	3	4	68.0	880	3	4
10	71.6	889	4	4								
Average	66.6		3.5	4.0	63.6		3.7	3.8	65.3		3.7	4.2
± 1 Std Dev	4.1		1.0	0.7	2.4		0.9	1.0	2.9		0.9	0.7
Minot Cooperator	Absorption	Volume	Requirement	Characteristic								
1	61.0	2850	5	5								
2	62.5	3050	3	3								
3	64.0	1038	4	4								
4	65.0	3104	5	5								
5	67.4	3200	3	3								
6	64.0	2950	4	4								
7	64.6	1090	3	4								
8	70.2	1000	4	4								
9	64.3	885	2	4								
10	68.5	1034	2	4								
Average	65.2		3.5	4.0								
± 1 Std Dev	2.8		1.1	0.7								
Williston Cooperator	Absorption	Volume	Requirement	Characteristic	Absorption	Volume	Requirement	Characteristic	Absorption	Volume	Requirement	Characteristic
1	62.0	2850	5	5	62.0	2850	5	5	65.0	2925	5	5
2	63.0	3100	3	3	58.0	3050	4	5	65.2	3400	3	3
3	64.0	1098	5	4	64.0	1125	5	5	64.0	1008	4	4
4	66.0	3162	5	5	63.0	3162	5	5	65.0	3045	5	5
5	67.7	3250	4	2	65.1	2850	4	3	67.2	3200	4	3
6	64.0	2900	5	4	62.0	2950	5	4	65.0	2600	5	5
7	65.0	1225	3	4	63.0	1110	4	3	63.7	1150	3	3
8	72.7	1135	4	5	70.7	1130	3	4	70.0	1073	4	3
9	64.8	1035	3	4	63.0	825	3	4	65.6	890	3	4
10	69.1	1128	4	3								
Average	65.8		4.1	3.9	63.4		4.2	4.2	65.6		4.0	3.9
± 1 Std Dev	3.2		0.9	1.0	3.4		0.8	0.8	1.9		0.9	0.9

Minot - M1 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check							Overall
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking		
1	59.0	2700	94.7	5	4	3	3	5	2	4	2	2	
2	60.5	2800	91.8	4	2	2	3	3	2	2	3	2	
3	63.0	940	90.6	2	3	2	3	3	2	3	2	2	
4	63.0	2927	94.3	4	4	2	2	2	2	3	2	2	
5	65.3	3000	93.8	1	4	1	4	5	2	3	3	3	
6	63.0	2600	88.1	2	2	2	3	4	2	5	2	3	
7	64.0	920	84.4	2	3	1	3	3	2	4	2	2	
8	67.2	875	87.5	4	4	2	2	2	2	2	2	2	
9	64.1	685	77.4	2	2	2	2	2	2	1	1	1	
10	68.0	804	77.8	2	3	1	2	5	2	1	1	1	
Average	63.7		88.0	2.8	3.1	1.8	2.7	3.4	2.0	2.8	2.0	2.0	
± 1 Std Dev	2.7		6.4	1.3	0.9	0.6	0.7	1.3	0.0	1.3	0.7	0.7	
Williston - W1 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check							Overall
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking		
1	59.0	2800	98.2	5	5	3	3	4	2	4	3	3	
2	57.0	2700	87.1	4	4	4	5	5	1	3	1	2	
3	62.0	945	86.1	3	2	1	3	3	2	2	1	2	
4	60.0	3104	98.2	5	5	3	4	4	1	4	2	2	
5	62.2	3175	97.7	3	3	2	5	5	1	3	3	3	
6	60.0	2800	96.6	3	3	3	4	3	1	5	3	5	
7	60.2	950	77.6	3	3	1	3	2	1	4	1	1	
8	67.7	830	73.1	4	4	3	3	2	2	2	2	2	
9	61.1	775	74.9	3	3	2	3	3	1	1	1	1	
10	64.0	873	77.4	3	3	2	5	5	1	3	1	2	
Average	61.3		86.7	3.6	3.5	2.4	3.8	3.6	1.3	3.1	1.8	2.3	
± 1 Std Dev	2.9		10.4	0.8	1.0	1.0	0.9	1.2	0.5	1.2	0.9	1.2	

Watertown - B2 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check							Overall
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking		
1	60.0	2800	101.8	4	4	3	2	3	3	3	3	3	
2	63.5	2750	96.5	2	2	3	2	3	2	3	2	3	
3	64.0	982	95.1	4	3	2	3	3	3	3	3	2	
4	66.0	3015	99.0	4	4	2	3	3	2	3	3	2	
5	68.6	3100	100.8	2	4	2	4	4	2	4	3	3	
6	64.0	2700	98.2	3	2	2	3	3	3	3	3	3	
7	66.1	1045	101.0	3	3	2	2	3	2	3	2	2	
8	67.6	990	94.3	2	4	2	3	5	2	2	4	4	
9	66.0	1000	96.6	3	3	3	2	4	3	2	3	3	
10	70.2	1000	99.8	1	4	2	3	4	2	2	2	2	
Average	65.6		98.3	2.8	3.3	2.3	2.7	3.5	2.4	2.8	2.8	2.7	
± 1 Std Dev	2.9		2.6	1.0	0.8	0.5	0.7	0.7	0.5	0.6	0.6	0.7	

Casselton - C2 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check							Overall
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking		
1	59.0	2950	98.3	5	5	3	2	3	3	5	3	3	
2	59.0	2850	101.8	4	4	4	2	2	2	1	2	2	
3	63.0	973	91.8	3	4	2	3	3	3	2	2	2	
4	63.0	2927	97.6	5	5	3	2	3	2	2	2	2	
5	64.2	2650	93.8	3	1	3	5	5	2	2	2	2	
6	62.0	2700	93.1	3	3	2	3	3	2	5	2	2	
7	62.4	1035	101.0	3	3	3	2	4	1	4	3	2	
8	68.7	950	93.6	5	3	3	2	4	2	2	4	4	
9	62.6	790	82.3	2	2	3	1	3	3	2	1	2	
10	66.1	1019	100.9	2	4	3	3	5	2	2	3	2	
Average	63.0		95.4	3.5	3.4	2.9	2.5	3.5	2.2	2.7	2.4	2.3	
± 1 Std Dev	2.9		5.9	1.2	1.3	0.6	1.1	1.0	0.6	1.4	0.8	0.7	

Minot - M2 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check							Overall
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking		
1	60.0	2750	96.5	5	5	3	2	4	3	3	3	3	
2	61.0	3000	98.4	3	4	4	5	5	3	3	4	4	
3	64.0	1020	98.3	4	3	3	3	3	2	2	3	3	
4	65.0	3162	101.9	5	5	3	2	2	2	3	2	2	
5	66.3	3150	98.4	1	1	1	4	5	3	3	3	3	
6	63.0	2950	100.0	3	3	2	3	3	3	4	3	3	
7	64.2	1180	108.3	2	3	2	3	4	3	3	3	3	
8	67.9	975	97.5	3	5	1	2	4	3	2	4	4	
9	63.7	855	96.6	2	3	2	1	2	3	1	2	2	
10	68.0	890	86.1	1	3	2	1	5	3	1	1	2	
Average	64.3		98.2	2.9	3.5	2.3	2.6	3.7	2.8	2.5	2.8	2.9	
± 1 Std Dev	2.6		5.5	1.4	1.3	0.9	1.3	1.2	0.4	1.0	0.9	0.7	

Factors Compared to Glenn Check												
	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
Casselton - C3												
Cooperator												
1	59.0	2900	96.7	5	5	3	2	4	3	5	3	3
2	60.0	3000	107.1	4	3	3	3	4	2	3	3	3
3	63.0	985	92.9	3	3	2	3	3	2	4	2	2
4	63.0	2927	97.6	5	5	2	3	2	2	2	2	2
5	64.9	3175	112.4	3	3	3	5	5	2	3	4	4
6	62.0	2700	93.1	3	3	2	3	3	2	5	3	3
7	62.6	990	96.6	2	3	2	2	3	2	4	2	2
8	65.2	975	96.1	3	3	2	3	4	2	3	3	3
9	62.8	820	85.4	2	3	3	1	2	3	3	1	2
10	66.8	1002	99.2	3	3	2	3	3	2	5	2	3
Average	62.9	2700	97.7	3.3	3.4	2.4	2.8	3.3	2.2	3.7	2.5	2.7
± 1 Std Dev	2.3		7.5	1.1	0.8	0.5	1.0	0.9	0.4	1.1	0.8	0.7
Factors Compared to Glenn Check												
Crookston - K3												
Cooperator												
1	56.0	2800	96.6	3	2	1	2	5	1	4	1	1
2	61.5	2700	96.4	4	4	2	3	3	1	3	2	2
3	60.0	848	89.3	1	2	1	3	4	2	3	2	1
4	65.0	2986	96.2	2	2	2	2	2	1	3	2	2
5	66.6	2500	86.2	2	4	3	3	4	1	3	1	3
6	63.0	2250	83.3	1	1	1	1	1	1	4	1	1
7	63.9	895	94.2	3	3	1	1	4	1	3	2	1
8	65.3	765	85.0	4	4	2	3	2	2	2	2	2
9	64.4	765	87.4	2	3	2	1	2	1	2	1	1
10	66.7	814	91.6	2	3	1	3	4	1	2	1	1
Average	63.2	2500	90.6	2.4	2.8	1.6	2.2	3.1	1.2	2.9	1.5	1.5
± 1 Std Dev	3.3		5.1	1.1	1.0	0.7	0.9	1.3	0.4	0.7	0.5	0.7
Factors Compared to Glenn Check												
Minot - M3												
Cooperator												
1	60.0	2800	98.2	3	2	2	3	3	3	3	3	3
2	61.5	2950	96.7	4	3	3	4	4	2	4	4	4
3	63.0	1018	98.1	4	4	3	3	3	4	3	3	3
4	65.0	3045	98.1	4	5	2	3	2	2	3	2	2
5	66.4	3125	97.7	2	3	2	5	4	2	3	3	2
6	63.0	2900	98.3	3	3	2	3	4	2	3	3	3
7	63.5	1075	98.6	3	4	2	3	3	2	2	2	2
8	68.3	960	96.0	4	4	2	2	3	2	2	3	4
9	63.4	815	92.1	2	3	2	2	2	3	2	2	2
10	67.4	940	90.9	2	3	3	2	4	2	2	2	2
Average	64.2	2800	96.5	3.1	3.5	2.3	2.9	3.2	2.4	2.7	2.7	2.7
± 1 Std Dev	2.6		2.8	0.9	0.7	0.5	1.0	0.8	0.7	0.7	0.7	0.8
Factors Compared to Glenn Check												
Williston - W3												
Cooperator												
1	60.0	2800	98.2	5	5	3	3	3	3	3	3	3
2	60.5	2950	95.2	4	5	4	5	5	2	3	3	3
3	64.0	963	87.7	3	3	2	3	3	3	3	2	2
4	65.0	3162	100.0	5	5	3	4	4	1	2	4	3
5	65.5	3000	92.3	3	2	2	4	5	2	3	2	3
6	63.0	2700	93.1	4	4	4	4	3	2	5	2	5
7	64.4	995	81.2	3	3	2	2	2	1	2	2	2
8	72.7	945	83.3	4	4	3	3	2	2	2	2	2
9	64.2	875	84.5	2	3	2	1	3	2	3	2	2
10	68.1	925	82.0	2	3	2	2	5	2	3	1	2
Average	64.7	2800	89.8	3.5	3.7	2.7	3.1	3.5	2.0	2.9	2.3	2.7
± 1 Std Dev	3.6		6.9	1.1	1.1	0.8	1.2	1.2	0.7	0.9	0.8	0.9

Casselton -C4 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check						
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	60.0	3000	100.0	5	5	3	2	2	3	4	3	3
2	61.0	3050	108.9	3	3	4	4	4	3	2	4	4
3	64.0	1040	98.1	4	4	3	3	3	3	3	3	3
4	65.0	3104	103.5	5	5	3	2	3	3	2	3	3
5	66.2	3100	109.7	3	1	3	5	5	3	3	5	4
6	63.0	2750	94.8	3	3	2	3	3	3	4	3	3
7	64.3	990	96.6	2	2	2	2	3	3	3	2	2
8	66.9	985	97.0	3	5	2	2	4	2	2	4	4
9	64.2	825	85.9	2	3	3	1	2	3	2	1	2
10	68.1	1001	99.1	2	4	2	2	3	3	3	2	3
Average	64.3		99.4	3.2	3.5	2.7	2.6	3.2	2.9	2.8	3.0	3.1
± 1 Std Dev	2.5		6.9	1.1	1.4	0.7	1.2	0.9	0.3	0.8	1.2	0.7

Watertown - B5 Cooperator	Factors Compared to Glenn Check											
	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	60.0	2850	103.6	4	4	3	3	4	3	4	3	3
2	63.5	3350	117.5	3	3	2	4	4	2	3	3	5
3	64.0	992	96.0	3	3	2	3	3	3	3	2	2
4	66.0	3104	101.9	5	5	3	4	2	2	3	2	2
5	68.4	3000	97.6	2	4	2	5	4	3	4	3	3
6	64.0	2600	94.5	3	2	2	3	3	2	3	2	2
7	65.4	1075	103.9	3	3	2	2	3	2	4	2	2
8	66.0	1010	96.2	3	4	3	4	5	2	2	4	4
9	65.3	895	86.5	2	3	3	3	3	3	3	1	2
10	69.3	980	97.8	2	4	2	2	5	2	3	2	2
Average	65.2	2600	99.6	3.0	3.5	2.4	3.3	3.6	2.4	3.2	2.4	2.7
± 1 Std Dev	2.6		8.1	0.9	0.8	0.5	0.9	1.0	0.5	0.6	0.8	1.1

Casselton - C5 Cooperator	Factors Compared to Glenn Check											
	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	59.0	2850	95.0	3	3	2	3	4	3	4	4	4
2	61.0	3100	110.7	2	4	3	3	4	2	2	3	3
3	63.0	976	92.1	3	3	2	3	3	3	4	2	2
4	65.0	2986	99.5	5	5	3	2	3	2	3	2	2
5	65.7	2825	100.0	2	4	2	5	5	2	3	3	3
6	63.0	2600	89.7	2	3	2	3	2	2	4	3	3
7	63.4	1005	98.0	2	3	2	4	4	2	4	4	2
8	67.1	960	94.6	3	5	2	3	4	2	3	4	4
9	63.3	770	80.2	2	3	3	2	2	3	2	1	2
10	67.3	994	98.4	2	4	2	3	4	2	4	3	3
Average	63.8	2600	95.8	2.6	3.7	2.3	3.1	3.5	2.3	3.3	2.9	2.8
± 1 Std Dev	2.6		7.9	1.0	0.8	0.5	0.9	1.0	0.5	0.8	1.0	0.8

Crookston - K5 Cooperator	Factors Compared to Glenn Check											
	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	58.0	2800	96.6	2	3	2	2	5	3	4	4	3
2	61.5	2850	101.8	4	3	3	4	4	2	3	4	4
3	62.0	886	93.3	2	3	2	3	3	2	3	2	2
4	65.0	2986	96.2	5	5	3	2	3	1	4	2	2
5	66.5	2600	89.7	2	3	3	4	5	2	3	1	3
6	63.0	2750	101.9	2	3	2	2	2	2	4	2	2
7	63.6	845	88.9	3	4	3	3	3	2	4	3	2
8	69.8	845	93.9	4	4	2	3	4	2	2	2	4
9	64.2	725	82.9	2	3	3	1	2	2	2	2	2
10	67.4	772	86.8	2	4	3	3	4	2	4	1	2
Average	64.1	2600	93.2	2.8	3.5	2.6	2.7	3.5	2.0	3.3	2.3	2.6
± 1 Std Dev	3.3		6.2	1.1	0.7	0.5	0.9	1.1	0.5	0.8	1.1	0.8

Minot - M5 Cooperator	Factors Compared to Glenn Check											
	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	60.0	2750	96.5	5	5	3	3	4	3	3	3	3
2	59.5	3050	100.0	2	3	2	5	5	3	3	5	4
3	64.0	966	93.1	3	3	1	3	3	2	4	2	2
4	63.0	3104	100.0	5	5	3	4	2	3	3	3	3
5	65.0	3150	98.4	1	3	1	4	4	3	3	3	3
6	62.0	2900	98.3	2	2	2	3	4	3	4	3	3
7	62.8	1000	91.7	2	3	1	3	3	3	3	2	2
8	68.4	930	93.0	3	4	2	2	3	2	3	4	4
9	62.7	760	85.9	2	2	2	3	2	3	2	1	2
10	66.8	854	82.6	2	3	1	2	5	3	2	2	2
Average	63.4	2600	94.0	2.7	3.3	1.8	3.2	3.5	2.8	3.0	2.8	2.8
± 1 Std Dev	2.8		6.0	1.3	1.1	0.8	0.9	1.1	0.4	0.7	1.1	0.8

Minot - M6 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check						
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	58.0	2700	94.7	2	2	1	2	4	2	3	2	2
2	57.0	2700	88.5	4	2	4	4	3	1	2	3	3
3	61.0	922	88.8	2	2	2	3	3	2	2	2	2
4	60.0	2809	90.5	3	3	1	1	1	1	2	1	1
5	62.0	3200	100.0	1	4	1	4	3	1	3	3	2
6	60.0	2800	94.9	2	3	2	3	4	1	3	3	3
7	59.8	975	89.4	3	3	2	3	2	1	4	2	2
8	63.1	885	88.5	3	3	2	3	2	2	2	2	2
9	60.3	665	75.1	2	2	2	1	2	1	1	1	1
10	63.8	874	84.5	2	3	2	2	5	1	1	1	1
Average	60.5		89.5	2.4	2.7	1.9	2.6	2.9	1.3	2.3	2.0	1.9
± 1 Std Dev	2.1		6.7	0.8	0.7	0.9	1.1	1.2	0.5	0.9	0.8	0.7

Williston - W6 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check						
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	58.0	2800	98.2	5	5	3	2	3	2	3	3	3
2	55.0	2400	77.4	2	2	2	5	4	1	3	1	1
3	61.0	988	90.0	4	4	2	3	3	4	2	2	2
4	59.0	3015	95.4	5	5	3	3	3	1	3	2	2
5	59.9	3225	99.2	4	4	3	4	5	1	3	3	3
6	58.0	2800	96.6	5	4	4	3	3	1	3	3	4
7	58.3	900	73.5	4	4	4	3	2	1	3	2	2
8	71.7	860	75.8	5	2	4	2	2	2	2	2	2
9	59.1	800	77.3	3	2	2	3	3	1	1	1	1
10	62.2	883	78.3	5	2	3	4	5	1	1	1	1
Average	60.2		86.2	4.2	3.4	3.0	3.2	3.3	1.5	2.4	2.0	2.1
± 1 Std Dev	4.5		10.6	1.0	1.3	0.8	0.9	1.1	1.0	0.8	0.8	1.0

Casselton - C7 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check						
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	60.0	2900	96.7	2	2	2	3	4	3	3	2	2
2	62.5	3000	107.1	3	3	2	4	3	3	3	4	3
3	64.0	975	92.0	3	4	2	3	3	2	3	2	2
4	66.0	3044	101.5	5	5	3	3	3	3	3	3	3
5	67.7	2700	95.6	3	3	3	5	5	3	3	2	2
6	64.0	2600	89.7	3	3	2	3	3	3	3	3	3
7	65.5	1000	97.6	3	2	2	4	4	3	3	4	3
8	68.1	975	96.1	3	4	2	3	4	2	3	4	4
9	65.6	755	78.6	2	2	3	2	2	3	3	1	2
10	69.4	1027	101.7	2	4	2	3	4	3	2	3	3
Average	65.3		95.6	2.9	3.2	2.3	3.3	3.5	2.8	2.9	2.8	2.7
± 1 Std Dev	2.8		7.8	0.9	1.0	0.5	0.8	0.8	0.4	0.3	1.0	0.7

Crookston - K7 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check						
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	59.0	2800	96.6	2	3	2	3	4	3	4	4	3
2	65.0	2750	98.2	2	2	4	4	3	3	3	3	3
3	63.0	905	95.3	2	3	2	3	3	2	3	2	2
4	66.0	2883	92.9	4	4	2	3	2	2	4	2	2
5	70.3	2900	100.0	2	1	3	5	5	3	3	3	4
6	65.0	2550	94.4	1	2	2	2	2	3	3	2	2
7	67.6	810	85.3	3	3	2	3	3	3	2	2	2
8	69.3	900	100.0	3	4	2	2	4	2	2	2	4
9	67.3	705	80.6	1	2	3	2	2	3	2	2	2
10	71.6	812	91.3	1	3	2	3	3	3	2	1	2
Average	66.4		93.5	2.1	2.7	2.4	3.0	3.1	2.7	2.8	2.3	2.6
± 1 Std Dev	3.7		6.3	1.0	0.9	0.7	0.9	1.0	0.5	0.8	0.8	0.8

Williston - W7 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check						
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	60.0	2900	101.8	5	5	3	3	3	3	3	3	3
2	62.5	2850	91.9	3	4	2	5	4	2	3	2	3
3	64.0	973.0	88.6	4	3	2	3	3	4	1	2	2
4	66.0	3104	98.2	5	5	3	3	4	2	3	3	3
5	67.7	3150	96.9	3	3	2	4	4	2	3	3	3
6	64.0	2900	100.0	3	3	3	4	2	2	3	3	4
7	65.4	1060	86.5	3	3	1	4	2	1	2	2	2
8	70.7	975	85.9	4	4	2	3	2	2	2	2	2
9	64.9	845	81.6	2	4	2	3	3	2	2	1	2
10	69.5	868	77.0	2	4	2	3	4	2	1	1	1
Average	65.5		90.8	3.4	3.8	2.2	3.5	3.1	2.2	2.3	2.2	2.5
± 1 Std Dev	3.2		8.3	1.1	0.8	0.6	0.7	0.9	0.8	0.8	0.8	0.8

Watertown - B8 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check						
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	61.0	2700	98.2	1	1	1	1	1	3	4	1	1
2	60.5	3300	115.8	2	4	4	4	3	2	2	3	4
3	64.0	890	86.2	1	1	1	3	2	2	2	1	1
4	63.0	2603	85.5	1	1	1	1	1	2	2	1	1
5	65.9	3125	101.6	2	1	2	4	3	2	3	3	3
6	63.0	2700	98.2	2	1	2	3	3	3	4	3	3
7	63.2	960	92.8	2	1	1	2	3	2	4	1	2
8	63.4	935	89.0	2	2	2	3	4	2	2	2	2
9	62.7	850	82.1	2	2	2	2	3	3	2	1	2
10	67.0	962	96.0	1	3	1	2	4	2	2	1	2
Average	63.4		94.5	1.6	1.7	1.7	2.5	2.7	2.3	2.7	1.7	2.1
± 1 Std Dev	2.0		9.8	0.5	1.1	0.9	1.1	1.1	0.5	0.9	0.9	1.0

		Factors Compared to Glenn Check											
		Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &	Protein	Milling	Baking	Overall
Watertown - B10	Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture				
	1	61.0	2850	103.6	3	3	2	3	3	3	3	2	2
	2	66.0	3050	107.0	4	4	4	3	2	2	3	2	4
	3	64.0	995	96.3	5	3	3	3	4	4	3	3	3
	4	66.0	3162	103.8	5	5	3	3	2	2	3	2	2
	5	70.9	2975	96.7	3	2	3	3	3	2	3	3	3
	6	64.0	2600	94.5	3	2	2	3	3	3	3	3	3
	7	68.3	1115	107.7	3	3	2	2	2	2	3	2	2
	8	70.0	995	94.8	3	3	3	3	3	2	2	3	3
	9	68.2	820	79.2	2	3	3	2	4	3	3	1	2
	10	72.1	925	92.3	2	3	2	2	5	2	2	2	2
	Average	67.1		97.6	3.3	3.1	2.7	2.7	3.1	2.5	2.8	2.3	2.6
	± 1 Std Dev	3.5		8.5	1.1	0.9	0.7	0.5	1.0	0.7	0.4	0.7	0.7

