Wheat Quality Council
Hard Spring Wheat Technical Committee

2012 Crop Milling and Baking Quality Data

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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.

Fourteen experimental lines of hard spring wheat were harvested at up to five locations in 2012 and evaluated for kernel, milling, and bread baking quality against the check cultivar 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. 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 2012 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.

Wheat and Flour Quality Data

Line: Line A (AUBR30023W) (Check- Glenn)

	Trait	Check M 3	Line M 1	Check W 3	Line W 1
I. USDA/ARS WQL Data					
1	Wheat Protein (12% mb)	15.1	14.7	18.0	16.8
2	Flour Protein (12% mb)	14.8	14.0	17.4	16.2
3	UPP/EPP (SDS unextractable/extractable polymeric proteins)	1.47	1.36	1.61	1.55
4	Market Value 1 (Score 1-6)	4.1	2.8	4.0	3.5
5	Market Value 2 (Score 1-10)	10.0	8.6	10.0	7.6
6	Test Weight (lb/bu)	61.4	59.5	59.0	55.1
7	1000 Kernel Weight (g)	27.5	28.2	22.6	21.9
	Kernel Size				
8	% Large	43	41	2	4
9	% Small	15	17	37	50
10	Wheat Moisture (%)	13.2	13.0	14.3	12.1
11	Wheat Ash (14% mb)	1.58	1.76	1.52	1.61
12	Wheat Falling Number (sec)	395	324	418	435
13	SKCS Hardness Index (SK-HI)	84.0	76.5	66.4	61.5
14	SK-HI Standard Deviation	19.5	18.4	18.1	18.6
15	Vitreous Kernels (%)	96	98	99	88
	Flour Extraction (%)				
16	Tempered Wheat Basis (%)	74.4	73.3	71.7	71.0
17	Total Product Basis (%)	73.5	73.4	72.7	70.4
18	Flour (Lbs)/ Wheat (Bu)	44.9	44.2	44.5	44.1
	Flour Characteristics				
19	Flour Color Brightness (L*)	90.8	91.0	90.1	90.3
20	Flour Color Yellow Scale (b*)	7.7	8.3	8.0	8.8
21	Flour Moisture (%)	11.8	11.8	11.9	11.6
22	Flour Ash (14% mb)	0.589	0.655	0.517	0.653
23	Falling Number (Malted) (sec)	253	252	252	256
	Farinograph				
24	Water Absorption (500bu)	67.6	66.1	65.8	64.7
25	Water Absorption (14%mb)	65.2	63.7	63.4	62.0
26	Arrival Time (min)	4.5	3.9	5.1	5.0
27	Peak Time (min)	9.4	6.2	16.5	21.4
28	Dough Stability (min)	9.7	6.5	33.3	27.4
29	Mixing tolerance Index (bu)	35	37	11	8
30	Time To Breakdown (min)	13.1	10.5	37.9	32.5

Line: Line A (AUBR30023W)

	Trait	Check M 3	Line M 1	Check W 3	Line W 1
II. Cooperator Results					
31	**Bake Absorption (%, 14% flour mb)**	66.6	64.8	67.1	65.5
32	**Loaf Volume (% Check)**	100.0	93.6	100.0	98.9
33	**Mixing Requirement** 5=Very Long, 4=Long, 3=Medium, 2=Short, 1=Very Short	3.9	3.0	4.6	4.7
34	**Dough Characteristics** 5=Bucky-Tough, 4=Strong-Elastic, 3=Medium-Pliable, 2=Mellow-Very Pliable, 1=Weak-Short or Sticky	4.3	3.7	4.2	4.2
35	**Mixing Tolerance** 5=Much More Tolerance, 4=More Tolerance, 3=Equivalent, 2=Less Tolerance, and 1=Much Less Tolerance when compared to check	3.0	2.2	3.0	2.8
36	**Internal Crumb Color** 5=Much Brighter, 4=Brighter, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to check	3.0	2.6	3.0	2.8
37	**Internal Grain and Texture** 5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check	3.0	2.8	3.0	3.1
III. Cooperator Evaluation (37-40)	5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check				
38	**Quality Trait 1-3: Protein**	3.0	2.6	3.0	2.5
39	**Quality Trait 4-22: Milling**	3.0	2.7	3.0	2.4
40	**Quality Trait 24-37: Baking**	3.0	2.3	3.0	2.5
41	**Quality Trait 1-37: Overall**	3.0	4.0	3.0	2.6

Line: MN 07098-6 (Check- Glenn)

	Trait	Check C 3	Line C 2	Check K 3	Line K 2
I. USDA/ARS WQL Data					
1	Wheat Protein (12% mb)	14.9	13.5	14.1	13.6
2	Flour Protein (12% mb)	14.2	12.5	13.5	12.8
3	UPP/EPP (SDS unextractable/extractable polymeric proteins)	1.33	1.17	1.38	1.16
4	Market Value 1 (Score 1-6)	4.8	4.1	4.4	4.0
5	Market Value 2 (Score 1-10)	10.0	8.4	10.0	8.4
6	Test Weight (lb/bu)	64.0	62.0	64.2	61.0
7	1000 Kernel Weight (g)	29.8	28.3	29.9	27.4
	Kernel Size				
8	% Large	55	38	52	27
9	% Small	11	17	12	21
10	Wheat Moisture (%)	12.1	12.0	12.9	12.5
11	Wheat Ash (14% mb)	1.47	1.44	1.58	1.31
12	Wheat Falling Number (sec)	433	461	420	485
13	SKCS Hardness Index (SK-HI)	90.4	85.4	92.7	88.1
14	SK-HI Standard Deviation	17.2	18.5	18.0	16.9
15	Vitreous Kernels (%)	96	67	99	89
	Flour Extraction (%)				
16	Tempered Wheat Basis (%)	72.6	75.6	75.6	72.3
17	Total Product Basis (%)	71.7	75.8	73.0	72.4
18	Flour (Lbs)/ Wheat (Bu)	43.8	45.6	45.6	43.6
	Flour Characteristics				
19	Flour Color Brightness (L*)	90.5	90.4	90.8	90.1
20	Flour Color Yellow Scale (b*)	7.5	8.1	7.6	8.2
21	Flour Moisture (%)	12.2	12.3	11.5	12.0
22	Flour Ash (14% mb)	0.543	0.550	0.512	0.551
23	Falling Number (Malted) (sec)	255	250	256	253
	Farinograph				
24	Water Absorption (500bu)	67.2	63.0	66.0	62.6
25	Water Absorption (14%mb)	65.2	61.0	63.2	60.4
26	Arrival Time (min)	4.9	3.1	3.5	3.5
27	Peak Time (min)	9.7	6.7	8.7	7.9
28	Dough Stability (min)	9.3	8.6	11.0	8.6
29	Mixing tolerance Index (bu)	32	30	22	37
30	Time To Breakdown (min)	14.5	11.4	14.5	12.3

