

Wheat Quality Council

Hard Spring Wheat Technical Committee

2010 Crop



February 15 – 17, 2011



Kansas City, MO

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.

Twelve experimental lines of hard spring wheat were grown at up to five locations in 2010 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 2010 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.

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1

I. USDA/ARS WQL Data		W9	W1	M9	M1
Trait		Glenn		Glenn	
1	Wheat Protein (12%mb)	16.9	17.3	15.1	15.7
2	Flour Protein (12%mb)	16.9	17.1	14.7	15.4
3	Market Value (Score 1-6)	4.2	4.1	2.7	1.9
4	Market Value (Score 1-10)		5.0		4.6
5	Test Weight (lb/bu)	60.3	56.6	59.4	50.6
6	1000 Kernel Weight (g)	24.7	29.2	24.0	23.4
7	Kernel Size % Large	9.0	22.0	47.0	29.0
8	Kernel Size % Small	20.0	12.0	13.0	23.0
9	Wheat Moisture (%)	10.7	11.3	12.0	12.2
10	Wheat Ash (14%mb)	1.40	1.47	1.71	1.92
11	Wheat Falling Number (sec)	400	487	316	297
12	SKCS Hardness Index	70	53	84	66
13	Vitreous Kernels (%)	98.0	96.2	91.2	62.1
Flour Extraction (%)					
14	Tempered Wheat Basis (%)	70.0	67.5	70.7	63.8
15	Total Product Basis (%)	74.0	71.5	73.8	67.9
16	Flour /Bu Wheat (lbs)	44.9	40.6	44.3	34.0
17	Flour Color Brightness (L*)	90.1	90.7	90.5	89.8
18	Flour Color Yellowness (b*)	9.0	7.0	8.4	8.3
19	Flour Moisture (%)	12.5	11.7	12.8	12.4
20	Flour Ash (14%mb)	0.465	0.511	0.524	0.727
21	Flour Falling Number (Malted) (sec)	252	247	270	260
Farinograph					
22	Water Absorption (500bu)	67.0	67.5	64.3	66.1
23	Water Absorption (14%mb)	65.3	64.9	62.9	64.3
24	Arrival Time (min)	4.5	5.3	3.3	4.1
25	Peak Time (min)	8.7	8.7	8.3	8.5
26	Dough Stability (min)	12.4	13.0	10.1	11.3
27	MTI (bu)	16.0	18.0	31.0	22.0
28	TTB (min)	16.8	17.2	13.0	15.1
II. Cooperator Results					
29	Bake Absorption (Average %)	66.5	66.3	62.8	63.2
30	Loaf Volume (% of Check)		97.0		93.0

Trait	II. Cooperator Results	W9 Glenn	W1	M9 Glenn	M1
31	Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	4.2	3.6	4.0	2.3
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	4.1	3.5	4.7	2.7
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		2.5		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		1.7
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		2.5		2.0
	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		3.3		2.7
	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		2.6		2.0
	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		2.6		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		2.6		1.7

I. USDA/ARS WQL Data		C9	C2	K9	K2
Trait		Glenn		Glenn	
1	Wheat Protein (12%mb)	14.0	13.6	13.3	11.5
2	Flour Protein (12%mb)	13.2	13.2	12.7	11.2
3	Market Value (Score 1-6)	3.1	3.4	4.1	3.0
4	Market Value (Score 1-10)		6.8		5.6
5	Test Weight (lb/bu)	60.9	59.8	63.0	60.5
6	1000 Kernel Weight (g)	29.3	27.8	28.8	29.4
7	Kernel Size % Large	58.0	68.0	59.0	59.0
8	Kernel Size % Small	6.0	5.0	7.0	7.0
9	Wheat Moisture (%)	12.7	12.7	10.1	9.5
10	Wheat Ash (14%mb)	1.69	1.67	1.57	1.64
11	Wheat Falling Number (sec)	356	536	457	572
12	SKCS Hardness Index	78	79	80	76
13	Vitreous Kernels (%)	5.6	8.4	20.0	5.5
Flour Extraction (%)					
14	Tempered Wheat Basis (%)	69.4	70.8	71.6	73.2
15	Total Product Basis (%)	73.2	74.9	75.1	77.0
16	Flour /Bu Wheat (lbs)	44.2	44.3	48.5	48.0
17	Flour Color Brightness (L*)	90.7	90.2	90.4	90.5
18	Flour Color Yellowness (b*)	7.9	9.1	8.5	9.8
19	Flour Moisture (%)	12.9	12.6	12.6	12.8
20	Flour Ash (14%mb)	0.431	0.620	0.504	0.555
21	Flour Falling Number (Malted) (sec)	253	254	255	248
Farinograph					
22	Water Absorption (500bu)	66.1	69.5	64.8	65.5
23	Water Absorption (14%mb)	64.8	67.9	63.2	64.1
24	Arrival Time (min)	1.8	2.3	1.7	1.5
25	Peak Time (min)	3.2	3.8	2.8	2.9
26	Dough Stability (min)	5.0	5.6	7.4	4.1
27	MTI (bu)	50.0	38.0	22.0	62.0
28	TTB (min)	6.5	7.9	8.8	5.7
II. Cooperator Results					
29	Bake Absorption (Average %)	65.2	66.5	63.7	63.1
30	Loaf Volume (% of Check)		90.4		89.9

Trait	II. Cooperator Results	C9 Glenn	C2	K9 Glenn	K2
31	Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	3.6	2.5	4.2	2.6
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	3.5	2.5	3.6	2.5
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		2.4		1.6
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		3.0		2.8
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		2.7		2.5
	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		2.5		1.4
	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		2.6		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		1.8		1.9
	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		1.8		1.6

I. USDA/ARS WQL Data		B9	B3	C9	C3	K9	K3	W9	W3	M9	M3
Trait		Glenn		Glenn		Glenn		Glenn		Glenn	
1	Wheat Protein (12%mb)	15.1	14.9	14.0	12.5	13.3	11.2	16.9	16.8	15.1	13.8
2	Flour Protein (12%mb)	14.8	14.7	13.2	11.9	12.7	10.8	16.9	16.5	14.7	13.6
3	Market Value (Score 1-6)	4.4	3.2	3.1	3.0	4.1	2.9	4.2	4.2	2.7	2.4
4	Market Value (Score 1-10)		5.0		6.2		4.6		5.6		5.0
5	Test Weight (lb/bu)	63.0	57.6	60.9	59.0	63.0	60.1	60.3	57.8	59.4	54.8
6	1000 Kernel Weight (g)	26.9	24.9	29.3	31.8	28.8	29.6	24.7	29.3	24.0	22.5
7	Kernel Size % Large	59.0	48.0	58.0	79.0	59.0	78.0	9.0	36.0	47.0	55.0
8	Kernel Size % Small	8.0	10.0	6.0	4.0	7.0	5.0	20.0	10.0	13.0	10.0
9	Wheat Moisture (%)	11.4	10.5	12.7	13.0	10.1	9.2	10.7	10.7	12.0	11.8
10	Wheat Ash (14%mb)	1.63	1.63	1.69	1.64	1.57	1.59	1.40	1.38	1.71	1.65
11	Wheat Falling Number (sec)	463	448	356	423	457	474	400	466	316	400
12	SKCS Hardness Index	83	82	78	65	80	67	70	69	84	79
13	Vitreous Kernels (%)	95.9	83.9	5.6	9.0	20.0	33.5	98.0	90.0	91.2	92.3
Flour Extraction (%)											
14	Tempered Wheat Basis (%)	69.8	70.0	69.4	71.2	71.6	72.0	70.0	69.3	70.7	69.8
15	Total Product Basis (%)	73.3	73.5	73.2	75.5	75.1	76.1	74.0	73.3	73.8	74.3
16	Flour /Bu Wheat (lbs)	46.6	43.2	44.2	43.8	48.5	47.0	44.9	42.9	44.3	40.4
17	Flour Color Brightness (L*)	89.5	90.5	90.7	90.1	90.4	90.6	90.1	90.1	90.5	90.0
18	Flour Color Yellowness (b*)	8.1	9.5	7.9	9.0	8.5	9.2	9.0	9.5	8.4	9.2
19	Flour Moisture (%)	12.9	12.8	12.9	12.2	12.6	12.2	12.5	12.5	12.8	12.8
20	Flour Ash (14%mb)	0.440	0.526	0.431	0.560	0.504	0.517	0.465	0.469	0.524	0.659
21	Flour Falling Number (Malted) (sec)	260	264	253	256	255	261	252	243	270	263
Farinograph											
22	Water Absorption (500bu)	65.4	64.7	66.1	63.6	64.8	63.1	67.0	68.7	64.3	65.1
23	Water Absorption (14%mb)	64.1	63.3	64.8	61.5	63.2	61.0	65.3	67.0	62.9	63.7
24	Arrival Time (min)	1.8	2.9	1.8	1.5	1.7	1.4	4.5	5.1	3.3	3.4
25	Peak Time (min)	4.5	7.5	3.2	3.9	2.8	2.3	8.7	7.8	8.3	7.5
26	Dough Stability (min)	10.2	12.0	5.0	6.7	7.4	3.5	12.4	7.7	10.1	9.3
27	MTI (bu)	23.0	25.0	50.0	33.0	22.0	49.0	16.0	25.0	31.0	28.0
28	TTB (min)	10.5	14.8	6.5	8.3	8.8	4.6	16.8	13.7	13.0	13.0
II. Cooperator Results											
29	Bake Absorption (Average %)	64.8	64.6	65.2	62.5	63.7	61.5	66.5	67.2	62.8	62.2
30	Loaf Volume (% of Check)		95.7		95.8		93.5		94.6		92.0

Trait	II. Cooperator Results	B9 Glenn	B3	C9 Glenn	C3	K9 Glenn	K3	W9 Glenn	W3	M9 Glenn	M3
31	Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	4.3	3.8	3.6	2.7	4.2	3.0	4.2	2.8	4.0	2.0
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	4.1	3.3	3.5	3.0	3.6	2.4	4.1	2.9	4.7	2.3
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		2.5		2.8		2.0		1.7		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		2.1		2.5		2.5		2.4		2.3
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		3.0		2.5		2.5		2.3
	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		2.8		1.5		1.5		2.8		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		2.4		3.0		3.1		3.0		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		2.5		2.2		2.2		2.5		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		2.3		2.2		2.1		2.4		2.0

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7

I. USDA/ARS WQL Data		W9	W4	M9	M4
Trait		Glenn		Glenn	
1	Wheat Protein (12%mb)	16.9	18.3	15.1	15.0
2	Flour Protein (12%mb)	16.9	18.2	14.7	14.8
3	Market Value (Score 1-6)	4.2	3.7	2.7	1.9
4	Market Value (Score 1-10)		5.4		4.2
5	Test Weight (lb/bu)	60.3	57.8	59.4	56.1
6	1000 Kernel Weight (g)	24.7	23.0	24.0	24.9
7	Kernel Size % Large	9.0	7.0	47.0	50.0
8	Kernel Size % Small	20.0	28.0	13.0	13.0
9	Wheat Moisture (%)	10.7	10.8	12.0	12.1
10	Wheat Ash (14%mb)	1.40	1.59	1.71	1.72
11	Wheat Falling Number (sec)	400	400	316	250
12	SKCS Hardness Index	70	66	84	79
13	Vitreous Kernels (%)	98.0	94.6	91.2	93.0
Flour Extraction (%)					
14	Tempered Wheat Basis (%)	70.0	70.5	70.7	69.8
15	Total Product Basis (%)	74.0	75.0	73.8	73.0
16	Flour /Bu Wheat (lbs)	44.9	43.5	44.3	41.3
17	Flour Color Brightness (L*)	90.1	89.9	90.5	90.5
18	Flour Color Yellowness (b*)	9.0	10.3	8.4	9.3
19	Flour Moisture (%)	12.5	13.0	12.8	13.3
20	Flour Ash (14%mb)	0.465	0.467	0.524	0.576
21	Flour Falling Number (Malted) (sec)	252	243	270	250
Farinograph					
22	Water Absorption (500bu)	67.0	68.1	64.3	65.7
23	Water Absorption (14%mb)	65.3	66.9	62.9	64.9
24	Arrival Time (min)	4.5	5.2	3.3	4.1
25	Peak Time (min)	8.7	8.8	8.3	8.0
26	Dough Stability (min)	12.4	12.0	10.1	9.5
27	MTI (bu)	16.0	23.0	31.0	30.0
28	TTB (min)	16.8	16.6	13.0	13.5
II. Cooperator Results					
29	Bake Absorption (Average %)	66.5	67.3	62.8	63.1
30	Loaf Volume (% of Check)		107.8		102.7

Trait	II. Cooperator Results	W9 Glenn	W4	M9 Glenn	M4
31	Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	4.2	3.5	4.0	2.3
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	4.1	4.1	4.7	2.7
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		2.9		2.0
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		2.8		2.7
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		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		3.9		2.7
	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		2.6		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		3.1		2.7
	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		3.1		2.3

I. USDA/ARS WQL Data		B9	B5	C9	C5	K9	K5	M9	M5
		Glenn		Glenn		Glenn		Glenn	
1	Wheat Protein (12%mb)	15.1	15.9	14.0	14.1	13.3	13.1	15.1	14.7
2	Flour Protein (12%mb)	14.8	15.8	13.2	13.4	12.7	12.4	14.7	14.5
3	Market Value (Score 1-6)	4.4	3.7	3.1	3.5	4.1	3.3	2.7	2.6
4	Market Value (Score 1-10)		5.0		5.6		5.0		5.0
5	Test Weight (lb/bu)	63.0	58.5	60.9	58.6	63.0	59.2	59.4	54.9
6	1000 Kernel Weight (g)	26.9	26.7	29.3	28.8	28.8	27.7	24.0	26.0
7	Kernel Size % Large	59.0	52.0	58.0	55.0	59.0	58.0	47.0	46.0
8	Kernel Size % Small	8.0	9.0	6.0	5.0	7.0	7.0	13.0	13.0
9	Wheat Moisture (%)	11.4	10.7	12.7	12.5	10.1	9.2	12.0	12.6
10	Wheat Ash (14%mb)	1.63	1.58	1.69	1.57	1.57	1.57	1.71	1.60
11	Wheat Falling Number (sec)	463	525	356	450	457	504	316	387
12	SKCS Hardness Index	83	72	78	57	80	61	84	66
13	Vitreous Kernels (%)	95.9	48.2	5.6	0.0	20.0	7.0	91.2	36.1
Flour Extraction (%)									
14	Tempered Wheat Basis (%)	69.8	71.1	69.4	72.0	71.6	72.5	70.7	70.4
15	Total Product Basis (%)	73.3	75.7	73.2	75.9	75.1	76.2	73.8	73.6
16	Flour /Bu Wheat (lbs)	46.6	44.5	44.2	44.2	48.5	46.7	44.3	40.4
17	Flour Color Brightness (L*)	89.5	89.1	90.7	91.0	90.4	90.8	90.5	90.6
18	Flour Color Yellowness (b*)	8.1	8.7	7.9	8.0	8.5	8.5	8.4	8.4
19	Flour Moisture (%)	12.9	11.7	12.9	12.8	12.6	12.9	12.8	12.9
20	Flour Ash (14%mb)	0.440	0.553	0.431	0.471	0.504	0.517	0.524	0.550
21	Flour Falling Number (Malted) (sec)	260	266	253	245	255	254	270	261
Farinograph									
22	Water Absorption (500bu)	65.4	67.3	66.1	64.6	64.8	62.2	64.3	64.2
23	Water Absorption (14%mb)	64.1	64.7	64.8	63.2	63.2	60.9	62.9	62.9
24	Arrival Time (min)	1.8	4.5	1.8	3.5	1.7	2.8	3.3	4.3
25	Peak Time (min)	4.5	7.4	3.2	7.2	2.8	6.9	8.3	8.0
26	Dough Stability (min)	10.2	7.6	5.0	7.4	7.4	8.8	10.1	8.8
27	MTI (bu)	23.0	29.0	50.0	34.0	22.0	31.0	31.0	27.0
28	TTB (min)	10.5	11.9	6.5	11.5	8.8	11.8	13.0	14.1
II. Cooperator Results									
29	Bake Absorption (Average %)	64.8	65.8	65.2	63.5	63.7	61.9	62.8	62.3
30	Loaf Volume (% of Check)		97.7		99.7		100.3		98.7

Trait	II. Cooperator Results	B9 Glenn	B5	C9 Glenn	C5	K9 Glenn	K5	M9 Glenn	M5
31	Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	4.3	3.0	3.6	2.0	4.2	2.6	4.0	2.3
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	4.1	3.2	3.5	2.3	3.6	2.4	4.7	3.0
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		2.7		2.5		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		2.4		3.1		3.2		2.7
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		2.6		2.7		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		3.8		3.0		2.7		3.3
	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		2.4		3.0		2.8		2.0
	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		3.0		2.5		2.5		3.0
	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		2.6		2.3		2.4		2.7

B (BR5874E)

11

I. USDA/ARS WQL Data		W9	W6	M9	M6
Trait		Glenn		Glenn	
1	Wheat Protein (12%mb)	16.9	16.6	15.1	14.9
2	Flour Protein (12%mb)	16.9	16.5	14.7	14.6
3	Market Value (Score 1-6)	4.2	3.3	2.7	2.1
4	Market Value (Score 1-10)		5.0		5.0
5	Test Weight (lb/bu)	60.3	53.4	59.4	49.5
6	1000 Kernel Weight (g)	24.7	21.9	24.0	19.0
7	Kernel Size % Large	9.0	1.0	47.0	22.0
8	Kernel Size % Small	20.0	27.0	13.0	38.0
9	Wheat Moisture (%)	10.7	10.8	12.0	12.2
10	Wheat Ash (14%mb)	1.40	1.39	1.71	1.65
11	Wheat Falling Number (sec)	400	400	316	343
12	SKCS Hardness Index	70	57	84	60
13	Vitreous Kernels (%)	98.0	70.4	91.2	37.4
Flour Extraction (%)					
14	Tempered Wheat Basis (%)	70.0	69.4	70.7	65.5
15	Total Product Basis (%)	74.0	73.9	73.8	71.0
16	Flour /Bu Wheat (lbs)	44.9	39.6	44.3	34.2
17	Flour Color Brightness (L*)	90.1	90.3	90.5	90.4
18	Flour Color Yellowness (b*)	9.0	9.3	8.4	8.7
19	Flour Moisture (%)	12.5	12.2	12.8	12.8
20	Flour Ash (14%mb)	0.465	0.526	0.524	0.616
21	Flour Falling Number (Malted) (sec)	252	250	270	254
Farinograph					
22	Water Absorption (500bu)	67.0	62.1	64.3	60.9
23	Water Absorption (14%mb)	65.3	60.0	62.9	59.5
24	Arrival Time (min)	4.5	4.2	3.3	4.0
25	Peak Time (min)	8.7	7.4	8.3	7.5
26	Dough Stability (min)	12.4	8.3	10.1	9.4
27	MTI (bu)	16.0	32.0	31.0	29.0
28	TTB (min)	16.8	12.1	13.0	13.4
II. Cooperator Results					
29	Bake Absorption (Average %)	66.5	62.5	62.8	61.6
30	Loaf Volume (% of Check)		99.1		94.7

B (BR5874E)

Trait	II. Cooperator Results	W9 Glenn	W6	M9 Glenn	M6
31	Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	4.2	3.9	4.0	2.3
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	4.1	3.5	4.7	2.7
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		2.0
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		2.3
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		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		3.0		2.7
	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		1.3
	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		3.0		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		3.0		2.0

ND905CL PLUS

13

I. USDA/ARS WQL Data		W9	W7	M9	M7
Trait		Glenn		Glenn	
1	Wheat Protein (12%mb)	16.9	17.3	15.1	15.5
2	Flour Protein (12%mb)	16.9	17.2	14.7	15.0
3	Market Value (Score 1-6)	4.2	3.5	2.7	2.6
4	Market Value (Score 1-10)		5.0		4.8
5	Test Weight (lb/bu)	60.3	58.4	59.4	54.1
6	1000 Kernel Weight (g)	24.7	26.5	24.0	23.9
7	Kernel Size % Large	9.0	21.0	47.0	33.0
8	Kernel Size % Small	20.0	12.0	13.0	21.0
9	Wheat Moisture (%)	10.7	11.1	12.0	12.0
10	Wheat Ash (14%mb)	1.40	1.49	1.71	1.83
11	Wheat Falling Number (sec)	400	320	316	398
12	SKCS Hardness Index	70	72	84	80
13	Vitreous Kernels (%)	98.0	89.8	91.2	90.1
Flour Extraction (%)					
14	Tempered Wheat Basis (%)	70.0	71.1	70.7	68.1
15	Total Product Basis (%)	74.0	73.4	73.8	71.8
16	Flour /Bu Wheat (lbs)	44.9	44.3	44.3	38.9
17	Flour Color Brightness (L*)	90.1	89.3	90.5	89.8
18	Flour Color Yellowness (b*)	9.0	9.9	8.4	9.7
19	Flour Moisture (%)	12.5	13.0	12.8	12.6
20	Flour Ash (14%mb)	0.465	0.510	0.524	0.622
21	Flour Falling Number (Malted) (sec)	252	256	270	272
Farinograph					
22	Water Absorption (500bu)	67.0	66.8	64.3	65.5
23	Water Absorption (14%mb)	65.3	65.6	62.9	63.9
24	Arrival Time (min)	4.5	4.9	3.3	4.1
25	Peak Time (min)	8.7	8.8	8.3	7.4
26	Dough Stability (min)	12.4	9.2	10.1	7.4
27	MTI (bu)	16.0	26.0	31.0	35.0
28	TTB (min)	16.8	14.3	13.0	11.4
II. Cooperator Results					
29	Bake Absorption (Average %)	66.5	66.0	62.8	63.1
30	Loaf Volume (% of Check)		101.6		98.3

Trait	II. Cooperator Results	W9 Glenn	W7	M9 Glenn	M7
31	Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	4.2	3.2	4.0	2.7
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	4.1	3.5	4.7	3.3
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		2.2		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		2.8		2.3
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		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		3.3		3.0
	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		2.3
	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		2.7
	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		3.1		2.7