		Factors Compared to Glenn Check											
		Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &	Protein	Milling	Baking	Overall
Casselton - C10	Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture				
	1	60.0	2800	93.3	5	5	3	3	5	3	3	3	3
	2	60.0	2650	94.6	3	4	2	2	2	3	3	1	2
	3	64.0	992	93.6	3	4	2	3	3	2	3	2	2
	4	63.0	3044	101.5	5	5	2	2	3	3	3	2	2
	5	65.1	3000	106.2	4	4	4	5	4	3	3	4	4
	6	62.0	2650	91.4	3	3	2	3	3	3	3	4	4
	7	62.5	1000	97.6	3	2	3	3	5	3	3	3	2
	8	68.5	985	97.0	4	3	3	4	4	2	3	4	4
	9	62.7	915	95.3	2	3	3	2	3	3	3	3	3
	10	66.6	936	92.7	3	4	3	2	4	3	3	2	2
	Average	63.4		96.3	3.5	3.7	2.7	2.9	3.6	2.8	3.0	2.8	2.8
	± 1 Std Dev	2.7		4.5	1.0	0.9	0.7	1.0	1.0	0.4	0.0	1.0	0.9

		Factors Compared to Glenn Check											
		Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &	Protein	Milling	Baking	Overall
Crookston - K10	Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture				
	1	59.0	2750	94.8	3	3	2	3	3	3	4	4	2
	2	62.0	2750	98.2	3	3	4	2	2	3	3	3	3
	3	63.0	932	98.1	3	3	3	3	3	3	2	3	3
	4	65.0	3104	100.0	5	5	3	2	2	2	4	3	3
	5	67.2	2950	101.7	3	1	4	4	4	3	3	3	4
	6	64.0	2325	86.1	3	3	4	3	2	3	4	1	1
	7	64.9	840	88.4	3	3	5	2	2	3	4	2	3
	8	72.3	900	100.0	4	4	3	3	2	4	4	4	3
	9	64.9	785	89.7	2	3	3	2	2	3	3	2	3
	10	68.8	888	99.9	3	4	4	3	3	3	4	3	3
	Average	65.1		95.7	3.2	3.2	3.5	2.7	2.5	3.0	3.5	2.8	2.8
	± 1 Std Dev	3.7		5.6	0.8	1.0	0.8	0.7	0.7	0.5	0.7	0.9	0.8

		Factors Compared to Glenn Check											
		Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &	Protein	Milling	Baking	Overall
Minot - M10	Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture				
	1	60.0	2750	96.5	3	3	2	2	3	3	2	3	3
	2	63.5	3050	100.0	3	4	4	2	2	3	3	2	3
	3	64.0	942	90.8	2	3	2	3	3	2	3	2	2
	4	66.0	3045	100.0	5	5	2	2	2	2	2	2	2
	5	68.4	3275	102.3	2	1	2	4	4	1	3	4	3
	6	65.0	2900	98.3	2	3	2	3	4	3	3	3	3
	7	66.1	1030	94.5	3	3	2	2	2	2	2	2	2
	8	68.1	940	94.0	3	5	2	2	3	2	3	3	3
	9	65.6	820	92.7	2	3	2	2	2	3	3	2	3
	10	70.3	908	87.8	2	3	2	2	4	2	3	3	3
	Average	65.7		95.7	2.7	3.3	2.2	2.4	2.9	2.3	2.7	2.6	2.7
	± 1 Std Dev	2.9		4.6	0.9	1.2	0.6	0.7	0.9	0.7	0.5	0.7	0.5

Minot - M11 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check						
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	60.0	2700	94.7	3	3	2	2	3	3	2	3	3
2	62.0	3250	106.6	4	2	3	4	3	3	3	3	3
3	64.0	983	94.7	3	2	2	3	3	2	4	2	2
4	65.0	3162	101.9	5	5	2	2	2	2	2	2	2
5	66.8	3025	94.5	2	3	2	5	4	1	3	2	3
6	64.0	2750	93.2	2	3	2	3	4	3	5	3	3
7	64.5	1135	104.1	3	3	2	3	3	2	2	3	2
8	66.3	975	97.5	3	5	2	3	4	2	2	4	4
9	64.5	780	88.1	2	3	2	2	2	3	3	1	2
10	68.3	900	87.0	2	3	2	3	3	2	3	3	2
Average	64.5		96.2	2.9	3.2	2.1	3.0	3.1	2.3	2.9	2.6	2.6
± 1 Std Dev	2.4		6.4	1.0	1.0	0.3	0.9	0.7	0.7	1.0	0.8	0.7

		Factors Compared to Glenn Check										
Casaseton - C12	Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &	Protein	Milling	Baking	Overall
Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture				
1	60.0	3100	103.3	3	3	2	3	3	3	5	4	4
2	61.5	2950	105.4	4	2	4	5	4	3	2	5	4
3	64.0	990	93.4	3	4	2	3	3	2	2	2	2
4	65.0	3074	102.5	5	5	3	3	2	3	3	2	2
5	66.7	2500	88.5	2	2	2	5	5	3	3	2	2
6	63.0	2850	98.3	2	3	2	3	3	3	5	3	na
7	64.4	1045	102.0	2	3	2	3	4	3	4	3	2
8	68.0	970	95.6	3	3	2	4	4	2	4	4	4
9	64.1	905	94.3	1	3	3	3	2	3	2	2	2
10	68.3	908	89.9	2	4	2	3	4	3	4	1	3
Average	64.5		97.3	2.7	3.2	2.4	3.5	3.4	2.8	3.4	2.8	2.8
± 1 Std Dev	2.7		5.9	1.2	0.9	0.7	0.8	1.0	0.4	1.2	1.2	1.0

		Factors Compared to Glenn Check										
Crookston - K12	Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &	Protein	Milling	Baking	Overall
Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture				
1	58.0	2900	100.0	3	3	2	4	5	2	5	4	3
2	62.0	2700	96.4	3	4	3	4	4	1	3	3	3
3	60.0	883	92.9	2	2	2	3	2	2	3	2	2
4	65.0	3104	100.0	5	5	3	3	3	1	3	2	2
5	67.0	2950	101.7	2	3	3	5	5	1	3	3	4
6	64.0	2200	81.5	2	2	3	3	2	1	5	1	1
7	64.4	860	90.5	3	3	3	4	3	1	5	2	2
8	69.5	835	92.8	4	4	2	4	4	2	4	4	4
9	64.4	810	92.6	2	3	3	3	2	2	3	3	3
10	68.1	825	92.8	2	4	3	4	3	1	5	2	3
Average	64.2		94.1	2.8	3.3	2.7	3.7	3.3	1.4	3.9	2.6	2.7
± 1 Std Dev	3.5		5.9	1.0	0.9	0.5	0.7	1.2	0.5	1.0	1.0	0.9

		Factors Compared to Glenn Check										
Minot - M12	Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &	Protein	Milling	Baking	Overall
Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture				
1	59.0	2775	97.4	3	2	2	3	3	3	4	3	3
2	62.0	3150	103.3	3	3	2	4	4	2	3	4	3
3	63.0	985.0	94.9	3	3	2	3	3	3	4	3	3
4	65.0	3104	100.0	5	5	3	4	2	2	4	2	2
5	66.7	3025	94.5	3	3	2	5	4	1	3	2	3
6	64.0	2800	94.9	2	3	2	3	4	2	5	3	3
7	64.7	1095	100.5	2	3	1	4	3	2	4	3	2
8	67.0	920	92.0	2	5	2	2	4	2	2	4	2
9	64.2	810	91.5	1	3	2	3	3	2	2	2	2
10	68.5	849	82.1	3	2	2	2	4	2	4	4	3
Average	64.4		95.1	2.7	3.2	2.0	3.3	3.4	2.1	3.5	3.0	2.6
± 1 Std Dev	2.7		5.9	1.1	1.0	0.5	0.9	0.7	0.6	1.0	0.8	0.5

		Factors Compared to Glenn Check										
Williston - W12	Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &	Protein	Milling	Baking	Overall
Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture				
1	61.0	2975	104.4	5	5	3	3	3	3	4	3	3
2	60.5	2900	93.5	2	3	4	5	4	2	3	2	3
3	64.0	1092	99.5	5	4	3	3	3	3	3	3	3
4	62.0	3162	100.0	5	5	3	4	4	2	4	4	3
5	65.5	3275	100.8	3	4	2	5	5	2	3	3	3
6	62.0	2950	101.7	4	4	4	4	3	3	4	3	4
7	63.4	1075	87.8	3	2	2	4	3	2	4	2	2
8	71.7	1030	90.7	4	4	4	3	3	2	2	3	3
9	63.4	1000	96.6	2	4	2	4	4	3	2	3	3
10	67.4	1057	93.7	3	4	2	5	4	2	4	3	3
Average	64.1		96.9	3.6	3.9	2.9	4.0	3.6	2.4	3.3	2.9	3.0
± 1 Std Dev	3.4		5.3	1.2	0.9	0.9	0.8	0.7	0.5	0.8	0.6	0.5

Watertown - B13 Cooperator	Factors Compared to Glenn Check											
	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	61.0	2650	96.4	2	1	1	1	1	3	4	1	1
2	65.0	3000	105.3	4	4	3	3	3	3	3	2	4
3	64.0	990	95.8	2	2	2	3	3	3	3	2	2
4	66.0	2927	96.1	4	3	2	3	1	3	3	2	2
5	70.0	3200	104.1	3	1	3	4	4	3	3	4	3
6	65.0	2625	95.5	3	2	2	3	3	3	3	2	3
7	67.7	1055	101.9	2	2	2	2	3	3	4	2	3
8	71.2	1015	96.7	2	3	2	3	5	3	2	5	4
9	67.2	905	87.4	2	3	3	2	3	3	3	2	3
10	71.9	952	95.0	2	3	2	2	5	3	2	2	2
Average	66.9		97.4	2.6	2.4	2.2	2.6	3.1	3.0	3.0	2.4	2.7
± 1 Std Dev	3.4		5.2	0.8	1.0	0.6	0.8	1.4	0.0	0.7	1.2	0.9

Williston - W14 Cooperator	Factors Compared to Glenn Check											
	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	62.0	2975	104.4	5	5	3	3	3	3	4	3	3
2	60.0	3450	111.3	3	4	3	4	4	3	3	5	5
3	64.0	1120	102.0	5	5	4	3	3	3	3	4	4
4	63.0	3104	98.2	5	5	3	4	3	2	4	3	3
5	65.2	3125	96.2	4	4	3	5	5	3	3	3	3
6	62.0	2950	101.7	5	4	4	4	3	3	4	3	4
7	62.7	1100	89.8	3	3	4	4	2	2	4	2	3
8	72.7	1110	97.8	5	4	4	2	2	3	2	3	3
9	62.9	1015	98.1	2	4	2	4	4	3	3	3	3
10	66.7	1068	94.7	3	3	3	3	3	3	3	2	3
Average	64.1		99.4	4.0	4.1	3.3	3.6	3.2	2.8	3.3	3.1	3.4
± 1 Std Dev	3.5		5.9	1.2	0.7	0.7	0.8	0.9	0.4	0.7	0.9	0.7

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Source of Wheat

<u>Source – Breeding Program</u>	<u>Code#</u>	<u>Identification</u>
WWW	1	A
AgriPro	2	01S0263-2B
North Dakota State University	3	ND811
Westbred	4	CA905-776
South Dakota State University	5	SD3948
WWW	6	B
North Dakota State University	7	ND810
Westbred	8	CA905-780
University Minnesota	10	MN03196
Westbred	11	BZ903-504
Norrth Dakota State University	12	ND808
South Dakota State University	13	SD4011
Westbred	14	CA905-781
North Dakota State University	9	Glenn Check

Field Plot Locations and Procedures

The experimental lines and Glenn check cultivar were grown at the following locations in the spring wheat region:

South Dakota State University, Watertown, SD – Jack Ingmanson
 Northwest Experiment Station, Crookston, MN – John Wiersma
 Agronomy Seed Farm, Casselton, ND – Tom Teigen
 North Central Agricultural Experiment Station, Minot, ND – Jay Fisher
 Williston Agricultural Experiment Station, Williston, ND

Wheat was seeded in large-scale plots of ½ acre in size to approximate commercial production. Cultural practices such as tillage and weed control common to each area were used. Consideration was also given to germination, seed size, and planting depth to provide stand uniformity. Based on soil test results from each location, nitrogen fertilizer was applied to the test plots at rates approaching higher levels than used commercially to more fully express the potential of each experimental line. Levels of phosphorus and potassium were applied in sufficient amounts so as not to be limiting factors. Each plot was individually harvested and the grain produced was thoroughly blended to obtain a uniform sample representing the entire plot.

2009 Hard Spring Wheat Production Sites

Entry #	Entry	Reference	Watertn	Cassel	Crooks	Minot	Willis
1	A	WWW				X	X
2	01S0263-28	AgriPro	X	X		X	
3	ND811	NDSU		X	X	X	X
4	CA905-776	Westbred		X			
5	SD3948	SDSU	X	X	X	X	
6	B	WWW				X	X
7	ND810	NDSU		X	X	X	X
8	CA905-780	Westbred	X				
9	Glenn	Check	X	X	X	X	X
10	MN03196	Un of MN	X	X	X	X	
11	BZ903-504	Westbred				X	
12	ND808	NDSU		X	X	X	X
13	SD4011	SDSU	X				
14	CA905-781	Westbred					X

Description of 2009 Hard Spring Wheat Lines (unedited)

A (SWQAC 1)

ARGBR1347 is a hard red spring wheat, developed by World Wide Wheat LLC (W3), using male sterile facilitated recurrent selection (MSFRS) population breeding methodology. It originated as a single F2 head selection out of W3's Argentinean nursery in 2003. Single head selection continued through the F5 generation. ARGBR1347 has been tested in replicated yield trials since 2005 at several W3 global locations with much success. The line possesses a high-yielding potential under adequate moisture conditions. It is resistant to stripe rust, and found to be adapted to Arizona, California and Argentinean environments.

01S0263-28 (SWQAC 2)

01S0263-28 is a hard red spring wheat developed by Syngenta Cereals. At this time, it is undergoing increase for release to Associates in 2011 with certified seed available for growers in the 2012 season. Its pedigree is "Norpro/Kelby". It has medium maturity and very good test weight. It is a short semidwarf, slightly taller than Kelby. Straw strength is very good, between Kelby and Kuntz. It is resistant to stem rust and moderately resistant to leaf rust. Protection to foliar diseases has been very good. Tolerance to FHB has been intermediate. Protein levels have been high, slightly lower than Kelby. 01S0263-28 is broadly adapted for the spring wheat growing areas of the Northern Plains.

ND811 (SWQAC 3)

ND811 is a hard red spring wheat (HRSW) wheat line selected from the DAPPS/2*REEDER cross. Dapps and Reeder are two HRSW cultivars released by NDSU. Dapps is an excellent quality cultivars and Reeder is well adapted to ND western regions and MT dry environments. ND811 is widely adapted to ND environments. It has an excellent performance, particularly in western region where Reeder is commonly grown. Overall, ND811 has a high grain yield, higher than most grown cultivars, particularly in the Western region. It is a semi-dwarf line and medium late (similar to Faller) and has a medium to strong straw strength similar to Alsen and Glenn. The protein level of ND811 is medium, similar to Reeder. ND811 has an average to good milling and baking properties similar to Reeder. Similarly, the test weight of ND811 is similar to Reeder. Overall ND811 has a good leaf diseases package and is medium susceptible to scab similar.

CA905-776 (SWQAC 4)

WB-Gary (Express/Knudson) is a good standing, medium height, later maturing version of high-yielding Samson. It will outyield Samson in long season environments under intense management. WB-Gary is resistant to stem rust, moderately resistant to moderately susceptible to leaf rust and susceptible to

stripe rust. It is moderately resistant to moderately susceptible to foliar disease (tan spot and Septoria) and susceptible to Fusarium head blight. WB-Gary has medium protein and test weight with an average SDS Sedimentation value of 118 mm.

SD3948 (SWQAC 5)

SD3948 ((Briggs/FN1500-118) is an experimental hard red spring wheat breeding line developed by the South Dakota Agricultural Experiment Station. It was originally derived as a single plant from within an F₄ plant population created in fall 2000. SD3948 was tested within South Dakota State University Preliminary Yield Trials (2005) and Advanced Yield Trials (AYT) from 2006 through 2009. It was also tested in the Uniform Regional Spring Wheat Nursery (URN) during 2007 and 2008 as well as the South Dakota Crop Performance Testing (CPT) trials in 2007 through 2009. In addition, SD3948 was evaluated by the Wheat Quality Council in 2009. Pending approval of the SDSU Variety Review and Release Committee, SD3948 should be made available to Registered seed producers in spring 2010. Coverage under the United States Plant Variety Protection Act will be sought.

Points of note associated with SD3948 include:

- 1 Good yield potential
- 2 High test weight
- 3 Adequate grain protein concentration
- 4 Early heading date
- 5 A good level of Fusarium Head Blight (FHB) resistance
- 6 Resistant to moderately resistant ratings for both leaf and stem rust

B (SWQAC 6)

CHBRW3-269 is a hard red spring wheat, developed by World Wide Wheat LLC (W3), using male sterile facilitated recurrent selection (MSFRS) population breeding methodology. It originated as a single F₂ head selection out of W3's Chilean nursery in 2002. Single head selection continued through the F₄ generation. CHBRW3-269 has been tested in replicated yield trials since 2004 at several W3 global locations with much success. The line possesses a high-yielding potential under adequate moisture conditions. It is resistant to stripe rust, and found to be adapted to Arizona, California, Chilean and Argentinean environments.

ND810 (SWQAC 7)

ND810 is a hard red spring wheat (HRSW) wheat line selected from the PARSHALL/3/GR*2/RL4137//AMIDON cross. Parshall and Amidon are HRSW cultivars released by NDSU. Previous to the release of Glenn, Parshall was the WQC quality check for the spring wheat for many years. ND810 is adapted to most ND. However, it is recommended to western region where Reeder is grown.

Overall, ND810 has high grain yield, better than most grown cultivars, particularly in the Western region. It is a conventional line (height); medium early (similar to Steele-ND and Alsen) and has medium to strong straw strength similar to Alsen. Protein of ND810 is very good similar to Steele-ND with good overall milling properties, particularly under western regions. Baking properties of ND810 is similar to Howard with average test weight similar to Alsen. ND810 has a good leaf diseases package with medium susceptible/Medium resistant to scab similar (similar to Steele-ND) and highly resistant to leaf and stem rusts.

CA905-780 (SWQAC 8)

Brogan (Granite/Briggs) is a shorter (4-6 inches), better standing version of the outstanding South Dakota State University variety Briggs. In most other respects it is very similar to Briggs. However, Brogan is 2 – 3 days later to head and appears to be more susceptible to bacterial blight than Briggs. Brogan has been among the yield leaders in our trials for the last three years. Brogan is moderately resistant to leaf rust, resistant to stem rust and moderately susceptible to stripe rust. It is moderately resistant to foliar disease (tan spot and Septoria) and moderately susceptible to susceptible to Fusarium head blight. Brogan has medium high test weight and protein like Briggs with an average SDS Sedimentation value of 106 mm.

MN03196 (SWQAC 10)

MN03196 is a mid maturity hard red spring wheat with good straw strength, grain yields and moderate scab resistance. The pedigree of MN03196 is Alsen-1//Parshall/MN97665. MN03196 has been a consistently high yielder in Minnesota and the hard red spring wheat region, performing well in the 2007 and 2008 regional performance nurseries. Grain protein is average compared to other cultivars, but test weight is above average. MN03196 is resistant to pre-harvest sprouting based on our simulated rainfall testing. MN03196 is resistant to stem rust and prevalent races of leaf rust. MN03196 has moderate resistance to Fusarium head blight (scab), comparable to 'RB07'.

BZ903-504 (SWQAC 11)

WB-Digger (Reeder/Zeke) is a good standing, medium-early maturity, medium height, medium protein, stay-green, management wheat. WB-Digger appears to out-yield high-yielding Samson in environments where the extra height and stay-green is an advantage. WB-Digger is a complement to Samson not a replacement. WB-Digger is moderately resistant to moderately susceptible to leaf rust, stripe rust, stem rust and foliar disease (tan spot and Septoria) and is susceptible to Fusarium head blight. WB-Digger has medium protein and test weight with an average SDS sedimentation value of 109 mm.

ND808 (SWQAC 12)

SD4011 (SWQAC 13)

SD4011 (Briggs/SD3618) is an experimental hard red spring wheat breeding line developed by the South Dakota Agricultural Experiment Station. It was originally derived as a single plant from within an F₄ plant population created in fall 2001. SD4011 was tested within South Dakota State University Preliminary Yield Trials (2006) and Advanced Yield Trials (AYT) from 2007 through 2009. SD4011 was evaluated for the first time by the Wheat Quality Council in 2009 and will likely be submitted for consideration again in 2010. Pending approval of the SDSU Variety Review and Release Committee, SD4011 could be made available to Registered seed producers in spring 2011. Coverage under the United States Plant Variety Protection Act will be sought.

Points of note associated with SD4011 include:

- 1 Good yield potential
- 2 High grain protein concentration
- 3 Short plant stature
- 4 Resistant to moderately resistant ratings for both leaf and stem rust

CA905-781 (SWQAC 14)

Edge (Hank/Knudson) is a management wheat marketed exclusively by Sabre Seeds. Edge is a good standing, medium-early maturity, medium height, high yielding, fast-drying wheat that is great to straight combine. Edge is susceptible to leaf rust, moderately resistant to stem rust and moderately susceptible to stripe rust. It is susceptible to foliar disease (tan spot and Septoria) and Fusarium head blight. Edge has medium to medium-high test weight and protein with an average SDS Sedimentation value of 116 mm

Grain Cleaning and Milling Procedures

Wheat (approximately 6 bu/variety) was cleaned in a Carter-Day Bulldog seed cleaner that was equipped with two rotating indent cylinders (#24 – coarse and #16 fine), a sizer cylinder (#5), vibrator, and air aspiration. Sixty pounds of cleaned wheat was tempered to 16.5% moisture basis and conditioned 16-18 hours. The tempered wheat was milled in a Buhler Experimental Mill, MLU, at adjusted feed rates between 69 g/min and 125 g/min. Flour from three break (B1, B2, B3) and three reduction (R1, R2, R3) sections of the mill were combined to straight grade flour.

Mill Time for 60 lbs Tempered Wheat				Feed Rate
Watertown	ID#	Minutes	Hours	g/min
MN03196	10	236	3.93	116
SD3948	5	247	4.12	110
01S0263-28	2	256	4.27	107
Glenn	9	258	4.30	106
SD4011	13	268	4.47	102
CA905-780	8	317	5.28	86
Casselton				
Glenn	9	222	3.70	123
ND810	7	239	3.98	114
MN03196	10	240	4.00	114
SD3948	5	254	4.23	107
ND808	12	269	4.48	101
CA905-776	4	291	4.85	94
ND811	3	314	5.23	87
01S0263-28	2	320	5.33	85
Crookston				
Glenn	9	226	3.77	121
ND810	7	233	3.88	117
MN03196	10	236	3.93	116
SD3948	5	247	4.12	110
ND808	12	260	4.33	105
ND811	3	307	5.12	89
Minot				
Glenn	9	233	3.88	117
MN03196	10	236	3.93	116
SD3948	5	241	4.02	113
BZ903-504	11	251	4.18	109
ND808	12	262	4.37	104
01S0263-28	2	318	5.30	86
ND811	3	321	5.35	85
B	6	325	5.42	84
A	1	393	6.55	69
Williston				
Glenn	9	218	3.63	125
ND810	7	264	4.40	103
ND808	12	269	4.48	101
CA905-781	14	275	4.58	99
A	1	304	5.07	90
B	6	329	5.48	83
ND811	3	342	5.70	80

The table illustrates the time and feed rate to mill 60 lbs of tempered wheat in the hard spring wheat configured Buhler mill. For each sample, feed rates were set to reduce caking of flour in the break and reduction sections and to maximize overall sieve efficiency. Low feed rates indicate poor milling efficiency of the sample.

Methods of Analyses

Wheat Market Value Score

Test Weight (AACC Method 55-10)

Wheat and Flour Protein (AACC46-30 – combustion method)

Wheat and Flour Ash (AACC Method 08-01)

Single Kernel Characterization System (hardness index)

Kernel Size (Sieving according to USDA/ARS WQL)

Wheat Falling Number (Perten Falling Number Instrument)

Vitreous Kernel Content (DHV analyses by FGIS grain testing service)

Flour Color (Minolta Colorimeter L* b* values)

Flour Extraction: % Total Product Basis (TPB), % Tempered Wheat Basis (TWB), and estimated Pounds of Straight Grade Flour/Bushel Wheat.