Line: MN 07098-6

	Trait	Check C 3	Line C 2	Check K 3	Line K 2
II. Cooperator Results					
31	**Bake Absorption (%, 14% flour mb)**	66.1	62.6	64.5	62.4
32	**Loaf Volume (% Check)**	100.0	96.1	100.0	96.8
33	**Mixing Requirement** 5=Very Long, 4=Long, 3=Medium, 2=Short, 1=Very Short	3.6	3.1	4.0	3.3
34	**Dough Characteristics** 5=Bucky-Tough, 4=Strong-Elastic, 3=Medium-Pliable, 2=Mellow-Very Pliable, 1=Weak-Short or Sticky	3.8	3.3	4.0	3.4
35	**Mixing Tolerance** 5=Much More Tolerance, 4=More Tolerance, 3=Equivalent, 2=Less Tolerance, and 1=Much Less Tolerance when compared to check	3.0	2.6	3.0	2.7
36	**Internal Crumb Color** 5=Much Brighter, 4=Brighter, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to check	3.0	3.0	3.0	2.6
37	**Internal Grain and Texture** 5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check	3.0	3.2	3.0	2.8
III. Cooperator Evaluation (37-40)	5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check				
38	**Quality Trait 1-3: Protein**	3.0	2.0	3.0	2.4
39	**Quality Trait 4-22: Milling**	3.0	3.6	3.0	2.2
40	**Quality Trait 24-37: Baking**	3.0	2.5	3.0	2.5
41	**Quality Trait 1-37: Overall**	3.0	2.6	3.0	2.3

Line: ND 818 (Elgin) (Check- Glenn)

	Trait	Check B 3	Line B 4	Check C 3	Line C 4	Check K 3	Line K 4	Check M 3	Line M 4	Check W 3	Line W 4
I. USDA/ARS WQL Data											
1	Wheat Protein (12% mb)	16.5	16.2	14.9	14.2	14.1	15.3	15.1	15.3	18.0	18.8
2	Flour Protein (12% mb)	15.4	15.3	14.2	13.6	13.5	14.5	14.8	15.0	17.4	18.3
3	UPP/EPP (SDS unextractable/extractable polymeric proteins)	1.09	1.18	1.33	1.32	1.38	1.26	1.47	1.45	1.61	1.44
4	Market Value 1 (Score 1-6)	4.4	3.6	4.8	3.7	4.4	4.2	4.1	3.7	4.0	3.5
5	Market Value 2 (Score 1-10)	10.0	8.4	10.0	7.8	10.0	8.0	10.0	8.8	10.0	8.8
6	Test Weight (lb/bu)	62.2	57.6	64.0	59.5	64.2	59.4	61.4	58.1	59.0	55.3
7	1000 Kernel Weight (g)	21.4	24.9	29.8	28.7	29.9	27.6	27.5	27.0	22.6	21.1
	Kernel Size										
8	% Large	28	17	55	43	52	37	43	35	2	2
9	% Small	18	22	11	14	12	15	15	17	37	47
10	Wheat Moisture (%)	13.1	13.1	12.1	11.9	12.9	12.7	13.2	12.6	14.3	12.6
11	Wheat Ash (14% mb)	1.71	1.70	1.47	1.55	1.58	1.33	1.58	1.55	1.52	1.56
12	Wheat Falling Number (sec)	445	472	433	508	420	479	395	442	418	496
13	SKCS Hardness Index (SK-HI)	91.2	87.2	90.4	84.4	92.7	84.4	84.0	77.3	66.4	64.2
14	SK-HI Standard Deviation	17.9	18.5	17.2	19.0	18.0	17.0	19.5	22.1	18.1	20.1
15	Vitreous Kernels (%)	99	92	96	89	99	99	96	98	99	99
	Flour Extraction (%)										
16	Tempered Wheat Basis (%)	72.8	72.1	72.6	75.0	75.6	75.7	74.4	71.7	71.7	70.5
17	Total Product Basis (%)	72.7	73.6	71.7	75.7	73.0	74.1	73.5	73.3	72.7	71.1
18	Flour (Lbs)/ Wheat (Bu)	43.9	43.5	43.8	45.3	45.6	45.7	44.9	43.2	44.5	43.8
	Flour Characteristics										
19	Flour Color Brightness (L*)	89.6	89.6	90.5	90.1	90.8	90.9	90.8	90.9	90.1	90.2
20	Flour Color Yellow Scale (b*)	7.9	8.5	7.5	8.1	7.6	7.9	7.7	8.1	8.0	8.4
21	Flour Moisture (%)	10.9	11.0	12.2	12.5	11.5	11.3	11.8	11.1	11.9	11.8
22	Flour Ash (14% mb)	0.69	0.55	0.54	0.62	0.51	0.47	0.59	0.59	0.52	0.53
23	Falling Number (Malted) (sec)	254	256	255	252	256	248	253	251	252	261
	Farinograph										
24	Water Absorption (500bu)	70.4	70.1	67.2	67.0	66.0	68.4	67.6	69.7	65.8	71.5
25	Water Absorption (14%mb)	67.0	66.7	65.2	65.2	63.2	65.3	65.2	66.4	63.4	69.0
26	Arrival Time (min)	4.4	5.3	4.9	4.2	3.5	4.5	4.5	5.0	5.1	6.4
27	Peak Time (min)	8.2	9.1	9.7	6.4	8.7	7.4	9.4	9.7	16.5	11.0
28	Dough Stability (min)	9.2	9.7	9.3	7.8	11.0	9.0	9.7	9.3	33.3	14.7
29	Mixing tolerance Index (bu)	27	29	32	24	22	20	35	31	11	21
30	Time To Breakdown (min)	13.5	14.1	14.5	12.8	14.5	13.8	13.1	14.6	37.9	19.7

Line: ND 818 (Elgin)

	Trait	Check B 3	Line B 4	Check C 3	Line C 4	Check K 3	Line K 4	Check M 3	Line M 4	Check W 3	Line W 4
II. Cooperator Results											
31	**Bake Absorption (%, 14% flour mb)**	67.8	67.4	66.1	65.5	64.5	66.0	66.6	67.1	67.1	70.5
32	**Loaf Volume (% Check)**	100.0	99.1	100.0	97.3	100.0	98.0	100.0	98.9	100.0	99.4
33	**Mixing Requirement** 5=Very Long, 4=Long, 3=Medium, 2=Short, 1=Very Short	3.5	3.4	3.6	2.7	4.0	3.1	3.9	3.5	4.6	4.0
34	**Dough Characteristics** 5=Bucky-Tough, 4=Strong-Elastic, 3=Medium-Pliable, 2=Mellow-Very Pliable, 1=Weak-Short or Sticky	4.0	3.9	3.8	2.8	4.0	3.2	4.3	4.0	4.2	4.1
35	**Mixing Tolerance** 5=Much More Tolerance, 4=More Tolerance, 3=Equivalent, 2=Less Tolerance, and 1=Much Less Tolerance when compared to check	3.0	3.0	3.0	2.3	3.0	2.3	3.0	2.9	3.0	2.6
36	**Internal Crumb Color** 5=Much Brighter, 4=Brighter, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to check	3.0	3.1	3.0	2.5	3.0	2.3	3.0	2.9	3.0	2.7
37	**Internal Grain and Texture** 5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check	3.0	2.8	3.0	2.8	3.0	2.3	3.0	3.1	3.0	3.0
III. Cooperator Evaluation (37-40) 5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check											
38	**Quality Trait 1-3: Protein**	3.0	3.0	3.0	2.5	3.0	4.0	3.0	3.1	3.0	3.5
39	**Quality Trait 4-22: Milling**	3.0	3.1	3.0	3.6	3.0	3.4	3.0	2.6	3.0	2.3
40	**Quality Trait 24-37: Baking**	3.0	2.8	3.0	2.5	3.0	2.5	3.0	3.1	3.0	2.5
41	**Quality Trait 1-37: Overall**	3.0	2.8	3.0	2.6	3.0	2.6	3.0	5.0	3.0	2.7