I. USDA/ARS WQL Data		C9	C8	M9	M8
Trait		Glenn		Glenn	
1	Wheat Protein (12%mb)	14.0	12.9	15.1	14.2
2	Flour Protein (12%mb)	13.2	12.1	14.7	13.8
3	Market Value (Score 1-6)	3.1	1.7	2.7	2.1
4	Market Value (Score 1-10)		3.0		5.0
5	Test Weight (lb/bu)	60.9	57.8	59.4	53.6
6	1000 Kernel Weight (g)	29.3	27.4	24.0	23.6
7	Kernel Size % Large	58.0	42.0	47.0	29.0
8	Kernel Size % Small	6.0	10.0	13.0	24.0
9	Wheat Moisture (%)	12.7	12.2	12.0	11.9
10	Wheat Ash (14%mb)	1.69	1.57	1.71	1.72
11	Wheat Falling Number (sec)	356	154	316	361
12	SKCS Hardness Index	78	76	84	87
13	Vitreous Kernels (%)	5.6	5.0	91.2	73.0
Flour Extraction (%)					
14	Tempered Wheat Basis (%)	69.4	71.6	70.7	69.8
15	Total Product Basis (%)	73.2	75.6	73.8	72.3
16	Flour /Bu Wheat (lbs)	44.2	40.9	44.3	39.5
17	Flour Color Brightness (L*)	90.7	90.3	90.5	89.8
18	Flour Color Yellowness (b*)	7.9	8.7	8.4	9.3
19	Flour Moisture (%)	12.9	12.7	12.8	12.8
20	Flour Ash (14%mb)	0.431	0.547	0.524	0.647
21	Flour Falling Number (Malted) (sec)	253	203	270	257
Farinograph					
22	Water Absorption (500bu)	66.1	64.3	64.3	64.4
23	Water Absorption (14%mb)	64.8	62.8	62.9	63.0
24	Arrival Time (min)	1.8	2.2	3.3	2.5
25	Peak Time (min)	3.2	5.5	8.3	7.0
26	Dough Stability (min)	5.0	7.1	10.1	10.8
27	MTI (bu)	50.0	40.0	31.0	27.0
28	TTB (min)	6.5	9.4	13.0	12.5
II. Cooperator Results					
29	Bake Absorption (Average %)	65.2	63.4	62.8	62.3
30	Loaf Volume (% of Check)		101.8		102.0

Trait	II. Cooperator Results	C9 Glenn	C8	M9 Glenn	M8
31	Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	3.6	4.1	4.0	4.0
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	3.5	3.9	4.7	4.7
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		3.5		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		3.3		3.0
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		3.3		3.0
	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		1.8		3.0
	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		2.4		2.0
	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		3.2		3.3
	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		3.0		3.3

I. USDA/ARS WQL Data		C9	C10	W9	W10	M9	M10
Trait		Glenn		Glenn		Glenn	
1	Wheat Protein (12%mb)	14.0	14.1	16.9	17.2	15.1	15.1
2	Flour Protein (12%mb)	13.2	13.6	16.9	17.1	14.7	14.8
3	Market Value (Score 1-6)	3.1	3.1	4.2	3.7	2.7	2.0
4	Market Value (Score 1-10)		6.0		4.8		4.6
5	Test Weight (lb/bu)	60.9	59.2	60.3	57.2	59.4	55.8
6	1000 Kernel Weight (g)	29.3	27.8	24.7	25.3	24.0	19.2
7	Kernel Size % Large	58.0	60.0	9.0	24.0	47.0	41.0
8	Kernel Size % Small	6.0	8.0	20.0	13.0	13.0	18.0
9	Wheat Moisture (%)	12.7	12.3	10.7	10.5	12.0	11.7
10	Wheat Ash (14%mb)	1.69	1.80	1.40	1.51	1.71	1.69
11	Wheat Falling Number (sec)	356	406	400	400	316	286
12	SKCS Hardness Index	78	69	70	69	84	78
13	Vitreous Kernels (%)	5.6	65.7	98.0	97.0	91.2	94.5
Flour Extraction (%)							
14	Tempered Wheat Basis (%)	69.4	72.1	70.0	70.8	70.7	70.7
15	Total Product Basis (%)	73.2	75.7	74.0	74.7	73.8	73.2
16	Flour /Bu Wheat (lbs)	44.2	44.8	44.9	43.4	44.3	41.6
17	Flour Color Brightness (L*)	90.7	90.7	90.1	90.1	90.5	90.3
18	Flour Color Yellowness (b*)	7.9	10.4	9.0	10.6	8.4	10.3
19	Flour Moisture (%)	12.9	12.8	12.5	12.6	12.8	13.0
20	Flour Ash (14%mb)	0.431	0.640	0.465	0.597	0.524	0.635
21	Flour Falling Number (Malted) (sec)	253	277	252	268	270	262
Farinograph							
22	Water Absorption (500bu)	66.1	64.8	67.0	68.8	64.3	65.2
23	Water Absorption (14%mb)	64.8	63.4	65.3	67.2	62.9	64.0
24	Arrival Time (min)	1.8	3.5	4.5	5.8	3.3	4.5
25	Peak Time (min)	3.2	6.7	8.7	10.7	8.3	7.9
26	Dough Stability (min)	5.0	8.4	12.4	13.2	10.1	8.6
27	MTI (bu)	50.0	25.0	16.0	17.0	31.0	28.0
28	TTB (min)	6.5	12.6	16.8	18.3	13.0	13.3
II. Cooperator Results							
29	Bake Absorption (Average %)	65.2	63.6	66.5	67.4	62.8	62.7
30	Loaf Volume (% of Check)		98.9		98.0		96.0

Trait	II. Cooperator Results	C9 Glenn	C10	W9 Glenn	W10	M9 Glenn	M10
31	Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	3.6	2.7	4.2	3.6	4.0	2.3
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	3.5	2.5	4.1	3.8	4.7	3.0
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		3.0		3.0		2.0
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		2.5		2.2		2.7
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		2.7		3.0
	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		3.1		3.0		2.7
	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		2.5		2.0
	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		2.6		2.7
	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		2.8		2.8		2.3

I. USDA/ARS WQL Data		W9	W11
Trait		Glenn	
1	Wheat Protein (12%mb)	16.9	16.9
2	Flour Protein (12%mb)	16.9	16.7
3	Market Value (Score 1-6)	4.2	3.6
4	Market Value (Score 1-10)		4.8
5	Test Weight (lb/bu)	60.3	55.8
6	1000 Kernel Weight (g)	24.7	27.0
7	Kernel Size % Large	9.0	27.0
8	Kernel Size % Small	20.0	11.0
9	Wheat Moisture (%)	10.7	10.7
10	Wheat Ash (14%mb)	1.40	1.51
11	Wheat Falling Number (sec)	400	400
12	SKCS Hardness Index	70	57
13	Vitreous Kernels (%)	98.0	95.1
Flour Extraction (%)			
14	Tempered Wheat Basis (%)	70.0	70.1
15	Total Product Basis (%)	74.0	73.4
16	Flour /Bu Wheat (lbs)	44.9	41.9
17	Flour Color Brightness (L*)	90.1	91.2
18	Flour Color Yellowness (b*)	9.0	8.5
19	Flour Moisture (%)	12.5	13.0
20	Flour Ash (14%mb)	0.465	0.539
21	Flour Falling Number (Malted) (sec)	252	254
Farinograph			
22	Water Absorption (500bu)	67.0	65.2
23	Water Absorption (14%mb)	65.3	64.0
24	Arrival Time (min)	4.5	5.2
25	Peak Time (min)	8.7	11.4
26	Dough Stability (min)	12.4	14.8
27	MTI (bu)	16.0	8.0
28	TTB (min)	16.8	20.0
II. Cooperator Results			
29	Bake Absorption (Average %)	66.5	65.1
30	Loaf Volume (% of Check)		101.5

Trait	II. Cooperator Results	W9 Glenn	W11
31	Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	4.2	4.5
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	4.1	4.3
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		3.5
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		2.9
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
	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		3.0
	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		2.6
	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		3.4
	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		3.3

I. USDA/ARS WQL Data		B9	B12	C9	C12	K9	K12	M9	M12
Trait		Glenn		Glenn		Glenn		Glenn	
1	Wheat Protein (12%mb)	15.1	14.5	14.0	12.9	13.3	11.9	15.1	14.7
2	Flour Protein (12%mb)	14.8	14.2	13.2	12.1	12.7	11.5	14.7	14.2
3	Market Value (Score 1-6)	4.4	3.6	3.1	3.1	4.1	3.5	2.7	2.7
4	Market Value (Score 1-10)		5.0		5.0		5.6		5.0
5	Test Weight (lb/bu)	63.0	59.1	60.9	58.2	63.0	60.5	59.4	53.9
6	1000 Kernel Weight (g)	26.9	29.2	29.3	30.9	28.8	35.8	24.0	25.8
7	Kernel Size % Large	59.0	64.0	58.0	80.0	59.0	79.0	47.0	47.0
8	Kernel Size % Small	8.0	8.0	6.0	5.0	7.0	5.0	13.0	16.0
9	Wheat Moisture (%)	11.4	10.6	12.7	12.4	10.1	9.3	12.0	13.6
10	Wheat Ash (14%mb)	1.63	1.51	1.69	1.60	1.57	1.47	1.71	1.66
11	Wheat Falling Number (sec)	463	464	356	430	457	444	316	392
12	SKCS Hardness Index	83	81	78	68	80	65	84	79
13	Vitreous Kernels (%)	95.9	65.0	5.6	2.0	20.0	15.5	91.2	89.2
Flour Extraction (%)									
14	Tempered Wheat Basis (%)	69.8	72.9	69.4	71.7	71.6	75.2	70.7	69.6
15	Total Product Basis (%)	73.3	76.8	73.2	76.4	75.1	79.0	73.8	74.1
16	Flour /Bu Wheat (lbs)	46.6	46.1	44.2	43.7	48.5	49.4	44.3	39.2
17	Flour Color Brightness (L*)	89.5	90.0	90.7	90.6	90.4	90.6	90.5	90.0
18	Flour Color Yellowness (b*)	8.1	7.4	7.9	6.8	8.5	7.0	8.4	8.0
19	Flour Moisture (%)	12.9	12.7	12.9	13.3	12.6	12.7	12.8	12.4
20	Flour Ash (14%mb)	0.440	0.542	0.431	0.541	0.504	0.539	0.524	0.641
21	Flour Falling Number (Malted) (sec)	260	252	253	247	255	247	270	274
Farinograph									
22	Water Absorption (500bu)	65.4	65.5	66.1	63.3	64.8	63.7	64.3	65.5
23	Water Absorption (14%mb)	64.1	64.0	64.8	62.5	63.2	62.2	62.9	63.7
24	Arrival Time (min)	1.8	2.5	1.8	1.5	1.7	1.5	3.3	3.9
25	Peak Time (min)	4.5	5.3	3.2	2.5	2.8	2.5	8.3	6.3
26	Dough Stability (min)	10.2	8.1	5.0	3.9	7.4	5.1	10.1	7.9
27	MTI (bu)	23.0	31.0	50.0	50.0	22.0	38.0	31.0	29.0
28	TTB (min)	10.5	10.3	6.5	5.5	8.8	6.7	13.0	11.5
II. Cooperator Results									
29	Bake Absorption (Average %)	64.8	64.8	65.2	62.4	63.7	61.8	62.8	62.5
30	Loaf Volume (% of Check)		97.7		98.0		94.0		92.7

Trait	II. Cooperator Results	B9 Glenn	B12	C9 Glenn	C12	K9 Glenn	K12	M9 Glenn	M12
31	Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	4.3	3.5	3.6	2.8	4.2	2.8	4.0	2.3
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	4.1	3.2	3.5	3.3	3.6	2.7	4.7	3.0
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		2.3		2.1		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		3.1		3.7		3.2		2.7
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		3.7		2.7		3.0
	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		1.8		2.1		3.0
	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		3.0		2.9		3.3		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		3.3		2.8		2.6		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		2.8		2.6		2.6		2.3

I. USDA/ARS WQL Data		C9	C13	M9	M13
Trait		Glenn		Glenn	
1	Wheat Protein (12%mb)	14.0	13.2	15.1	14.2
2	Flour Protein (12%mb)	13.2	12.7	14.7	13.8
3	Market Value (Score 1-6)	3.1	3.0	2.7	1.9
4	Market Value (Score 1-10)		4.8		4.8
5	Test Weight (lb/bu)	60.9	58.3	59.4	54.2
6	1000 Kernel Weight (g)	29.3	28.1	24.0	22.8
7	Kernel Size % Large	58.0	54.0	47.0	30.0
8	Kernel Size % Small	6.0	10.0	13.0	19.0
9	Wheat Moisture (%)	12.7	12.3	12.0	12.3
10	Wheat Ash (14%mb)	1.69	1.80	1.71	1.83
11	Wheat Falling Number (sec)	356	424	316	335
12	SKCS Hardness Index	78	78	84	95
13	Vitreous Kernels (%)	5.6	11.4	91.2	76.5
Flour Extraction (%)					
14	Tempered Wheat Basis (%)	69.4	71.0	70.7	69.0
15	Total Product Basis (%)	73.2	74.5	73.8	72.1
16	Flour /Bu Wheat (lbs)	44.2	43.4	44.3	39.4
17	Flour Color Brightness (L*)	90.7	89.8	90.5	89.9
18	Flour Color Yellowness (b*)	7.9	9.2	8.4	9.9
19	Flour Moisture (%)	12.9	12.9	12.8	13.2
20	Flour Ash (14%mb)	0.431	0.588	0.524	0.660
21	Flour Falling Number (Malted) (sec)	253	254	270	261
Farinograph					
22	Water Absorption (500bu)	66.1	65.2	64.3	64.6
23	Water Absorption (14%mb)	64.8	63.9	62.9	63.7
24	Arrival Time (min)	1.8	1.6	3.3	2.5
25	Peak Time (min)	3.2	2.5	8.3	7.2
26	Dough Stability (min)	5.0	5.6	10.1	12.0
27	MTI (bu)	50.0	37.0	31.0	21.0
28	TTB (min)	6.5	6.8	13.0	13.6
II. Cooperator Results					
29	Bake Absorption (Average %)	65.2	64.0	62.8	62.3
30	Loaf Volume (% of Check)		96.3		95.0

Trait	II. Cooperator Results	C9 Glenn	C13	M9 Glenn	M13
31	Mixing Requirement 5 Very Long 4 Long 3 Medium 2 Short 1 Very Short	3.6	4.2	4.0	3.7
32	Dough Characteristics 5 Bucky-Tough 4 Strong-Elastic 3 Medium-Pliable 2 Mellow-Very Pliable 1 Weak-Short or Sticky	3.5	4.2	4.7	4.3
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		3.2		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		2.9		2.7
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		3.0
	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		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		2.5		2.0
	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		2.7
	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		2.7		2.7

Glenn Checks 2010 and 2009 Crop Years

2010 Hard Spring Wheat Crop					2009 Hard Spring Wheat Crop			
Watertown Cooperator	Bake	Loaf	Mixing	Dough	Bake	Loaf	Mixing	Dough
	Absorption	Volume	Requirement	Characteristic		Absorption	Volume	Requirement
1	60.0	2800	5	5	61.0	2750	4	4
2	60.5	2950	3	3	65.0	2850	3	3
3	64.0	1047	4	4	64.0	1033	5	4
4	64.0	3104	5	5	66.0	3045	5	5
5	66.1	2675	3	4	70.0	3075	3	3
6	70.4	1118	5	4	65.0	2750	4	3
7	64.0	2750	5	5	67.3	1035	3	4
8	63.9	1025	4	3	70.4	1050	4	5
9	70.7	1083	5	4	67.2	1035	3	4
10	65.6	910	3	4	71.1	1002	3	5
11	64.0	2675	5	4				
Average	64.8		4.3	4.1	66.7		3.7	4.0
± 1 Std Dev	3.4		0.9	0.7	3.2		0.8	0.8
Casselton Cooperator	Bake	Loaf	Mixing	Dough	Bake	Loaf	Mixing	Dough
	Absorption	Volume	Requirement	Characteristic		Absorption	Volume	Requirement
1	59.0	2900	5	5	60.0	3000	5	5
2	62.0	3000	3	3	61.5	2800	3	3
3	63.0	997	3	3	64.0	1060	5	4
4	65.0	3074	5	5	65.0	3000	5	5
5	66.8	2775	3	3	66.4	2825	3	3
6	70.9	1024	4	3	63.0	2900	4	4
7	64.0	2750	3	3	64.6	1025	3	4
8	64.6	990	4	4	70.7	1015	5	3
9	71.2	1000	4	3	65.1	960	3	4
10	66.1	915	3	4	68.7	1010	4	3
11	64.5	2600	3	3				
Average	65.2		3.6	3.5	64.9		4.0	3.8
± 1 Std Dev	3.6		0.8	0.8	3.2		0.9	0.8
Crookston Cooperator	Bake	Loaf	Mixing	Dough	Bake	Loaf	Mixing	Dough
	Absorption	Volume	Requirement	Characteristic		Absorption	Volume	Requirement
1	59.0	2900	5	5	59.0	2900	4	4
2	61.0	3000	3	3	64.5	2800	3	3
3	62.0	990	4	3	63.0	950	4	4
4	63.0	3104	5	5	66.0	3104	5	5
5	65.2	2900	3	4	69.7	2900	2	4
6	69.6	1001	4	3	65.0	2700	2	3
7	63.0	2800	5	4	67.1	950	4	4
8	63.3	1045	4	3	73.0	900	4	5
9	67.7	973	5	3	67.2	875	3	4
10	65.1	890	3	3	71.6	889	4	4
11	61.5	2675	5	4				
Average	63.7		4.2	3.6	66.6		3.5	4.0
± 1 Std Dev	3.1		0.9	0.8	4.1		1.0	0.7
Williston Cooperator	Bake	Loaf	Mixing	Dough	Bake	Loaf	Mixing	Dough
	Absorption	Volume	Requirement	Characteristic		Absorption	Volume	Requirement
1	63.0	2750	5	5	62.0	2850	5	5
2	62.5	2850	3	3	63.0	3100	3	3
3	64.0	1092	5	5	64.0	1098	5	4
4	66.0	2956	5	5	66.0	3162	5	5
5	67.3	2775	3	3	67.7	3250	4	2
6	72.2	1175	4	4	64.0	2900	5	4
7	64.0	2400	5	4	65.0	1225	3	4
8	65.5	1150	3	3	72.7	1135	4	5
9	75.7	1135	5	4	64.8	1035	3	4
10	66.2	895	3	4	69.1	1128	4	3
11	65.5	2600	5	5				
Average	66.5		4.2	4.1	65.8		4.1	3.9
± 1 Std Dev	4.0		1.0	0.8	3.2		0.9	1.0
Minot Cooperator	Bake	Loaf	Mixing	Dough	Bake	Loaf	Mixing	Dough
	Absorption	Volume	Requirement	Characteristic		Absorption	Volume	Requirement
1	61.0	2825	5	5	61.0	2850	5	5
2					62.5	3050	3	3
3	64.0	1057	5	5	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	63.3	895	2	4	68.5	1034	2	4
11								
Average	62.8		4.0	4.7	65.2		3.5	4.0
± 1 Std Dev	1.6		1.7	0.6	2.8		1.1	0.7

Williston - W1 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Quality Factors Compared to Glenn Check							Overall
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking		
1	63.0	2800	102	5	5	3	3	3	3	3	3	3	
2	62.0	2750	96	2	4	2	3	2	4	2	2	2	
3	64.0	1018	93	3	3	2	3	3	2	4	2	2	
4	66.0	2604	88	5	5	2	1	1	4	2	1	1	
5	66.9	2800	101	4	3	3	5	4	3	3	3	3	
6	72.4	1120	95	3	3	3	4	3	3	2	3	3	
7	64.0	2600	108	5	4	3	3	3	4	4	3	3	
8	66.0	1140	99	3	2	3	3	3	4	2	3	3	
9	70.7	1018	95	3	4	2	3	3	3	2	4	4	
10	65.5	820	92	2	3	3	1	2	3	2	3	3	
11	68.5	2550	98	5	3	2	1	1			2	2	
Average	66.3		97.0	3.6	3.5	2.5	2.7	2.5	3.3	2.6	2.6	2.6	
± 1 Std Dev	3.2		5.5	1.2	0.9	0.5	1.3	0.9	0.7	0.8	0.8	0.8	

Minot - M1 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Quality Factors Compared to Glenn Check							Overall
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking		
1	61.0	2900	103	2	2	2	3	3	4	3	2	2	
3	64.0	963	91	3	3	2	1	2	1	2	1	1	
10	64.6	765	85	2	3	3	1	1	3	1	2	2	
Average	63.2		93.0	2.3	2.7	2.3	1.7	2.0	2.7	2.0	1.7	1.7	
± 1 Std Dev	1.9		9.2	0.6	0.6	0.6	1.2	1.0	1.5	1.0	0.6	0.6	

Casselton - C2 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Quality Factors Compared to Glenn Check						Overall
						Mix Tolerance	Crumb Color	Grain & Texture Protein		Milling	Baking	
1	59.0	2700	93	2	2	2	4	4	3	2	2	2
2	65.0	2900	97	4	1	2	2	2	2	1	2	2
3	63.0	872	87	2	2	2	3	3	2	3	2	2
4	66.0	3104	101	1	3	1	4	3	2	2	2	2
5	69.9	2475	89	3	3	4	5	4	3	3	1	1
6	74.7	896	88	2	2	3	3	3	3	2	3	2
7	66.0	2300	84	3	2	2	1	1	2	4	1	1
8	68.0	925	93	3	3	3	3	2	2	3	2	2
9	65.7	875	86	3	3	2	3	2	3	3	2	2
10	69.0	740	81	2	3	3	2	2	3	3	1	2
11	65.0	2500	96	2	3	2	3	4			2	2
Average	66.5		90.4	2.5	2.5	2.4	3.0	2.7	2.5	2.6	1.8	1.8
± 1 Std Dev	4.0		6.0	0.8	0.7	0.8	1.1	1.0	0.5	0.8	0.6	0.4

Crookston - K2 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Quality Factors Compared to Glenn Check						Overall
						Mix Tolerance	Crumb Color	Grain & Texture Protein		Milling	Baking	
1	57.0	2700	93	3	3	1	3	4	2	2	2	2
2	58.0	2950	98	4	2	2	4	1	1	2	2	2
3	60.0	873	88	2	2	1	3	2	1	3	2	2
4	63.0	3044	98	2	1	1	2	3	1	2	2	1
5	66.1	2325	80	2	3	2	5	3	1	3	1	1
6	70.5	875	86	3	3	1	3	3	1	2	2	1
7	63.0	2700	96	3	3	2	3	3	1	4	3	3
8	64.0	850	81	3	3	1	2	3	1	4	2	1
9	67.2	840	86	3	2	2	2	2	2	2	2	2
10	64.7	775	87	2	3	3	2	2	3	3	2	2
11	61.0	2575	96	2	3	2	2	1			1	1
Average	63.1		89.9	2.6	2.5	1.6	2.8	2.5	1.4	2.7	1.9	1.6
± 1 Std Dev	4.0		6.6	0.7	0.7	0.7	1.0	0.9	0.7	0.8	0.5	0.7