Farinograph

Water Absorption (Brabender Computerized Farinograph w/50 g bowl) – 14%mb and 500 bu.

Arrival Time: time required for the top of the curve to reach the 500 BU line after addition of water.

Peak Time: time between addition of water and development of the maximum consistency of the dough

Stability: difference in time between the point at which the top of the curve first intercepts the 500 BU line (arrival time) and the point at which the top of the curve leaves the 500 BU line (departure time).

Mechanical Tolerance Index (MTI): difference in BU between the top of the curve at the peak and the top of the curve measured 5 min after the peak is reached.

Time to Breakdown (TTB): time from the start of mixing to the time at which consistency has decreased 30 BU from the peak point.

Mixograph

Bake Cooperator Results/Evaluation:

Bake Absorption (Actual - %)

Loaf Volume (% of Check)
 Mixing Requirement
 Dough Characteristics
 Mixing Tolerance
 Internal Crumb Color
 Internal Crumb Grain and Texture

Bake Cooperator Quality Assessment:
 Protein Content
 Milling
 Baking
 Overall Comparison

Test Bake Procedures

Samples of flour were shipped to the following cooperators for evaluation of baking properties. The flour had been uniformly malted to a falling number of approximately 250 sec. Bleach was not added to the flour. Each cooperator test baked the flour according to their standard method using either straight dough, sponge and dough, or other test bake method. Cooperator data were returned to the WQL for compilation of results.

Bake Cooperators

ADM Milling	Olathe, Kansas
Bay State Milling Company	Winona, Minnesota
Cargill (Horizon Milling)	Minnetonka, Minnesota
Cereal Food Processors, Inc.	Wichita, Kansas
General Mills, Inc	Minneapolis, Minnesota
Wheat Marketing Center	Portland, Oregon
North Dakota State Mill	Grand Forks, North Dakota
North Dakota State University	
Department of Cereal Science	Fargo, North Dakota
USDA/ARS Grain Marketing &	
Production Research Center	Manhattan, Kansas
USDA/ARS Hard Red Spring & Durum	
Wheat Quality Laboratory	Fargo, North Dakota

2009 Spring Wheat Field Production Data

Notes on production as relates to climatic conditions, disease (scab etc.) that could affect grain quality.

	Watertown	Casselton	Crookston	Minot	Williston
At Planting	The plots were planted in cool moist soils with good seed to soil contact.	Conditions at planting were near normal although it was much colder than normal conditions at the end of May. Soil moisture was adequate and emergence was completed by June 2nd.	The 2009 Spring Wheat Quality Trial was planted into some of our lighter soil. The soil conditions were moist at planting and made for an excellent seed bed.	The Minot area experienced near record snowfall over the 08/09 winter. This led to a late start on planting of all crops in the area. At planting we had good conditions for germination and early plant growth. Soil conditions were cool and wet, with	Ideal soil conditions at planting. Good moisture.
During Growth	Extremely high winds in early leaf stages.	Growth was near normal but somewhat slower than normal due to below normal temperatures. The growing season temperatures were about 4 degrees below average. Good supplies of subsoil moisture made up for rainfall shortage during July which was	Unusually cool growing season for the 2009 wheat crop.	Our whole growing season was conducive to growing cereal crops. We had adequate moisture and cool conditions all summer. The plants were not stressed during growth. Weed control was done in a timely fashion, thus the	We became dry after seeding. The plants were stressed. Some tillers burnt off due to the lack of moisture
At Flowering	Frequent rains during flowering causing moderate head scab in area fields.	Cool and relatively dry mornings were the norm. Light to no morning dews were the norms, hence the decision to not apply fungicide.	Bacterial leaf stripe was observed.	Cool conditions and no shortage of soil moisture made for good conditions for the wheat plants. There was no hot weather during flowering, this led to good seed set. It should be noted that with the cool	Cooler temperatures. Adequate moisture. The crop needed more heat units.
During Maturation	Multiple showers after physiological maturity reducing color and test weight.	Warmer than normal monthly temp and higher than average rainfall slowed maturation. (The actual weather conditions for this period of plant development were probably not warm by relative conditions since the growing season was about a month later than normal.)	Because of the cool temperatures, ripening was a slow process.	Our cool wet conditions continued through harvest. This did lead to some harvest difficulties with the trial receiving some rain on the mature grain. There was some seed bleaching, but no sprout issues.	Cooler temperatures. Dry conditions.
At Harvest	Dry at harvest.	This late in the season we lacked the good drying days to get the grain moisture down to a good level. Therefore the harvest was undertaken at approximately 15% moisture.	There were no problems at harvest other than waiting till the crop matured.	Once the material dried from the rains we experienced there were no other harvest difficulties. The avg harvest moisture was 12.5 %.	Dry and cooler conditions.

Location					
Variable	Watertown	Casselton	Crookston	Minot	Williston
Planting Date	4/28/2009	5/24/2009	5/8/2009	6/2/2009	5/19/2009
Harvest Date	8/27/2009	9/21/2009	9/3/2009	9/29/2009	9/9/2009
Fertilizer (lb/A)					
N	162	155	17 + 126	150 lbs Urea	100 lb/ac
P	140	25	14	30 lbs 11-52-0	0
K	360	0	286	-	0
Herbicide/rate					
Broadleaf	Bronate Ultra/ 1.2 Pt.,6/1/09	.8 pt Bison Advanced	Bronate/1 pt/A	12oz/ac. Huskie/.2oz Harmony GT	Bronate/1 pt/A
Grass	-	.5 pt Puma	Puma/1/2 pt/A	.66 pt Puma	.5 pt Puma
Fungicide	Folicur/4 oz., 7/1/09	none	-	3 oz. Headline at Herb app.	-

Climatologic Data					
Month	Average Temperature (⁰ F)/Precipitation (in)				
	Watertown	Casselton	Crookston	Minot	Williston
April	-	33.6 /1.15	41.0/0.88	47.3/1.12	42/1.55
May	55/1.55	53 /1.77	51.7/2.50	63.35/1.51	54/0.61
June	63/2.98	63.5 /2.65	62.6/4.55	71.8/1.97	62/1.49
July	66/3.78	67 /1.26	65.3/3.43	74.9/1.52	66/2.55
August	66.5/3.07	65.7/2.72	64.4/3.2	75.7/1.8	66/0.27
September	-	64/ 2.35	-	76.0/3.95	-

Yield Data					
Cultivar	Yield (bu/acre) / Test Wt / % Moisture				
	Watertown	Casselton	Crookston	Minot	Williston
SWQAC 1	*	*	*	**	**
SWQAC 2	51.8/59.5/12.7	57.5/**/**	*	**	*
SWQAC 3	*	62.8/**/**	52/60/14.93	**	**
SWQAC 4	*	66.4/**/**	*	*	*
SWQAC 5	60.6/60.3/12.9	68/**/**	60/61/15.34	**	*
SWQAC 6	*	*	*	**	**
SWQAC 7	*	58/**/**	63/60/14.52	**	**
SWQAC 8	33.8/58.3/12.5	*	*	*	*
SWQAC 9	45.2/59.9/12.7	53/**/**	57/61/14.93	**	**
SWQAC 10	44.3/60.1/12.9	61.7/**/**	60/62/15.13	**	*
SWQAC 11	*	*	*	**	*
SWQAC 12	*	53.8/**/**	66/61/14.52	**	**
SWQAC 13	42.6/57.6/12.5	*	*	*	*
SWQAC 14	*	*	*	*	**

* Not Increased at this site ** = No data available

Wheat Marketing Score

The development of a Wheat Marketing Score (WMS) or Export Marketing Score was discussed at the Hard Spring Wheat planning meeting in March, 2004. The purpose for developing a WMS was to facilitate a better understanding of wheat quality in marketing systems. Two WMS methods were developed and tested. For each method, the quality variables of TW, 1000 KWT, FN, Wheat Protein, and Wheat Ash were incorporated for calculating the WMS. Method #1 was developed on a scale of 0 to 6 where the Glenn Check was evaluated along with the experimental lines for each growing location. Method #2 was developed on a scale of 0 to 10 where the experimental lines were evaluated against the Glenn Check for each growing location.

Wheat Marketing Score – Method #1

WHEAT MARKETING SCORE or EXPORT MARKETING SCORE

	Test Weight	1000 KWT	Falling Number	Wheat Protein	Wheat Ash	
Variation(+/-) from Target Value:	1lb/bu	3 g up, 4 g down	25 sec	1.0%	0.1%	
SCORE						
6	63 lb/bu	39 g	425 sec	16.5%	1.35%	
5	62 lb/bu	36 g	400 sec	15.5%	1.45%	
4	61 lb/bu	33g	375 sec	14.5%	1.55%	
TARGET VALUE:	3	60 lb/bu	30 g	350 sec	13.5%	1.65%
2	59 lb/bu	26 g	325 sec	12.5%	1.75%	
1	58 lb/bu	22 g	300 sec	11.5%	1.85%	
0	57 lb/bu	18 g	275 sec	10.5%	1.95%	

$$\text{Wheat Marketing Score} = (\text{TW} \times 2) + (1000\text{KWT} \times 2) + (\text{FN} \times 2) + (\text{Protein} \times 3) + (\text{Ash} \times 1) / 10$$

Wheat Marketing Score – Method #

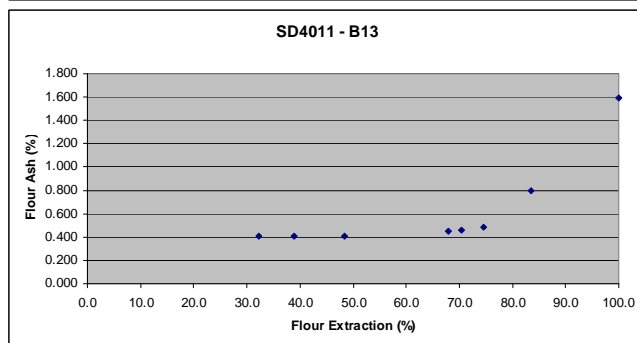
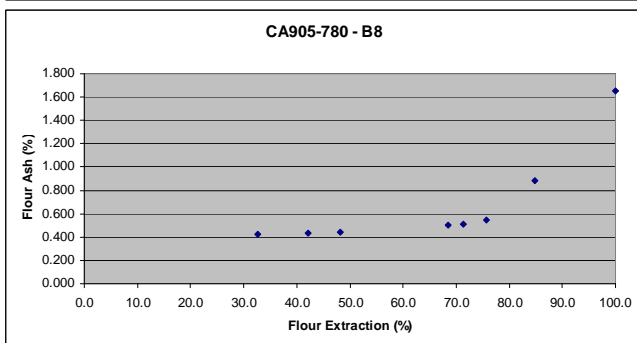
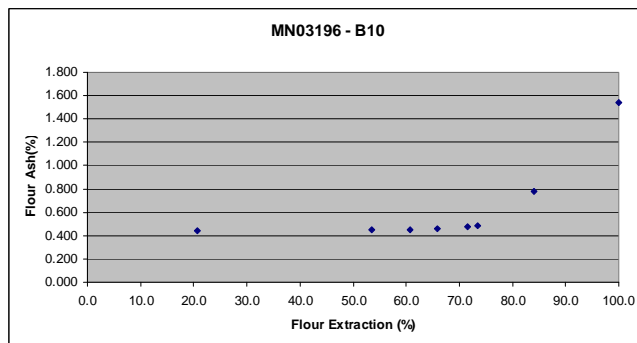
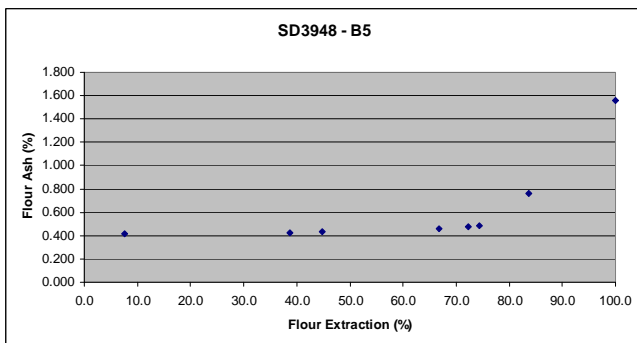
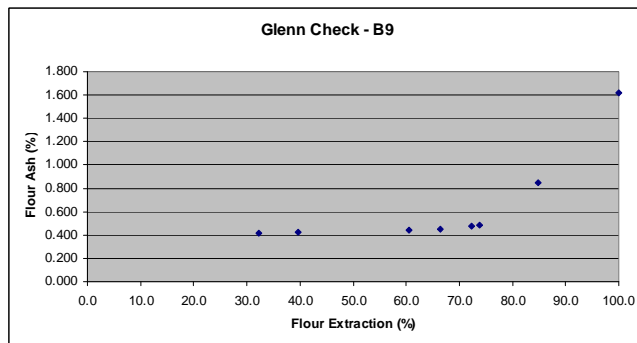
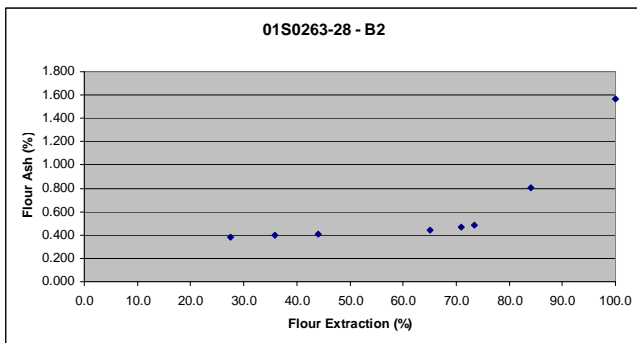
Rules for Score Calculation

Weight of each Factor	Weighting
Protein	0.3
Test Weight (TW)	0.2
Falling Number	0.2
Thousand Kernel Weight (TKW)	0.2
Wheat Ash	0.1

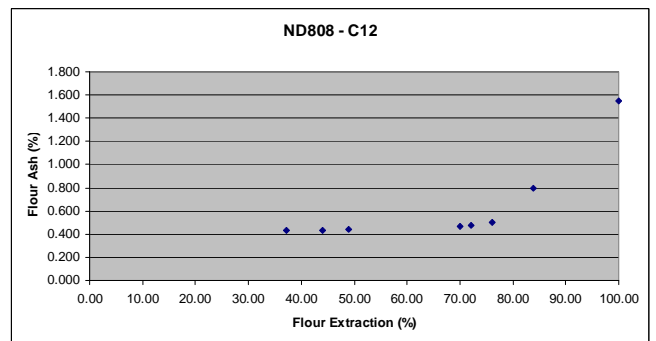
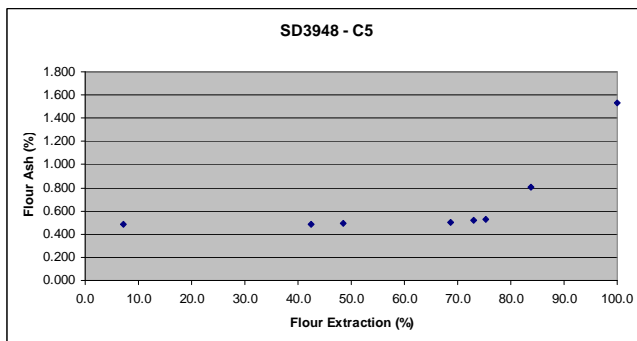
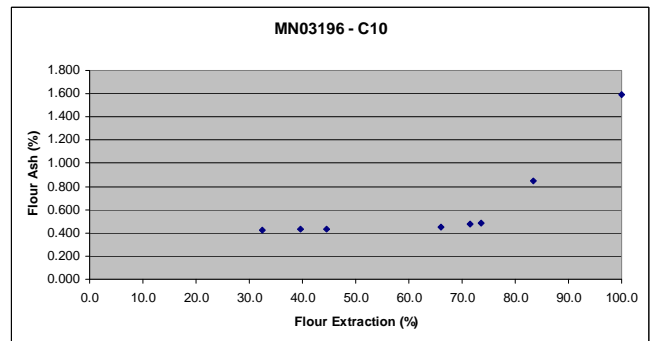
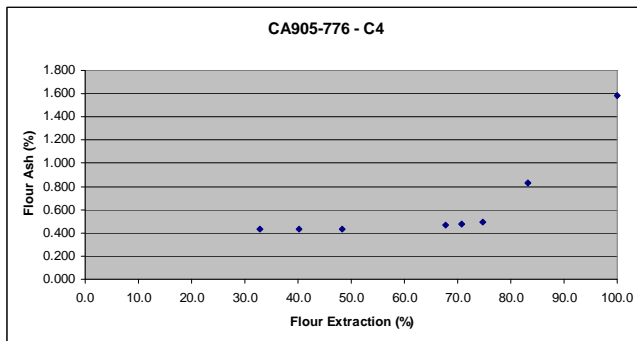
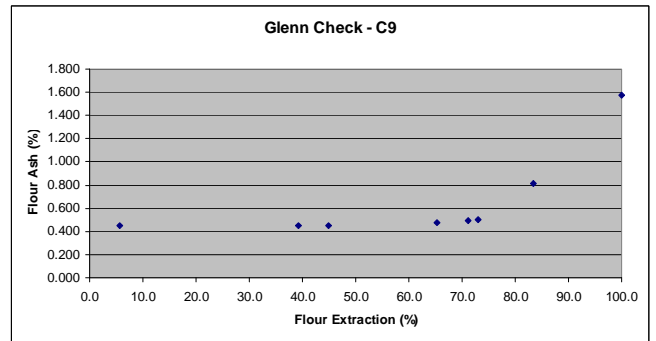
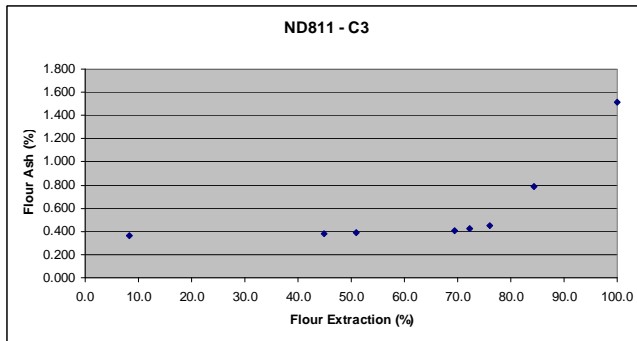
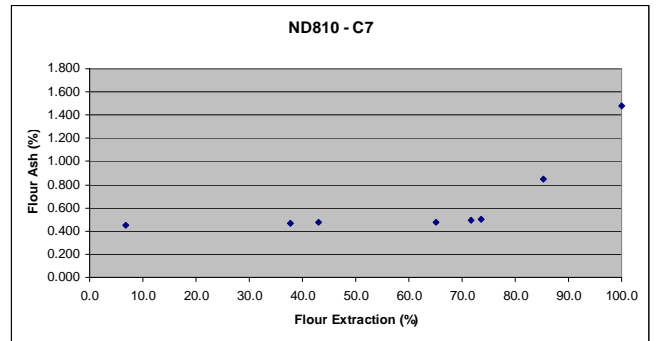
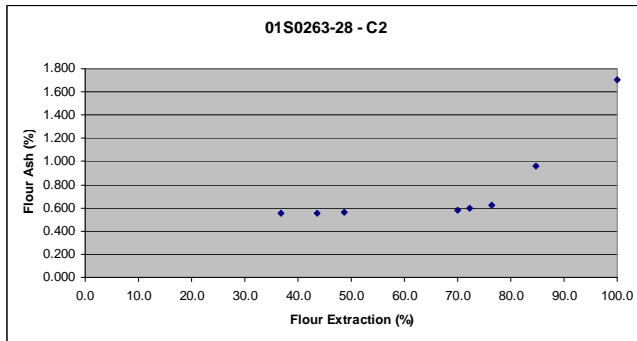
Component Score	Entered Line minus Check value equals difference (Diff)				
	0	2	4	6	8
Protein	Diff<-2.5	-2.501<Diff<-2	-2.001<Diff<-1.5	-1.501<Diff<-1	-1.001<Diff<-0.5
TestWeight	Diff<-5	-5.001<Diff<-4	-4.001<Diff<-3	-3.001<Diff<-2	-2.001<Diff<-1
Falling Number	Diff<-125	-125.01<Diff<-100	-100.01<Diff<75	-75.01<Diff<50	-50.01<Diff<-25
Thousand Kernel Weight	Diff<-10	-10.001<Diff<-8	-8.001<Diff<-6	-6.001<Diff<-4	-4.001<Diff<-2
Wheat Ash					

Component Score	10	8	6	4	2	0
Protein	-0.501<Di 2<Diff<3.001		3<Diff<4.001	4<Diff<5.001	5<Diff<6.001	Diff>6
TestWeight	-1.001<Di 2<Diff<4.001		4<Diff<6.001	6<Diff<8.001	8<Diff<10.001	Diff>10
Falling Number	-25.01<Diff					
Thousand Kernel Weight	-2.001<Di 4<Diff<8.001		8<Diff<12.001	12<Diff<16.001	16<Diff<20.001	Diff>20
Wheat Ash	Diff<0.1010.1<Diff<0.201		0.2<Diff<0.301	0.3<Diff<0.401	0.4<Diff<0.501	Diff>0.5

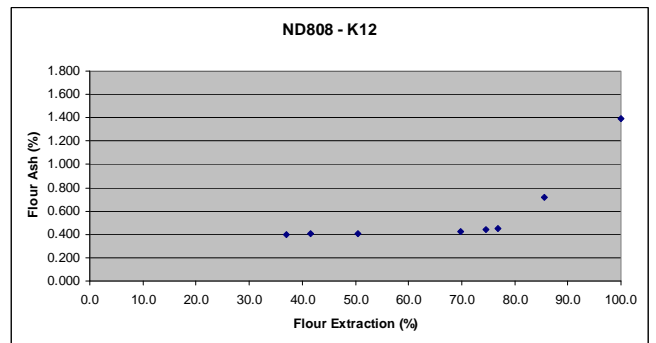
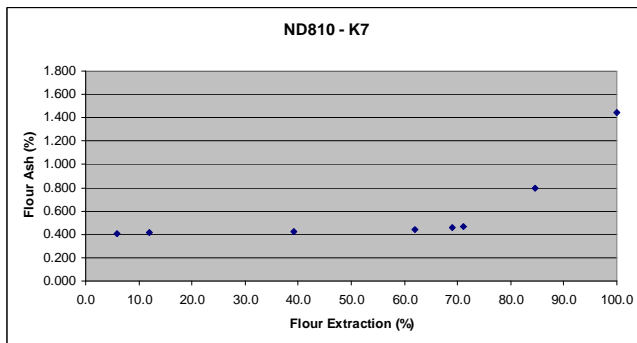
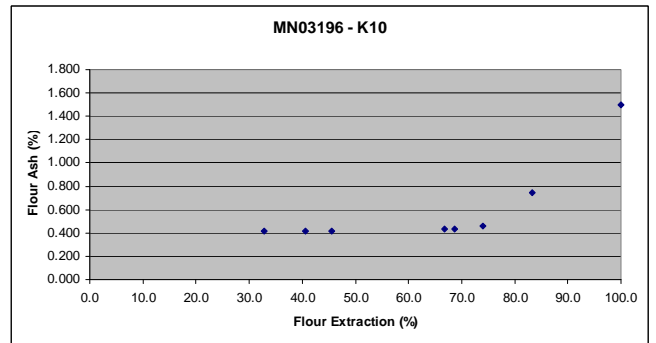
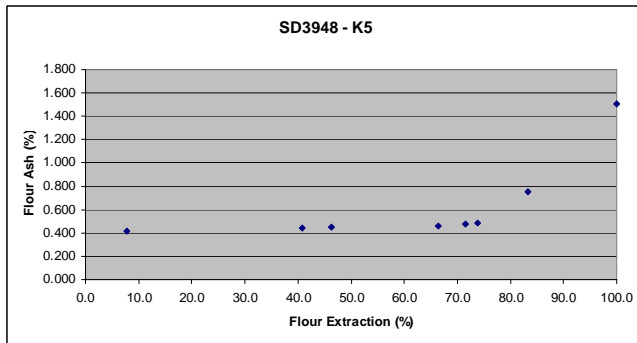
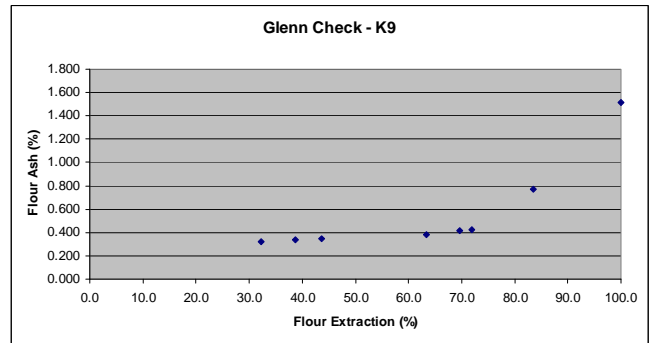
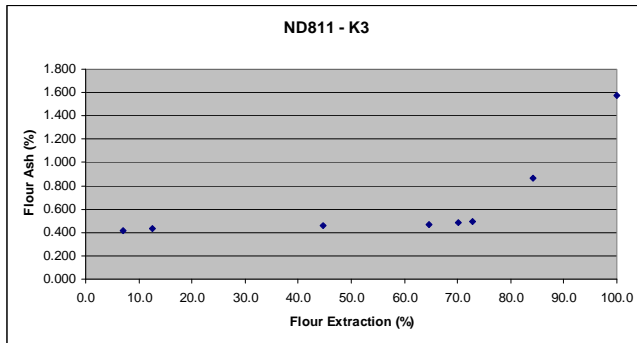
Cumulative Ash Curves – Watertown, SD