Line: MT 0832 (Duclair) (Check- Glenn)

	Trait	Check M 3	Line M 5	Check W 3	Line W 5
I. USDA/ARS WQL Data					
1	Wheat Protein (12% mb)	15.1	15.4	18.0	16.8
2	Flour Protein (12% mb)	14.8	15.2	17.4	16.3
3	UPP/EPP (SDS unextractable/extractable polymeric proteins)	1.47	1.01	1.61	1.42
4	Market Value 1 (Score 1-6)	4.1	3.0	4.0	3.7
5	Market Value 2 (Score 1-10)	10.0	8.0	10.0	8.0
6	Test Weight (lb/bu)	61.4	56.5	59.0	56.2
7	1000 Kernel Weight (g)	27.5	29.7	22.6	24.6
	Kernel Size				
8	% Large	43	45	2	5
9	% Small	15	14	37	32
10	Wheat Moisture (%)	13.2	12.5	14.3	12.2
11	Wheat Ash (14% mb)	1.58	1.80	1.52	1.55
12	Wheat Falling Number (sec)	395	380	418	490
13	SKCS Hardness Index (SK-HI)	84.0	59.3	66.4	53.3
14	SK-HI Standard Deviation	19.5	25.1	18.1	18.6
15	Vitreous Kernels (%)	96	92	99	97
	Flour Extraction (%)				
16	Tempered Wheat Basis (%)	74.4	72.6	71.7	72.3
17	Total Product Basis (%)	73.5	71.4	72.7	73.4
18	Flour (Lbs)/ Wheat (Bu)	44.9	43.8	44.5	44.9
	Flour Characteristics				
19	Flour Color Brightness (L*)	90.8	91.1	90.1	90.4
20	Flour Color Yellow Scale (b*)	7.7	7.1	8.0	7.5
21	Flour Moisture (%)	11.8	11.6	11.9	11.2
22	Flour Ash (14% mb)	0.589	0.683	0.517	0.542
23	Falling Number (Malted) (sec)	253	257	252	252
	Farinograph				
24	Water Absorption (500bu)	67.6	66.7	65.8	66.7
25	Water Absorption (14%mb)	65.2	63.9	63.4	63.5
26	Arrival Time (min)	4.5	4.4	5.1	4.9
27	Peak Time (min)	9.4	7.9	16.5	10.0
28	Dough Stability (min)	9.7	8.6	33.3	11.3
29	Mixing tolerance Index (bu)	35	30	11	29
30	Time To Breakdown (min)	13.1	12.7	37.9	14.3

Line: MT 0832 (Duclair)

	Trait	Check M 3	Line M 5	Check W 3	Line W 5
II. Cooperator Results					
31	**Bake Absorption (%, 14% flour mb)**	66.6	65.2	67.1	66.6
32	**Loaf Volume (% Check)**	100.0	96.9	100.0	97.1
33	**Mixing Requirement** 5=Very Long, 4=Long, 3=Medium, 2=Short, 1=Very Short	3.9	3.3	4.6	3.9
34	**Dough Characteristics** 5=Bucky-Tough, 4=Strong-Elastic, 3=Medium-Pliable, 2=Mellow-Very Pliable, 1=Weak-Short or Sticky	4.3	3.4	4.2	4.1
35	**Mixing Tolerance** 5=Much More Tolerance, 4=More Tolerance, 3=Equivalent, 2=Less Tolerance, and 1=Much Less Tolerance when compared to check	3.0	2.8	3.0	2.7
36	**Internal Crumb Color** 5=Much Brighter, 4=Brighter, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to check	3.0	2.9	3.0	2.8
37	**Internal Grain and Texture** 5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check	3.0	3.0	3.0	2.8
III. Cooperator Evaluation (37-40)	5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check				
38	**Quality Trait 1-3: Protein**	3.0	3.5	3.0	2.5
39	**Quality Trait 4-22: Milling**	3.0	2.0	3.0	3.2
40	**Quality Trait 24-37: Baking**	3.0	2.6	3.0	2.7
41	**Quality Trait 1-37: Overall**	3.0	3.0	3.0	2.8

Line: Line B (AUBR31117W) (Check- Glenn)

	Trait	Check M 3	Line M 6	Check W 3	Line W 6
I. USDA/ARS WQL Data					
1	Wheat Protein (12% mb)	15.1	15.7	18.0	14.3
2	Flour Protein (12% mb)	14.8	15.2	17.4	13.4
3	UPP/EPP (SDS unextractable/extractable polymeric proteins)	1.47	1.01	1.61	1.54
4	Market Value 1 (Score 1-6)	4.1	2.7	4.0	3.6
5	Market Value 2 (Score 1-10)	10.0	7.0	10.0	6.6
6	Test Weight (lb/bu)	61.4	57.0	59.0	59.0
7	1000 Kernel Weight (g)	27.5	30.0	22.6	29.7
	Kernel Size				
8	% Large	43	56	2	32
9	% Small	15	11	37	12
10	Wheat Moisture (%)	13.2	12.6	14.3	11.7
11	Wheat Ash (14% mb)	1.58	1.72	1.52	1.55
12	Wheat Falling Number (sec)	395	311	418	413
13	SKCS Hardness Index (SK-HI)	84.0	56.4	66.4	73.8
14	SK-HI Standard Deviation	19.5	29.6	18.1	16.6
15	Vitreous Kernels (%)	96	80	99	97
	Flour Extraction (%)				
16	Tempered Wheat Basis (%)	74.4	74.5	71.7	72.4
17	Total Product Basis (%)	73.5	70.7	72.7	73.5
18	Flour (Lbs)/ Wheat (Bu)	44.9	45.0	44.5	45.0
	Flour Characteristics				
19	Flour Color Brightness (L*)	90.8	90.5	90.1	90.4
20	Flour Color Yellow Scale (b*)	7.7	6.7	8.0	6.7
21	Flour Moisture (%)	11.8	11.3	11.9	11.5
22	Flour Ash (14% mb)	0.589	0.732	0.517	0.503
23	Falling Number (Malted) (sec)	253	253	252	256
	Farinograph				
24	Water Absorption (500bu)	67.6	66.5	65.8	64.2
25	Water Absorption (14%mb)	65.2	63.4	63.4	61.1
26	Arrival Time (min)	4.5	4.6	5.1	2.6
27	Peak Time (min)	9.4	7.0	16.5	8.2
28	Dough Stability (min)	9.7	6.6	33.3	10.5
29	Mixing tolerance Index (bu)	35	37	11	29
30	Time To Breakdown (min)	13.1	10.9	37.9	13.2