Quality Factors Compared to Glenn Check												
Watertown - B3												
Cooperator	Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &	Protein	Milling	Baking	Overall
	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture				
1	61.0	2700	96	4	3	2	3	3	3	2	2	2
2	61.5	3050	103	4	4	2	1	2	3	2	1	2
3	64.0	1022	98	3	3	2	3	2	2	2	2	2
4	63.0	2927	94	5	4	2	2	1	2	2	2	2
5	65.3	2575	96	5	4	3	3	4	3	3	3	3
6	69.5	1026	92	4	4	3	2	3	3	2	2	1
7	64.0	2550	93	2	2	1	1	1	3	3	3	2
8	63.2	1040	101	4	3	4	2	4	3	3	3	2
9	67.7	1058	98	4	3	3	3	4	3	2	4	4
10	65.7	810	89	3	3	4	2	2	3	3	2	2
11	66.0	2475	93	4	3	2	1	4			3	3
Average	64.6		95.7	3.8	3.3	2.5	2.1	2.7	2.8	2.4	2.5	2.3
± 1 Std Dev	2.6		4.1	0.9	0.6	0.9	0.8	1.2	0.4	0.5	0.8	0.8
Quality Factors Compared to Glenn Check												
Casselton - C3												
Cooperator	Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &	Protein	Milling	Baking	Overall
	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture				
1	58.0	2700	93	2	2	2	2	2	2	1	2	1
2	58.5	2800	93	2	4	4	2	2	1	2	2	2
3	60.0	967	97	2	2	2	3	3	2	4	2	2
4	61.0	2897	94	2	3	1	4	3	1	2	2	2
5	63.5	2800	101	3	3	4	4	5	1	3	3	3
6	68.4	976	95	4	3	4	3	3	1	4	2	3
7	61.0	2600	95	3	3	3	1	1	1	4	1	1
8	62.1	995	101	3	3	4	2	2	1	4	2	2
9	67.2	915	92	4	4	2	3	4	2	3	4	4
10	64.6	830	91	3	3	3	2	4	3	3	2	2
11	63.0	2650	102	2	3	2	2	4			2	2
Average	62.5		95.8	2.7	3.0	2.8	2.5	3.0	1.5	3.0	2.2	2.2
± 1 Std Dev	3.3		3.9	0.8	0.6	1.1	0.9	1.2	0.7	1.1	0.8	0.9
Quality Factors Compared to Glenn Check												
Crookston - K3												
Cooperator	Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &	Protein	Milling	Baking	Overall
	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture				
1	57.0	2700	93	2	3	1	3	2	2	2	2	2
2	58.0	3000	100	4	2	4	2	2	1	3	2	2
3	60.0	917	93	2	2	2	3	2	2	3	2	2
4	61.0	3015	97	2	2	1	2	2	1	3	2	2
5	63.0	2550	88	1	1	2	4	4	1	3	2	2
6	67.9	932	93	5	3	1	3	3	1	4	2	2
7	61.0	2600	93	3	3	2	3	3	1	4	2	2
8	61.6	885	85	4	2	1	2	3	1	4	2	1
9	64.7	910	94	5	2	3	3	3	3	2	3	3
10	63.1	845	95	3	3	3	2	2	2	3	3	3
11	59.0	2600	97	2	3	2	1	1			2	2
Average	61.5		93.5	3.0	2.4	2.0	2.5	2.5	1.5	3.1	2.2	2.1
± 1 Std Dev	3.1		4.2	1.3	0.7	1.0	0.8	0.8	0.7	0.7	0.4	0.5
Quality Factors Compared to Glenn Check												
Williston - W3												
Cooperator	Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &	Protein	Milling	Baking	Overall
	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture				
1	62.0	2600	95	1	2	1	3	3	3	3	1	1
2	64.0	2900	102	2	4	2	2	2	3	3	4	3
3	64.0	1015	93	3	3	2	3	4	2	4	2	2
4	66.0	2662	90	2	2	1	1	1	3	2	1	1
5	69.0	2825	102	3	3	2	4	4	3	3	3	3
6	73.8	1085	92	3	2	1	3	3	3	4	2	2
7	65.0	2550	106	5	4	3	2	3	3	3	3	3
8	67.2	1025	89	3	2	1	2	2	3	3	2	2
9	72.2	950	84	3	4	2	3	2	2	2	2	2
10	67.2	845	94	2	3	2	1	2	3	3	3	3
11	69.0	2450	94	4	3	2	2	1			4	4
Average	67.2		94.6	2.8	2.9	1.7	2.4	2.5	2.8	3.0	2.5	2.4
± 1 Std Dev	3.6		6.4	1.1	0.8	0.6	0.9	1.0	0.4	0.7	1.0	0.9
Quality Factors Compared to Glenn Check												
Minot - M3												
Cooperator	Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &	Protein	Milling	Baking	Overall
	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture				
1	60.0	2700	96	1	1	1	3	3	2	3	2	2
3	63.0	1003	95	3	3	2	3	2	2	2	2	2
10	63.6	765	85	2	3	2	1	2	3	2	2	2
Average	62.2		92.0	2.0	2.3	1.7	2.3	2.3	2.3	2.3	2.0	2.0
± 1 Std Dev	1.9		6.1	1.0	1.2	0.6	1.2	0.6	0.6	0.6	0.0	0.0

Williston - W4 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Quality Factors Compared to Glenn Check						Overall
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	
1	64.0	2800	102	3	3	2	4	3	3	2	2	2
2	64.0	3250	114	4	5	5	3	4	4	3	2	4
3	64.0	1200	110	5	4	3	3	4	4	2	4	4
4	66.0	3104	105	5	5	3	2	2	5	3	3	3
5	68.9	3125	113	4	4	2	4	4	4	3	4	4
6	73.3	1302	111	2	4	3	3	2	4	2	4	3
7	65.0	2500	104	5	4	3	2	2	4	3	3	3
8	66.6	1280	111	2	3	3	1	1	4	3	1	1
9	74.7	1185	104	3	4	2	4	3	4	2	4	4
10	66.1	970	108	1	4	3	2	3	3	3	4	3
11	68.0	2700	104	5	5	3	3	2			3	3
Average	67.3		107.8	3.5	4.1	2.9	2.8	2.7	3.9	2.6	3.1	3.1
± 1 Std Dev	3.7		4.2	1.4	0.7	0.8	1.0	1.0	0.6	0.5	1.0	0.9

Minot - M4 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Quality Factors Compared to Glenn Check						Overall
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	
1	61.0	2900.0	103	2	2	2	3	4	3	2	2	2
3	64.0	1057	100	4	3	2	3	3	2	3	2	2
10	64.2	940.0	105	1	3	2	2	3	3	3	4	3
Average	63.1		102.7	2.3	2.7	2.0	2.7	3.3	2.7	2.7	2.7	2.3
± 1 Std Dev	1.8		2.5	1.5	0.6	0.0	0.6	0.6	0.6	0.6	1.2	0.6

		Quality Factors Compared to Glenn Check											
Watertown - B5		Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &				
Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture	Protein	Milling	Baking	Overall	
1	62.0	2725	97	3	3	2	3	3	4	2	2	2	
2	61.0	2950	100	2	2	4	1	2	4	2	2	2	
3	64.0	1048	100	3	4	2	3	3	2	2	3	3	
4	65.0	2927	94	5	4	2	2	3	4	2	3	2	
5	66.7	2925	109	3	3	3	4	4	5	3	5	5	
6	72.4	1136	102	3	3	2	3	3	4	2	3	1	
7	65.0	2450	89	2	2	1	2	2	4	4	4	2	
8	65.8	1080	105	3	4	2	2	3	4	3	2	3	
9	68.2	1088	100	3	4	2	3	4	4	2	4	4	
10	66.1	755	83	2	3	3	1	1	3	2	2	2	
11	67.5	2575	96	4	3	2	2	4			3	3	
Average	65.8		97.7	3.0	3.2	2.3	2.4	2.9	3.8	2.4	3.0	2.6	
± 1 Std Dev	3.1		7.2	0.9	0.8	0.8	0.9	0.9	0.8	0.7	1.0	1.1	

		Quality Factors Compared to Glenn Check											
Casselton - C5		Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &				
Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture	Protein	Milling	Baking	Overall	
1	59.0	2600	90	1	1	1	2	1	3	3	1	1	
2	60.0	3250	108	2	1	4	3	3	3	3	5	4	
3	63.0	1003	101	2	3	2	3	3	2	2	2	2	
4	63.0	3044	99	1	1	1	4	3	3	3	2	2	
5	65.2	2650	96	3	1	4	5	4	3	3	2	2	
6	69.5	1063	104	2	2	4	4	2	3	2	3	2	
7	62.0	2550	93	3	3	3	1	1	3	4	1	1	
8	63.1	1040	105	2	3	4	3	2	3	4	2	2	
9	66.2	988	99	2	4	2	3	4	4	3	4	4	
10	63.6	905	99	2	3	3	3	3	3	3	3	3	
11	63.5	2675	103	2	3	2	3	3			2	2	
Average	63.5		99.7	2.0	2.3	2.7	3.1	2.6	3.0	3.0	2.5	2.3	
± 1 Std Dev	2.9		5.3	0.6	1.1	1.2	1.0	1.0	0.5	0.7	1.2	1.0	

		Quality Factors Compared to Glenn Check											
Crookston - K5		Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &				
Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture	Protein	Milling	Baking	Overall	
1	58.0	2850	98	2	2	1	3	2	3	2	2	2	
2	60.0	3500	117	2	2	4	4	3	3	3	4	4	
3	62.0	992	100	3	2	2	3	3	2	2	2	2	
4	61.0	2956	95	1	1	1	2	3	2	3	1	1	
5	62.9	2950	102	4	2	2	4	3	3	3	3	3	
6	67.4	1050	105	3	2	3	4	2	3	2	3	2	
7	60.0	2750	98	4	4	3	4	4	2	4	2	2	
8	60.7	1010	97	3	2	4	2	4	3	4	2	2	
9	65.2	965	99	3	3	2	4	3	3	2	4	3	
10	61.2	830	93	2	3	3	3	2	3	3	3	3	
11	62.0	2650	99	2	3	2	2	1			2	2	
Average	61.9		100.3	2.6	2.4	2.5	3.2	2.7	2.7	2.8	2.5	2.4	
± 1 Std Dev	2.6		6.4	0.9	0.8	1.0	0.9	0.9	0.5	0.8	0.9	0.8	

		Quality Factors Compared to Glenn Check											
Minot - M5		Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &				
Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture	Protein	Milling	Baking	Overall	
1	60.0	2900	103	2	2	2	3	4	3	2	2	2	
3	64.0	1068	101	4	3	3	3	3	4	3	4	4	
10	62.8	825	92	1	4	2	2	3	3	1	3	2	
Average	62.3		98.7	2.3	3.0	2.3	2.7	3.3	3.3	2.0	3.0	2.7	
± 1 Std Dev	2.1		5.9	1.5	1.0	0.6	0.6	0.6	0.6	1.0	1.0	1.2	

		Quality Factors Compared to Glenn Check										
Williston - W6	Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &				
Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
1	63.0	2800	102	2	3	2	4	3	3	2	2	2
2	57.0	3000	105	4	2	4	3	3	2	2	4	3
3	64.0	1042	95	4	3	3	3	3	4	2	4	4
4	60.0	3104	105	5	5	3	3	2	3	2	2	2
5	62.0	2900	105	3	3	2		3	3	3	4	4
6	66.9	1166	99	4	4	1	3	4	3	1	2	2
7	60.0	2450	102	5	4	3	3	3	3	5	4	4
8	60.6	1070	93	3	4	1	1	3	3	3	2	2
9	69.7	1103	100	5	4	2	3	5	3	2	4	4
10	60.9	720	80	3	3	2	1	1	3	1	1	2
11	63.0	2700	104	5	4	3	2	2			4	4
Average	62.5		99.1	3.9	3.5	2.4	2.6	2.9	3.0	2.3	3.0	3.0
± 1 Std Dev	3.5		7.5	1.0	0.8	0.9	1.0	1.0	0.5	1.2	1.2	1.0

		Quality Factors Compared to Glenn Check										
Minot - M6	Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &				
Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
1	61.0	2700.0	96	1	1	1	3	4	3	1	2	2
3	64.0	1028	97	4	3	3	3	3	2	2	2	2
10	59.7	815.0	91	2	4	2	1	1	3	1	3	2
Average	61.6		94.7	2.3	2.7	2.0	2.3	2.7	2.7	1.3	2.3	2.0
± 1 Std Dev	2.2		3.2	1.5	1.5	1.0	1.2	1.5	0.6	0.6	0.6	0.0

Williston - W7 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Quality Factors Compared to Glenn Check						Overall
						Mix Tolerance	Crumb Color	Grain & Texture Protein		Milling	Baking	
1	63.0	2900	105	2	3	2	4	3	3	2	2	2
2	62.5	3250	114	2	2	2	4	2	3	2	4	4
3	64.0	1052	96	4	3	2	3	3	3	4	3	3
4	66.0	2721	92	5	5	2	3	3	4	3	2	2
5	67.6	3200	115	3	3	2		4	3	3	5	5
6	71.8	1176	100	2	4	2	3	3	3	2	2	2
7	64.0	2400	100	5	4	3	2	3	3	3	3	3
8	65.3	1160	101	2	2	2	2	1	4	4	2	2
9	72.2	1065	94	3	3	2	3	2	4	2	4	4
10	64.8	845	94	2	4	2	2	3	3	3	3	3
11	65.0	2725	107	5	5	3	2	3			4	4
Average	66.0		101.6	3.2	3.5	2.2	2.8	2.7	3.3	2.8	3.1	3.1
± 1 Std Dev	3.3		7.9	1.3	1.0	0.4	0.8	0.8	0.5	0.8	1.0	1.0

Minot - M7 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Quality Factors Compared to Glenn Check						Overall
						Mix Tolerance	Crumb Color	Grain & Texture Protein		Milling	Baking	
1	61.0	2700	96	2	2	2	3	3	3	3	2	2
3	64.0	1045	99	4	4	3	3	3	3	2	3	3
10	64.2	895	100	2	4	2	1	2	3	2	3	3
Average	63.1		98.3	2.7	3.3	2.3	2.3	2.7	3.0	2.3	2.7	2.7
± 1 Std Dev	1.8		2.1	1.2	1.2	0.6	1.2	0.6	0.0	0.6	0.6	0.6

Casselton - C8 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Quality Factors Compared to Glenn Check							Overall
						Mix Tolerance	Crumb Color	Grain & Texture Protein		Milling	Baking		
1	58.0	3100	107	5	5	3	3	3	2	2	3	3	
2	60.0	2850	95	4	5	2	2	2	1	2	2	2	
3	61.0	1015	102	3	3	3	3	3	3	2	4	4	
4	63.0	3104	101	5	5	3	5	3	1	2	3	3	
5	64.8	3075	111	4	4	4	4	3	2	3	4	4	
6	69.5	1060	104	4	4	4	3	3	1	1	3	2	
7	62.0	2800	102	4	3	3	5	5	1	4	4	4	
8	62.8	955	96	4	3	4	3	1	2	4	2	2	
9	67.7	1022	102	4	3	5	3	5	2	2	5	5	
10	65.1	880	96	3	4	3	2	3	3	2	3	2	
11	63.0	2700	104	5	4	4	3	5			2	2	
Average	63.4		101.8	4.1	3.9	3.5	3.3	3.3	1.8	2.4	3.2	3.0	
± 1 Std Dev	3.3		4.9	0.7	0.8	0.8	1.0	1.3	0.8	1.0	1.0	1.1	

Minot - M8 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Quality Factors Compared to Glenn Check							Overall
						Mix Tolerance	Crumb Color	Grain & Texture Protein		Milling	Baking		
1	60.0	2850	101	5	5	3	3	3	2	2	3	3	
3	63.0	1090	103	4	5	4	3	3	4	2	4	4	
10	63.9	910	102	3	4	3	3	3	3	2	3	3	
Average	62.3		102.0	4.0	4.7	3.3	3.0	3.0	3.0	2.0	3.3	3.3	
± 1 Std Dev	2.0		1.0	1.0	0.6	0.6	0.0	0.0	1.0	0.0	0.6	0.6	

						Quality Factors Compared to Glenn Check						
Casselton - C10	Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &				
Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
1	60.0	2750	95	2	2	2	2	2	3	3	2	2
2	60.5	3200	107	2	1	3	2	3	3	1	5	4
3	63.0	972	97	2	3	2	3	3	2	3	2	2
4	63.0	3074	100	4	3	2	5	4	3	2	4	3
5	65.4	2725	98	4	1	4	4	4	3	3	3	3
6	70.0	998	97	3	3	4	2	3	3	3	3	3
7	62.0	2800	102	4	4	3	3	3	3	4	4	4
8	63.3	1060	107	2	2	4	1	3	3	4	2	2
9	66.7	995	100	2	3	2	3	4	5	2	5	4
10	62.8	795	87	2	3	4	1	3	3	4	2	2
11	63.0	2550	98	3	3	3	2	4			2	2
Average	63.6		98.9	2.7	2.5	3.0	2.5	3.3	3.1	2.9	3.1	2.8
± 1 Std Dev	2.8		5.6	0.9	0.9	0.9	1.2	0.6	0.7	1.0	1.2	0.9

						Quality Factors Compared to Glenn Check						
Williston - W10	Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &				
Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
1	63.0	2800	102	5	5	3	4	3	3	2	3	3
2	64.0	3300	116	2	2	4	2	2	3	1	4	4
3	64.0	1002	92	3	3	1	3	2	2	3	2	2
4	66.0	2868	97	5	5	3	2	3	4	2	2	2
5	69.2	2825	102	4	4	4		4	3	3	4	4
6	73.7	1180	100	3	4	3	3	4	3	2	3	3
7	65.0	2450	102	5	4	3	2	2	3	4	4	4
8	67.3	1045	91	3	2	4	1	3	3	3	1	2
9	72.7	1070	94	3	5	2	2	1	3	2	1	2
10	66.8	760	85	2	3	3	1	2	3	3	2	2
11	69.5	2525	97	5	5	3	2	4			3	3
Average	67.4		98.0	3.6	3.8	3.0	2.2	2.7	3.0	2.5	2.6	2.8
± 1 Std Dev	3.5		8.0	1.2	1.2	0.9	0.9	1.0	0.5	0.8	1.1	0.9

						Quality Factors Compared to Glenn Check						
Minot - M10	Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &				
Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
1	61.0	3000	106	3	3	2	4	4	3	2	3	2
3	64.0	965	91	2	3	2	3	3	2	2	2	2
10	63.2	815	91	2	3	2	1	2	3	2	3	3
Average	62.7		96.0	2.3	3.0	2.0	2.7	3.0	2.7	2.0	2.7	2.3
± 1 Std Dev	1.6		8.7	0.6	0.0	0.0	1.5	1.0	0.6	0.0	0.6	0.6

Williston - W11 Cooperator	Quality 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	63.0	2775	101	5	5	3	4	3	3	2	3	3
2	61.0	2850	100	4	5	5	3	4	3	2	2	2
3	64.0	1150	105	5	4	3	3	3	4	4	4	4
4	64.0	2956	100	5	5	3	2	2	3	2	2	2
5	66.0	2800	101	4	3	5		4	3	3	4	4
6	70.3	1253	107	5	4	4	3	3	3	2	4	4
7	63.0	2450	102	5	4	3	3	3	3	4	4	4
8	63.7	1060	92	4	4	4	2	2	3	3	2	2
9	71.7	1110	98	5	4	3	4	5	2	2	4	4
10	64.4	985	110	3	4	3	3	3	3	2	4	3
11	64.5	2600	100	5	5	3	2	5			4	4
Average	65.1		101.5	4.5	4.3	3.5	2.9	3.4	3.0	2.6	3.4	3.3
± 1 Std Dev	3.2		4.7	0.7	0.6	0.8	0.7	1.0	0.5	0.8	0.9	0.9

Watertown - B12 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Quality Factors Compared to Glenn Check							Overall
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking		
1	60.0	3000	107	5	4	3	3	3	3	3	4	3	
2	61.0	3250	110	2	2	2	4	4	2	2	4	4	
3	64.0	1033	99	4	4	4	3	4	4	4	4	4	
4	64.0	2927	94	5	4	2	3	3	2	3	3	2	
5	66.0	2800	105	3	3	3	5	3	2	3	4	4	
6	70.6	1013	91	4	3	2	3	3	2	3	2	1	
7	64.0	2650	96	2	2	1	3	3	2	4	4	2	
8	64.0	1060	103	3	4	2	3	3	2	4	3	3	
9	70.7	950	88	4	3	2	3	3	2	2	3	3	
10	65.0	785	86	2	3	3	2	2	3	2	2	2	
11	63.0	2575	96	5	3	2	2	5			3	3	
Average	64.8		97.7	3.5	3.2	2.4	3.1	3.3	2.4	3.0	3.3	2.8	
± 1 Std Dev	3.4		7.8	1.2	0.8	0.8	0.8	0.8	0.7	0.8	0.8	1.0	

Casselton - C12 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Quality Factors Compared to Glenn Check							Overall
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking		
1	58.0	2700	93	2	2	1	4	4	2	2	2	2	
2	59.5	3150	105	4	4	3	4	3	1	2	4	3	
3	61.0	973	97	2	3	2	3	3	2	3	2	2	
4	61.0	2986	97	4	4	2	3	4	1	2	2	2	
5	64.5	2825	102	2	2	3	5	4	3	3	3	3	
6	68.0	969	95	3	3	2	4	2	1	4	2	2	
7	61.0	2900	105	3	4	3	4	4	1	4	4	4	
8	61.8	955	96	3	3	2	4	3	2	4	3	2	
9	66.7	930	93	3	5	2	3	5	2	2	5	5	
10	63.0	810	89	2	3	2	3	4	3	3	2	2	
11	61.5	2750	106	3	3	3	4	5			2	2	
Average	62.4		98.0	2.8	3.3	2.3	3.7	3.7	1.8	2.9	2.8	2.6	
± 1 Std Dev	3.0		5.7	0.8	0.9	0.6	0.6	0.9	0.8	0.9	1.1	1.0	

Crooskton - K12 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Quality Factors Compared to Glenn Check							Overall
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking		
1	57.0	2850	98	2	2	1	3	2	2	2	2	2	
2	59.0	3000	100	2	4	2	3	2	1	2	3	2	
3	60.0	928	94	3	3	3	3	3	4	4	3	3	
4	61.0	2853	92	2	2	1	3	3	1	3	2	2	
5	64.2	2325	80	3	1	2	2	1	3	3	1	1	
6	68.5	945	94	4	3	2	4	3	2	4	2	3	
7	61.0	2800	100	4	5	3	4	4	1	5	4	4	
8	62.2	930	89	3	2	2	4	4	2	5	3	3	
9	64.7	910	94	3	2	2	4	2	2	2	3	3	
10	63.7	825	93	2	3	3	3	3	3	3	3	3	
11	59.0	2675	100	3	3	2	2	3			3	3	
Average	61.8		94.0	2.8	2.7	2.1	3.2	2.7	2.1	3.3	2.6	2.6	
± 1 Std Dev	3.3		5.9	0.8	1.1	0.7	0.8	0.9	1.0	1.2	0.8	0.8	

Minot - M12 Cooperator	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Quality Factors Compared to Glenn Check							Overall
						Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking		
1	60.0	2625	93	3	3	2	4	4	3	2	2	2	
3	64.0	1020	97	3	3	3	3	3	3	3	3	3	
10	63.5	790	88	1	3	2	1	2	3	2	2	2	
Average	62.5		92.7	2.3	3.0	2.3	2.7	3.0	3.0	2.3	2.3	2.3	
± 1 Std Dev	2.2		4.5	1.2	0.0	0.6	1.5	1.0	0.0	0.6	0.6	0.6	

		Quality Factors Compared to Glenn Check										
Casselton - C13	Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &				
Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
1	59.0	2925	101	5	5	3	3	3	3	2	3	3
2	61.0	2450	82	4	5	2	1	1	1	2	1	1
3	62.0	890	89	2	3	2	3	3	3	3	3	3
4	63.0	3108	101	5	5	3	5	4	2	2	4	4
5	65.9	2825	102	2	2	4	3	3	3	3	3	3
6	70.4	1030	101	5	5	3	3	3	2	1	3	3
7	62.0	2750	100	4	4	3	5	5	2	4	4	4
8	63.7	965	97	5	4	3	2	2	2	3	2	2
9	68.7	905	91	5	5	5	3	3	2	2	3	3
10	65.0	875	96	4	4	3	2	3	3	3	4	3
11	63.0	2575	99	5	4	4	2	5			1	1
Average	64.0		96.3	4.2	4.2	3.2	2.9	3.2	2.3	2.5	2.8	2.7
± 1 Std Dev	3.3		6.4	1.2	1.0	0.9	1.2	1.2	0.7	0.8	1.1	1.0

		Quality Factors Compared to Glenn Check										
Minot - M13	Bake	Loaf	LV	Mixing	Dough	Mix	Crumb	Grain &				
Cooperator	Absorption	Volume	% of CK	Requirement	Characteristic	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
1	60.0	2700	96	5	5	3	3	3	2	2	3	3
3	63.0	942	89	3	5	2	3	3	2	2	2	2
10	63.9	895	100	3	3	3	2	3	3	2	3	3
Average	62.3		95.0	3.7	4.3	2.7	2.7	3.0	2.3	2.0	2.7	2.7
± 1 Std Dev	2.0		5.6	1.2	1.2	0.6	0.6	0.0	0.6	0.0	0.6	0.6

Appendix

	Page #
Appendix.....	38
Source of Wheat.....	39
Field Plot Locations and Procedures.....	40
Wheat Production Sites.....	40
Field Production Data.....	41
Climate, Disease, Field Conditions.....	42 – 46
Description of 2010 Hard Spring Wheat Lines.....	47 – 49
Grain Cleaning and Milling Procedures.....	50
Methods of Analyses.....	50 – 51
Test Bake Procedures.....	51
Bake Cooperators.....	52
Wheat Marketing Score.....	53 – 55
Cumulative Ash Curves (by location).....	56 – 61
Farinograms.....	62 – 71
Mixograms.....	72 – 77
Wheat Quality Traits (by location).....	78 - 81

Source of Wheat

Source – Breeding Program	Code#	Identification
WWW	1	A
University Minnesota	2	MN05214-3
North Dakota State University	3	ND811*
North Dakota State University	4	ND901CL PLUS
South Dakota State University	5	SD4011*
WWW	6	B
North Dakota State University	7	ND905CL PLUS
Westbred	8	CA908-879
Norrth Dakota State University	10	NDSW612
Westbred	11	CA907-816W
Norrth Dakota State University	12	ND808*
Westbred	13	CA908-877
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.