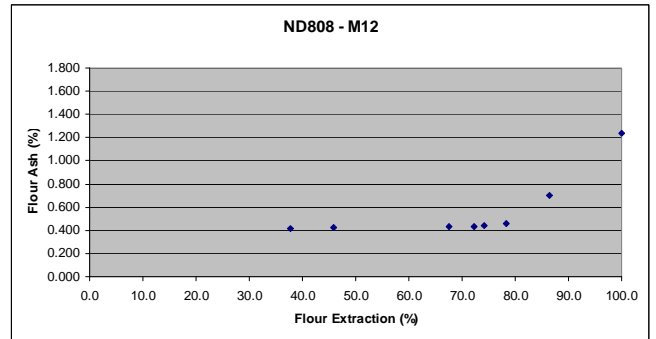
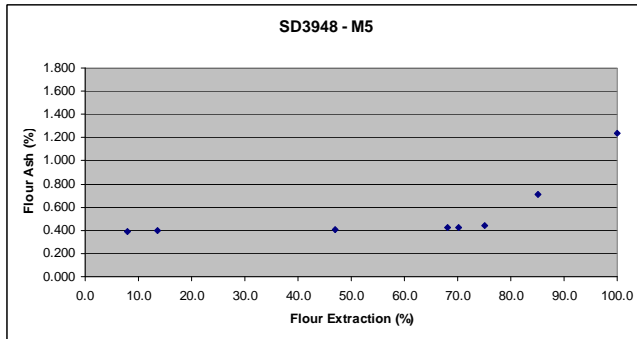
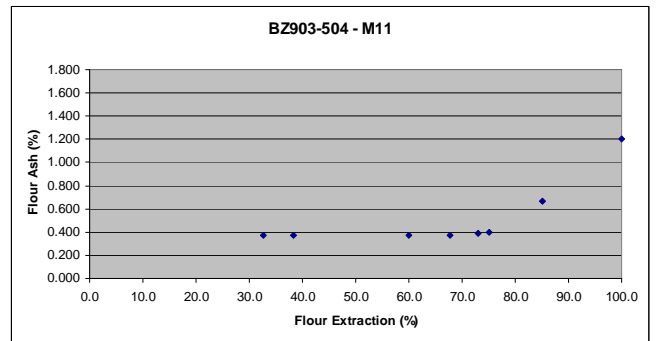
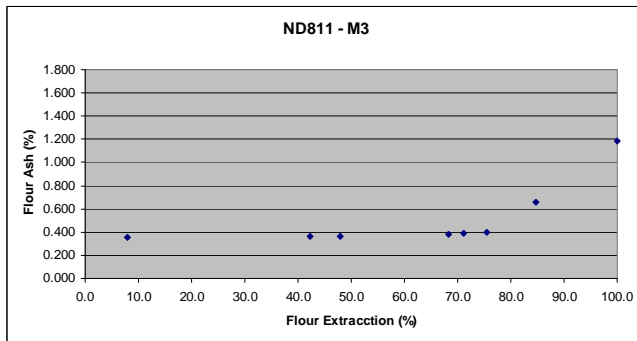
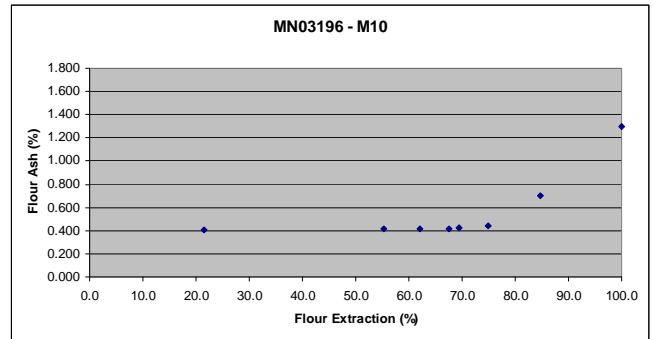
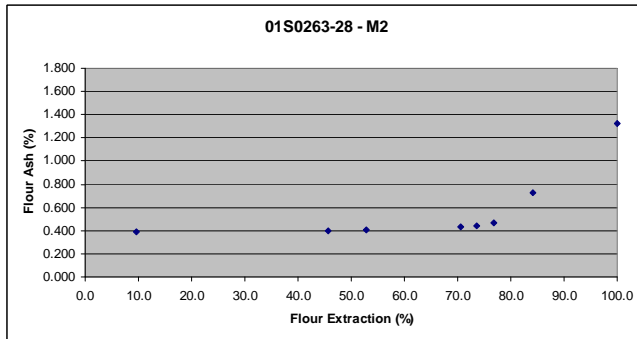
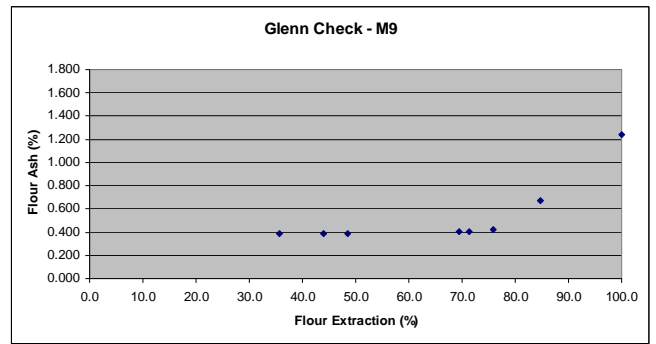
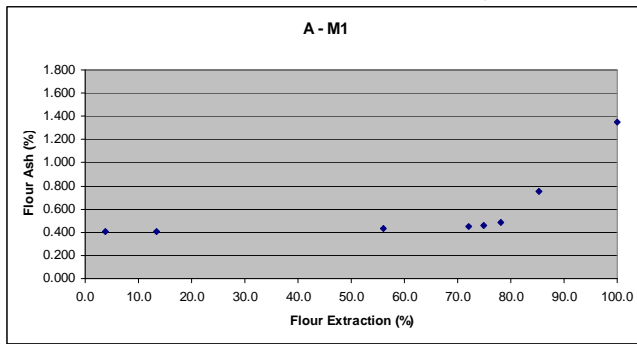
Cumulative Ash Curves – Casselton, ND

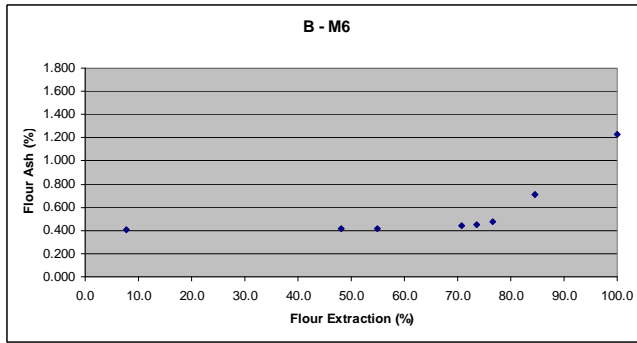


Cumulative Ash Curves – Crookston, MN

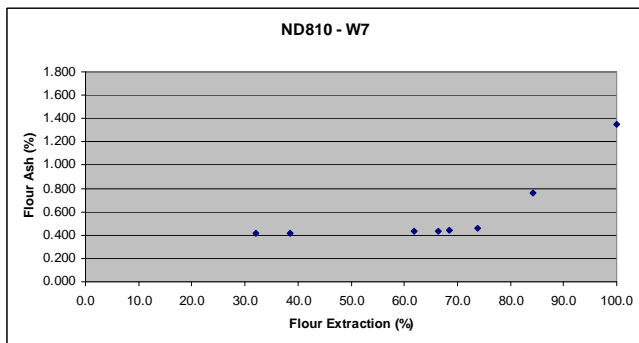
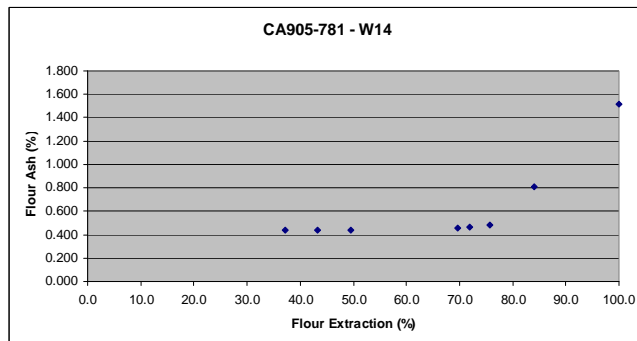
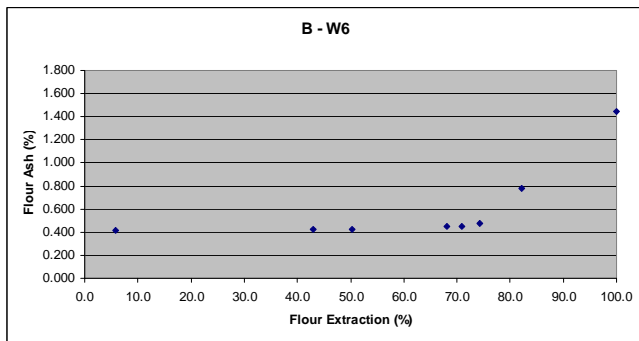
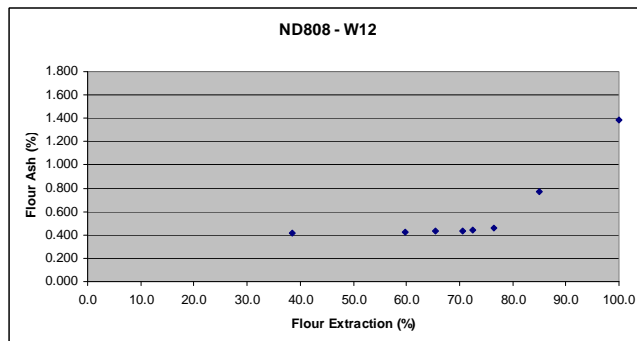
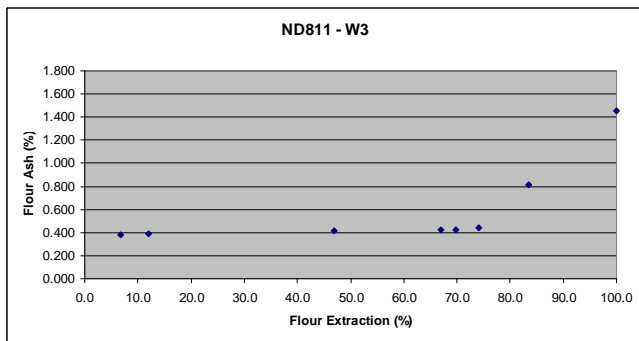
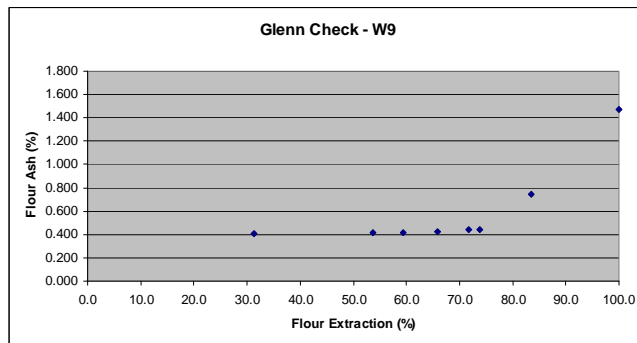
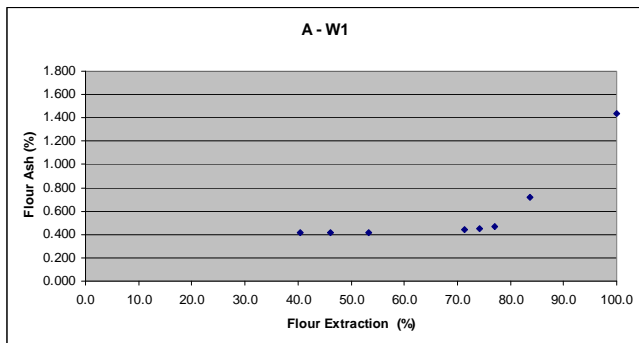


Cumulative Ash Curves – Minot, ND



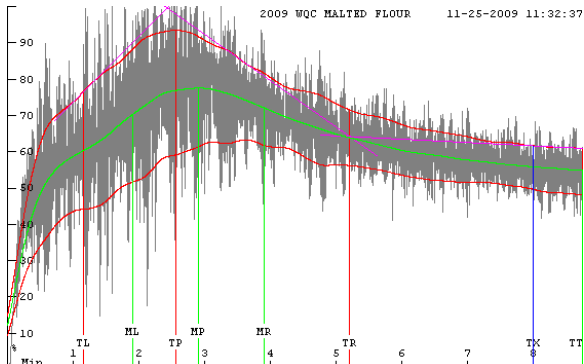


Cumulative Ash Curves – Williston, ND

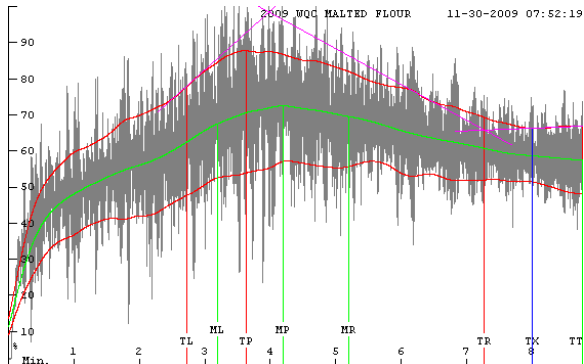


Mixograms

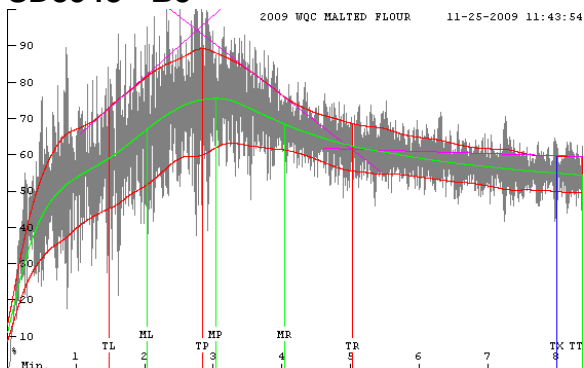
01S0263-28 - B2



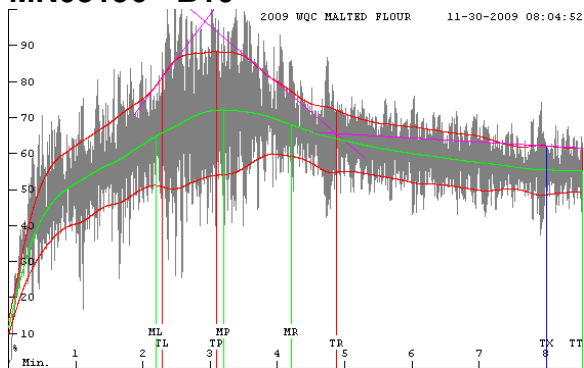
Glenn Check - B9



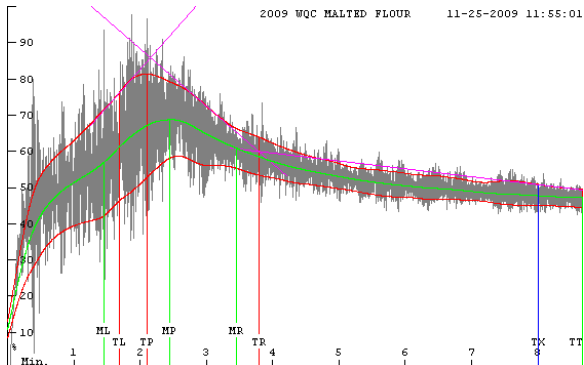
SD3948 - B5



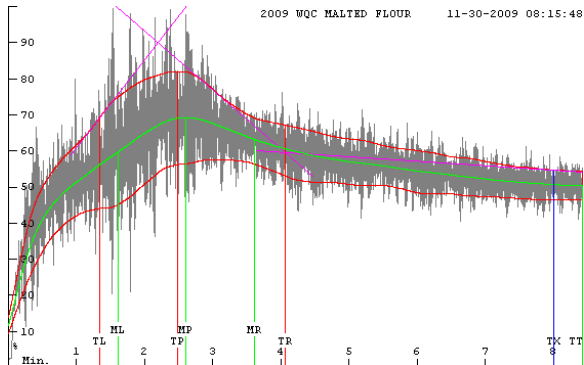
MN03196 - B10



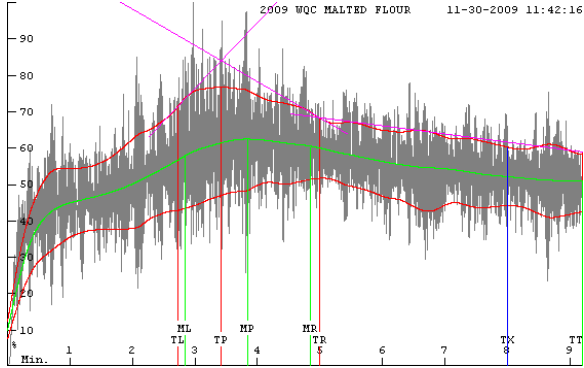
CA905-780 - B8



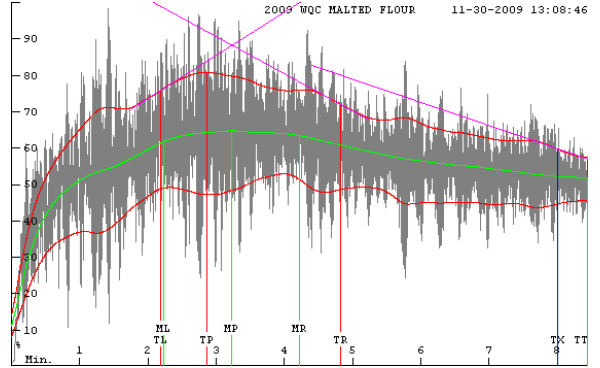
SD4011 - B13



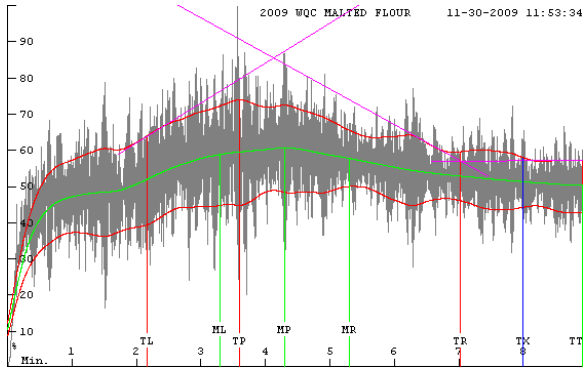
01S0263-28 - C2



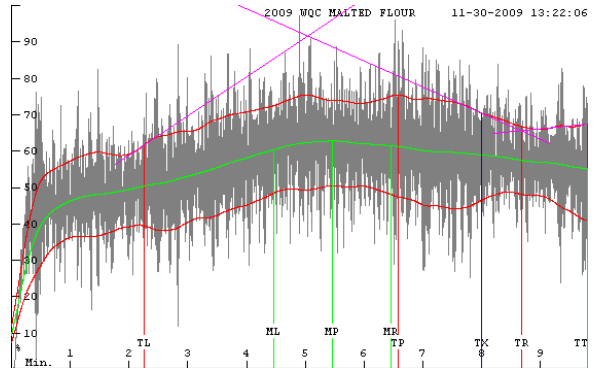
ND810 - C7



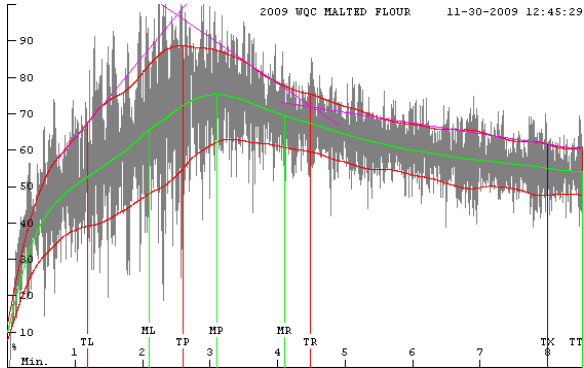
ND811 - C3



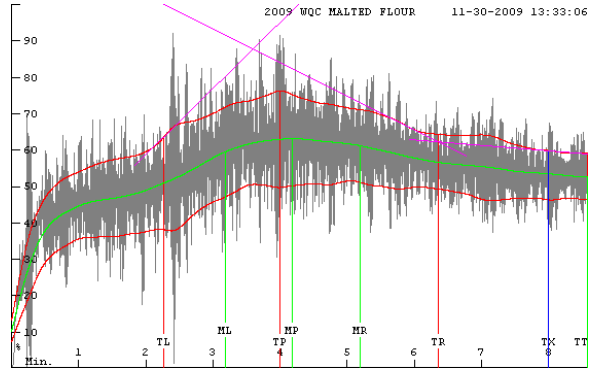
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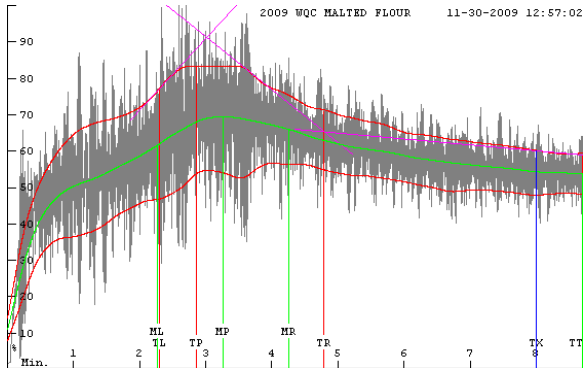
CA905-776 - C4