Line: Line B (AUBR31117W)

	Trait	Check M 3	Line M 6	Check W 3	Line W 6
II. Cooperator Results					
31	**Bake Absorption (%, 14% flour mb)**	66.6	65.4	67.1	63.9
32	**Loaf Volume (% Check)**	100.0	92.4	100.0	86.9
33	**Mixing Requirement** 5=Very Long, 4=Long, 3=Medium, 2=Short, 1=Very Short	3.9	3.0	4.6	3.9
34	**Dough Characteristics** 5=Bucky-Tough, 4=Strong-Elastic, 3=Medium-Pliable, 2=Mellow-Very Pliable, 1=Weak-Short or Sticky	4.3	3.2	4.2	4.4
35	**Mixing Tolerance** 5=Much More Tolerance, 4=More Tolerance, 3=Equivalent, 2=Less Tolerance, and 1=Much Less Tolerance when compared to check	3.0	2.0	3.0	2.5
36	**Internal Crumb Color** 5=Much Brighter, 4=Brighter, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to check	3.0	2.5	3.0	3.2
37	**Internal Grain and Texture** 5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check	3.0	2.7	3.0	2.8
III. Cooperator Evaluation (37-40)	5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check				
38	**Quality Trait 1-3: Protein**	3.0	3.5	3.0	1.5
39	**Quality Trait 4-22: Milling**	3.0	2.0	3.0	3.5
40	**Quality Trait 24-37: Baking**	3.0	2.0	3.0	2.2
41	**Quality Trait 1-37: Overall**	3.0	2.8	3.0	2.3

Line: SD 4178 (Check- Glenn)

	Trait	Check B 3	Line B 7	Check C 3	Line C 7
I. USDA/ARS WQL Data					
1	Wheat Protein (12% mb)	16.5	15.1	14.9	13.6
2	Flour Protein (12% mb)	15.4	14.1	14.2	12.8
3	UPP/EPP (SDS unextractable/extractable polymeric proteins)	1.09	1.29	1.33	1.12
4	Market Value 1 (Score 1-6)	4.4	3.7	4.8	4.1
5	Market Value 2 (Score 1-10)	10.0	7.2	10.0	7.6
6	Test Weight (lb/bu)	62.2	59.1	64.0	60.6
7	1000 Kernel Weight (g)	21.4	27.0	29.8	31.3
	Kernel Size				
8	% Large	28	14	55	43
9	% Small	18	29	11	18
10	Wheat Moisture (%)	13.1	13.0	12.1	11.9
11	Wheat Ash (14% mb)	1.71	1.69	1.47	1.43
12	Wheat Falling Number (sec)	445	458	433	462
13	SKCS Hardness Index (SK-HI)	91.2	74.4	90.4	64.0
14	SK-HI Standard Deviation	17.9	18.1	17.2	18.0
15	Vitreous Kernels (%)	99	96	96	52
	Flour Extraction (%)				
16	Tempered Wheat Basis (%)	72.8	74.6	72.6	72.7
17	Total Product Basis (%)	72.7	75.9	71.7	74.6
18	Flour (Lbs)/ Wheat (Bu)	43.9	45.0	43.8	43.9
	Flour Characteristics				
19	Flour Color Brightness (L*)	89.6	90.0	90.5	89.6
20	Flour Color Yellow Scale (b*)	7.9	8.4	7.5	7.9
21	Flour Moisture (%)	10.9	11.1	12.2	12.5
22	Flour Ash (14% mb)	0.690	0.601	0.543	0.568
23	Falling Number (Malted) (sec)	254	253	255	250
	Farinograph				
24	Water Absorption (500bu)	70.4	65.3	67.2	61.8
25	Water Absorption (14%mb)	67.0	62.0	65.2	60.0
26	Arrival Time (min)	4.4	4.9	4.9	3.5
27	Peak Time (min)	8.2	7.9	9.7	5.5
28	Dough Stability (min)	9.2	11.1	9.3	6.5
29	Mixing tolerance Index (bu)	27	18	32	32
30	Time To Breakdown (min)	13.5	15.7	14.5	9.7

Line: SD 4178

	Trait	Check B 3	Line B 7	Check C 3	Line C 7
II. Cooperator Results					
31	**Bake Absorption (%, 14% flour mb)**	67.8	64.6	66.1	62.3
32	**Loaf Volume (% Check)**	100.0	100.0	100.0	93.5
33	**Mixing Requirement** 5=Very Long, 4=Long, 3=Medium, 2=Short, 1=Very Short	3.5	3.9	3.6	2.3
34	**Dough Characteristics** 5=Bucky-Tough, 4=Strong-Elastic, 3=Medium-Pliable, 2=Mellow-Very Pliable, 1=Weak-Short or Sticky	4.0	3.9	3.8	2.6
35	**Mixing Tolerance** 5=Much More Tolerance, 4=More Tolerance, 3=Equivalent, 2=Less Tolerance, and 1=Much Less Tolerance when compared to check	3.0	3.2	3.0	2.0
36	**Internal Crumb Color** 5=Much Brighter, 4=Brighter, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to check	3.0	3.4	3.0	2.5
37	**Internal Grain and Texture** 5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check	3.0	3.3	3.0	2.6
III. Cooperator Evaluation (37-40)	5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check				
38	**Quality Trait 1-3: Protein**	3.0	2.3	3.0	2.0
39	**Quality Trait 4-22: Milling**	3.0	4.1	3.0	3.1
40	**Quality Trait 24-37: Baking**	3.0	3.4	3.0	2.3
41	**Quality Trait 1-37: Overall**	3.0	3.3	3.0	2.2

Line: Line C (BR2306) (Check- Glenn)