Wheat Production Sites

Entry #	Entry	Source	Production Sites				
			Watertown	Casselton	Crookston	Minot	Williston
1	BR3677	WWW				X	X
2	MN05214-3	Un of MN		X	X		
3	ND811	NDSU	X	X	X	X	X
4	ND901CL PLUS	NDSU				X	X
5	SD4011	SDSU	X	X	X	X	
6	BR5874E	WWW				X	X
7	ND905CL PLUS	NDSU				X	X
8	CA908-879	Westbred		X		X	
9	Glenn	Check	X	X	X	X	X
10	NDSW612	NDSU		X		X	X
11	CA907-816W	Westbred					X
12	ND808	NDSU	X	X	X	X	
13	CA908-877	Westbred		X		X	

Field Production Data

Field Production Data 2010 Spring Wheat (WQC) Quality Trials

Variable	Location				
	Watertown	Casselton	Crookston	Minot	Williston
Planting Date	5/5/2010	4/26 (SWQAC10,5/18)	5/11/2010	5/20/2010	5/17/2010
Harvest Date	8/17/2010	9/2/2010	8/19/2010	8/27/2010	8/27/2010
Fertilizer (lb/A)					
N	225	125#	added 200 lb/A	200#/ac. Urea	100# Urea
P	70	50	Adequate	50# 11-52-0	75#
K	130	0	Adequate		
Herbicide/rate					
Broadleaf	Bronate Ultra 0.66 Pt.	1 pt. Widematch, 3/4 pt 2,4-D	Bronate/1 pt/A	Bronate @ .75 pt./ac.	1.7 pt Wolverine
Grass	Puma 0.50 Pt.	.4Pt Puma	Puma/1/2 pt/A	Puma @ .66 pt./ac.	/
Fungicide	Headline (9oz.) and Folicur (4oz.)	/	*	Headline @ 4oz/ac.	/
* = No Application	.				
Climatologic Data					
Month	Average Temperature (°F)/Precipitation (in)				
	Watertown	Casselton	Crookston	Minot	Williston
April	/	50.2/1.13	41.0/0.88	47/1.57	48.2/0.92
May	Not Available	56.1/3.41	51.7/2.50	52/4.02	53.0/4.65
June	66.2/6.07	66.2/3.79	62.6/4.55	63/4.82	64.8/2.10
July	70.0/3.23	71.2/4.83	65.3/3.43	68/2.44	71.0/2.41
August	70.6/4.87	66.3/3.2	70.2/2.28	68/2.59	70.9/3.14
* = Not Applicable					
Yield Data					
Cultivar	Yield (bu/acre) / Test Wt / % Moisture				
	Watertown	Casselton	Crookston	Minot	Williston
SWQAC 1	*	*	*	/ /	/ /
SWQAC 2	*	50.3/59/12.5	49/57/14.1	*	*
SWQAC 3	53.7/ 54.3 /12.2	58.7/59/12.9	48/57/15.1	/ /	/ /
SWQAC 4	*	*	*	/ /	/ /
SWQAC 5	63.9/ 55.2 /12.8	60.1/58/12.5	59/56/16.0	/ /	*
SWQAC 6	*	*	*	/ /	/ /
SWQAC 7	*	*	*	/ /	/ /
SWQAC 8	*	56.9/57/11.9	*	/ /	*
SWQAC 9	39.0/59.6/13.0	48.8/60/12.9	55/59/14.9	/ /	/ /
SWQAC 10	*	45.8/58/12.5	*	/ /	/ /
SWQAC 11	*	*	*	*	/ /
SWQAC 12	67.3/56.2/12.9	58.3/57/12.5	64/58/14.1	/ /	*
SWQAC 13	*	61.5/57/11.8	*	/ /	*
* Not increased at this site ** = No data available					

Casselton

At Planting	Seed was seeded into a mellow, freshly tilled seedbed with ample moisture. The weather then turned rainy and cool which resulted in longer than average emergence times but with uniform emergence and good stands.
During Growth	Generally the season was moderate in temperature with ample rainfall. No significant periods of stress due to too much or too little rain. There were a couple of intense rain storms accompanied by strong winds which flattened the crop and caused some lodging which was present until harvest.
At Flowering	Relatively cool and dry w/o heavy dews. Resulting in the decision to not apply fungicide.
During Maturation	A few showers interspersed with sunny days which delayed field dry down and delayed harvest.
At Harvest	Cloudy and cool days slowed the direct harvest and delayed harvest during the latter part of August.

Crookston

At Planting	Adequate moisture at planting.
During Growth	Average growing season for the 2010 wheat crop.
At Flowering	Plenty of moisture during the flowering stage.
During Maturation	Average temperatures during maturity.
At Harvest	There were no problems at harvest other than unwanted rains.

Minot

At Planting	<p>Overall the NCREC station in Minot location had a good year. There was above average to excessive precipitation at planting. This was reflected in the delayed planting date here at the center.</p> <p>Planting conditions were warm and wet, allowing for good stand establishment.</p>
During Growth	<p>Moderate temperatures and continued rainfall promoted vigorous plant growth with good tillering. The wet conditions also promoted development of various leaf diseases. Due to this disease growth headline fungicide was applied with the herbicide application at the 5 leaf stage. This application did halt further disease spread and establishment.</p>
At Flowering	<p>The summer continued with warmer and dryer growing conditions at flowering, thus there was limited scab pressure on the trial. Visual scab scoring averaged between 1.5-2.5%. Due to these low numbers no fungicide was applied at flowering.</p>
During Maturation	<p>Dry field conditions occurred during crop dry down. A small amount of rainfall did occur, causing slight bleaching, but for the most part quality was good.</p>
At Harvest	<p>Several days of dry weather occurred prior to harvest. All entry's were harvested at 13.5% moisture or lower. All entries expressed good standability and harvest went smoothly. Harvest yields were above average with mean yields at the station being 55.5 bushels/ac. Test weight at the center averaged 59.9 and protein averaged 14.1.</p> <p>Overall it was a successful year at the NCREC.</p>

Williston

At Planting	Adequate moisture. Good planting conditions.
During Growth	Good growing conditions.
At Flowering	Some Stress. Higher temperatures, windy and some small periods of drier conditions.
During Maturation	some higher temperatures. Periods of rainfall.
At Harvest	Good conditions.

Description of 2010 Hard Spring Wheat Lines

SWQAC #1 A (BR3677)

BR3677 is a hard red spring wheat derived from a 1993 F₂ head selection from a World Wide Wheat, L.L.C. (W³) male sterile facilitated recurrent selection (MSFRS) quality hard red spring wheat population grown at Maricopa Arizona. Generation advancement was by best plant selection that continued through the F₇. The F₃ generation was grown at Moscow, Idaho with severe Hessian Fly pressure. A breeder strip was grown in Ronan, Montana in 1997. Head rows were grown for purity in 1998 at Maricopa and subsequent Foundation seed fields were grown at Eloy, Arizona and Kings County California in the production year 2000. BR3677 appears to have relatively strong gluten. Yield is excellent when grown in low rainfall areas. This variety has tolerance to leaf rust and Hessian Fly.

SWQAC #2 (MN05214-3)

MN05214-3 is a mid maturity hard red spring wheat with a unique combination of good straw strength and Fusarium head blight resistance. The Fusarium head blight resistance of MN05214-3 is equivalent to the best varieties currently available. The pedigree of MN05214-3 is Ada*2//RL4970-4. Grain yield is average but protein and test weight are above average. MN05214-3 is resistant to preharvest sprouting and moderately resistant to leaf rust.

SWQAC #3 (ND811)

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.

SWQAC #4 (ND901CL PLUS)

SWQAC #5 (SD4011)

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

SWQAC #6 B (BR5874E)

BR5874E is a hard red spring wheat derived from a 1995 F₂ head selection from a World Wide Wheat L.L.C. (W³) male sterile facilitated recurrent selection (MFSRS) quality hard red spring population grown at Maricopa, Arizona. Generation advancement was by best plant selection through the F₇. A comprehensive quality evaluation indicated that BR5874 flour produced a superior loaf of bread. Consequently it was head-rowed for purity in 2003. Head rows were generally very irregular. Six individual rows, BR5874A to BR5874F were selected for evaluation and increase. In California 2004 it was determined that BR5874 was segregating for stripe rust resistance. BR5874E and BR5874C exhibited resistance to stripe rust. As BR5874E seemed to have the strongest resistance and was also found to be resistant to leaf rust, and therefore was chosen for increase and variety development. A strip increase of BR5874E was grown at Maricopa, Arizona in 2005. It appeared very uniform, medium late in maturity and medium tall, but very sturdy. BR5874E was increased for Foundation seed at W³'s nursery at the University of Arizona, Maricopa Experimental Station in 2006.

SWQAC #7 (ND905CL PLUS)

ND905CL has the Clearfield (Beyond) herbicide resistant genes that belongs to BASF Company. It has wide Adaptation but intended to the Western ND same as ND901CLPlus. Overall, grain yield of ND905CL is superior to ND901CLPlus. It is a conventional height line; medium early (similar to ND901CLPlus and earlier than Mott); and has medium to strong straw strength similar to Faller. Protein of ND905CL is high, similar to ND901CL and better than Reeder. Milling is good with flour extraction better than ND901CLPlus. Similarly, baking of ND905CL is good b similar to Steele-ND and better than Reeder. Test weight of ND905CL is average similar to Reeder. Overall, ND905CL has a very good leaf diseases package. It is resistant/medium resistant to leaf and stem rusts and medium resistant to scab similar to Alsen.

SWQAC #8 (CA908-879)

CA908-879 (McNeal/Knudson) is a medium height, late maturity, hard red spring wheat line, with good to average Standability, and excellent

yield punch. It is moderately susceptible to susceptible to leaf rust, foliar disease, and Fusarium head blight, and is resistant to the prevalent races of stem rust. CA908-879 is a management wheat adapted to the wheat growing areas of northern MN and ND. CA908-879 has medium protein and test weight, with very strong gluten.

SWQAC #10 (NDSW612)

NDSW612 is a hard white spring wheat. However, it does not have all white color genes. It has wide adaptation but intended to the Central and Western ND where the risks of pre-harvesting sprouting is prominent. Overall, grain yield of NDSW612 is high compared to Agawam and slightly less than Alpine white wheat cultivars. It is a semi-dwarf; medium late (similar Mott), and has a medium to strong straw strength similar to Mott. Protein of NDSW612 is good similar to Steele-ND BUT higher than both Agawam and Alpine white wheat. Milling of NDSW612 is high with flour extraction better than Glenn and less than Faller. Baking of NDSW612 is good similar to Alpine and better than Agawam white wheat. NDSW612 test weight is average similar to Alpine. Overall, NDSW612 has an excellent good leaf diseases package. It is resistant to medium resistant to leaf and stem rusts. It is medium susceptible to scab.

SWQAC #11 (CA907-816W)

CA907-816W (Waikea/FI903-728) is a hard white spring wheat semi dwarf with early maturity, good standability and yield. It is a management variety that is moderately susceptible to leaf rust, stem rust, foliar disease, and fusarium head blight. CA907-816W has medium protein and test weight and strong gluten. It is adapted to the growing areas of Western North Dakota.

SWQAC #12 (ND808)

SWQAC #13 (CA908-877)

CA-908-877 (McNeal/Parshall//Knudson) is a medium height, medium maturity, hard red spring wheat line, with good to average Standability, and excellent yield punch. It is moderately susceptible to susceptible to leaf rust, foliar disease, and Fusarium head blight, and is resistant to the prevalent races of stem rust. CA908-877 is a management wheat adapted to the wheat growing areas of ND and MN. CA908-877 has medium protein and test weight, with very strong gluten.

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. From the Watertown, Casselton, Crookston, and Williston locations, sixty pounds of cleaned wheat was tempered to 16.5% moisture basis and conditioned 16-18 hours. Wheat harvested from Minot was weathered and of poor quality, therefore, only eleven pounds of wheat was tempered and conditioned from that location. The tempered wheat was milled in a Buhler Experimental Mill, MLU, at an average feed rate of 100 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.

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
ConAgra Foods	Omaha, NE
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

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:	SCORE	1lb/bu	3 g up, 4 g down	25 sec	1.0%	0.1%
	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 #2

Rules for Score Calculation

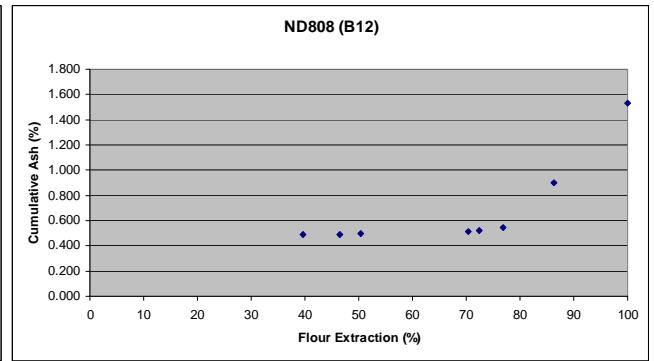
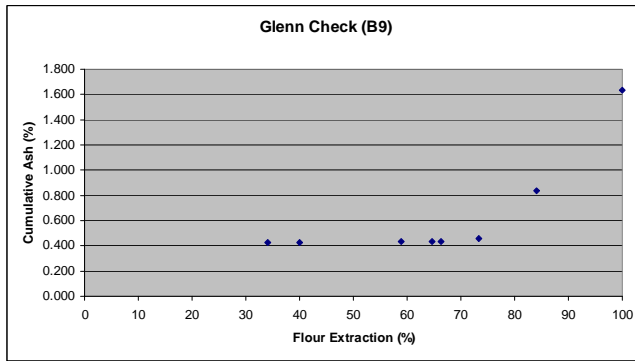
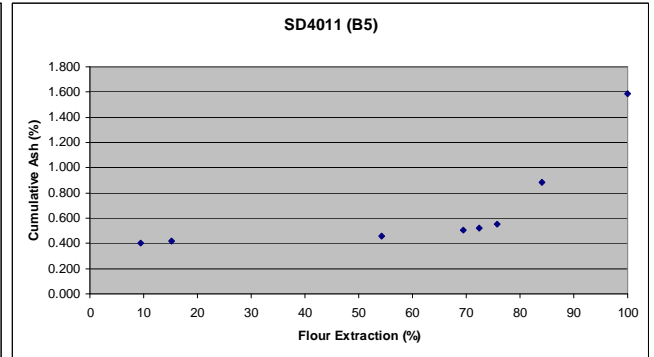
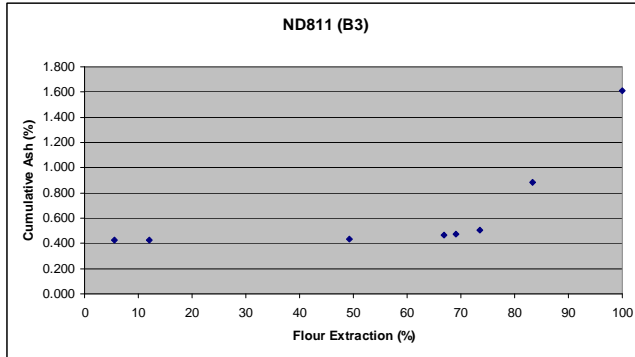
Weight of each Factor	Weighting
Protein	0.3
Test Weight (TW)	0.2
Falling Number	0.2
Thousand Kernel Weight (TKW)	0.2
Wheat Ash	0.1

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					

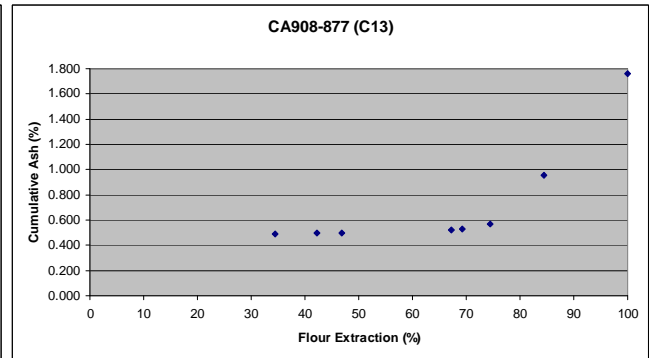
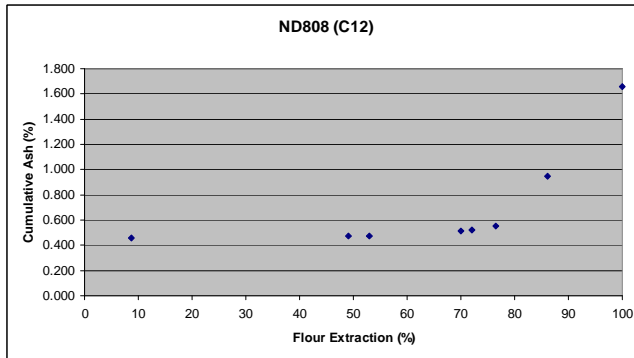
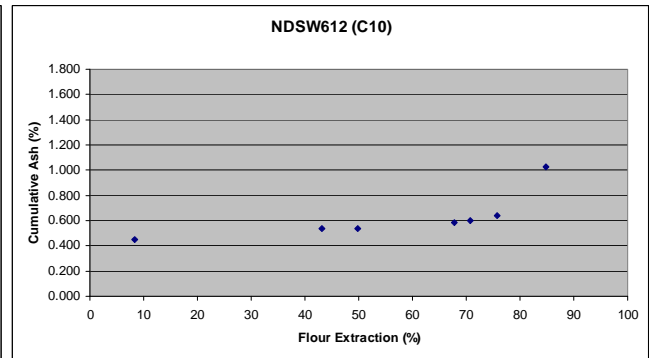
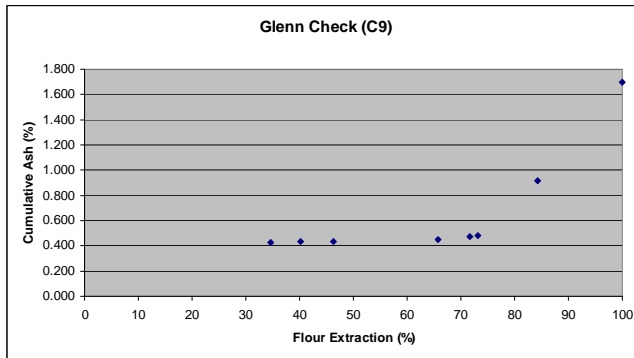
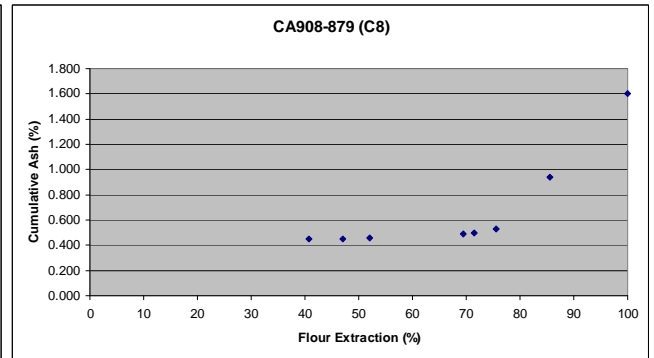
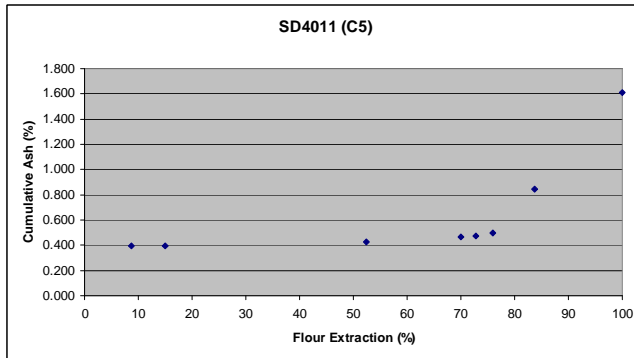
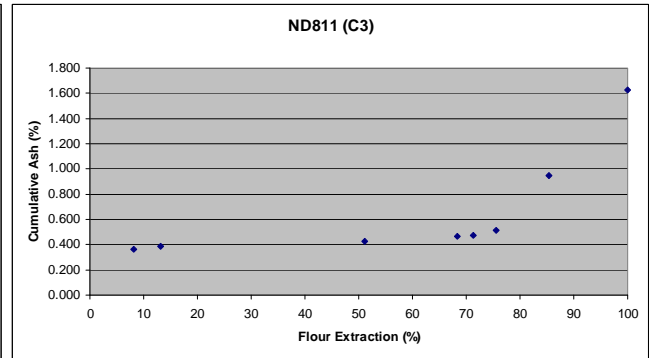
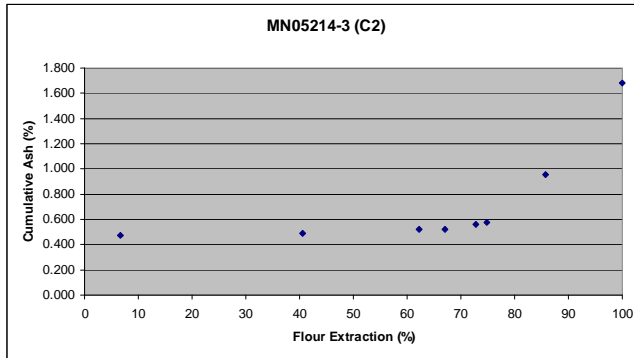
Component Score	10	8	6	4	2	0
Protein	-0.501<Di 2<Diff<3.001		3<Diff<4.001	4<Diff<5.001	5<Diff<6.001	Diff>6
TestWeight	-1.001<Di 2<Diff<4.001		4<Diff<6.001	6<Diff<8.001	8<Diff<10.001	Diff>10
Falling Number	-25.01<Diff					
Thousand Kernel Weight	-2.001<Di 4<Diff<8.001		8<Diff<12.001	12<Diff<16.001	16<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