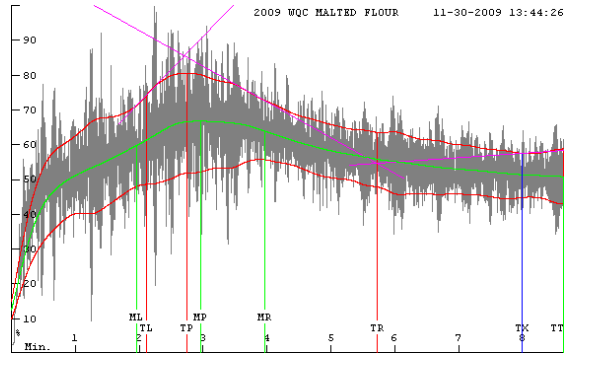
MN03196 - C10



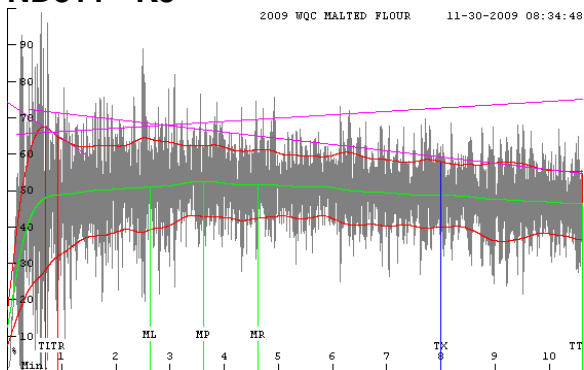
SD3948 - C5



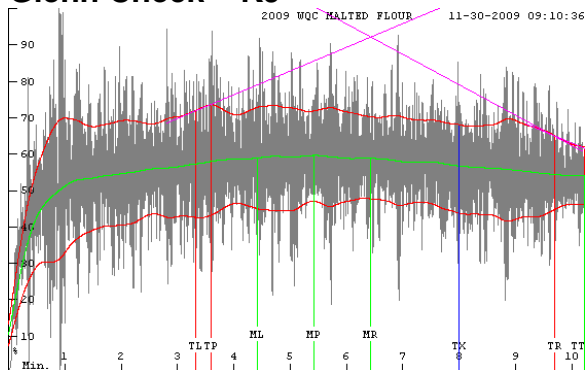
ND808 - C12



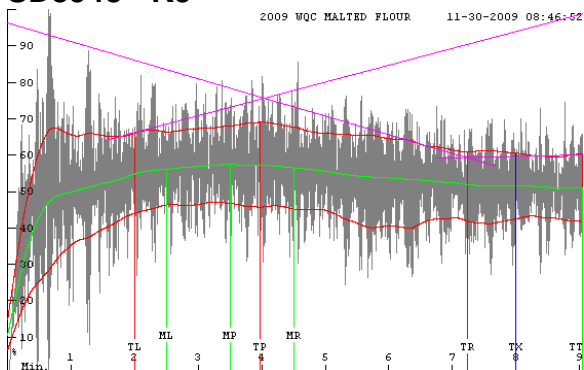
ND811 - K3



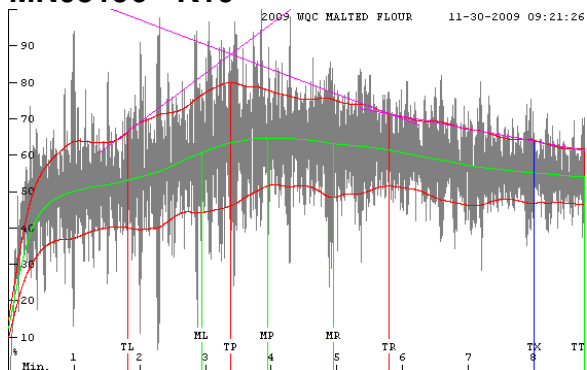
Glenn Check - K9



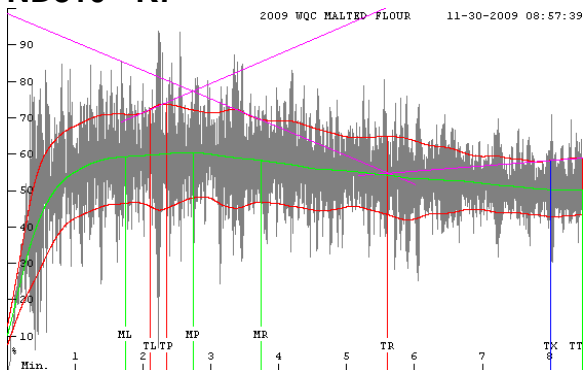
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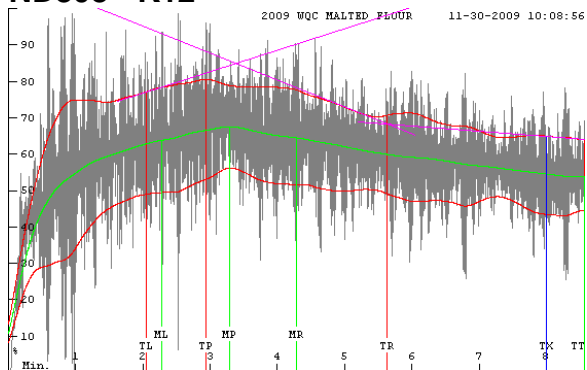
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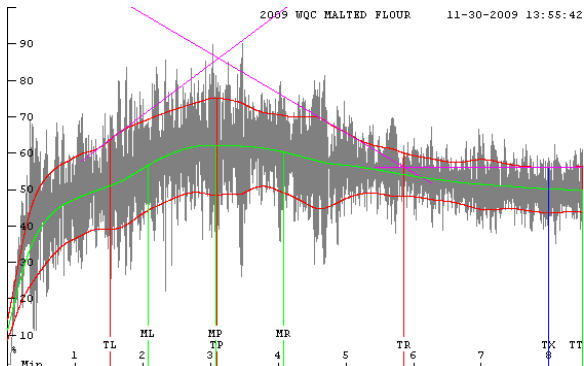
ND810 - K7



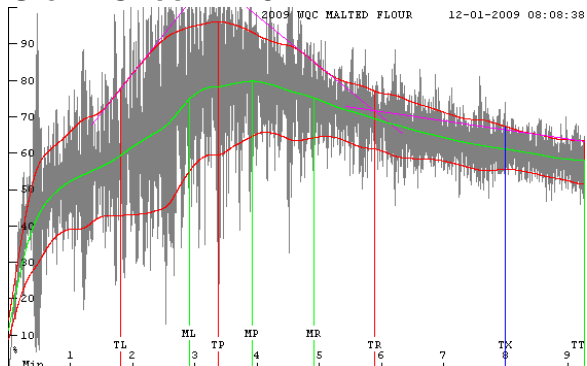
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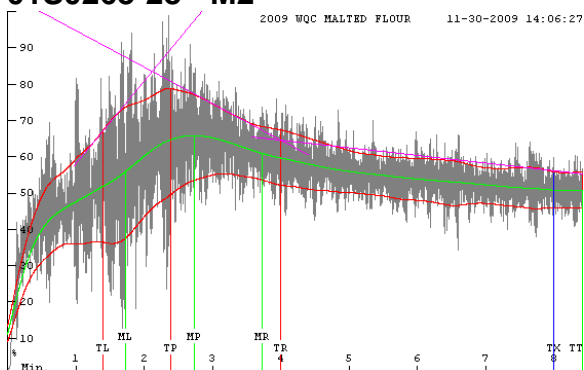
A - M1



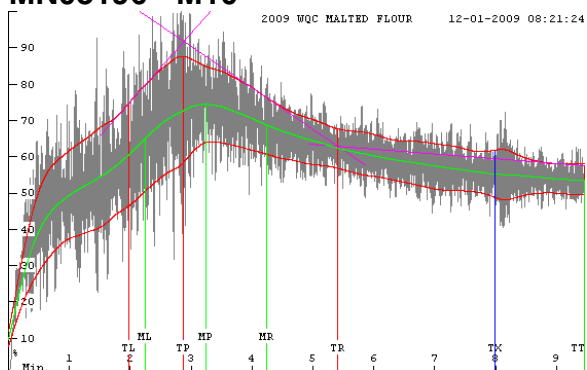
Glenn Check - M9



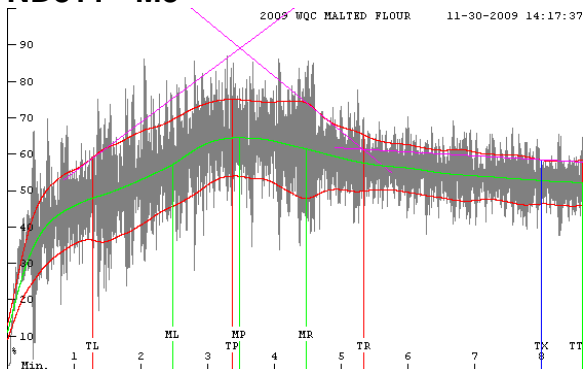
01S0263-28 - M2



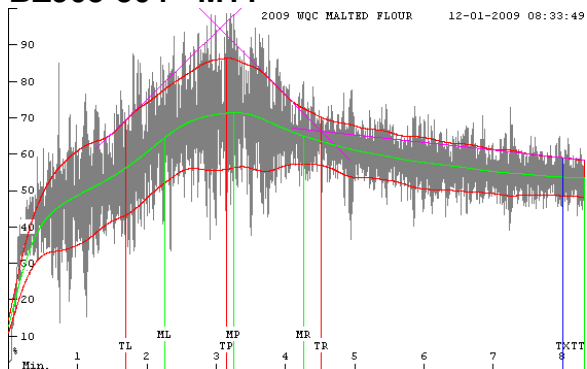
MN03196 - M10



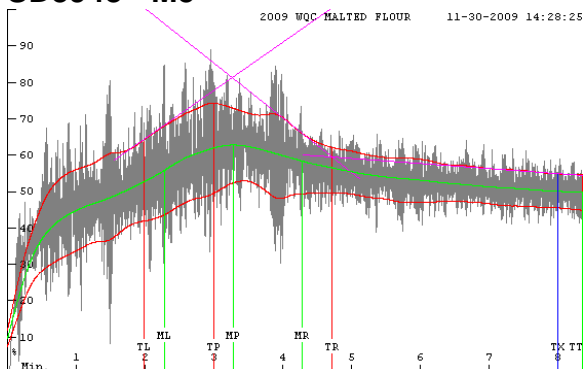
ND811 - M3



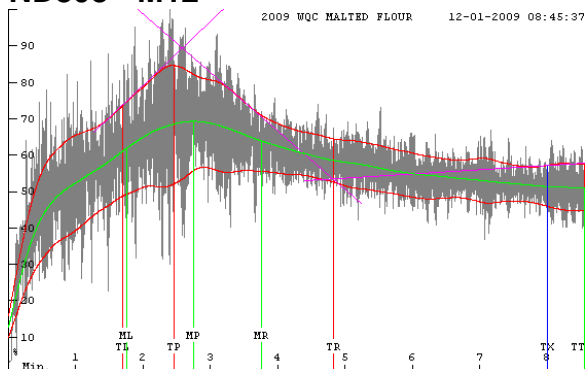
BZ903-504 - M11



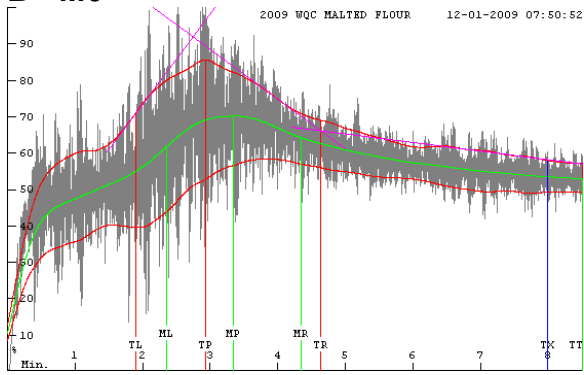
SD3948 - M5



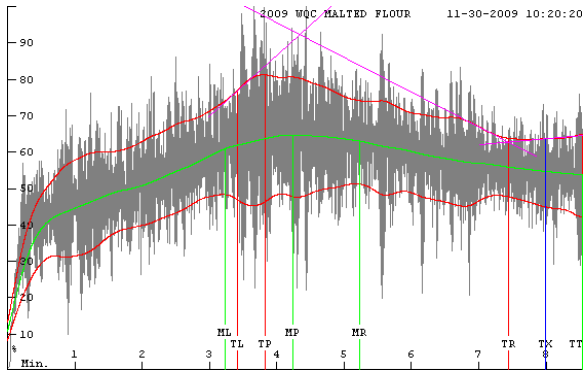
ND808 - M12



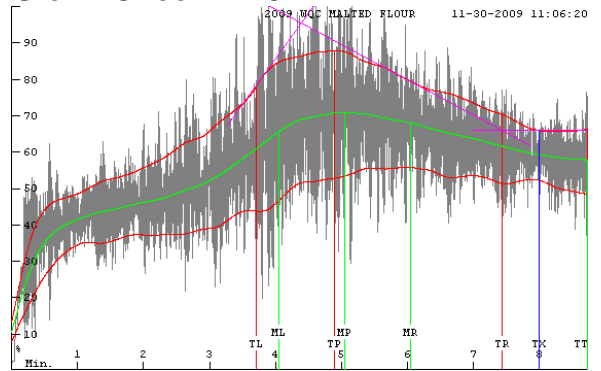
B - M6



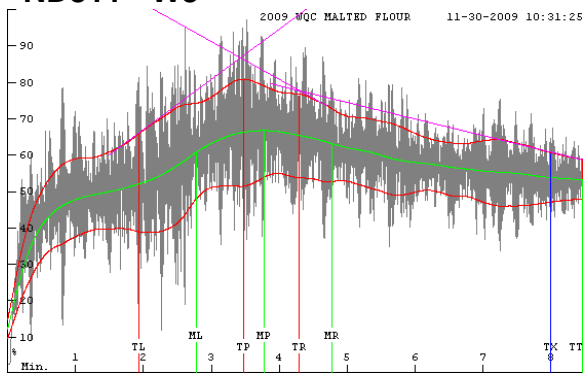
A - W1



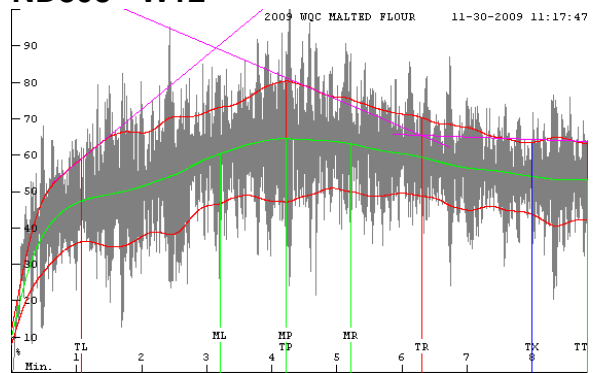
Glenn Check - W9



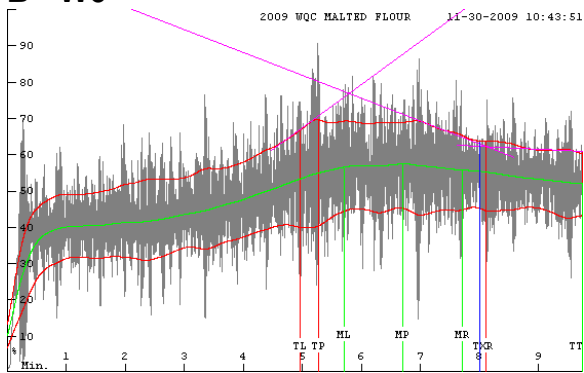
ND811 - W3



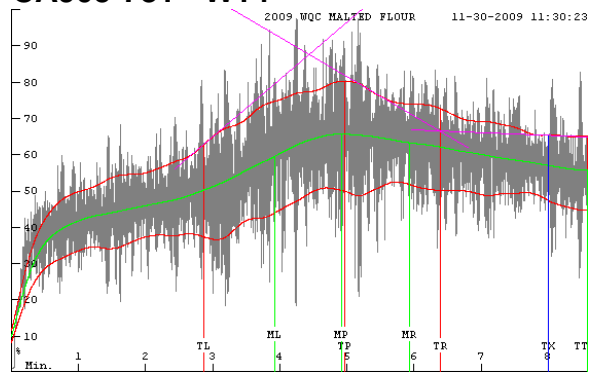
ND808 - W12



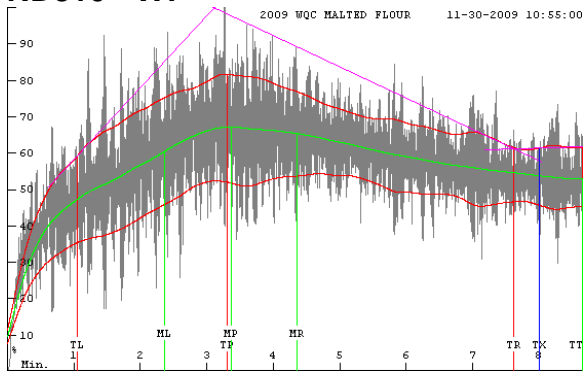
B - W6



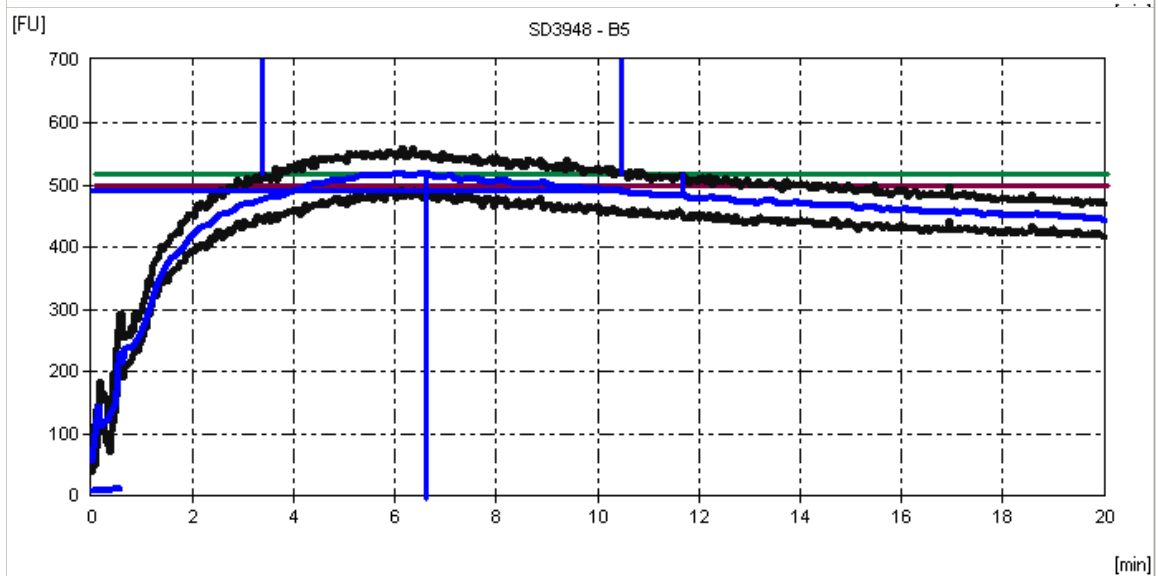
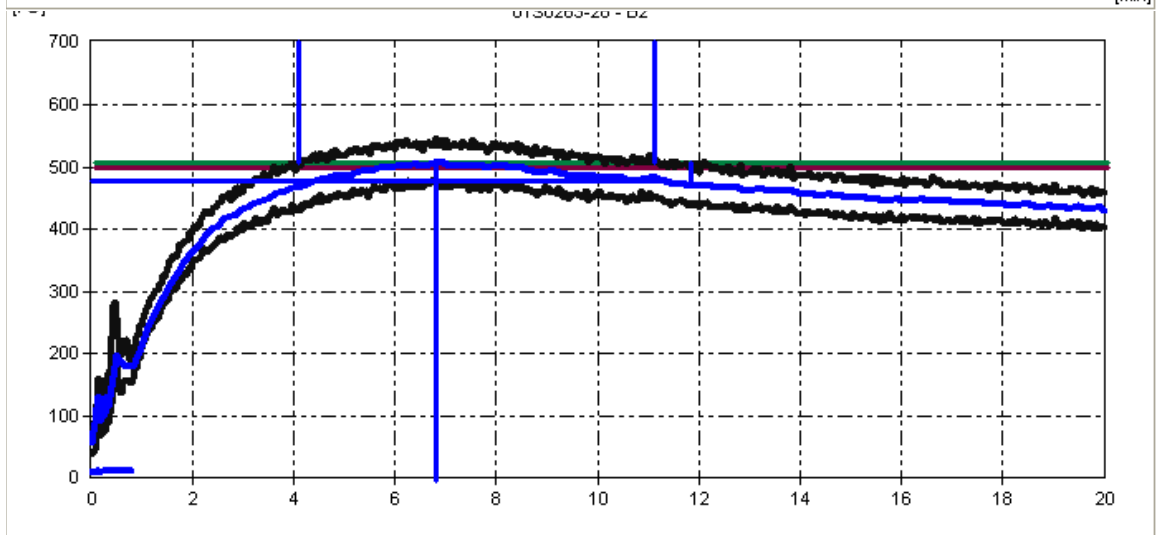
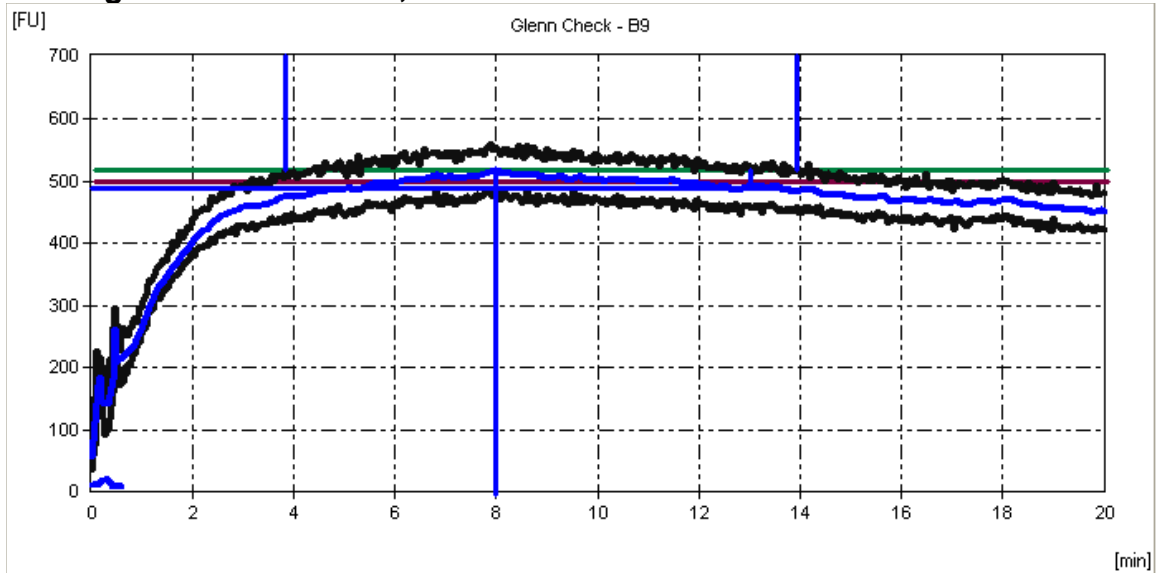
CA905-781 - W14