	Trait	Check M 3	Line M 8	Check W 3	Line W 8
I. USDA/ARS WQL Data					
1	Wheat Protein (12% mb)	15.1	14.9	18.0	16.2
2	Flour Protein (12% mb)	14.8	14.5	17.4	15.1
3	UPP/EPP (SDS unextractable/extractable polymeric proteins)	1.47	1.16	1.61	1.26
4	Market Value 1 (Score 1-6)	4.1	3.4	4.0	2.9
5	Market Value 2 (Score 1-10)	10.0	8.8	10.0	5.6
6	Test Weight (lb/bu)	61.4	57.6	59.0	57.0
7	1000 Kernel Weight (g)	27.5	28.4	22.6	29.8
	Kernel Size				
8	% Large	43	43	2	44
9	% Small	15	15	37	9
10	Wheat Moisture (%)	13.2	13.0	14.3	11.8
11	Wheat Ash (14% mb)	1.58	1.66	1.52	1.67
12	Wheat Falling Number (sec)	395	419	418	316
13	SKCS Hardness Index (SK-HI)	84.0	80.3	66.4	46.3
14	SK-HI Standard Deviation	19.5	18.9	18.1	26.0
15	Vitreous Kernels (%)	96	98	99	85
	Flour Extraction (%)				
16	Tempered Wheat Basis (%)	74.4	71.9	71.7	70.0
17	Total Product Basis (%)	73.5	71.5	72.7	71.2
18	Flour (Lbs)/ Wheat (Bu)	44.9	43.4	44.5	43.5
	Flour Characteristics				
19	Flour Color Brightness (L*)	90.8	90.6	90.1	91.3
20	Flour Color Yellow Scale (b*)	7.7	7.3	8.0	6.4
21	Flour Moisture (%)	11.8	11.4	11.9	11.5
22	Flour Ash (14% mb)	0.589	0.663	0.517	0.597
23	Falling Number (Malted) (sec)	253	255	252	254
	Farinograph				
24	Water Absorption (500bu)	67.6	68.9	65.8	64.0
25	Water Absorption (14%mb)	65.2	65.9	63.4	61.1
26	Arrival Time (min)	4.5	3.7	5.1	4.1
27	Peak Time (min)	9.4	6.7	16.5	6.9
28	Dough Stability (min)	9.7	7.8	33.3	6.8
29	Mixing tolerance Index (bu)	35	35	11	34
30	Time To Breakdown (min)	13.1	11.3	37.9	11.1

Line: Line C (BR2306)

	Trait	Check M 3	Line M 8	Check W 3	Line W 8
	II. Cooperator Results				
31	**Bake Absorption (%, 14% flour mb)**	66.6	66.9	67.1	64.5
32	**Loaf Volume (% Check)**	100.0	96.3	100.0	84.8
33	**Mixing Requirement** 5=Very Long, 4=Long, 3=Medium, 2=Short, 1=Very Short	3.9	3.3	4.6	2.8
34	**Dough Characteristics** 5=Bucky-Tough, 4=Strong-Elastic, 3=Medium-Pliable, 2=Mellow-Very Pliable, 1=Weak-Short or Sticky	4.3	3.8	4.2	3.3
35	**Mixing Tolerance** 5=Much More Tolerance, 4=More Tolerance, 3=Equivalent, 2=Less Tolerance, and 1=Much Less Tolerance when compared to check	3.0	2.5	3.0	1.8
36	**Internal Crumb Color** 5=Much Brighter, 4=Brighter, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to check	3.0	3.1	3.0	2.8
37	**Internal Grain and Texture** 5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check	3.0	3.0	3.0	2.5
	III. Cooperator Evaluation (37-40) 5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check				
38	**Quality Trait 1-3: Protein**	3.0	3.0	3.0	2.4
39	**Quality Trait 4-22: Milling**	3.0	1.9	3.0	2.4
40	**Quality Trait 24-37: Baking**	3.0	2.8	3.0	1.8
41	**Quality Trait 1-37: Overall**	3.0	2.3	3.0	1.8

Line: ND 819 (Check- Glenn)

	Trait	Check C 3	Line C 9	Check M 3	Line M 9
I. USDA/ARS WQL Data					
1	Wheat Protein (12% mb)	14.9	15.0	15.1	15.5
2	Flour Protein (12% mb)	14.2	13.8	14.8	15.2
3	UPP/EPP (SDS unextractable/extractable polymeric proteins)	1.33	1.25	1.47	1.16
4	Market Value 1 (Score 1-6)	4.8	4.4	4.1	4.0
5	Market Value 2 (Score 1-10)	10.0	8.8	10.0	9.2
6	Test Weight (lb/bu)	64.0	60.9	61.4	59.4
7	1000 Kernel Weight (g)	29.8	30.9	27.5	26.2
	Kernel Size				
8	% Large	55	58	43	39
9	% Small	11	10	15	16
10	Wheat Moisture (%)	12.1	11.8	13.2	12.8
11	Wheat Ash (14% mb)	1.47	1.53	1.58	1.58
12	Wheat Falling Number (sec)	433	454	395	469
13	SKCS Hardness Index (SK-HI)	90.4	86.0	84.0	80.9
14	SK-HI Standard Deviation	17.2	17.9	19.5	19.8
15	Vitreous Kernels (%)	96	75	96	98
	Flour Extraction (%)				
16	Tempered Wheat Basis (%)	72.6	76.2	74.4	72.8
17	Total Product Basis (%)	71.7	74.2	73.5	72.4
18	Flour (Lbs)/ Wheat (Bu)	43.8	46.0	44.9	44.0
	Flour Characteristics				
19	Flour Color Brightness (L*)	90.5	90.4	90.8	90.5
20	Flour Color Yellow Scale (b*)	7.5	8.1	7.7	7.9
21	Flour Moisture (%)	12.2	12.2	11.8	11.2
22	Flour Ash (14% mb)	0.543	0.553	0.589	0.656
23	Falling Number (Malted) (sec)	255	245	253	250
	Farinograph				
24	Water Absorption (500bu)	67.2	69.3	67.6	71.2
25	Water Absorption (14%mb)	65.2	67.3	65.2	68.0
26	Arrival Time (min)	4.9	4.1	4.5	5.6
27	Peak Time (min)	9.7	7.9	9.4	7.7
28	Dough Stability (min)	9.3	8.3	9.7	8.0
29	Mixing tolerance Index (bu)	32	31	35	24
30	Time To Breakdown (min)	14.5	12.6	13.1	13.7

Line: ND 819

	Trait	Check C 3	Line C 9	Check M 3	Line M 9
II. Cooperator Results					
31	**Bake Absorption (%, 14% flour mb)**	66.1	66.7	66.6	68.0
32	**Loaf Volume (% Check)**	100.0	103.2	100.0	98.4
33	**Mixing Requirement** 5=Very Long, 4=Long, 3=Medium, 2=Short, 1=Very Short	3.6	2.9	3.9	3.0
34	**Dough Characteristics** 5=Bucky-Tough, 4=Strong-Elastic, 3=Medium-Pliable, 2=Mellow-Very Pliable, 1=Weak-Short or Sticky	3.8	3.2	4.3	4.0
35	**Mixing Tolerance** 5=Much More Tolerance, 4=More Tolerance, 3=Equivalent, 2=Less Tolerance, and 1=Much Less Tolerance when compared to check	3.0	2.4	3.0	2.9
36	**Internal Crumb Color** 5=Much Brighter, 4=Brighter, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to check	3.0	3.7	3.0	3.0
37	**Internal Grain and Texture** 5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check	3.0	3.4	3.0	2.9
III. Cooperator Evaluation (37-40)	5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check				
38	**Quality Trait 1-3: Protein**	3.0	2.9	3.0	3.5
39	**Quality Trait 4-22: Milling**	3.0	3.7	3.0	2.5
40	**Quality Trait 24-37: Baking**	3.0	3.5	3.0	2.9
41	**Quality Trait 1-37: Overall**	3.0	3.4	3.0	2.5