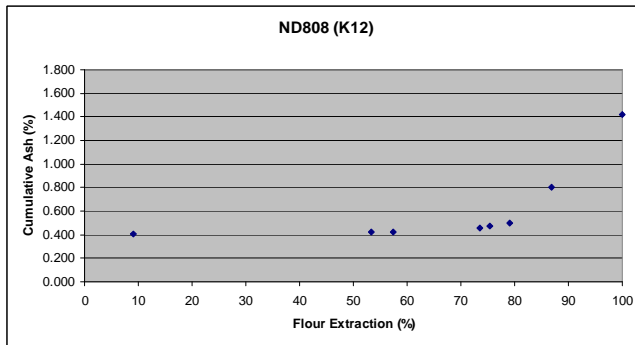
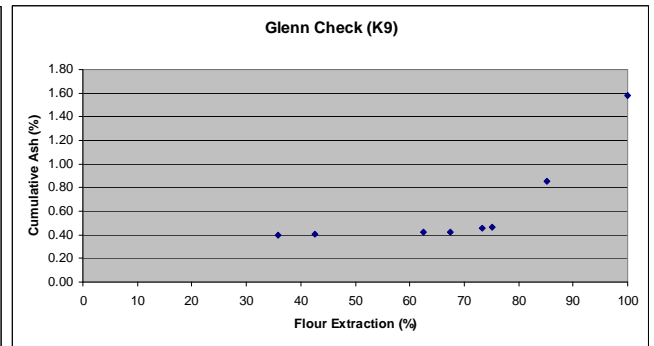
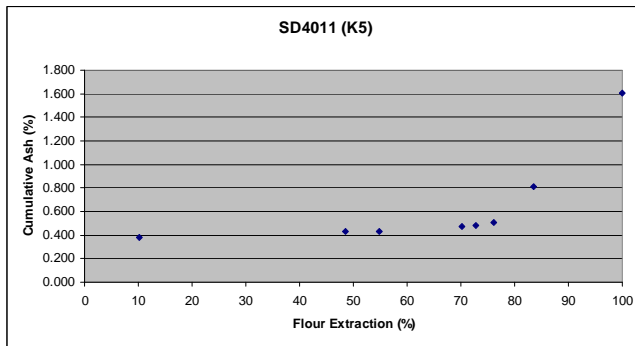
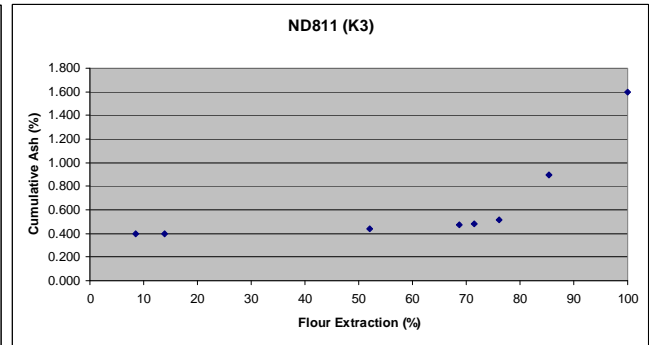
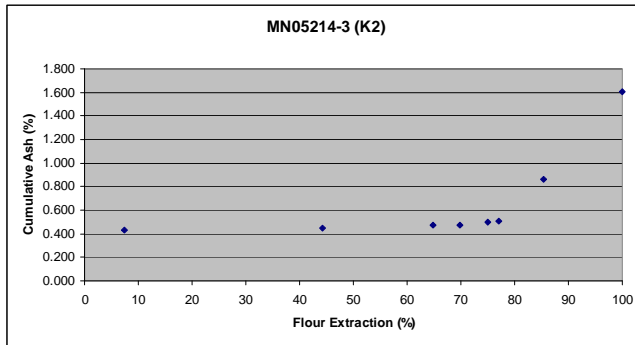
Watertown Cumulative Ash Curves



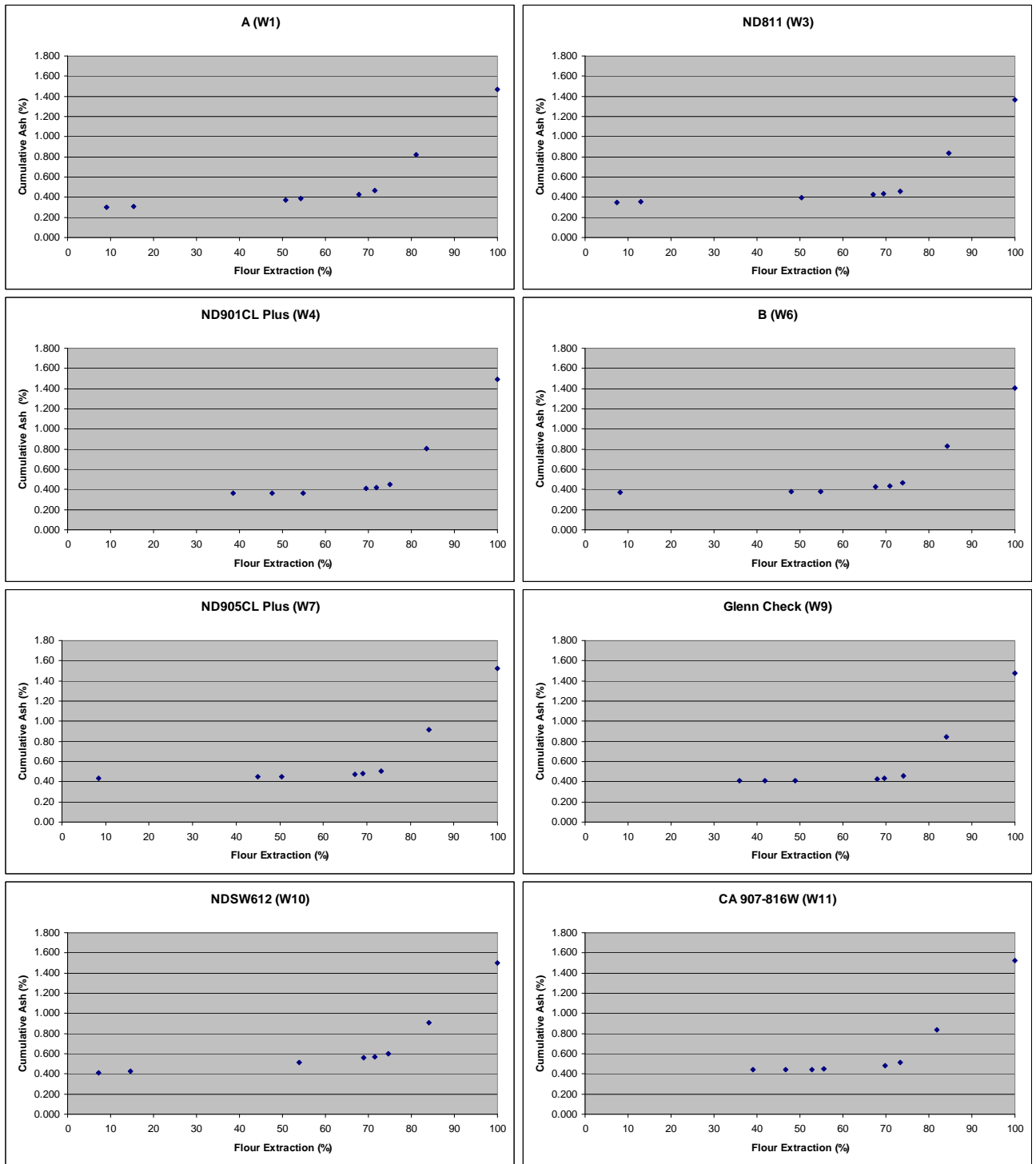
Casselton Cumulative Ash Curves



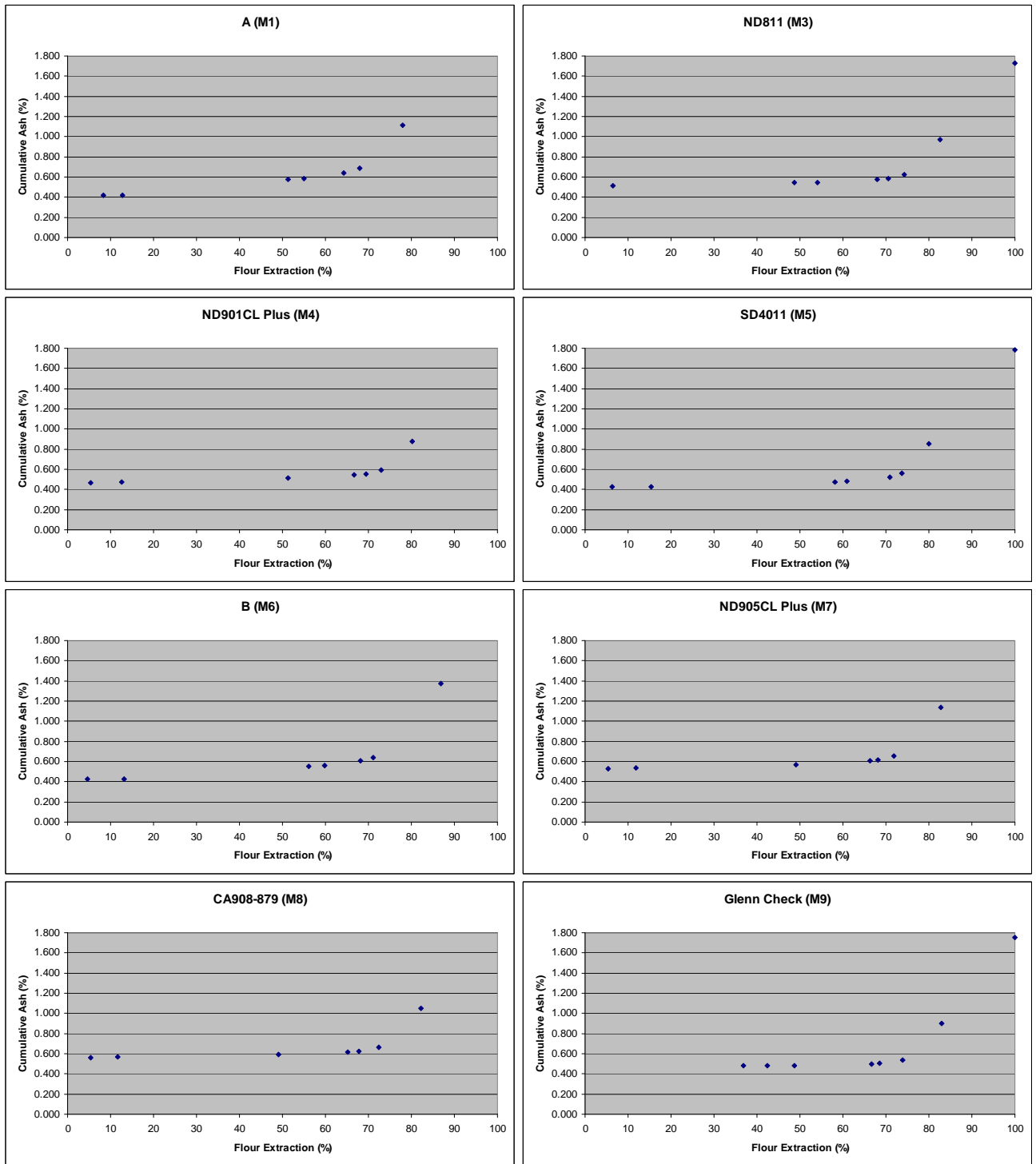
Crookston Cumulative Ash Curves

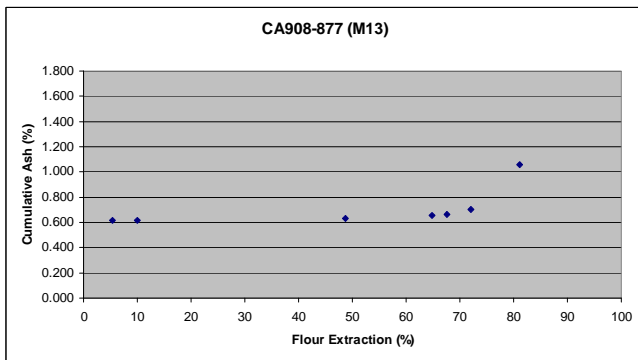
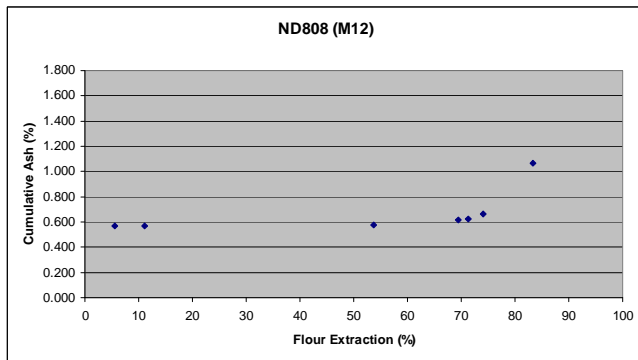
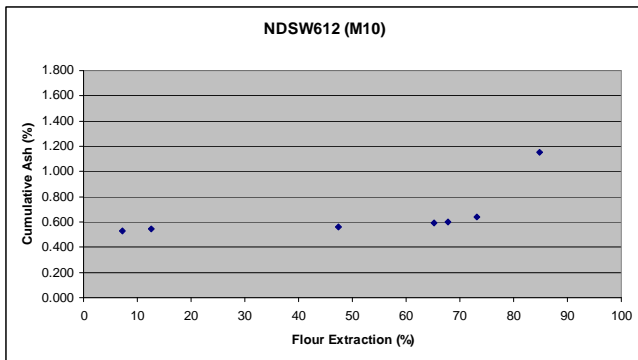


Williston Cumulative Ash Curves



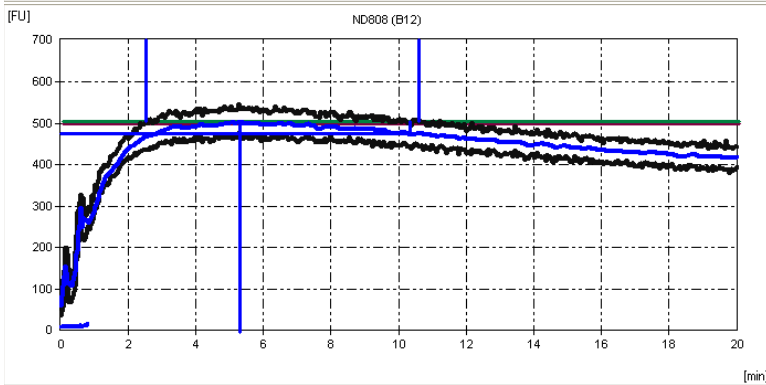
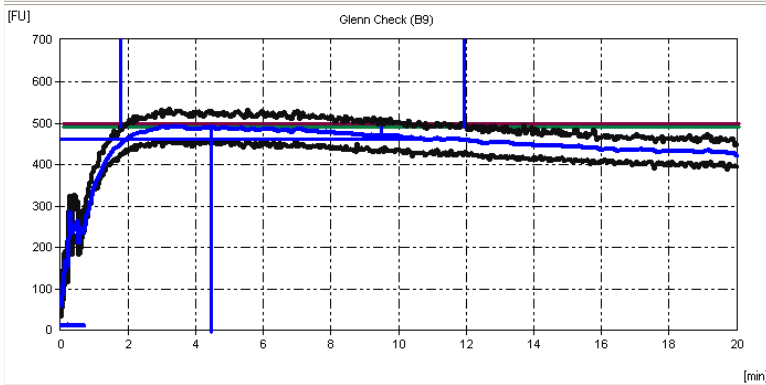
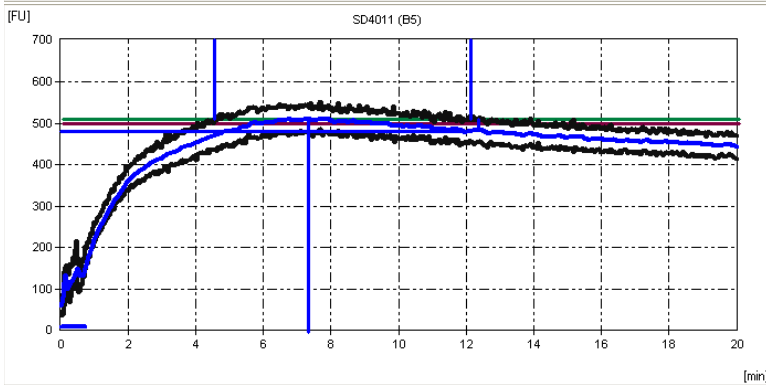
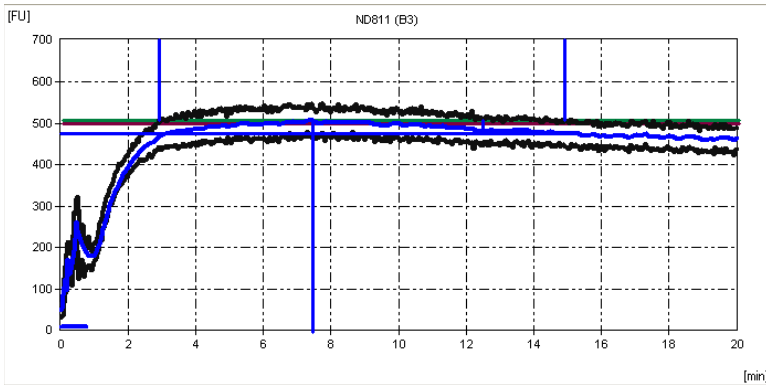
Minot Cumulative Ash Curves