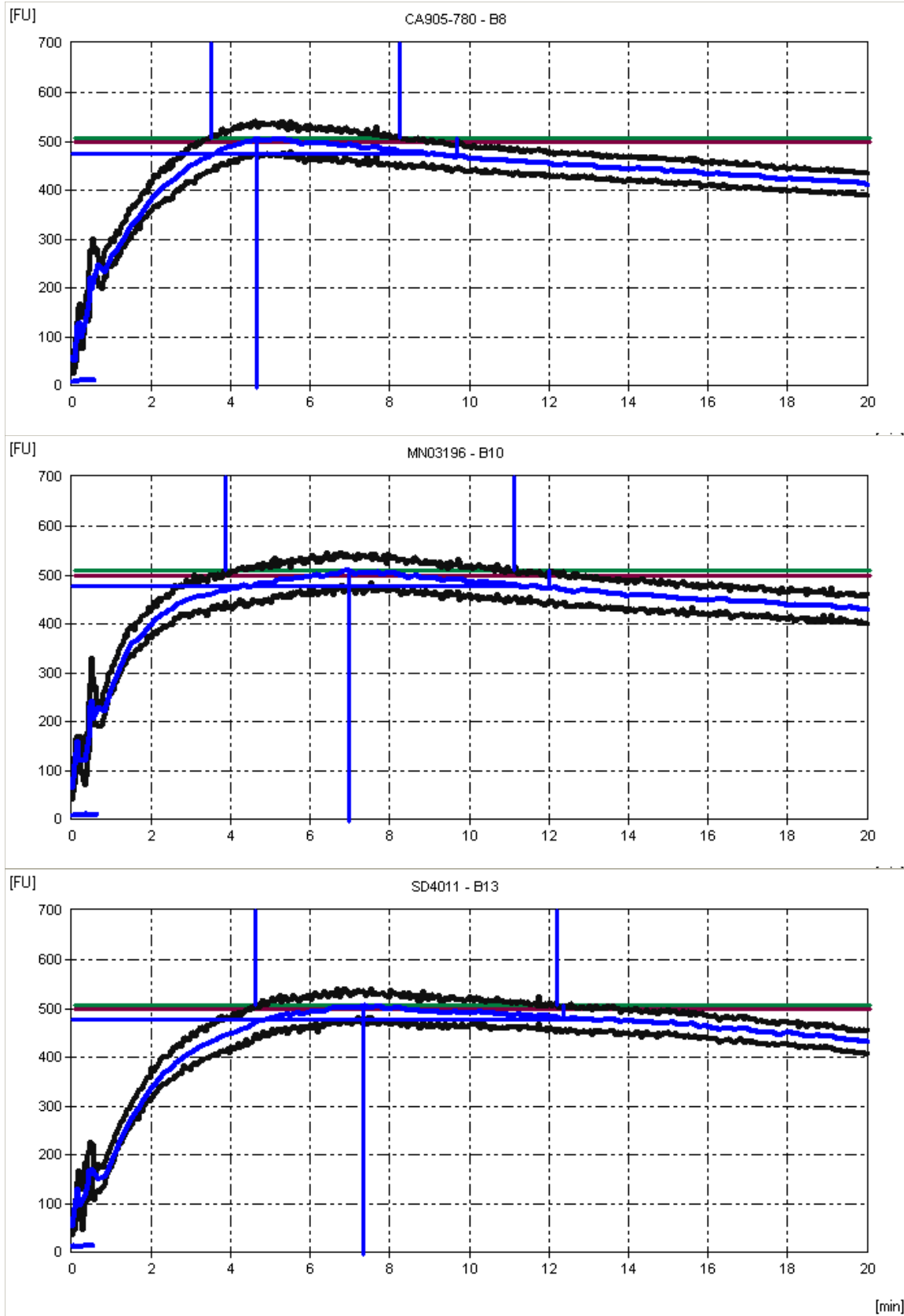


ND810 - W7

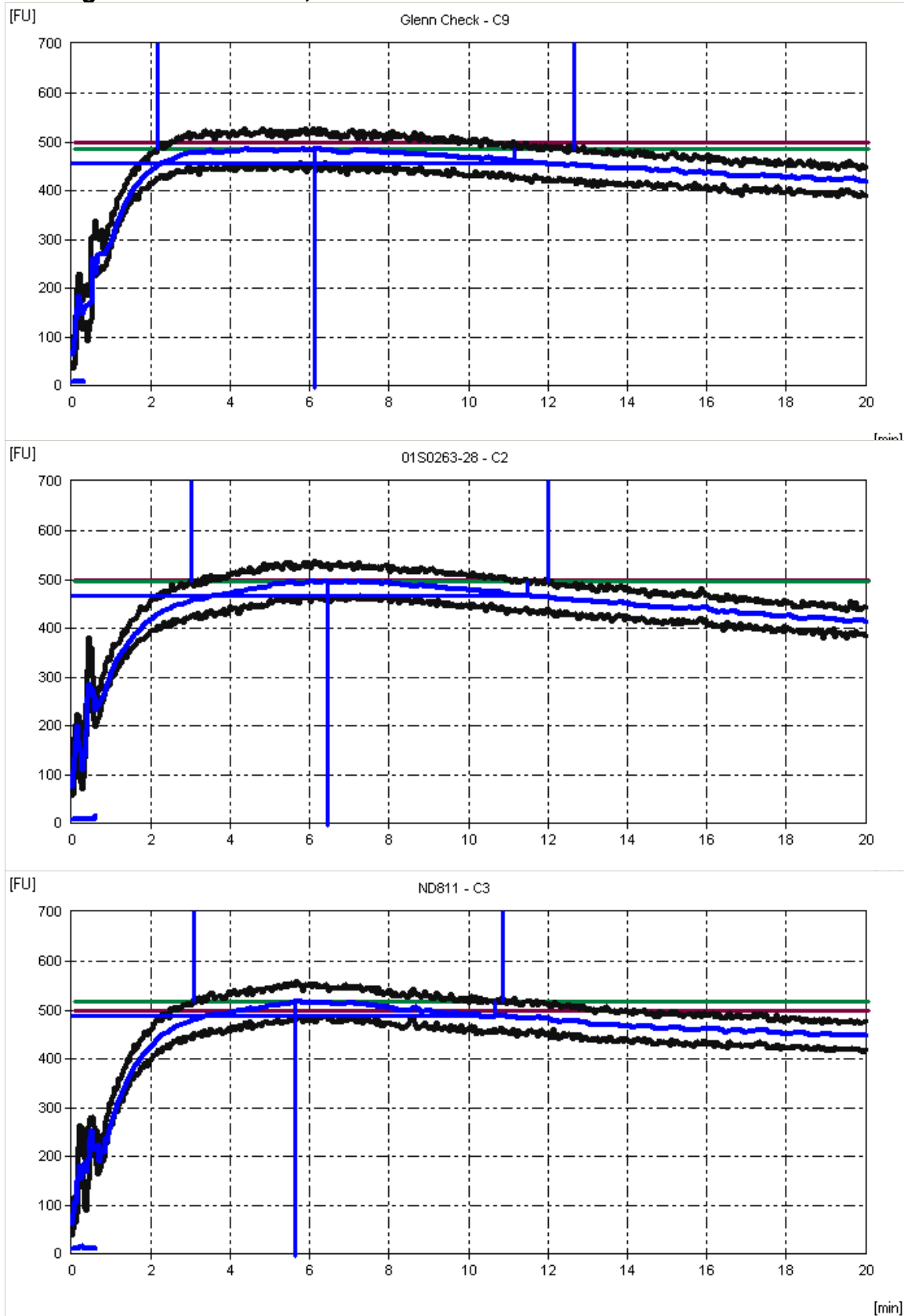


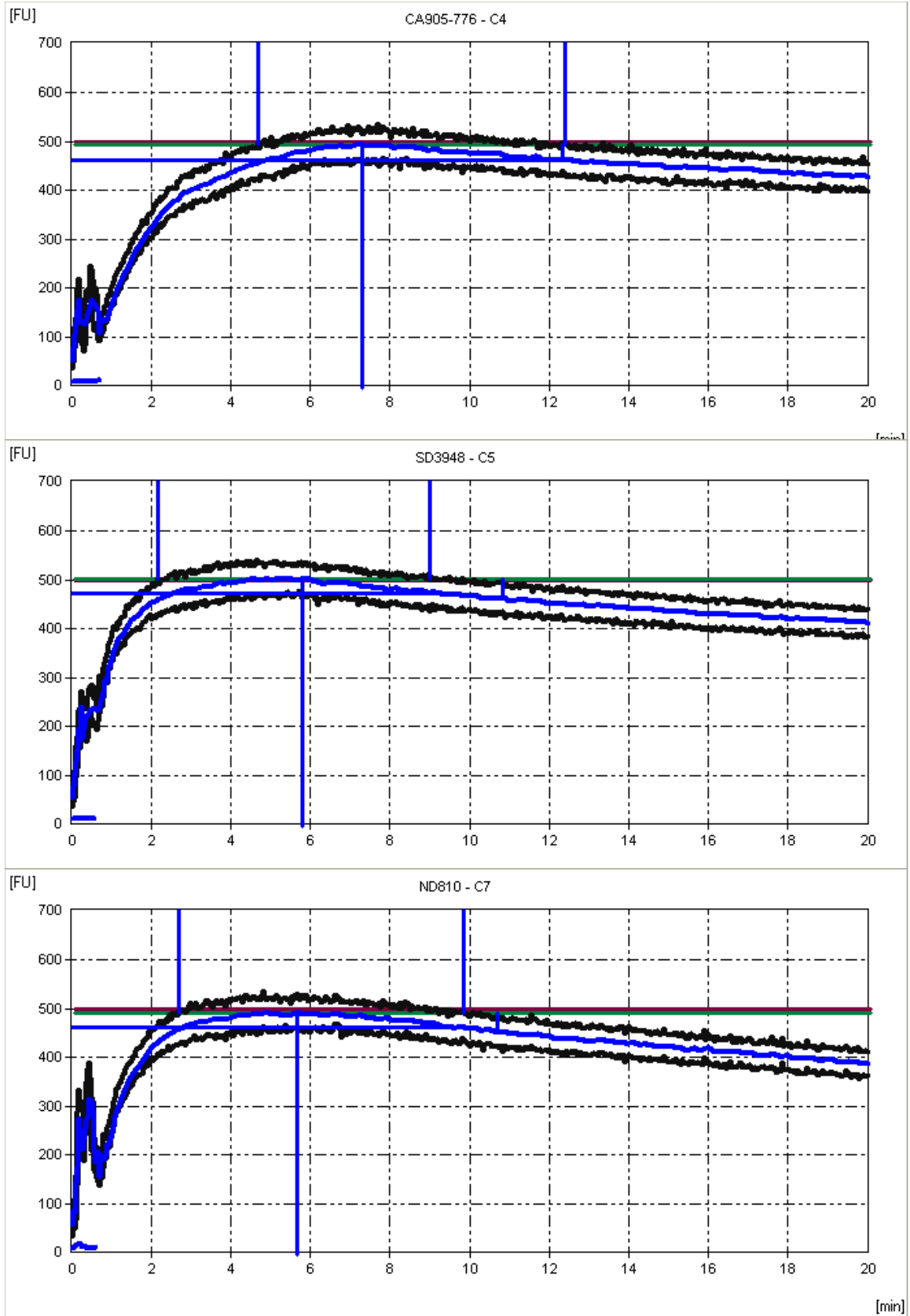
Farinograms – Watertown, SD

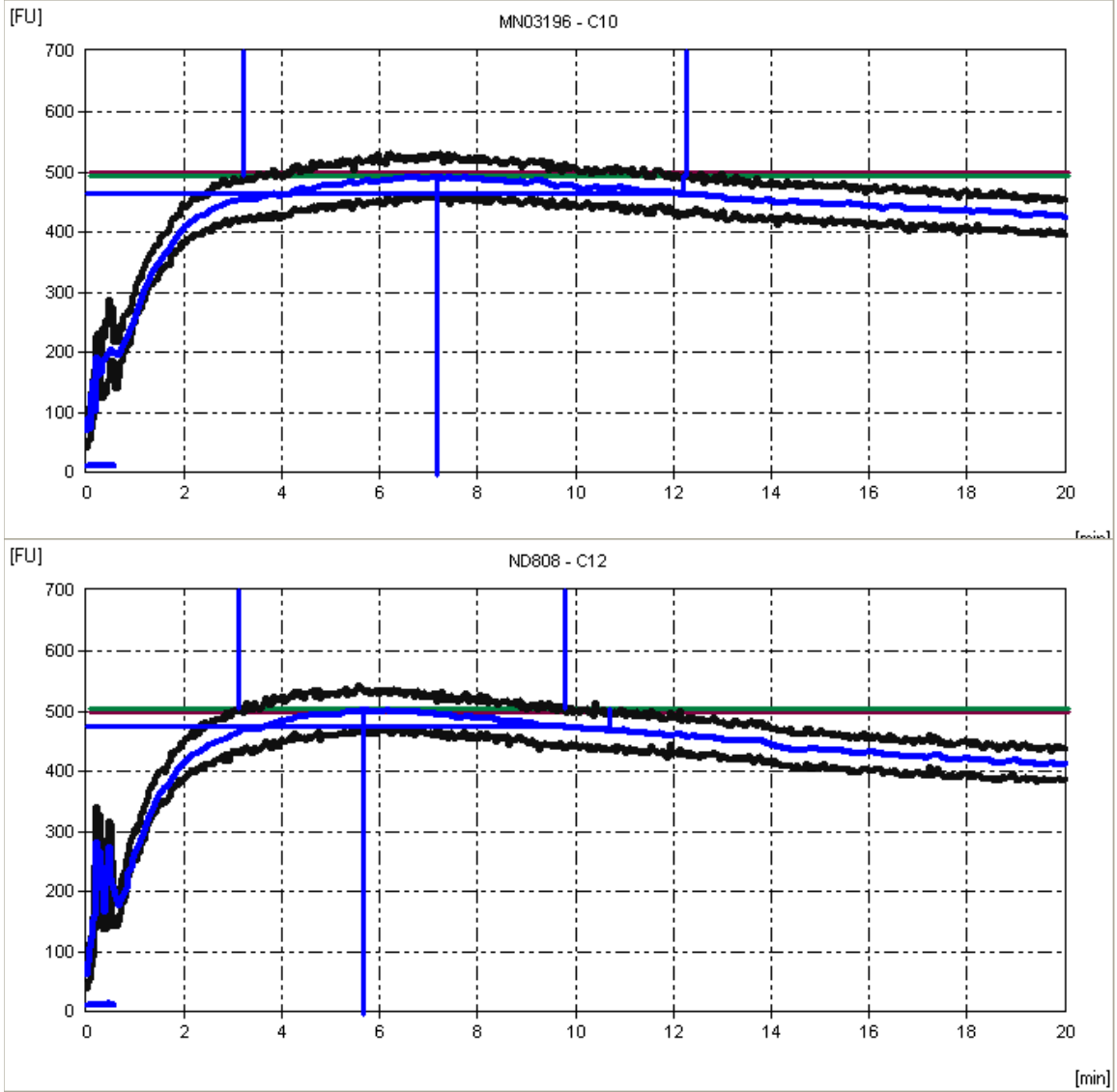




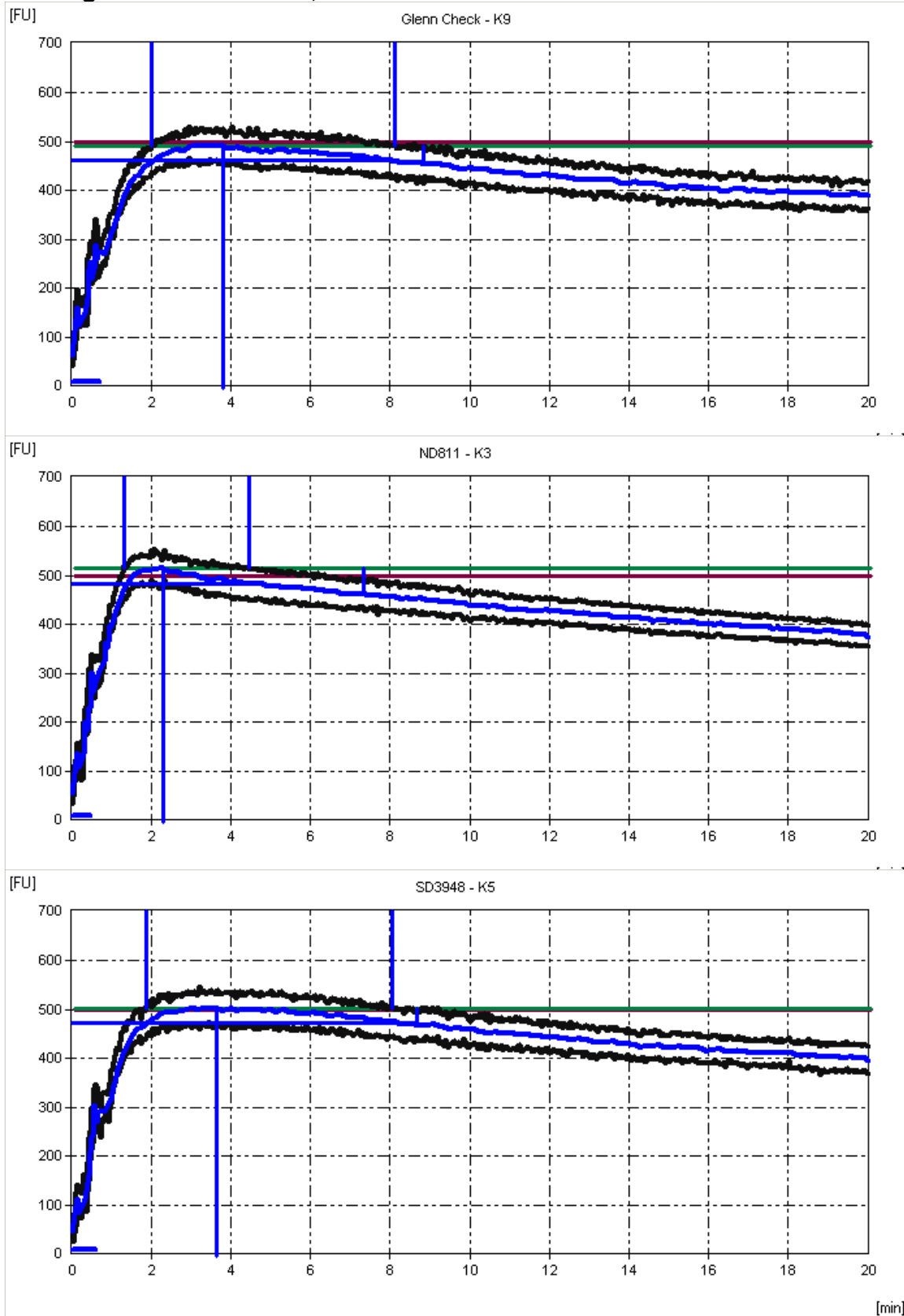
Farinograms – Casselton, ND

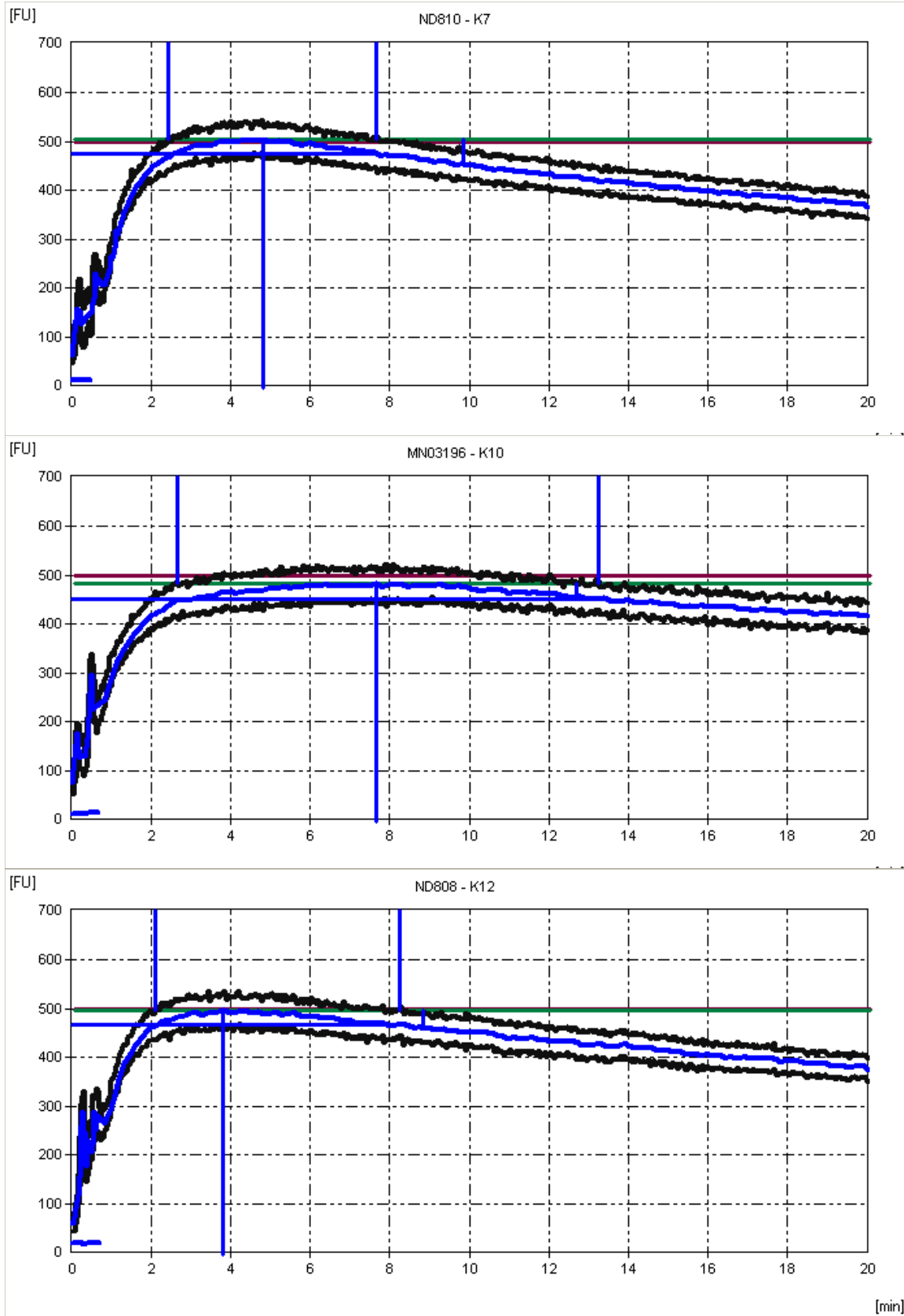




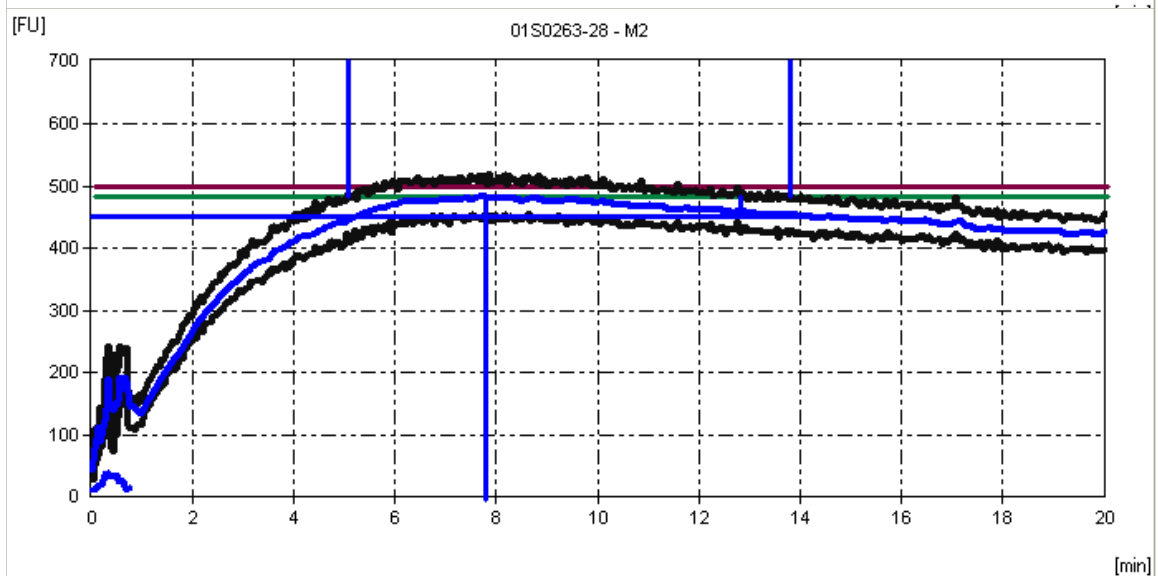
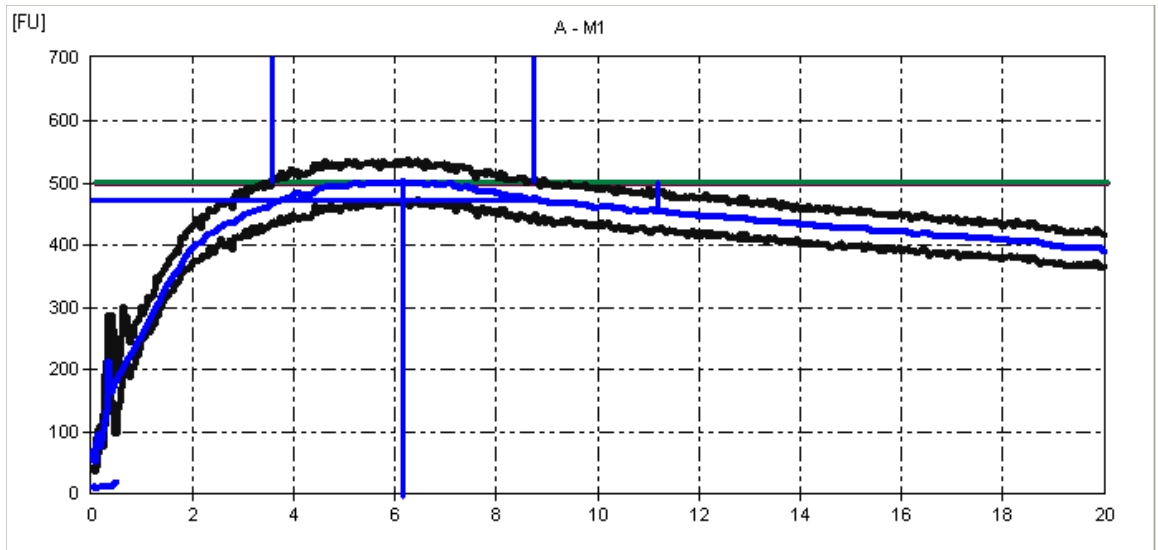
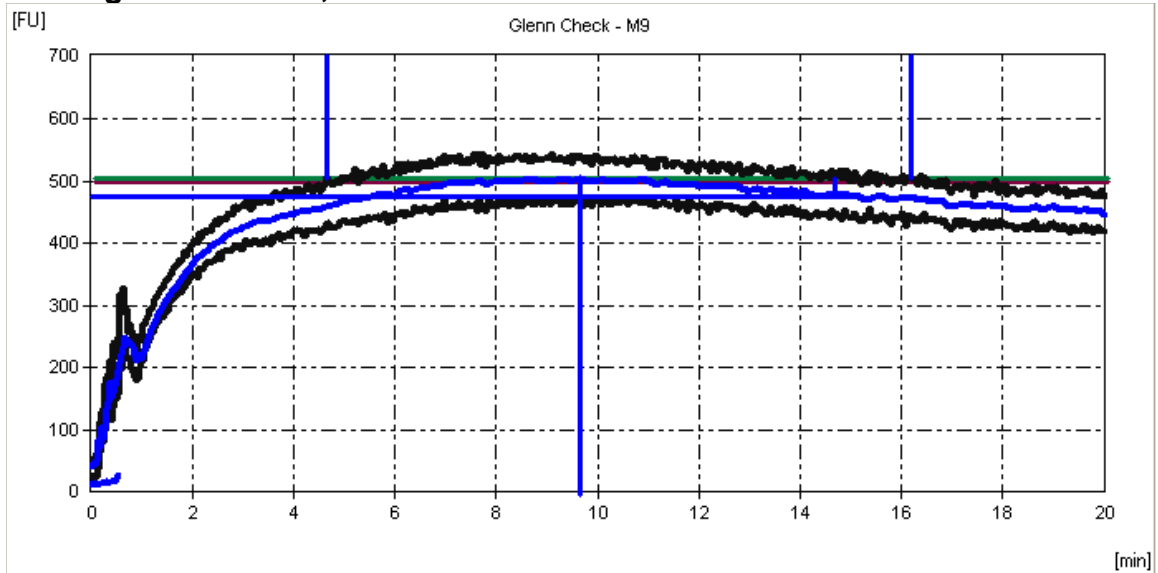