Line: 11 Fx Mn (LCS Breakaway) (Check- Glenn)

	Trait	Check B 3	Line B10	Check C 3	Line C10	Check K 3	Line K10	Check M 3	Line M10	Check W 3	Line W10
I. USDA/ARS WQL Data											
1	Wheat Protein (12% mb)	16.5	16.4	14.9	14.6	14.1	15.5	15.1	15.2	18.0	17.5
2	Flour Protein (12% mb)	15.4	15.3	14.2	13.3	13.5	14.6	14.8	14.8	17.4	16.8
3	UPP/EPP (SDS unextractable/extractable polymeric proteins)	1.09	1.22	1.33	1.14	1.38	1.21	1.47	1.18	1.61	1.37
4	Market Value 1 (Score 1-6)	4.4	3.8	4.8	4.5	4.4	5.0	4.1	4.2	4.0	4.2
5	Market Value 2 (Score 1-10)	10.0	8.8	10.0	9.6	10.0	9.2	10.0	10.0	10.0	9.4
6	Test Weight (lb/bu)	62.2	58.2	64.0	62.0	64.2	62.1	61.4	60.8	59.0	59.7
7	1000 Kernel Weight (g)	21.4	24.4	29.8	30.2	29.9	30.9	27.5	28.0	22.6	22.6
	Kernel Size										
8	% Large	28	16	55	57	52	54	43	41	2	10
9	% Small	18	27	11	12	12	11	15	19	37	33
10	Wheat Moisture (%)	13.1	12.8	12.1	11.7	12.9	12.3	13.2	13.3	14.3	11.4
11	Wheat Ash (14% mb)	1.71	1.72	1.47	1.48	1.58	1.33	1.58	1.52	1.52	1.54
12	Wheat Falling Number (sec)	445	471	433	467	420	590	395	415	418	494
13	SKCS Hardness Index (SK-HI)	91.2	82.1	90.4	83.2	92.7	79.9	84.0	80.8	66.4	68.7
14	SK-HI Standard Deviation	17.9	18.0	17.2	17.5	18.0	16.6	19.5	19.6	18.1	18.9
15	Vitreous Kernels (%)	99	99	96	83	99	98	96	99	99	98
	Flour Extraction (%)										
16	Tempered Wheat Basis (%)	72.8	73.0	72.6	72.1	75.6	72.6	74.4	71.8	71.7	71.9
17	Total Product Basis (%)	72.7	72.7	71.7	71.0	73.0	72.9	73.5	71.8	72.7	72.7
18	Flour (Lbs)/ Wheat (Bu)	43.9	44.1	43.8	43.5	45.6	43.8	44.9	43.4	44.5	44.7
	Flour Characteristics										
19	Flour Color Brightness (L*)	89.6	89.9	90.5	91.0	90.8	90.3	90.8	90.8	90.1	90.1
20	Flour Color Yellow Scale (b*)	7.9	8.3	7.5	7.4	7.6	8.0	7.7	7.8	8.0	8.0
21	Flour Moisture (%)	10.9	10.5	12.2	12.8	11.5	12.0	11.8	11.4	11.9	11.8
22	Flour Ash (14% mb)	0.690	0.571	0.543	0.574	0.512	0.444	0.589	0.541	0.517	0.507
23	Falling Number (Malted) (sec)	254	250	255	251	256	250	253	253	252	258
	Farinograph										
24	Water Absorption (500bu)	70.4	69.1	67.2	63.4	66.0	64.5	67.6	68.9	65.8	68.0
25	Water Absorption (14%mb)	67.0	65.1	65.2	62.0	63.2	62.3	65.2	66.0	63.4	65.5
26	Arrival Time (min)	4.4	4.1	4.9	3.7	3.5	3.6	4.5	4.1	5.1	4.6
27	Peak Time (min)	8.2	8.1	9.7	6.5	8.7	7.4	9.4	7.6	16.5	7.9
28	Dough Stability (min)	9.2	9.6	9.3	9.6	11.0	7.5	9.7	6.9	33.3	10.5
29	Mixing tolerance Index (bu)	27	29	32	21	22	37	35	36	11	24
30	Time To Breakdown (min)	13.5	13.7	14.5	14.3	14.5	10.8	13.1	11.4	37.9	14.0

Line: 11 Fx Mn (LCS Breakaway)

Trait	Check B 3	Line B10	Check C 3	Line C10	Check K 3	Line K10	Check M 3	Line M10	W 3	W10
II. Cooperator Results										
31 Bake Absorption (%, 14% flour mb)	67.8	66.6	66.1	63.3	64.5	64.6	66.6	67.0	67.1	67.6
32 Loaf Volume (% Check)	100.0	97.8	100.0	95.7	100.0	99.8	100.0	98.3	100.0	95.1
33 Mixing Requirement 5=Very Long, 4=Long, 3=Medium, 2=Short, 1=Very Short	3.5	3.3	3.6	2.8	4.0	2.8	3.9	3.3	4.6	3.6
34 Dough Characteristics 5=Bucky-Tough, 4=Strong-Elastic, 3=Medium-Pliable, 2=Mellow-Very Pliable, 1=Weak-Short or Sticky	4.0	3.6	3.8	3.3	4.0	3.1	4.3	3.8	4.2	4.0
35 Mixing Tolerance 5=Much More Tolerance, 4=More Tolerance, 3=Equivalent, 2=Less Tolerance, and 1=Much Less Tolerance when compared to check	3.0	2.8	3.0	2.5	3.0	2.3	3.0	2.8	3.0	2.5
36 Internal Crumb Color 5=Much Brighter, 4=Brighter, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to check	3.0	3.0	3.0	2.9	3.0	2.5	3.0	3.2	3.0	2.9
37 Internal Grain and Texture 5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check	3.0	2.8	3.0	2.8	3.0	2.7	3.0	3.1	3.0	3.1
III. Cooperator Evaluation (37-40) 5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check										
38 Quality Trait 1-3: Protein	3.0	3.0	3.0	2.6	3.0	4.2	3.0	3.2	3.0	2.9
39 Quality Trait 4-22: Milling	3.0	3.1	3.0	3.1	3.0	2.8	3.0	2.5	3.0	3.0
40 Quality Trait 24-37: Baking	3.0	2.8	3.0	2.6	3.0	2.9	3.0	2.8	3.0	2.3
41 Quality Trait 1-37: Overall	3.0	2.9	3.0	2.6	3.0	3.0	3.0	2.7	3.0	2.6

Line: ND 812 (Check- Glenn)