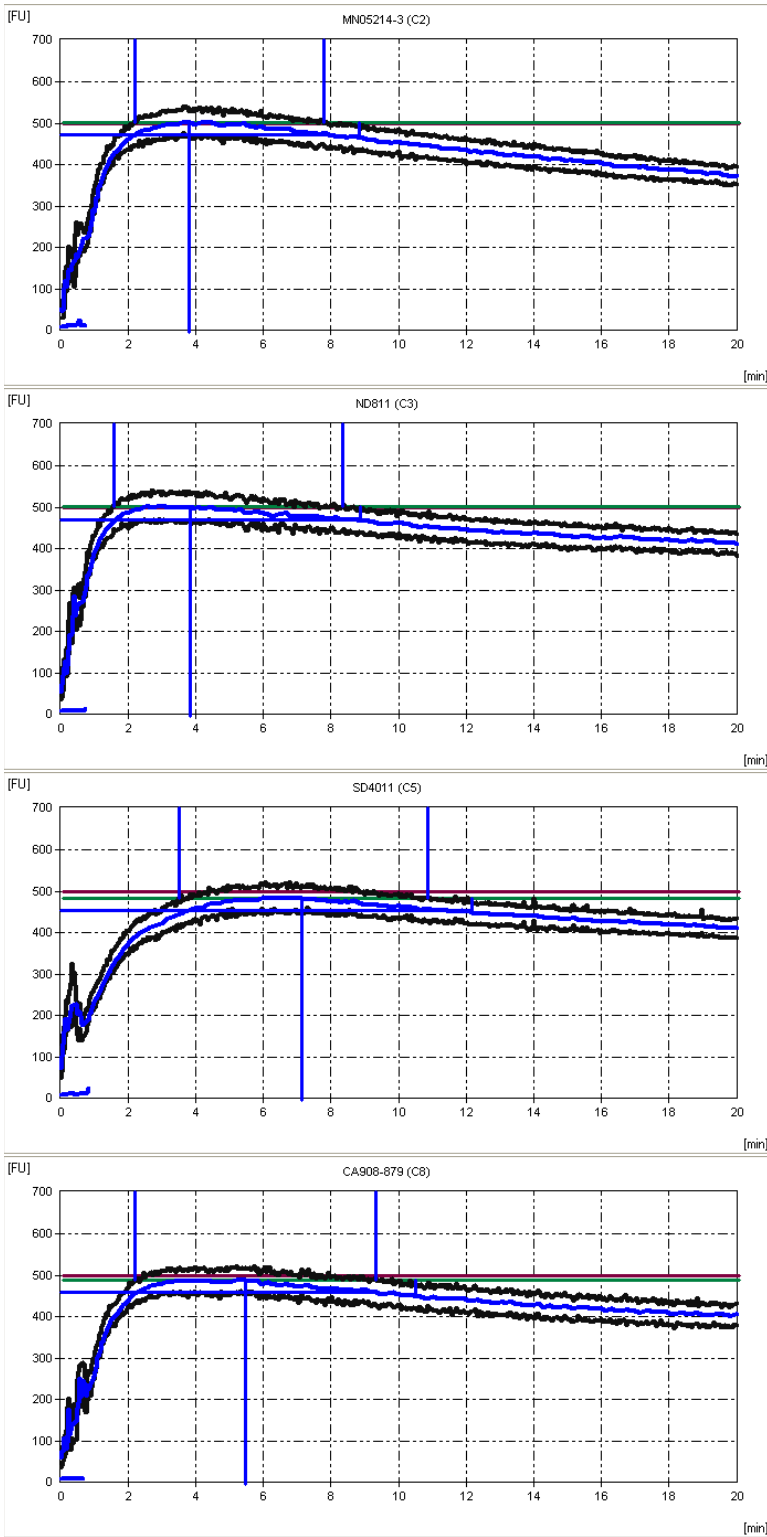


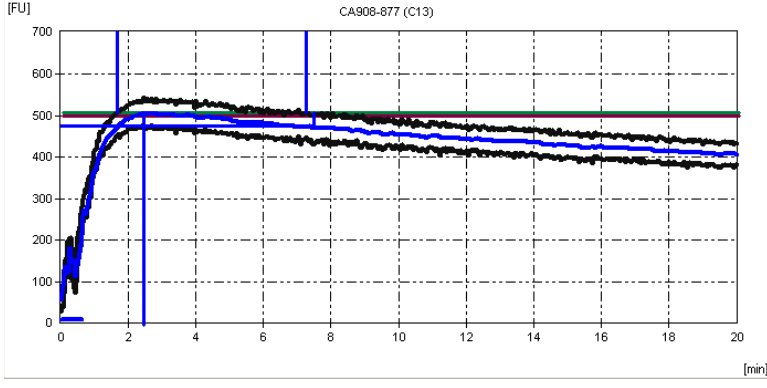
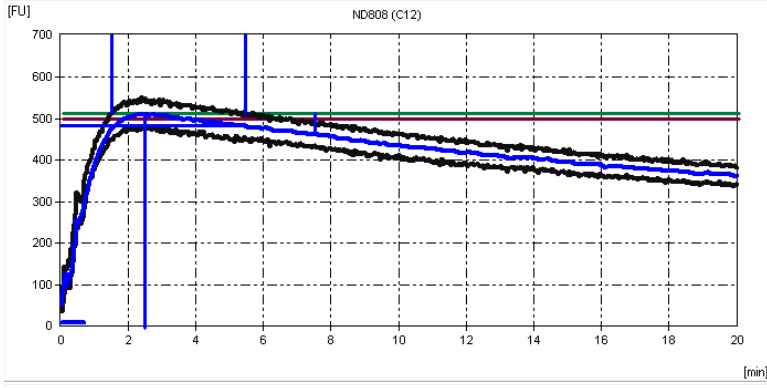
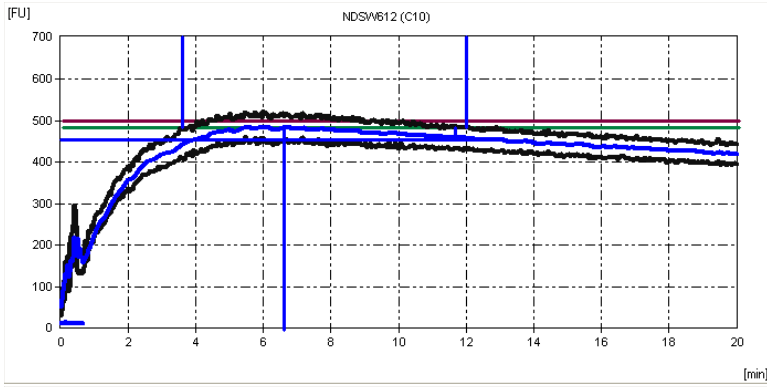
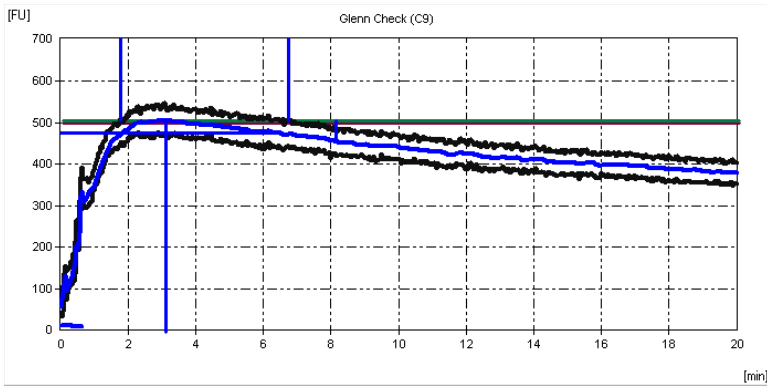
Farinograms

Watertown Farinograms

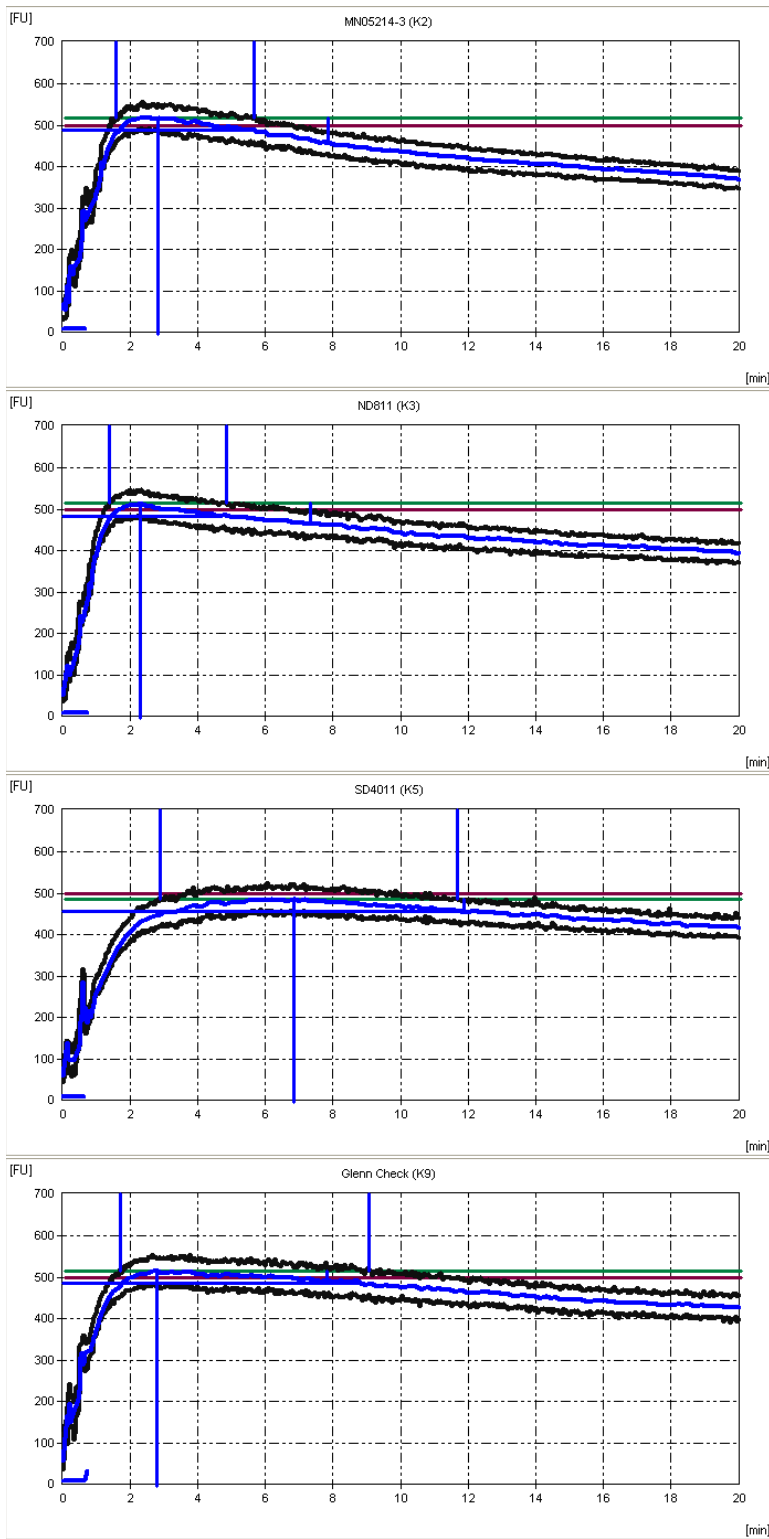


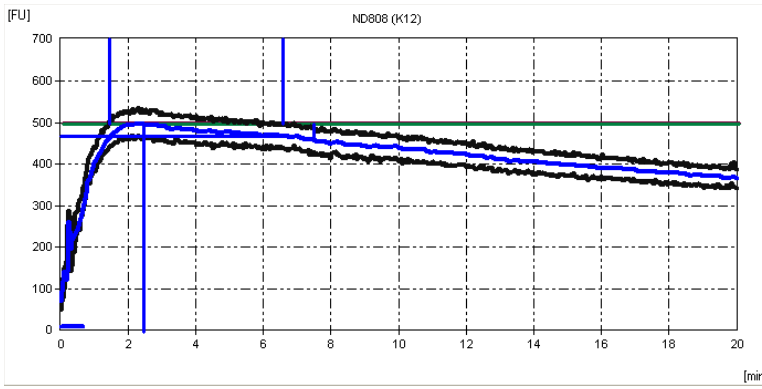
Casselton Farinograms



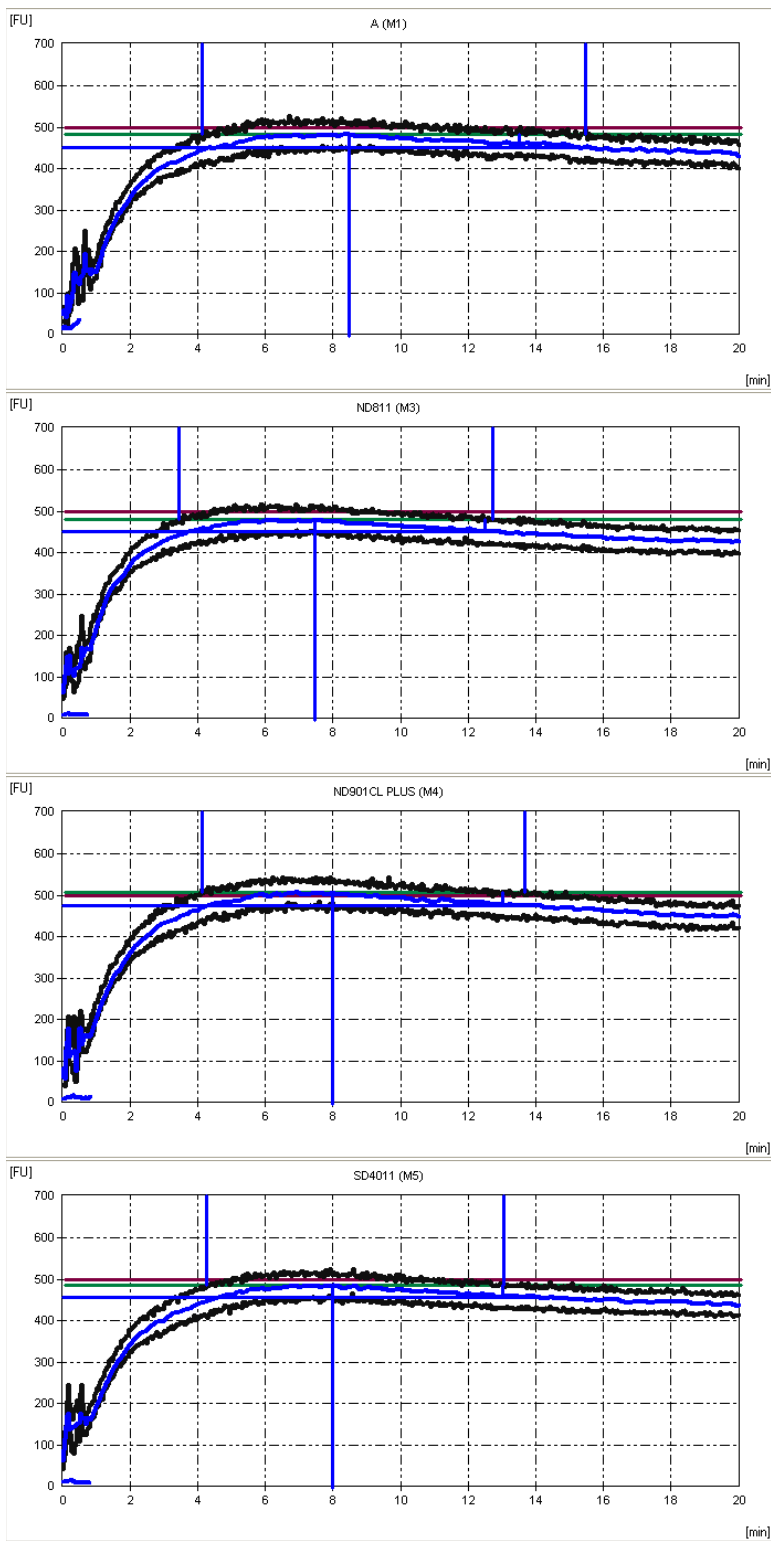


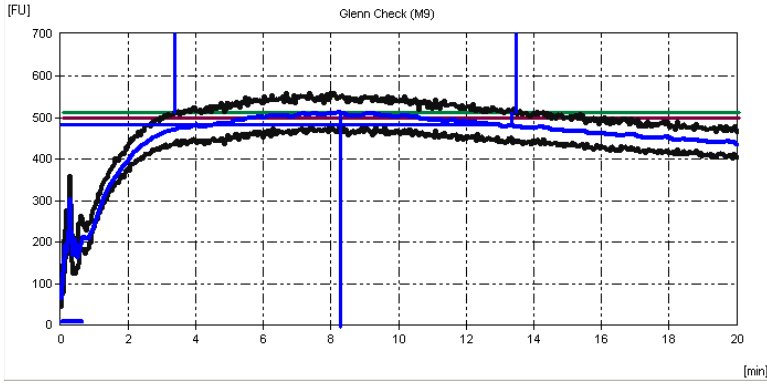
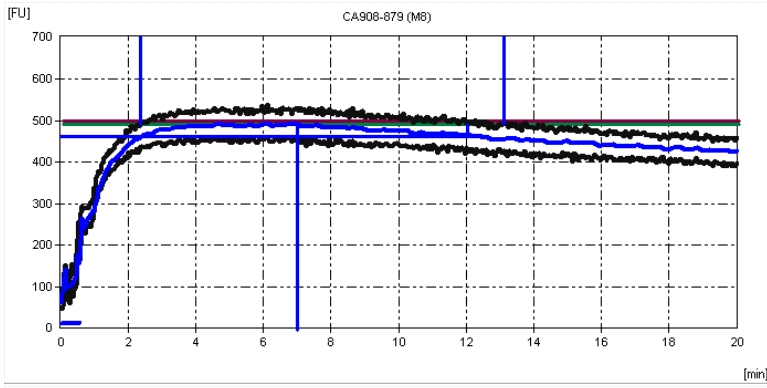
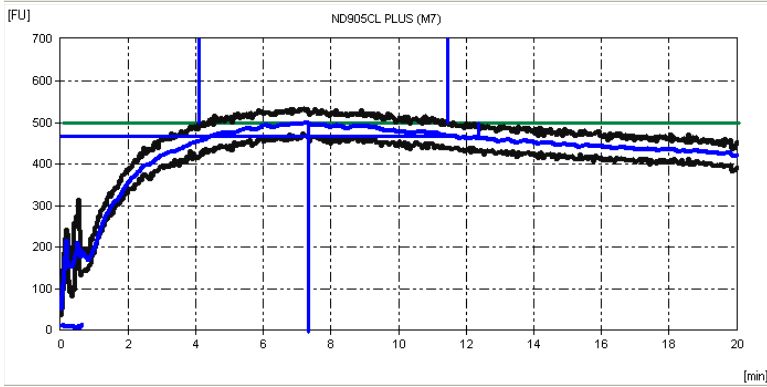
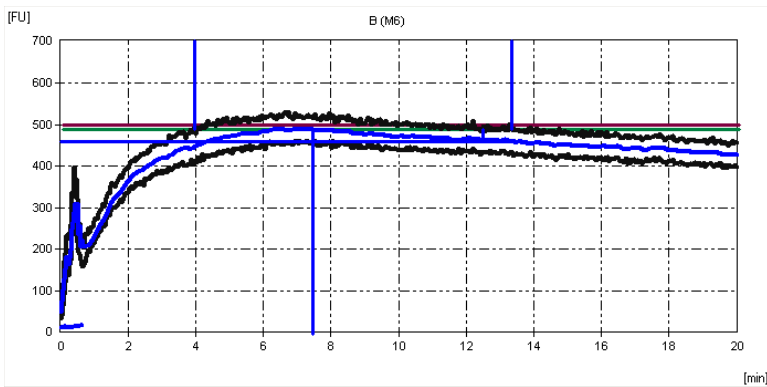
Crookston Farinograms

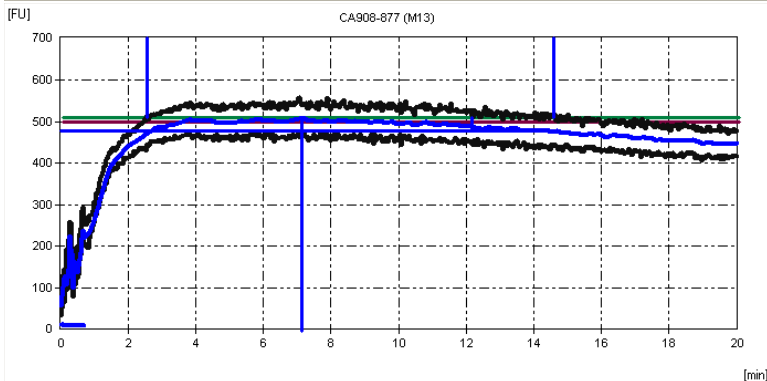
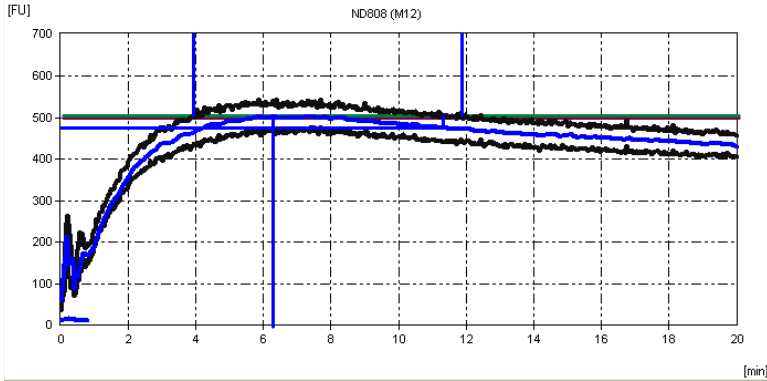
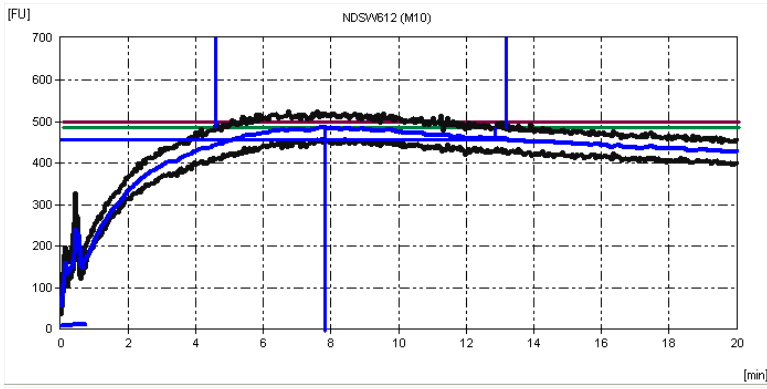




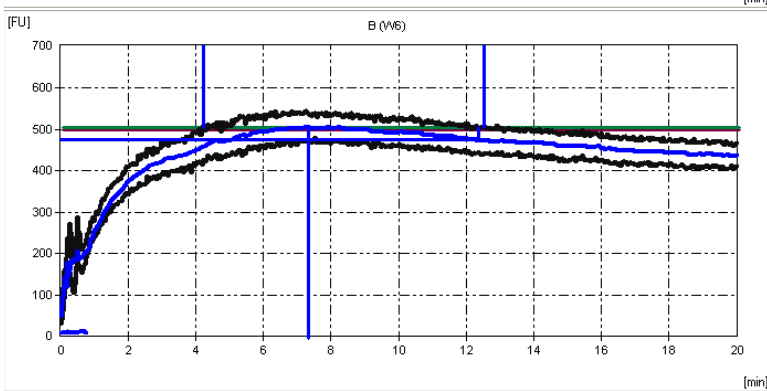
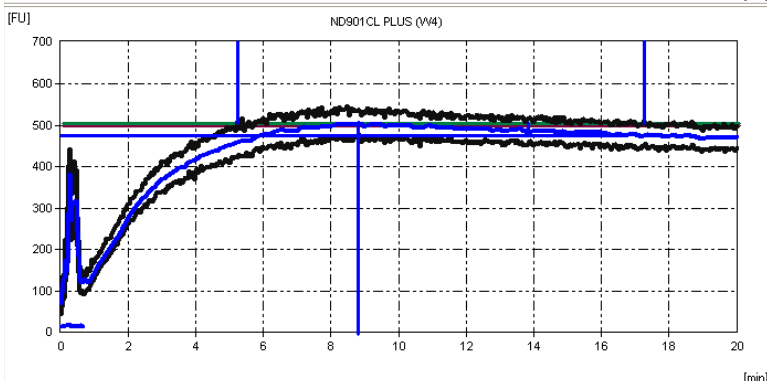
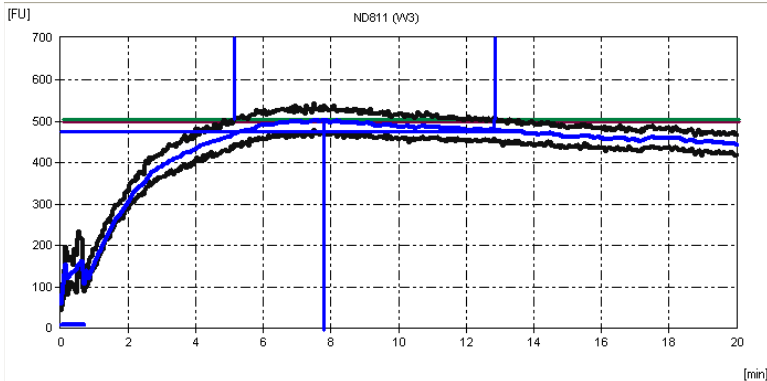
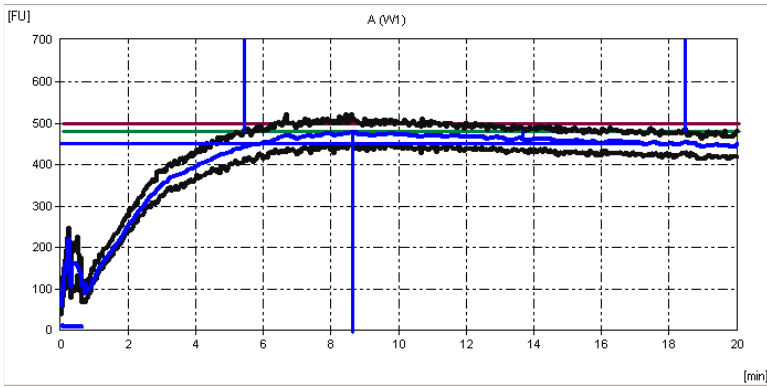
Minot Farinograms