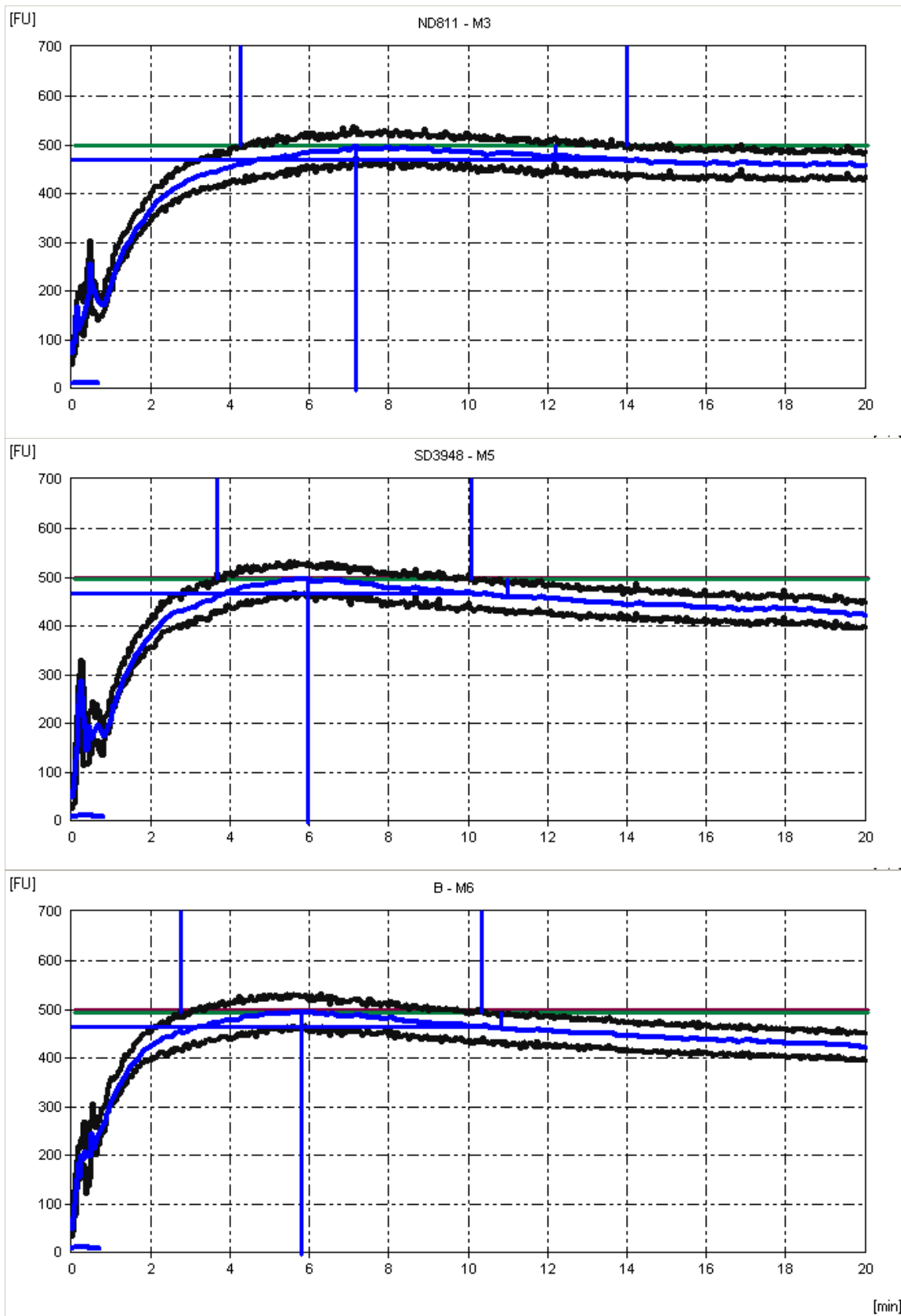
Farinograms – Crookston, MN

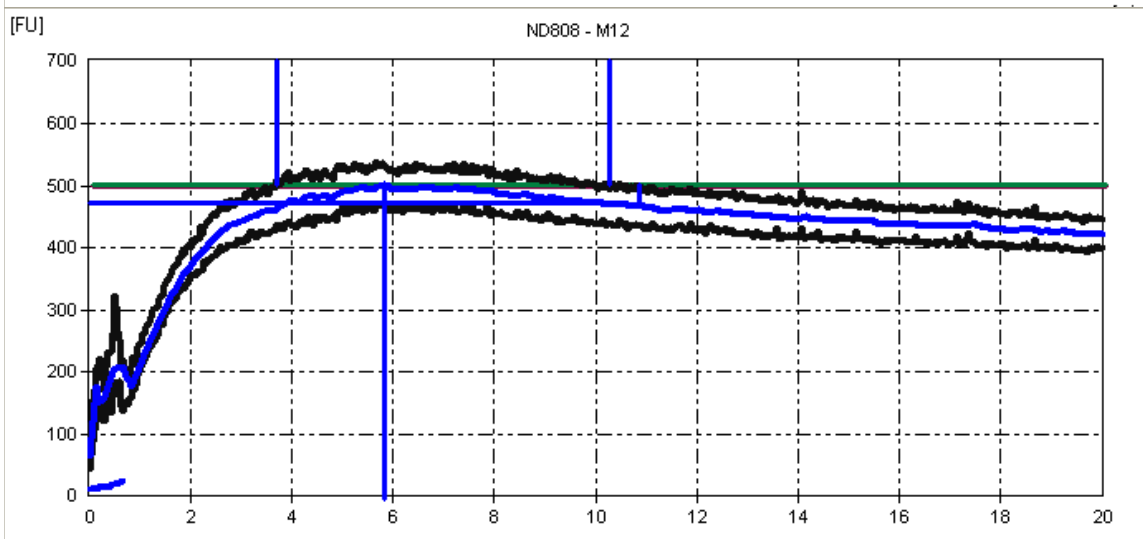
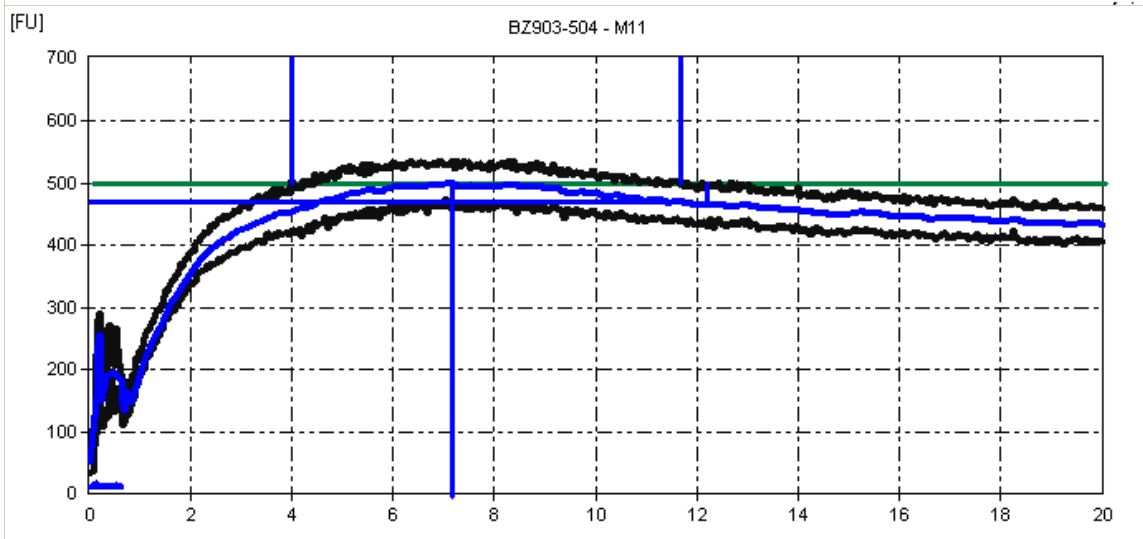
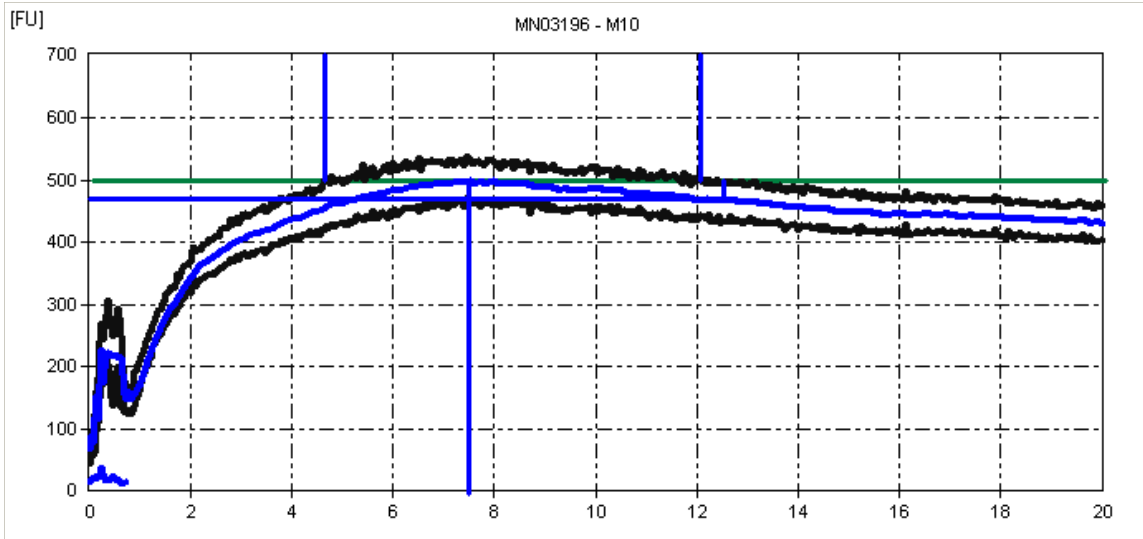




Farinograms – Minot, ND

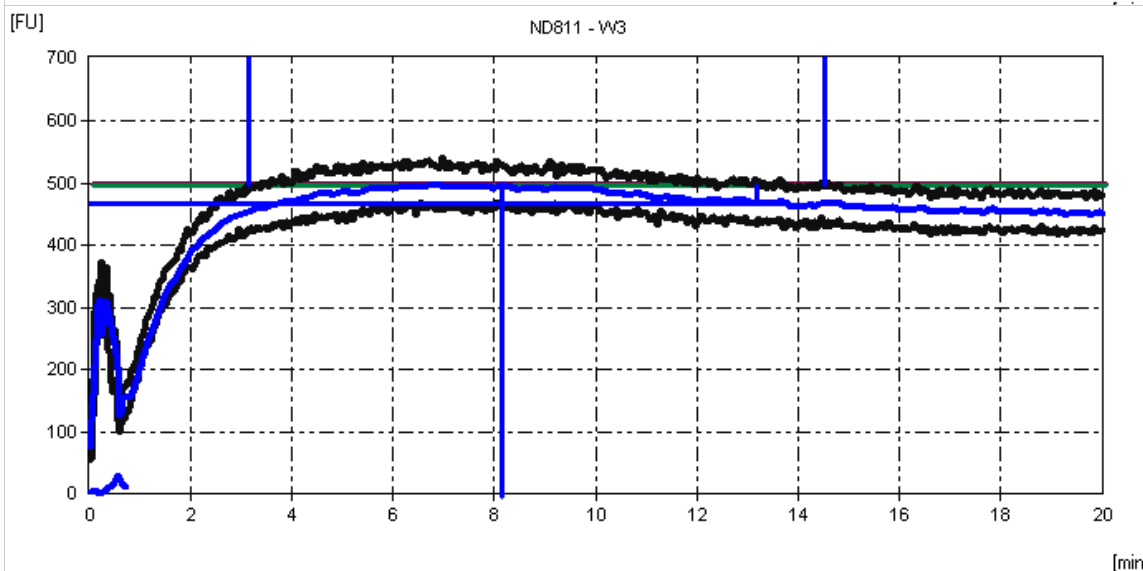
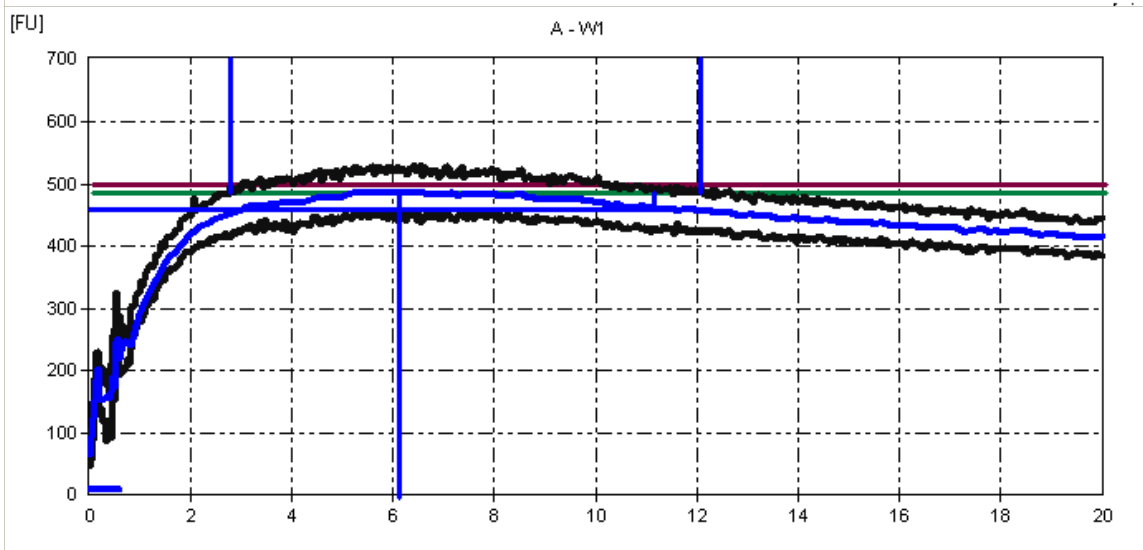
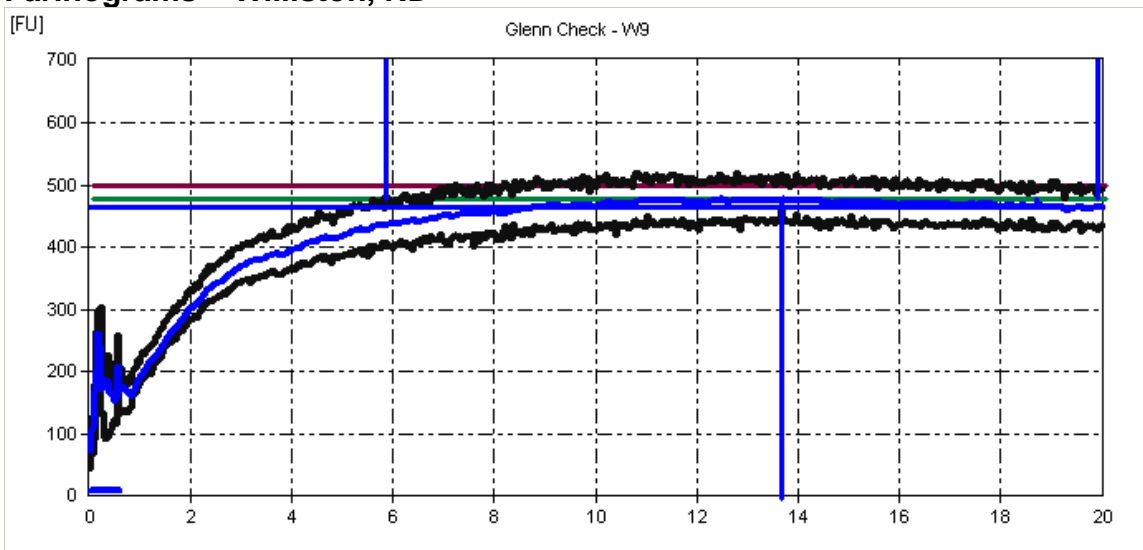




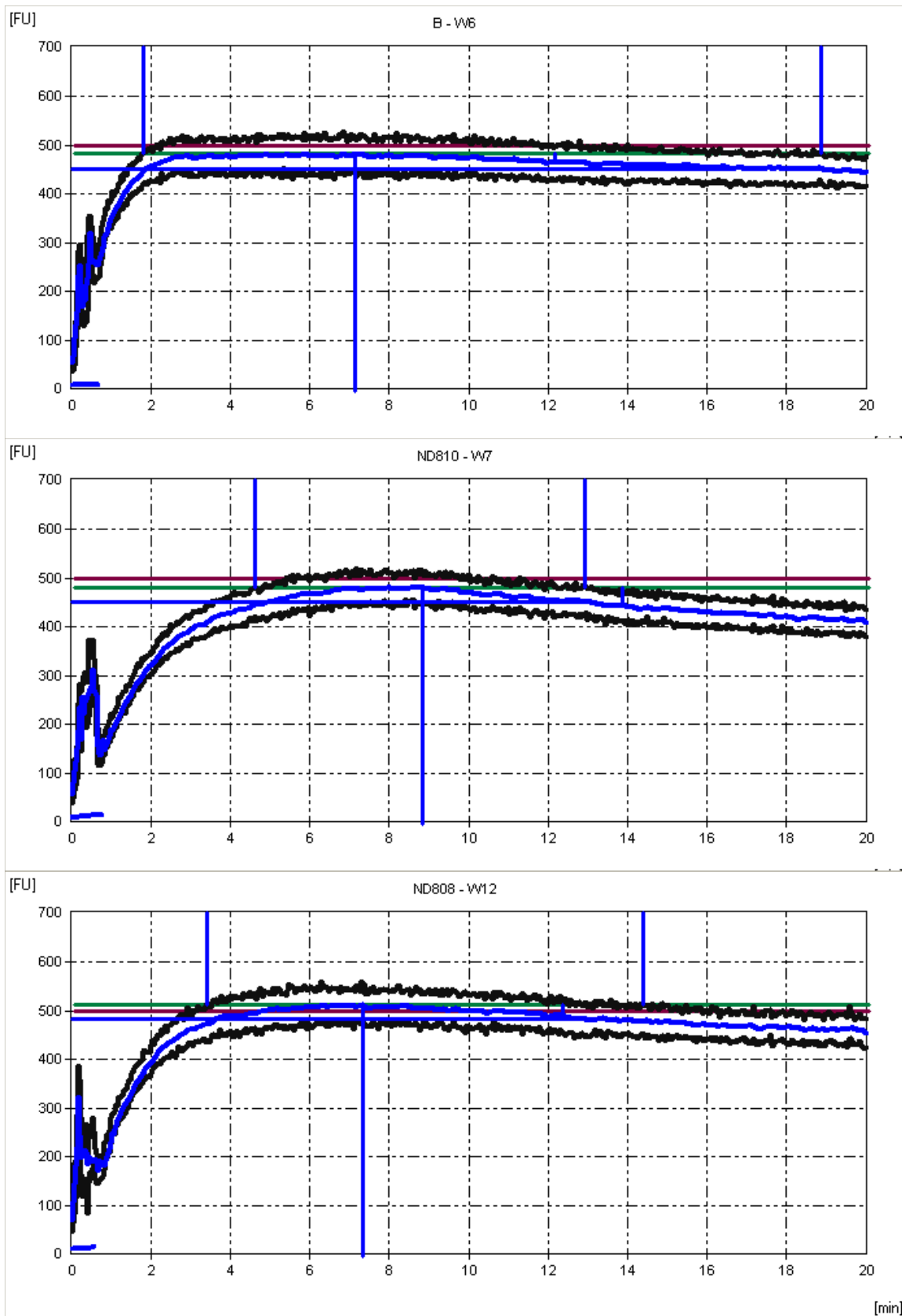


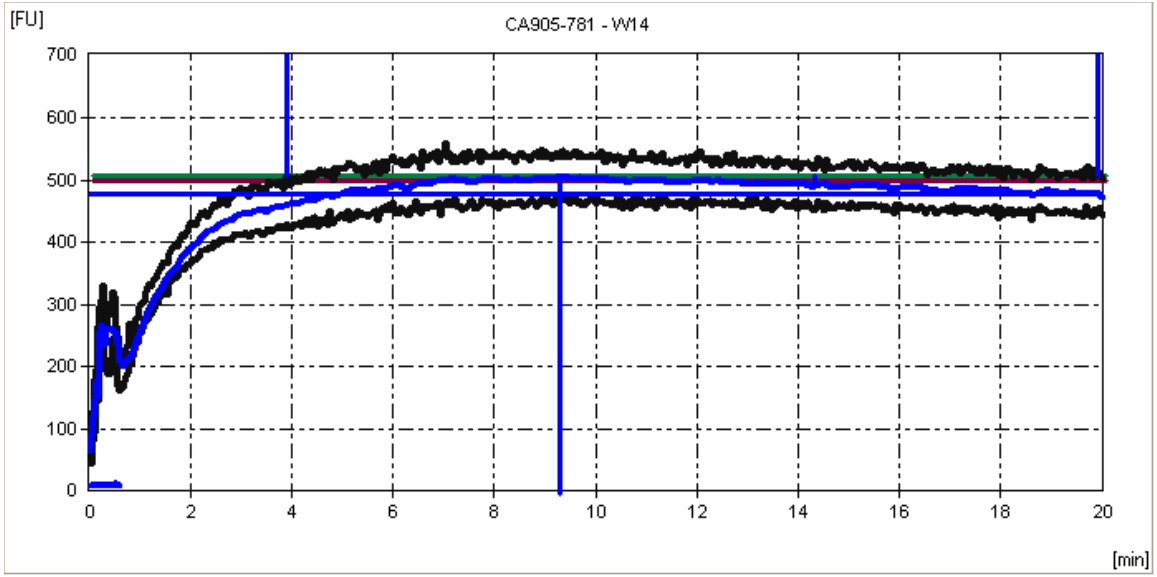
[min]