	Trait	Check C 3	Line C11	Check M 3	Line M11
I. USDA/ARS WQL Data					
1	Wheat Protein (12% mb)	14.9	14.6	15.1	15.4
2	Flour Protein (12% mb)	14.2	13.8	14.8	14.8
3	UPP/EPP (SDS unextractable/extractable polymeric proteins)	1.33	1.28	1.47	1.33
4	Market Value 1 (Score 1-6)	4.8	4.6	4.1	4.0
5	Market Value 2 (Score 1-10)	10.0	9.6	10.0	9.6
6	Test Weight (lb/bu)	64.0	62.4	61.4	60.1
7	1000 Kernel Weight (g)	29.8	30.1	27.5	26.5
	Kernel Size				
8	% Large	55	53	43	40
9	% Small	11	12	15	16
10	Wheat Moisture (%)	12.1	12.0	13.2	13.9
11	Wheat Ash (14% mb)	1.47	1.48	1.58	1.59
12	Wheat Falling Number (sec)	433	457	395	417
13	SKCS Hardness Index (SK-HI)	90.4	94.3	84.0	89.8
14	SK-HI Standard Deviation	17.2	17.9	19.5	18.6
15	Vitreous Kernels (%)	96	95	96	97
	Flour Extraction (%)				
16	Tempered Wheat Basis (%)	72.6	75.4	74.4	70.8
17	Total Product Basis (%)	71.7	75.5	73.5	70.5
18	Flour (Lbs)/ Wheat (Bu)	43.8	45.5	44.9	42.7
	Flour Characteristics				
19	Flour Color Brightness (L*)	90.5	90.3	90.8	89.8
20	Flour Color Yellow Scale (b*)	7.5	8.1	7.7	8.4
21	Flour Moisture (%)	12.2	12.1	11.8	11.7
22	Flour Ash (14% mb)	0.543	0.536	0.589	0.562
23	Falling Number (Malted) (sec)	255	250	253	250
	Farinograph				
24	Water Absorption (500bu)	67.2	67.4	67.6	68.8
25	Water Absorption (14%mb)	65.2	65.2	65.2	66.2
26	Arrival Time (min)	4.9	4.0	4.5	4.0
27	Peak Time (min)	9.7	5.6	9.4	7.9
28	Dough Stability (min)	9.3	7.8	9.7	9.0
29	Mixing tolerance Index (bu)	32	26	35	29
30	Time To Breakdown (min)	14.5	12.0	13.1	13.0

Line: ND 812

	Trait	Check C 3	Line C11	Check M 3	Line M11
II. Cooperator Results					
31	**Bake Absorption (%, 14% flour mb)**	66.1	65.7	66.6	67.2
32	**Loaf Volume (% Check)**	100.0	98.3	100.0	99.0
33	**Mixing Requirement** 5=Very Long, 4=Long, 3=Medium, 2=Short, 1=Very Short	3.6	2.7	3.9	3.5
34	**Dough Characteristics** 5=Bucky-Tough, 4=Strong-Elastic, 3=Medium-Pliable, 2=Mellow-Very Pliable, 1=Weak-Short or Sticky	3.8	3.1	4.3	3.9
35	**Mixing Tolerance** 5=Much More Tolerance, 4=More Tolerance, 3=Equivalent, 2=Less Tolerance, and 1=Much Less Tolerance when compared to check	3.0	2.3	3.0	2.9
36	**Internal Crumb Color** 5=Much Brighter, 4=Brighter, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to check	3.0	2.9	3.0	3.3
37	**Internal Grain and Texture** 5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check	3.0	2.7	3.0	3.3
III. Cooperator Evaluation (37-40)	5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check				
38	**Quality Trait 1-3: Protein**	3.0	2.8	3.0	3.1
39	**Quality Trait 4-22: Milling**	3.0	3.8	3.0	2.0
40	**Quality Trait 24-37: Baking**	3.0	2.8	3.0	3.3
41	**Quality Trait 1-37: Overall**	3.0	2.9	3.0	2.8

Line: MN 06028 (Check- Glenn)

	Trait	Check C 3	Line C12	Check K 3	Line K12
I. USDA/ARS WQL Data					
1	Wheat Protein (12% mb)	14.9	15.3	14.1	15.5
2	Flour Protein (12% mb)	14.2	14.3	13.5	15.1
3	UPP/EPP (SDS unextractable/extractable polymeric proteins)	1.33	1.19	1.38	1.59
4	Market Value 1 (Score 1-6)	4.8	4.9	4.4	4.9
5	Market Value 2 (Score 1-10)	10.0	9.0	10.0	9.2
6	Test Weight (lb/bu)	64.0	62.4	64.2	61.4
7	1000 Kernel Weight (g)	29.8	34.2	29.9	33.9
	Kernel Size				
8	% Large	55	65	52	46
9	% Small	11	8	12	11
10	Wheat Moisture (%)	12.1	11.7	12.9	12.2
11	Wheat Ash (14% mb)	1.47	1.66	1.58	1.44
12	Wheat Falling Number (sec)	433	494	420	517
13	SKCS Hardness Index (SK-HI)	90.4	78.5	92.7	77.6
14	SK-HI Standard Deviation	17.2	16.4	18.0	17.4
15	Vitreous Kernels (%)	96	80	99	100
	Flour Extraction (%)				
16	Tempered Wheat Basis (%)	72.6	74.5	75.6	73.7
17	Total Product Basis (%)	71.7	74.7	73.0	72.6
18	Flour (Lbs)/ Wheat (Bu)	43.8	44.9	45.6	44.5
	Flour Characteristics				
19	Flour Color Brightness (L*)	90.5	90.9	90.8	90.4
20	Flour Color Yellow Scale (b*)	7.5	6.9	7.6	6.6
21	Flour Moisture (%)	12.2	12.0	11.5	11.6
22	Flour Ash (14% mb)	0.543	0.582	0.512	0.539
23	Falling Number (Malted) (sec)	255	243	256	248
	Farinograph				
24	Water Absorption (500bu)	67.2	65.6	66.0	65.7
25	Water Absorption (14%mb)	65.2	63.3	63.2	62.9
26	Arrival Time (min)	4.9	3.9	3.5	3.9
27	Peak Time (min)	9.7	10.1	8.7	9.2
28	Dough Stability (min)	9.3	13.1	11.0	30.0
29	Mixing tolerance Index (bu)	32	20	22	15
30	Time To Breakdown (min)	14.5	17.1	14.5	33.8