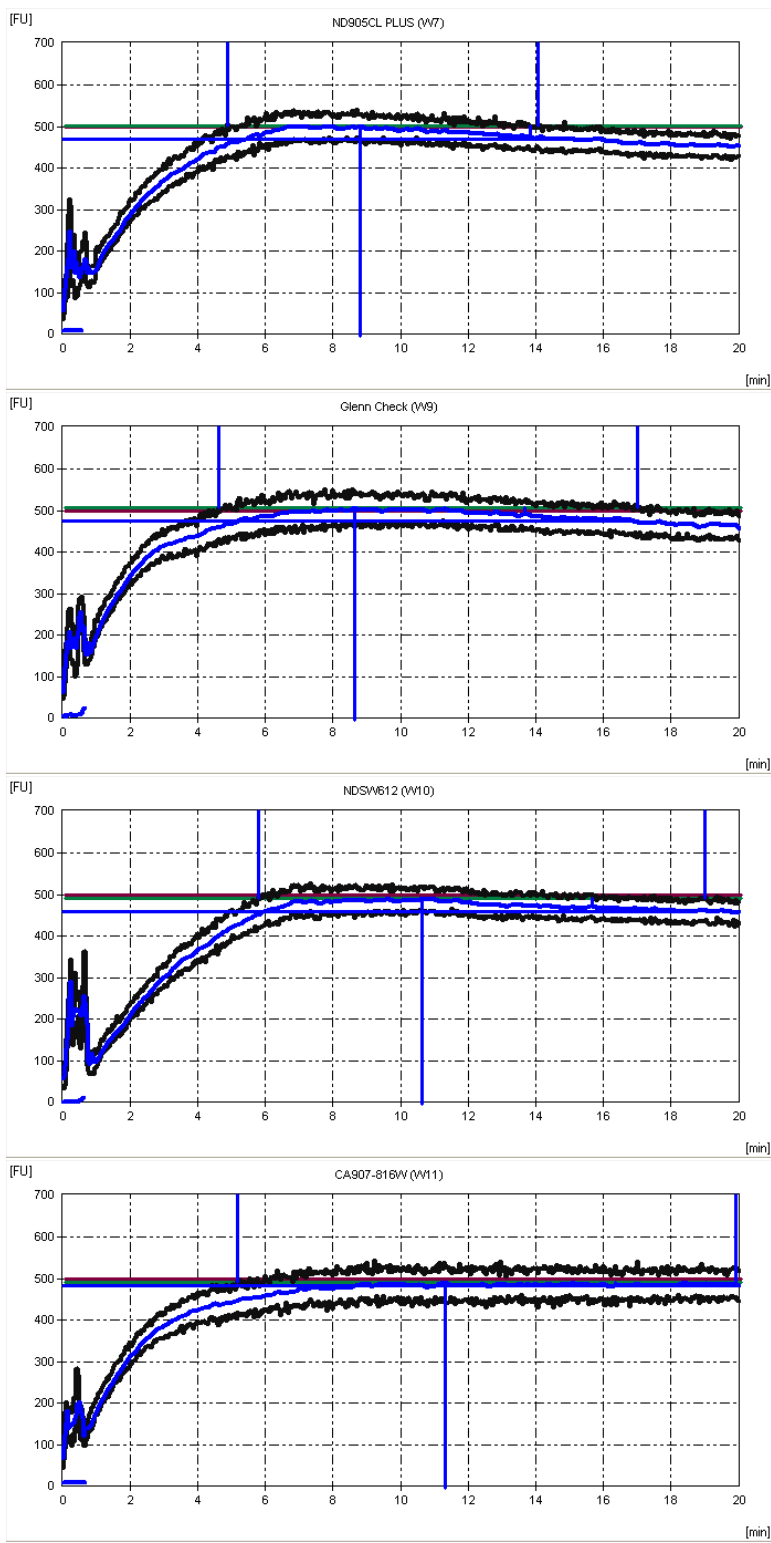






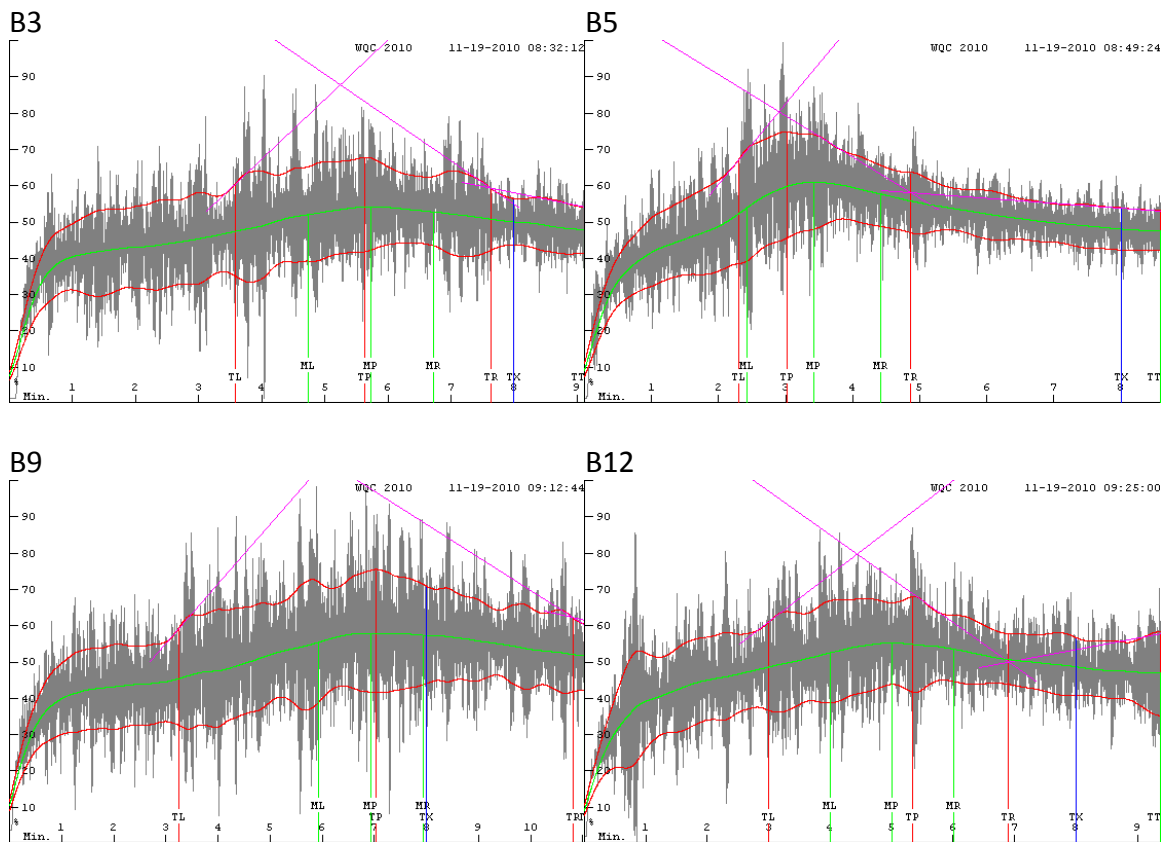
Williston Farinograms



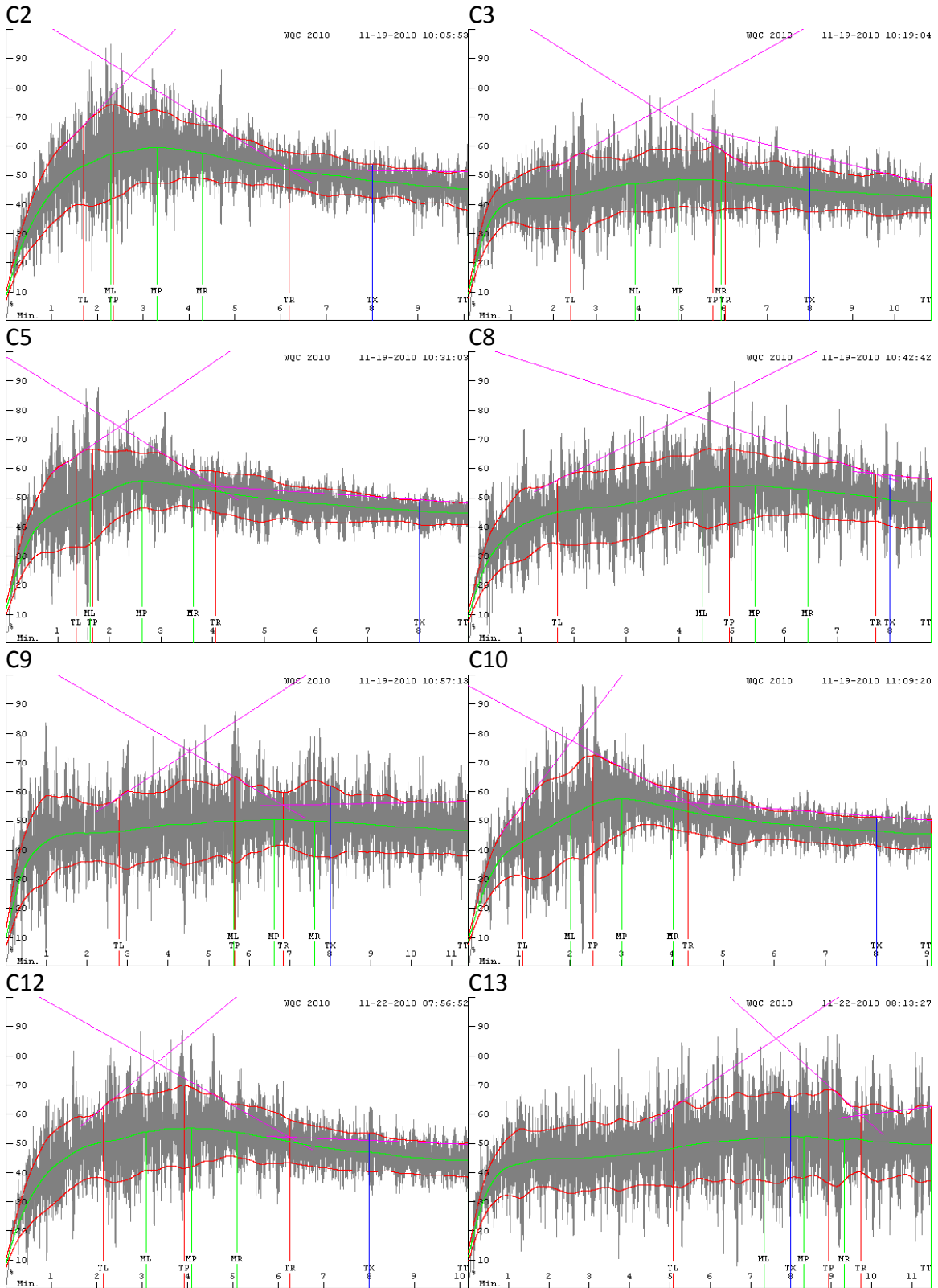


Mixograms

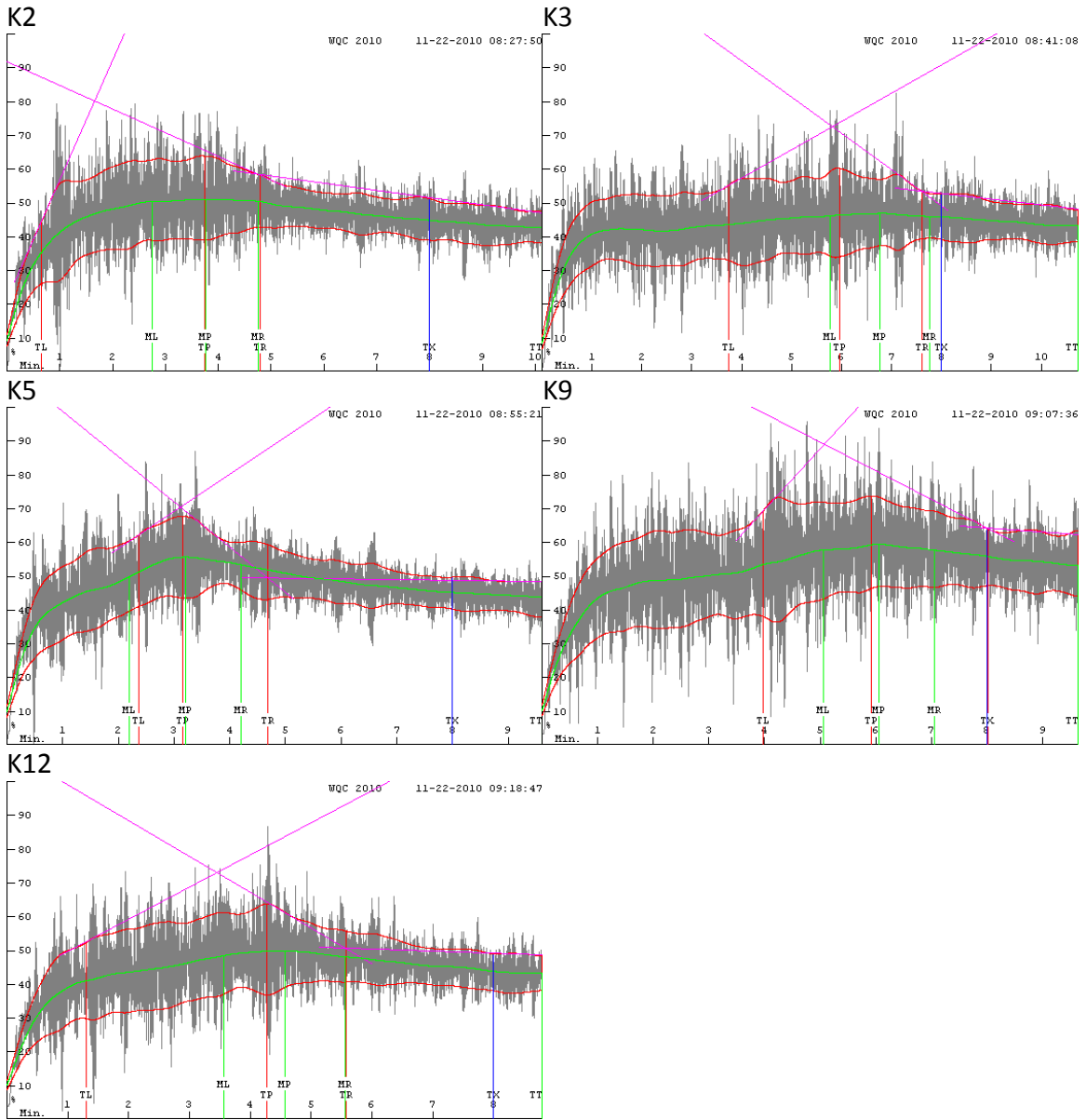
Watertown Mixograms



Casselton Mixograms

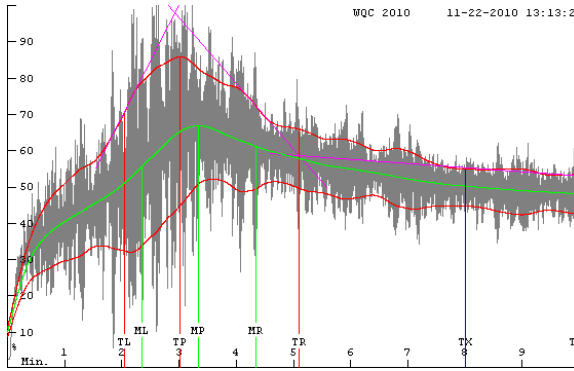


Crookston Mixograms

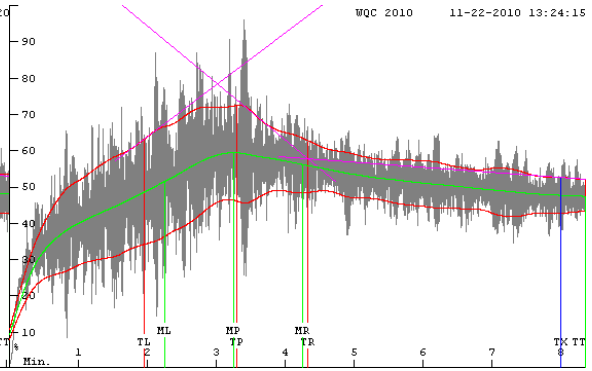


Williston Mixograms

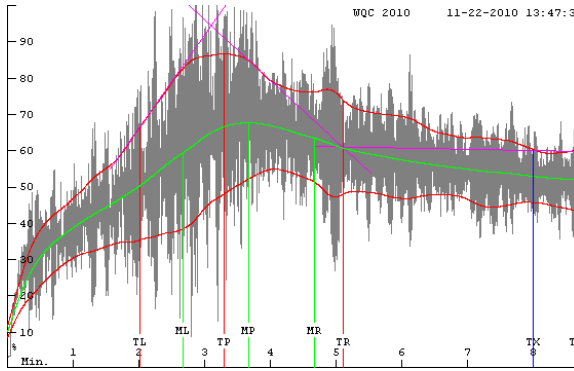
W1



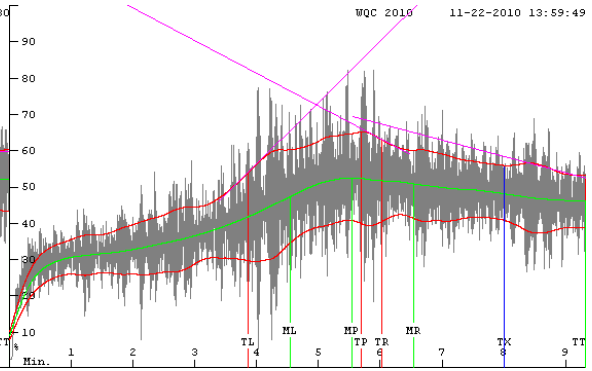
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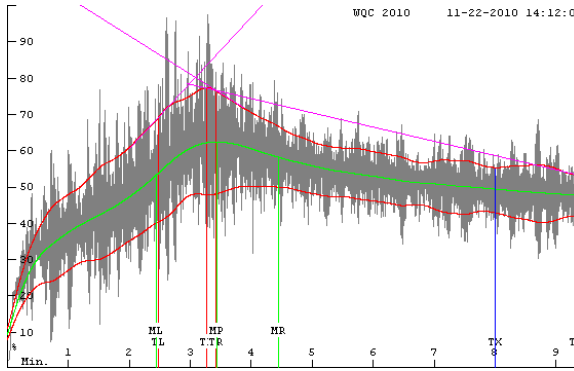
W4