Farinograms – Williston, ND

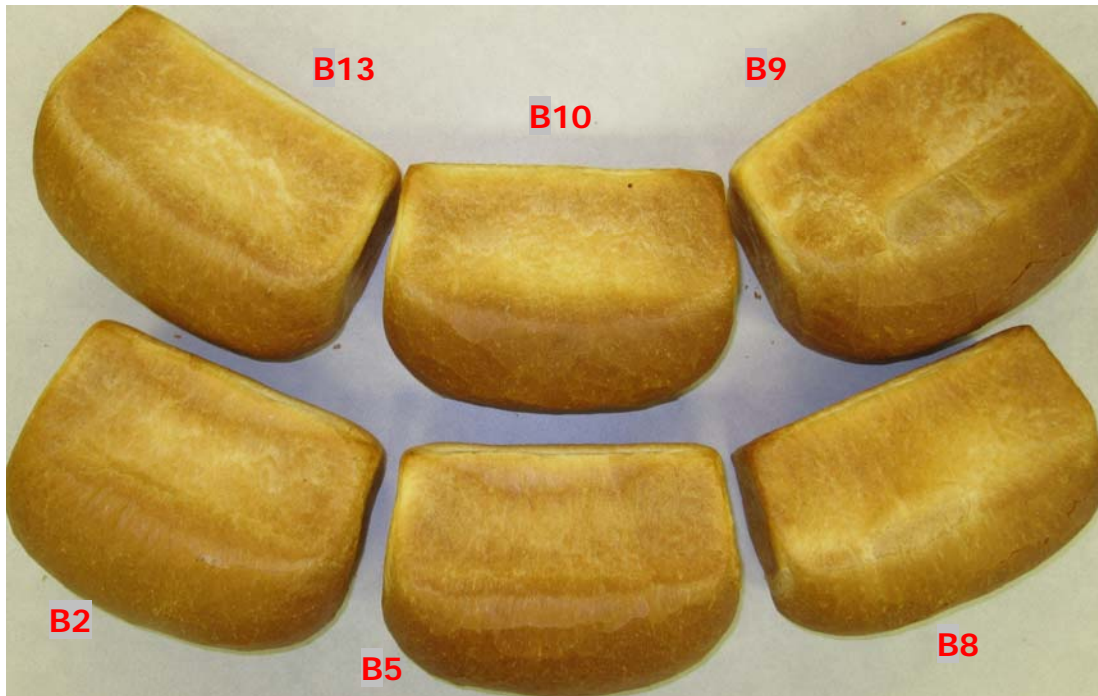


[min]

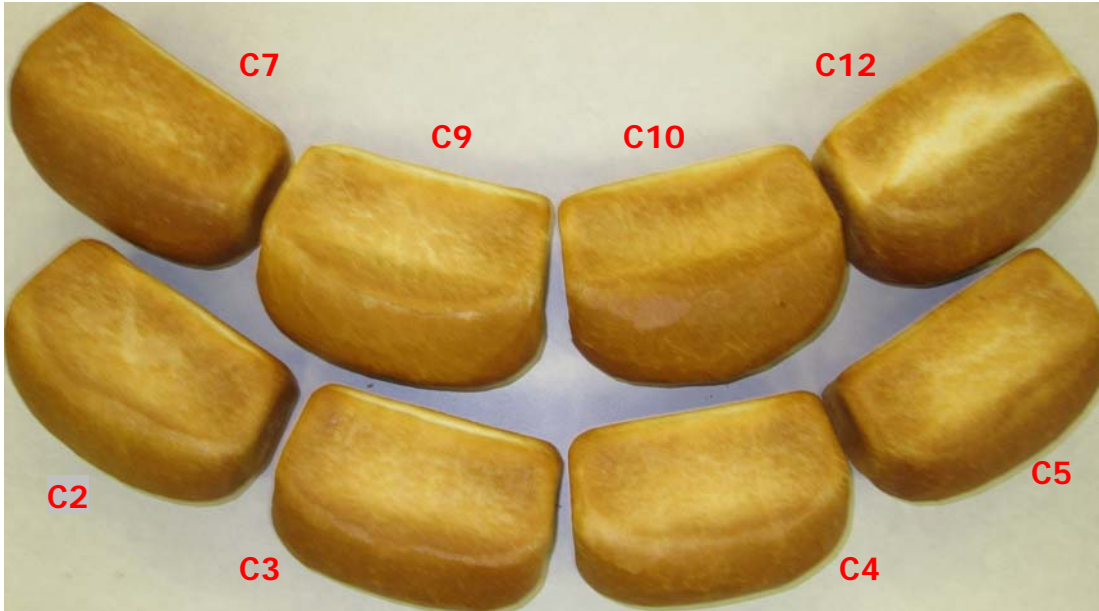




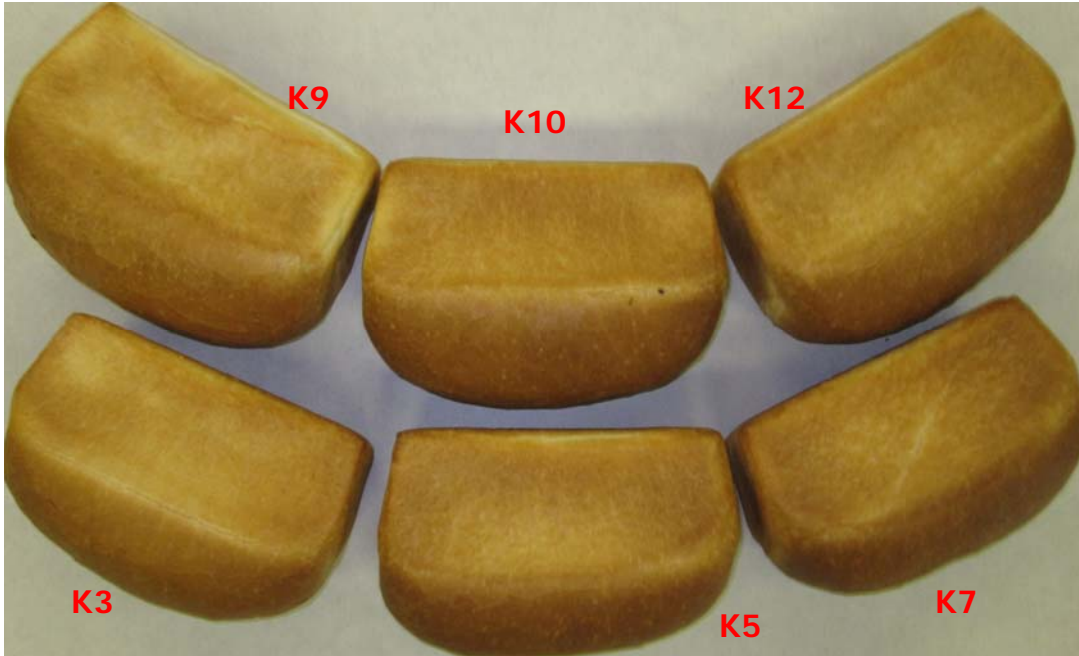
Watertown – Bread Images (100 g loaves – USDA/WQL)



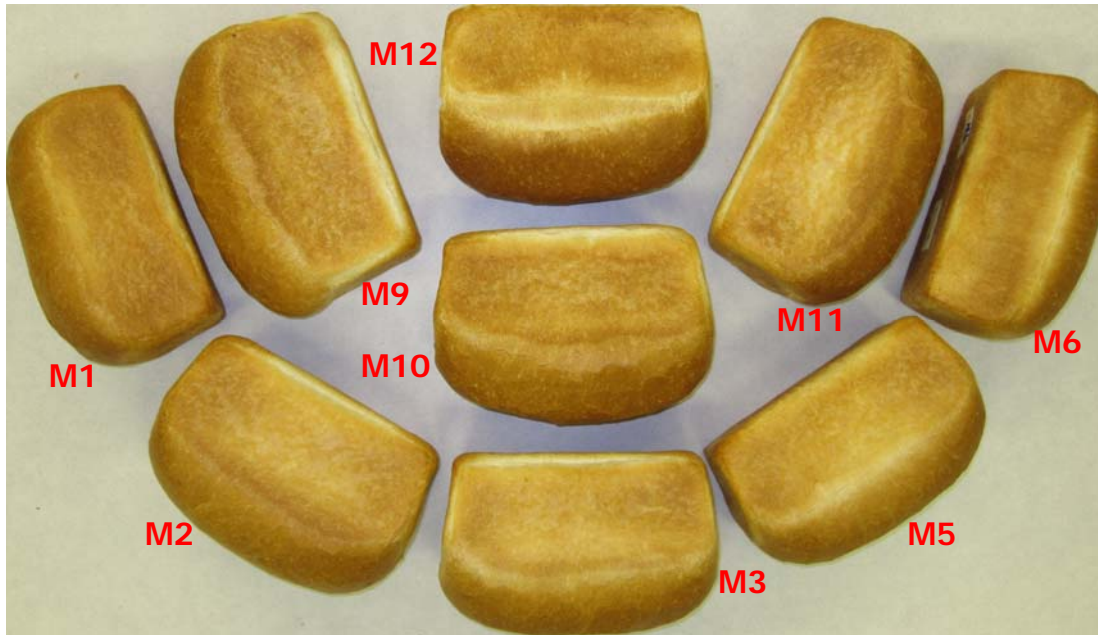
Casselton - Bread Images (100 g loaves – USDA/WQL)



Crookston - Bread Images (100 g loaves – USDA/WQL)



Minot - Bread Images (100 g loaves – USDA/WQL)



Williston - Bread Images (100 g loaves – USDA/WQL)



2009 Kernel Characteristics by Location

Entry	Wheat Protein 12%mb	Flour Protein 12%mb	Wheat Market Score		Test Weight lb/bu	Kernel Weight g/1000	Kernel Size		Wheat Moisture %	Wheat Ash 14%mb	Falling Number sec	SKCS Hardness Index	Vitreous Kernels %
			1 to 6	1 to 10			large (g)	small (g)					
Watertown (B)													
01S0263-28	14.8	14.4	4.4	8.6	62.2	33.4	75	5	10.7	1.58	457	77.8	59.3
SD3948	14.6	14.3	4.6	9	62.0	35.7	81	4	10.8	1.51	453	83.6	65.0
CA905-780	15.1	14.5	4.2	8.8	60.2	33.9	69	5	10.5	1.60	623	67.9	57.6
Glenn	15.5	15.2	4.8	10	63.3	35.6	79	3	10.8	1.57	400	83.7	92.0
MN03196	14.8	14.6	4.6	9	62.6	33.1	71	7	10.2	1.54	445	89.6	82.7
SD4011	15.5	15.2	4.2	8.8	59.8	34.1	76	4	10.5	1.53	447	71.4	62.3
Casselton (C)													
01S0263-28	13.6	13.3	3.0	7.8	59.7	29.6	46	11	9.8	1.59	371	87.4	65.6
ND811	13.9	13.5	4.2	8.6	62.0	32.8	77	5	10.9	1.40	454	78.8	65.6
CA905-776	14.4	13.9	3.5	8.8	61.4	29.5	55	8	10.1	1.52	380	74.2	58.4
SD3948	13.7	13.2	3.9	9	61.8	32.2	65	5	10.3	1.48	417	83.0	41.6
ND810	14.4	13.7	4.1	9.6	61.7	28.6	49	9	9.6	1.47	479	81.8	61.4
Glenn	14.5	14.0	4.2	10	63.6	28.3	47	9	10.2	1.54	418	88.6	90.2
MN03196	14.3	13.7	4.1	9.6	62.1	28.8	53	10	9.6	1.57	461	85.1	82.8
ND808	14.3	13.8	4.0	8.8	60.6	33.4	70	6	9.6	1.51	460	79.7	57.2
Crookston (K)													
ND811	11.1	10.3	3.0	6.2	62.3	36.0	83	3	9.6	1.49	322	83.1	51.5
SD3948	13.1	12.4	4.2	8.4	63.2	35.7	81	3	9.6	1.46	399	81.0	54.5
ND810	13.9	13.0	4.3	9.6	63.0	32.1	71	5	9.3	1.41	431	87.0	50.7
Glenn	14.1	13.3	3.7	10	64.5	33.4	71	4	9.7	1.47	312	87.5	91.2
MN03196	13.8	13.4	4.1	9.6	64.0	30.8	57	9	9.6	1.38	406	87.9	82.6
ND808	12.2	11.7	3.9	7.4	63.0	37.7	87	3	9.7	1.31	336	76.0	92.4
Minot (M)													
A	13.7	12.9	3.5	7.4	59.1	33.1	74	3	10.6	1.33	384	73.1	14.2
01S0263-28	14.7	14.2	4.0	9	61.0	29.7	57	8	9.6	1.30	396	64.7	5.4
ND811	14.0	13.5	4.0	8.6	60.1	34.0	43	5	10.6	1.15	421	74.0	27.3
SD3948	14.8	14.0	4.5	10	61.9	34.8	78	3	10.6	1.19	405	74.3	11.4
B	12.8	11.8	3.4	6.4	59.8	29.6	46	10	10.1	1.17	407	66.2	6.7
Glenn	14.8	14.7	4.4	10	62.8	32.5	68	5	10.1	1.19	388	72.7	71.0
MN03196	14.3	13.6	4.3	9.4	62.3	33.3	67	7	10.4	1.24	410	78.7	67.2
BZ903-504	14.4	13.5	4.1	8.8	60.4	37.9	81	3	10.4	1.19	391	70.4	53.6
ND808	13.9	13.1	4.0	8.2	60.6	39.2	83	3	9.9	1.18	373	67.5	10.8
Williston (W)													
A	13.3	12.7	3.4	5.8	58.6	27.8	55	7	9.7	1.39	579	70.4	26.0
ND811	14.4	14.0	3.9	7.4	59.9	29.0	47	8	10.0	1.38	479	77.3	88.4
B	12.9	12.0	3.4	6.2	59.4	26.8	25	13	9.7	1.36	495	61.2	7.5
ND810	14.5	14.0	3.9	7	60.2	25.7	22	17	9.8	1.33	477	81.7	89.1
Glenn	16.6	15.9	4.8	10	62.4	28.4	27	11	9.4	1.44	464	76.6	98.0
ND808	15.3	14.7	4.0	8.2	58.7	30.3	47	9	9.5	1.35	466	73.7	80.0
CA905-781	16.2	15.5	4.2	8.8	59.4	31.7	50	8	9.8	1.46	479	62.8	82.1

Flour Characteristics by Location

Entry	Flour Extraction			Flour Color		Flour Moisture %	Flour Ash 14%mb	Flour FN Malted sec
	TWB %	TPB %	Flour/bu wheat Lbs	L*	b*			
Watertown (B)								
01S0263-28	70.1	73.5	45.7	89.7	10.3	13.1	0.529	251
SD3948	71.5	74.5	46.7	90.0	9.0	13.6	0.516	252
CA905-780	72.7	75.6	45.8	89.9	8.7	13.3	0.579	252
Glenn	69.9	73.7	46.2	89.8	8.2	13.3	0.518	251
MN03196	70.0	73.5	45.9	89.7	8.6	13.2	0.539	258
SD4011	72.3	74.5	45.3	89.8	8.3	12.9	0.507	257
Casselton (C)								
01S0263-28	72.4	76.3	45.9	89.1	10.3	12.5	0.615	258
ND811	72.4	76.0	46.9	89.7	9.2	13.0	0.499	256
CA905-776	70.9	74.7	45.9	89.5	10.7	12.6	0.530	254
SD3948	71.9	75.2	46.7	89.3	9.2	13.0	0.528	259
ND810	70.3	73.6	46.3	89.0	8.5	12.9	0.504	253
Glenn	69.4	73.1	46.6	89.9	8.4	12.5	0.473	252
MN03196	70.6	73.6	46.9	89.6	8.9	13.2	0.497	255
ND808	72.4	76.1	47.0	89.6	7.4	13.0	0.525	253
Crookston (K)								
ND811	69.2	72.7	46.0	90.0	9.3	13.1	0.484	248
SD3948	70.5	73.7	47.3	90.1	8.3	13.5	0.478	256
ND810	68.1	71.2	45.9	89.6	7.7	13.3	0.476	276
Glenn	68.8	72.0	47.2	90.2	7.5	13.2	0.468	259
MN03196	70.6	74.0	47.9	90.0	8.7	13.0	0.450	267
ND808	73.2	76.8	49.0	90.3	6.7	13.2	0.452	252
Minot (M)								
A	73.6	78.0	46.2	89.7	8.9	12.1	0.505	254
01S0263-28	73.1	76.8	47.8	89.5	10.4	12.8	0.454	269
ND811	72.2	75.4	45.8	89.9	9.4	13.5	0.390	250
SD3948	72.9	75.2	47.8	89.7	8.7	12.9	0.475	258
B	73.4	76.6	46.5	90.0	8.5	12.9	0.490	251
Glenn	72.9	75.9	48.5	90.0	8.1	13.4	0.433	252
MN03196	71.8	75.0	47.3	89.8	8.5	13.0	0.441	267
BZ903-504	71.5	75.1	45.8	89.9	8.7	13.0	0.434	266
ND808	74.7	78.4	48.3	89.8	7.2	12.7	0.456	251
Williston (W)								
A	73.5	77.1	46.3	90.6	8.9	12.7	0.470	250
ND811	69.8	74.1	44.6	90.5	9.3	11.9	0.479	249
B	70.8	74.3	44.4	90.8	8.6	12.3	0.476	241
ND810	70.0	73.8	44.9	89.9	9.0	12.8	0.471	264
Glenn	70.6	73.8	46.8	90.2	8.9	13.3	0.458	247
ND808	73.0	76.4	45.7	90.2	7.1	12.8	0.454	231
CA905-781	72.2	75.8	45.5	89.9	8.2	13.1	0.472	249

Mixograph Characteristics by Location

Entry	Mixograph						
	Envelope Peak Time Min	Envelope Peak Value %	Envelope Peak Width %	Midline Peak Time Min	Midline Peak Value %	Midline Peak Width %	Midline Peak Integral %tg*min
Watertown (B)							
01S0263-28	2.6	93.4	34.4	2.9	77.5	30.4	176.8
SD3948	2.9	89.2	29.2	3.0	75.5	26.2	173.6
CA905-780	2.1	81.3	28.6	2.5	68.7	21.1	127.0
Glenn	3.6	87.7	33.8	4.2	72.5	29.6	232.3
MN03196	3.1	88.3	34.3	3.2	72.1	34.0	177.3
SD4011	2.5	82.0	25.8	2.6	69.2	25.5	136.9
Casselton (C)							
01S0263-28	3.4	76.8	29.8	3.9	62.5	27.4	188.6
ND811	3.6	73.9	29.1	4.3	60.6	24.1	217.0
CA905-776	2.6	88.7	33.9	3.1	75.3	25.2	171.1
SD3948	2.9	83.5	29.6	3.3	69.5	29.3	174.1
ND810	2.9	80.8	33.5	3.2	64.8	31.4	170.3
Glenn	6.6	75.4	28.0	5.5	62.8	23.5	279.0
MN03196	4.0	76.2	26.6	4.2	63.1	25.0	206.9
ND808	2.8	80.5	28.6	3.0	66.8	27.9	156.7
Crookston (K)							
ND811	0.7	67.5	39.0	3.6	52.4	19.5	172.9
SD3948	4.0	69.0	23.3	3.5	57.4	21.3	175.9
ND810	2.3	73.7	28.6	2.7	60.3	24.2	141.8
Glenn	3.6	73.5	30.4	5.4	59.6	24.9	289.2
MN03196	3.4	79.9	33.9	4.0	64.7	26.3	209.2
ND808	2.9	80.5	27.5	3.3	67.5	22.7	183.4
Minot (M)							
A	3.1	75.1	26.7	3.1	62.2	26.8	152.1
01S0263-28	2.4	78.7	29.2	2.7	65.8	23.6	136.0
ND811	3.4	75.1	21.2	3.5	64.5	21.0	172.3
SD3948	3.0	74.3	24.8	3.3	62.8	20.3	158.0
B	2.9	85.5	32.8	3.4	70.2	25.6	176.2
Glenn	3.4	96.1	36.6	3.9	79.7	28.7	235.8
MN03196	2.9	87.6	29.4	3.2	74.4	20.9	176.8
BZ903-504	3.1	86.3	30.5	3.3	71.4	29.9	176.5
ND808	2.5	84.6	32.5	2.8	69.3	26.4	148.9
Williston (W)							
A	3.8	81.2	34.9	4.2	64.7	32.8	214.9
ND811	3.5	80.8	29.4	3.8	66.7	25.2	195.0
B	5.3	69.6	29.2	6.7	57.4	23.7	306.6
ND810	3.3	81.7	29.6	3.4	67.2	29.7	171.3
Glenn	4.9	87.8	34.9	5.1	70.9	34.1	255.5
ND808	4.2	80.3	33.2	4.2	64.5	33.2	214.8
CA905-781	5.0	80.3	30.3	4.9	65.7	30.1	239.0

Farinograph Characteristics by Location

Farinograph							
Entry	Water Abs 500 bu %	Water Abs 14%mb %	Arrival Time min	Peak Time min	Dough Stability min	MTI bu	TTB min
Watertown (B)							
01S0263-28	67.6	66.6	4.2	6.8	7.0	37.0	11.3
SD3948	66.9	66.4	3.5	6.7	7.1	35.0	10.5
CA905-780	64.7	63.9	3.6	4.7	4.8	37.0	8.9
Glenn	68.8	68.0	3.9	8.0	10.1	26.0	13.6
MN03196	69.8	68.9	3.9	7.0	7.3	37.0	11.2
SD4011	69.2	68.0	4.5	7.4	7.6	28.0	13.1
Casselton (C)							
01S0263-28	63.9	62.2	3.0	6.5	9.0	28.0	11.1
ND811	64.1	62.9	3.2	5.7	7.8	31.0	10.3
CA905-776	65.8	64.2	4.7	7.3	7.7	31.0	12.3
SD3948	64.9	63.7	2.2	5.8	6.8	39.0	9.3
ND810	67.0	65.7	2.8	5.7	7.2	40.0	9.6
Glenn	66.1	64.4	2.2	6.2	10.5	25.0	12.0
MN03196	64.0	63.1	3.3	7.2	9.0	31.0	12.1
ND808	65.9	64.7	3.2	5.7	6.7	36.0	9.8
Crookston (K)							
ND811	65.4	64.4	1.5	2.3	3.1	51.0	4.5
SD3948	65.1	64.5	1.9	3.7	6.2	35.0	8.2
ND810	69.1	68.3	2.5	4.9	5.2	50.0	7.7
Glenn	68.6	67.7	2.0	3.8	6.1	36.0	8.1
MN03196	66.4	65.2	2.8	7.7	10.6	25.0	12.9
ND808	65.9	65.0	2.1	3.8	6.2	37.0	7.9
Minot (M)							
A	65.5	63.3	3.5	6.2	5.2	48.0	8.9
01S0263-28	65.7	64.3	5.0	7.8	8.7	21.0	14.2
ND811	65.0	64.4	4.2	7.2	9.7	19.0	14.3
SD3948	64.3	63.0	3.7	6.0	6.4	38.0	10.1
B	61.3	60.0	2.8	5.8	7.6	33.0	10.5
Glenn	66.1	65.4	4.7	9.7	11.5	25.0	15.2
MN03196	67.6	66.4	4.7	7.5	7.4	33.0	11.9
BZ903-504	66.0	64.8	4.0	7.2	7.7	34.0	11.4
ND808	66.2	64.7	3.8	5.9	6.6	34.0	10.1
Williston (W)							
A	61.7	60.2	2.8	6.2	9.3	27.0	12.0
ND811	65.9	63.5	3.2	8.2	11.4	29.0	13.8
B	59.8	57.9	1.8	7.2	17.1	18.0	16.6
ND810	66.9	65.5	4.6	8.9	8.3	39.0	13.1
Glenn	66.5	65.7	5.8	13.7	14.1	12.0	20.0
ND808	64.9	63.5	3.5	7.4	11.0	22.0	13.0
CA905-781	64.2	63.2	3.9	9.3	16.0	16.0	20.0