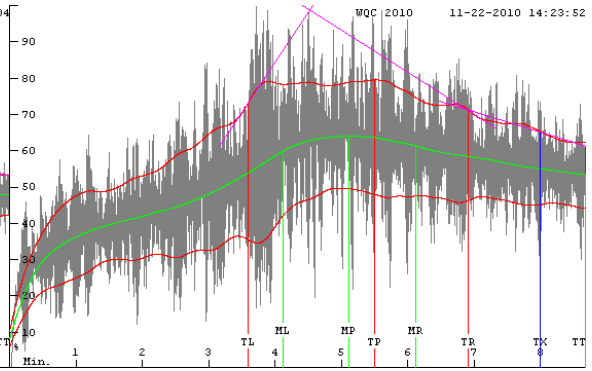
W6



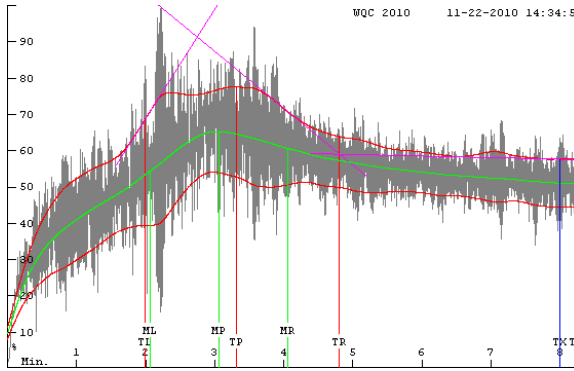
W7



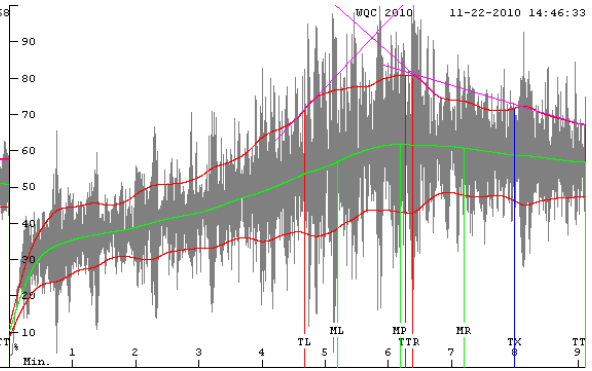
W9



W10

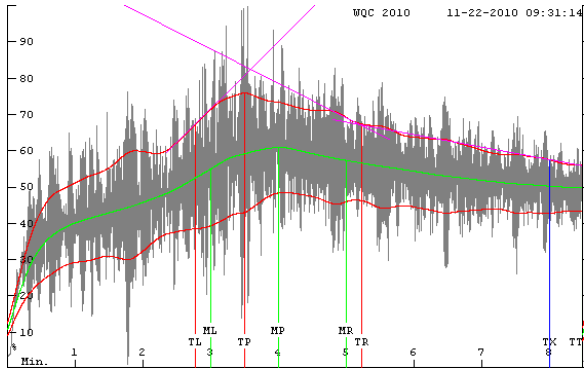


W11

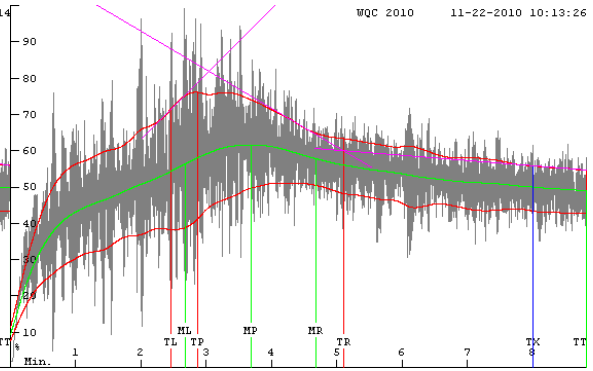


Minot Mixograms

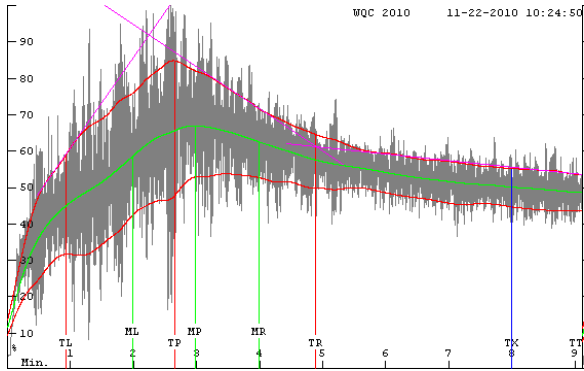
M1



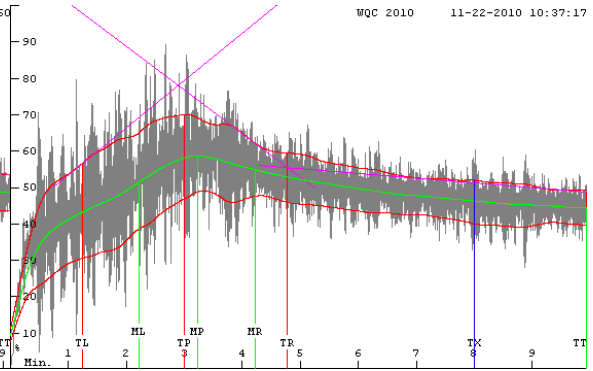
M3



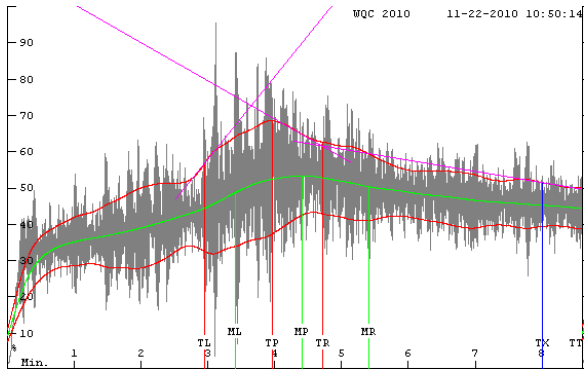
M4



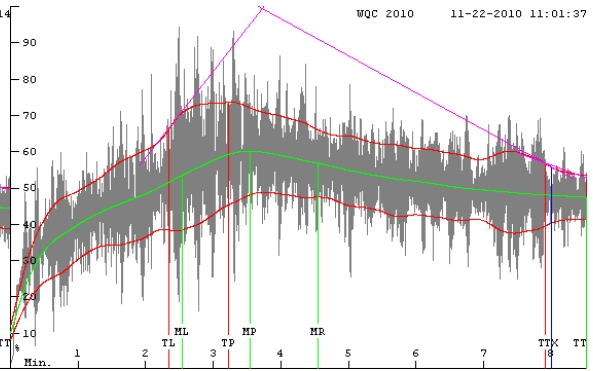
M5



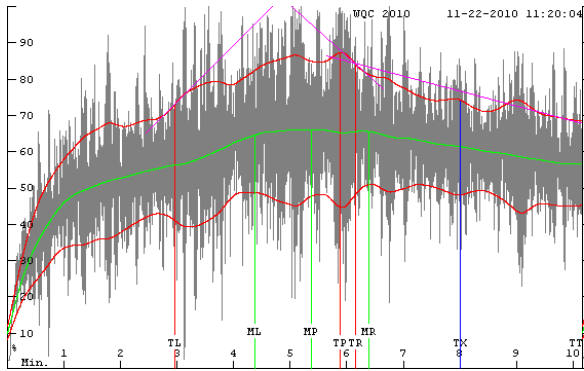
M6



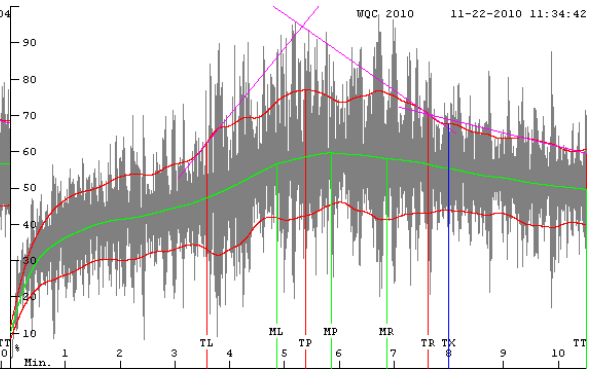
M7



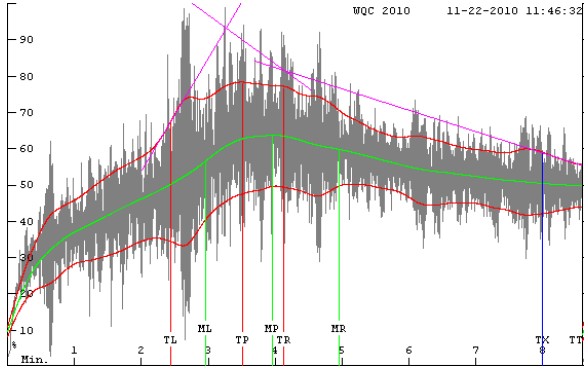
M8



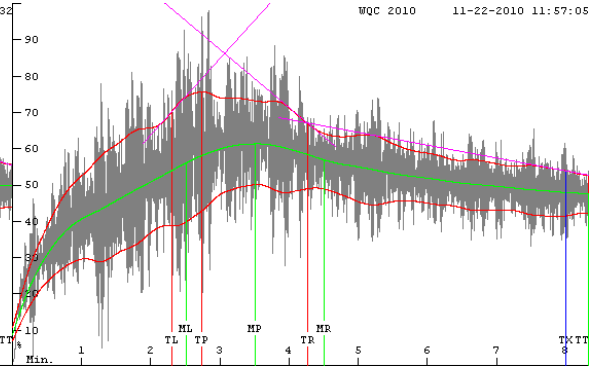
M9



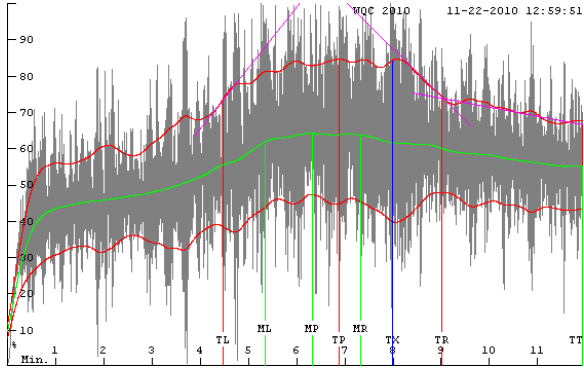
M10



M12



M13



2010 Kernel Characteristics by Location

ID		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)														
ND811	B3	14.9	14.7	3.2	5.0	57.6	24.9	48.0	10.0	10.5	1.63	448	82	83.9
SD4011	B5	15.9	15.8	3.7	5.0	58.5	26.7	52.0	9.0	10.7	1.58	525	72	48.2
	Glenn	B9	15.1	14.8	4.4	63.0	26.9	59.0	8.0	11.4	1.63	463	83	95.9
ND808	B12	14.5	14.2	3.6	5.0	59.1	29.2	64.0	8.0	10.6	1.51	464	81	65.0
Casselton (C)														
MN05214-3	C2	13.6	13.2	3.4	6.8	59.8	27.8	68.0	5.0	12.7	1.67	536	79	8.4
ND811	C3	12.5	11.9	3.0	6.2	59.0	31.8	79.0	4.0	13.0	1.64	423	65	9.0
SD4011	C5	14.1	13.4	3.5	5.6	58.6	28.8	55.0	5.0	12.5	1.57	450	57	0.0
CA908-879	C8	12.9	12.1	1.7	3.0	57.8	27.4	42.0	10.0	12.2	1.57	154	76	5.0
	Glenn	C9	14.0	13.2	3.1	60.9	29.3	58.0	6.0	12.7	1.69	356	78	5.6
NDSW612	C10	14.1	13.6	3.1	6.0	59.2	27.8	60.0	8.0	12.3	1.80	406	69	65.7
ND808	C12	12.9	12.1	3.1	5.0	58.2	30.9	80.0	5.0	12.4	1.60	430	68	2.0
CA908-877	C13	13.2	12.7	3.0	4.8	58.3	28.1	54.0	10.0	12.3	1.80	424	78	11.4
Crookston (K)														
MN05214-3	K2	11.5	11.2	3.0	5.6	60.5	29.4	59.0	7.0	9.5	1.64	572	76	5.5
ND811	K3	11.2	10.8	2.9	4.6	60.1	29.6	78.0	5.0	9.2	1.59	474	67	33.5
SD4011	K5	13.1	12.4	3.3	5.0	59.2	27.7	58.0	7.0	9.2	1.57	504	61	7.0
	Glenn	K9	13.3	12.7	4.1	63.0	28.8	59.0	7.0	10.1	1.57	457	80	20.0
ND808	K12	11.9	11.5	3.5	5.6	60.5	35.8	79.0	5.0	9.3	1.47	444	65	15.5
Williston (W)														
A	W1	17.3	17.1	4.1	5.0	56.6	29.2	22.0	12.0	11.3	1.47	487	53	96.2
ND811	W3	16.8	16.5	4.2	5.6	57.8	29.3	36.0	10.0	10.7	1.38	466	69	90.0
ND901CL PLUS	W4	18.3	18.2	3.7	5.4	57.8	23.0	7.0	28.0	10.8	1.59	400	66	94.6
B	W6	16.6	16.5	3.3	5.0	53.4	21.9	1.0	27.0	10.8	1.39	400	57	70.4
ND905CL PLUS	W7	17.3	17.2	3.5	5.0	58.4	26.5	21.0	12.0	11.1	1.49	320	72	89.8
	Glenn	W9	16.9	16.9	4.2	60.3	24.7	9.0	20.0	10.7	1.40	400	70	98.0
NDSW612	W10	17.2	17.1	3.7	4.8	57.2	25.3	24.0	13.0	10.5	1.51	400	69	97.0
CA907-816W	W11	16.9	16.7	3.6	4.8	55.8	27.0	27.0	11.0	10.7	1.51	400	57	95.1
Minot (M)														
A	M1	15.7	15.4	1.9	4.6	50.6	23.4	29.0	23.0	12.2	1.92	297	66	62.1
ND811	M3	13.8	13.6	2.4	5.0	54.8	22.5	55.0	10.0	11.8	1.65	400	79	92.3
ND901CL PLUS	M4	15.0	14.8	1.9	4.2	56.1	24.9	50.0	13.0	12.1	1.72	250	79	93.0
SD4011	M5	14.7	14.5	2.6	5.0	54.9	26.0	46.0	13.0	12.6	1.60	387	66	36.1
B	M6	14.9	14.6	2.1	5.0	49.5	19.0	22.0	38.0	12.2	1.65	343	60	37.4
ND905CL PLUS	M7	15.5	15.0	2.6	4.8	54.1	23.9	33.0	21.0	12.0	1.83	398	80	90.1
CA908-879	M8	14.2	13.8	2.1	5.0	53.6	23.6	29.0	24.0	11.9	1.72	361	87	73.0
	Glenn	M9	15.1	14.7	2.7	59.4	24.0	47.0	13.0	12.0	1.71	316	84	91.2
NDSW612	M10	15.1	14.8	2.0	4.6	55.8	19.2	41.0	18.0	11.7	1.69	286	78	94.5
ND808	M12	14.7	14.2	2.7	5.0	53.9	25.8	47.0	16.0	13.6	1.66	392	79	89.2
CA908-877	M13	14.2	13.8	1.9	4.8	54.2	22.8	30.0	19.0	12.3	1.83	335	95	76.5

Flour Characteristics by Location

ID		Flour Extraction				Flour Color				Flour Moisture %	Flour Ash 14%mb	Flour FN Malted sec
		TWB	TPB	Flour/bu wheat Lbs	L*	b*	L	b				
		%	%									
Watertown (B)												
ND811	B3	70.0	73.5	43.2	90.5	9.5	88.0	9.1	12.8	0.526	264	
SD4011	B5	71.1	75.7	44.5	89.1	8.7	86.2	8.3	11.7	0.553	266	
Glenn	B9	69.8	73.3	46.6	89.5	8.1	86.8	7.8	12.9	0.440	260	
ND808	B12	72.9	76.8	46.1	90.0	7.4	87.3	7.2	12.7	0.542	252	
Casselton (C)												
MN05214-3	C2	70.8	74.9	44.3	90.2	9.1	87.5	8.7	12.6	0.620	254	
ND811	C3	71.2	75.5	43.8	90.1	9.0	87.5	8.6	12.2	0.560	256	
SD4011	C5	72.0	75.9	44.2	91.0	8.0	88.5	7.8	12.8	0.471	245	
CA908-879	C8	71.6	75.6	40.9	90.3	8.7	87.7	8.4	12.7	0.547	203	
Glenn	C9	69.4	73.2	44.2	90.7	7.9	88.2	7.6	12.9	0.431	253	
NDSW612	C10	72.1	75.7	44.8	90.7	10.4	88.2	9.9	12.8	0.640	277	
ND808	C12	71.7	76.4	43.7	90.6	6.8	88.1	6.6	13.3	0.541	247	
CA908-877	C13	71.0	74.5	43.4	89.8	9.2	87.1	8.8	12.9	0.588	254	
Crookston (K)												
MN05214-3	K2	73.2	77.0	48.0	90.5	9.8	88.0	9.4	12.8	0.555	248	
ND811	K3	72.0	76.1	47.0	90.6	9.2	88.1	8.8	12.2	0.517	261	
SD4011	K5	72.5	76.2	46.7	90.8	8.5	88.3	8.2	12.9	0.517	254	
Glenn	K9	71.6	75.1	48.5	90.4	8.5	87.9	8.2	12.6	0.504	255	
ND808	K12	75.2	79.0	49.4	90.6	7.0	88.1	6.7	12.7	0.539	247	
Williston (W)												
A	W1	67.5	71.5	40.6	90.7	7.0	88.2	6.8	11.7	0.511	247	
ND811	W3	69.3	73.3	42.9	90.1	9.5	87.5	9.1	12.5	0.469	243	
ND901CL PLUS	W4	70.5	75.0	43.5	89.9	10.3	87.3	9.8	13.0	0.467	243	
B	W6	69.4	73.9	39.6	90.3	9.3	87.7	8.9	12.2	0.526	250	
ND905CL PLUS	W7	71.1	73.4	44.3	89.3	9.9	86.4	9.3	13.0	0.510	256	
Glenn	W9	70.0	74.0	44.9	90.1	9.0	87.5	8.6	12.5	0.465	252	
NDSW612	W10	70.8	74.7	43.4	90.1	10.6	87.5	10.1	12.6	0.597	268	
CA907-816W	W11	70.1	73.4	41.9	91.2	8.5	88.9	8.2	13.0	0.539	254	
Minot (M)												
A	M1	63.8	67.9	34.0	89.8	8.3	87.1	7.9	12.4	0.727	260	
ND811	M3	69.8	74.3	40.4	90.0	9.2	87.4	8.8	12.8	0.659	263	
ND901CL PLUS	M4	69.8	73.0	41.3	90.5	9.3	87.9	8.9	13.3	0.576	250	
SD4011	M5	70.4	73.6	40.4	90.6	8.4	88.1	8.1	12.9	0.550	261	
B	M6	65.5	71.0	34.2	90.4	8.7	87.8	8.4	12.8	0.616	254	
ND905CL PLUS	M7	68.1	71.8	38.9	89.8	9.7	87.1	9.2	12.6	0.622	272	
CA908-879	M8	69.8	72.3	39.5	89.8	9.3	87.1	8.9	12.8	0.647	257	
Glenn	M9	70.7	73.8	44.3	90.5	8.4	87.9	8.1	12.8	0.524	270	
NDSW612	M10	70.7	73.2	41.6	90.3	10.3	87.7	9.8	13.0	0.635	262	
ND808	M12	69.6	74.1	39.2	90.0	8.0	87.4	7.7	12.4	0.641	274	
CA908-877	M13	69.0	72.1	39.4	89.9	9.9	87.3	9.4	13.2	0.660	261	

Farinograph Characteristics by Location

		Farinograph						
ID		Water Abs	Water Abs	Arrival Time	Peak Time	Dough Stability	MTI	TTB
		500 bu %	14%mb %					
Watertown (B)								
ND811	B3	64.7	63.3	2.9	7.5	12.0	25.0	14.8
SD4011	B5	67.3	64.7	4.5	7.4	7.6	29.0	11.9
Glenn	B9	65.4	64.1	1.8	4.5	10.2	23.0	10.5
ND808	B12	65.5	64.0	2.5	5.3	8.1	31.0	10.3
Casselton (C)								
MN05214-3	C2	69.5	67.9	2.3	3.8	5.6	38.0	7.9
ND811	C3	63.6	61.5	1.5	3.9	6.7	33.0	8.3
SD4011	C5	64.6	63.2	3.5	7.2	7.4	34.0	11.5
CA908-879	C8	64.3	62.8	2.2	5.5	7.1	40.0	9.4
Glenn	C9	66.1	64.8	1.8	3.2	5.0	50.0	6.5
NDSW612	C10	64.8	63.4	3.5	6.7	8.4	25.0	12.6
ND808	C12	63.3	62.5	1.5	2.5	3.9	50.0	5.5
CA908-877	C13	65.2	63.9	1.6	2.5	5.6	37.0	6.8
Crookston (K)								
MN05214-3	K2	65.5	64.1	1.5	2.9	4.1	62.0	5.7
ND811	K3	63.1	61.0	1.4	2.3	3.5	49.0	4.6
SD4011	K5	62.2	60.9	2.8	6.9	8.8	31.0	11.8
Glenn	K9	64.8	63.2	1.7	2.8	7.4	22.0	8.8
ND808	K12	63.7	62.2	1.5	2.5	5.1	38.0	6.7
Williston (W)								
A	W1	67.5	64.9	5.3	8.7	13.0	18.0	17.2
ND811	W3	68.7	67.0	5.1	7.8	7.7	25.0	13.7
ND901CL PLUS	W4	68.1	66.9	5.2	8.8	12.0	23.0	16.6
B	W6	62.1	60.0	4.2	7.4	8.3	32.0	12.1
ND905CL PLUS	W7	66.8	65.6	4.9	8.8	9.2	26.0	14.3
Glenn	W9	67.0	65.3	4.5	8.7	12.4	16.0	16.8
NDSW612	W10	68.8	67.2	5.8	10.7	13.2	17.0	18.3
CA907-816W	W11	65.2	64.0	5.2	11.4	14.8	8.0	20.0
Minot (M)								
A	M1	66.1	64.3	4.1	8.5	11.3	22.0	15.1
ND811	M3	65.1	63.7	3.4	7.5	9.3	28.0	13.0
ND901CL PLUS	M4	65.7	64.9	4.1	8.0	9.5	30.0	13.5
SD4011	M5	64.2	62.9	4.3	8.0	8.8	27.0	14.1
B	M6	60.9	59.5	4.0	7.5	9.4	29.0	13.4
ND905CL PLUS	M7	65.5	63.9	4.1	7.4	7.4	35.0	11.4
CA908-879	M8	64.4	63.0	2.5	7.0	10.8	27.0	12.5
Glenn	M9	64.3	62.9	3.3	8.3	10.1	31.0	13.0
NDSW612	M10	65.2	64.0	4.5	7.9	8.6	28.0	13.3
ND808	M12	65.5	63.7	3.9	6.3	7.9	29.0	11.5
CA908-877	M13	64.6	63.7	2.5	7.2	12.0	21.0	13.6

Mixograph Characteristics by Location

		Mixogram						
ID		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)								
ND811	B3	5.6	67.8	26.0	5.7	54.2	25.4	252.9
SD4011	B5	3.0	74.8	29.2	3.4	61.0	26.0	156.3
Glenn	B9	7.0	75.4	34.0	6.9	57.8	33.5	318.6
ND808	B12	5.3	68.0	26.4	5.0	55.2	22.5	222.4
Casselton (C)								
MN05214-3	C2	2.4	74.3	32.0	3.3	59.6	25.0	155.8
ND811	C3	5.7	59.8	22.1	4.9	48.6	19.9	206.5
SD4011	C5	1.7	66.7	31.8	2.6	55.7	18.7	117.2
CA908-879	C8	5.0	66.7	25.8	5.4	54.1	22.1	246.9
Glenn	C9	5.6	64.9	29.8	6.6	50.5	18.8	300.9
NDSW612	C10	2.4	72.4	33.3	3.0	57.5	22.7	133.6
ND808	C12	3.9	69.8	28.4	4.1	55.1	27.3	185.7
CA908-877	C13	8.9	68.4	32.2	8.3	52.3	29.0	381.6
Crookston (K)								
MN05214-3	K2	3.7	63.9	24.9	3.8	51.1	24.9	163.2
ND811	K3	6.0	60.2	26.2	6.8	46.9	19.7	283.8
SD4011	K5	3.2	67.7	24.1	3.2	55.7	24.1	140.5
Glenn	K9	5.9	73.7	27.2	6.1	59.5	26.5	295.7
ND808	K12	4.3	63.8	27.0	4.6	49.8	22.2	191.6
Williston (W)								
A	W1	3.0	85.8	41.1	3.4	66.9	31.5	156.3
ND811	W3	3.3	72.6	26.3	3.3	59.4	25.9	143.2
ND901CL PLUS	W4	3.3	86.7	38.7	3.7	67.7	32.7	174.4
B	W6	5.7	65.2	25.2	5.5	52.5	24.0	205.3
ND905CL PLUS	W7	3.3	77.3	29.6	3.4	62.4	28.1	151.5
Glenn	W9	5.5	79.5	31.6	5.1	64.0	29.3	233.6
NDSW612	W10	3.3	77.6	24.8	3.1	65.2	22.9	141.1
CA907-816W	W11	6.3	81.0	37.9	6.2	61.7	37.7	275.0
Minot (M)								
A	M1	3.5	75.8	32.9	4.0	60.9	25.0	182.6
ND811	M3	2.9	76.1	34.9	3.7	61.6	24.4	174.2
ND901CL PLUS	M4	2.7	84.8	37.1	3.0	66.9	29.1	148.7
SD4011	M5	3.0	70.1	23.2	3.2	58.7	20.4	143.2
B	M6	4.0	68.5	31.2	4.4	53.3	22.2	177.3
ND905CL PLUS	M7	3.2	73.6	28.2	3.6	60.2	24.0	159.7
CA908-879	M8	5.9	87.2	42.6	5.4	66.0	37.1	285.7
Glenn	M9	5.4	77.0	34.6	5.9	59.7	29.2	261.1
NDSW612	M10	3.5	78.3	30.8	4.0	63.7	27.8	179.5
ND808	M12	2.7	75.6	32.9	3.5	61.3	23.1	161.3
CA908-877	M13	6.9	84.6	39.9	6.3	64.2	35.5	313.9

Interpreting Mixogram Results

Among the numbers on the previous page, the time to peak (maximum mixing resistance) for both the top of the envelope and mid line is shown, including envelope and mid line % of full value. These values are traditionally the most meaningful. A mid line peak time around 3 to 5 minutes and 60% scale are usually about right for bread flour. Very steep slopes left-of-peak and right-of-peak are undesirable, which indicates a flour sample with low tolerance and high sensitivity to mixing time.

Delayed peaks and narrow widths (especially at about 8 minutes) are often taken as indicating 'weakness'.

Integral values for the midline section are for the areas beneath the mid line from time zero to the point in question. Units are the vertical axis (% torque) multiplied by the horizontal axis (minutes). These values represent the work put into the flour and water in order to develop the dough.

In summary, the mid line time to peak and % peak values, the top line ascending and descending slopes, and the bandwidth at 8 minutes are the values most used. 'Best' values are typically determined by the breeder, miller, and baker. (Mixsmart Documentation and Instructions, A.E. Walker and C.E. Walker, 2004, National Mfg.)