Line: MN 06028

	Trait	Check C 3	Line C12	Check K 3	Line K12
II. Cooperator Results					
31	**Bake Absorption (%, 14% flour mb)**	66.1	64.8	64.5	65.5
32	**Loaf Volume (% Check)**	100.0	100.7	100.0	99.9
33	**Mixing Requirement** 5=Very Long, 4=Long, 3=Medium, 2=Short, 1=Very Short	3.6	4.2	4.0	4.5
34	**Dough Characteristics** 5=Bucky-Tough, 4=Strong-Elastic, 3=Medium-Pliable, 2=Mellow-Very Pliable, 1=Weak-Short or Sticky	3.8	3.9	4.0	4.5
35	**Mixing Tolerance** 5=Much More Tolerance, 4=More Tolerance, 3=Equivalent, 2=Less Tolerance, and 1=Much Less Tolerance when compared to check	3.0	3.5	3.0	3.6
36	**Internal Crumb Color** 5=Much Brighter, 4=Brighter, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to check	3.0	3.3	3.0	3.0
37	**Internal Grain and Texture** 5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check	3.0	3.1	3.0	3.3
III. Cooperator Evaluation (37-40)	5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check				
38	**Quality Trait 1-3: Protein**	3.0	3.3	3.0	4.5
39	**Quality Trait 4-22: Milling**	3.0	4.0	3.0	2.9
40	**Quality Trait 24-37: Baking**	3.0	3.5	3.0	3.4
41	**Quality Trait 1-37: Overall**	3.0	3.6	3.0	3.4

Line: 03S0257-3 (SY Rowyn) (Check- Glenn)

	Trait	Check B 3	Line B13	Check C 3	Line C13	Check K 3	Line K13
I. USDA/ARS WQL Data							
1	Wheat Protein (12% mb)	16.5	16.2	14.9	13.5	14.1	13.7
2	Flour Protein (12% mb)	15.4	15.1	14.2	12.8	13.5	13.4
3	UPP/EPP (SDS unextractable/extractable polymeric proteins)	1.09	1.22	1.33	1.13	1.38	1.39
4	Market Value 1 (Score 1-6)	4.4	3.4	4.8	3.6	4.4	3.8
5	Market Value 2 (Score 1-10)	10.0	8.0	10.0	6.8	10.0	8.0
6	Test Weight (lb/bu)	62.2	57.0	64.0	59.9	64.2	59.9
7	1000 Kernel Weight (g)	21.4	22.2	29.8	27.3	29.9	26.2
	Kernel Size						
8	% Large	28	8	55	38	52	26
9	% Small	18	36	11	18	12	24
10	Wheat Moisture (%)	13.1	12.9	12.1	11.7	12.9	12.7
11	Wheat Ash (14% mb)	1.71	1.68	1.47	1.53	1.58	1.35
12	Wheat Falling Number (sec)	445	545	433	482	420	503
13	SKCS Hardness Index (SK-HI)	91.2	77.6	90.4	71.0	92.7	70.5
14	SK-HI Standard Deviation	17.9	19.7	17.2	17.9	18.0	15.9
15	Vitreous Kernels (%)	99	92	96	35	99	76
	Flour Extraction (%)						
16	Tempered Wheat Basis (%)	72.8	72.1	72.6	75.4	75.6	75.8
17	Total Product Basis (%)	72.7	71.9	71.7	75.7	73.0	75.4
18	Flour (Lbs)/ Wheat (Bu)	43.9	43.5	43.8	45.5	45.6	45.8
	Flour Characteristics						
19	Flour Color Brightness (L*)	89.6	89.5	90.5	90.6	90.8	90.0
20	Flour Color Yellow Scale (b*)	7.9	9.2	7.5	8.5	7.6	8.5
21	Flour Moisture (%)	10.9	11.5	12.2	11.7	11.5	11.7
22	Flour Ash (14% mb)	0.690	0.632	0.543	0.577	0.512	0.491
23	Falling Number (Malted) (sec)	254	262	255	248	256	250
	Farinograph						
24	Water Absorption (500bu)	70.4	66.6	67.2	63.1	66.0	63.0
25	Water Absorption (14%mb)	67.0	63.8	65.2	60.5	63.2	60.4
26	Arrival Time (min)	4.4	4.2	4.9	3.9	3.5	3.2
27	Peak Time (min)	8.2	10.4	9.7	8.7	8.7	10.4
28	Dough Stability (min)	9.2	24.4	9.3	11.5	11.0	32.0
29	Mixing tolerance Index (bu)	27	7	32	24	22	16
30	Time To Breakdown (min)	13.5	26.4	14.5	15.5	14.5	33.6

Line: 03S0257-3 (SY Rowyn)

	Trait	Check B 3	Line B13	Check C 3	Line C13	Check K 3	Line K13
II. Cooperator Results							
31	**Bake Absorption (%, 14% flour mb)**	67.8	66.0	66.1	62.6	64.5	62.9
32	**Loaf Volume (% Check)**	100.0	107.1	100.0	101.3	100.0	100.5
33	**Mixing Requirement** 5=Very Long, 4=Long, 3=Medium, 2=Short, 1=Very Short	3.5	4.6	3.6	4.2	4.0	4.8
34	**Dough Characteristics** 5=Bucky-Tough, 4=Strong-Elastic, 3=Medium-Pliable, 2=Mellow-Very Pliable, 1=Weak-Short or Sticky	4.0	4.3	3.8	4.1	4.0	4.5
35	**Mixing Tolerance** 5=Much More Tolerance, 4=More Tolerance, 3=Equivalent, 2=Less Tolerance, and 1=Much Less Tolerance when compared to check	3.0	3.8	3.0	3.5	3.0	3.8
36	**Internal Crumb Color** 5=Much Brighter, 4=Brighter, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to check	3.0	3.3	3.0	3.0	3.0	2.6
37	**Internal Grain and Texture** 5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check	3.0	3.5	3.0	3.3	3.0	3.2
III. Cooperator Evaluation (37-40)	5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check						
38	**Quality Trait 1-3: Protein**	3.0	3.1	3.0	2.1	3.0	3.1
39	**Quality Trait 4-22: Milling**	3.0	3.0	3.0	3.7	3.0	3.1
40	**Quality Trait 24-37: Baking**	3.0	3.7	3.0	3.2	3.0	3.1
41	**Quality Trait 1-37: Overall**	3.0	3.6	3.0	3.0	3.0	3.1

Line: ND 816 (Check- Glenn)

	Trait	Check C 3	Line C14	Check M 3	Line M14
I. USDA/ARS WQL Data					
1	Wheat Protein (12% mb)	14.9	14.6	15.1	15.5
2	Flour Protein (12% mb)	14.2	13.3	14.8	14.9
3	UPP/EPP (SDS unextractable/extractable polymeric proteins)	1.33	1.09	1.47	1.25
4	Market Value 1 (Score 1-6)	4.8	4.4	4.1	4.2
5	Market Value 2 (Score 1-10)	10.0	9.4	10.0	9.6
6	Test Weight (lb/bu)	64.0	62.2	61.4	59.7
7	1000 Kernel Weight (g)	29.8	30.3	27.5	30.1
	Kernel Size				
8	% Large	55	61	43	50
9	% Small	11	10	15	13
10	Wheat Moisture (%)	12.1	12.0	13.2	13.7
11	Wheat Ash (14% mb)	1.47	1.61	1.58	1.60
12	Wheat Falling Number (sec)	433	445	395	421
13	SKCS Hardness Index (SK-HI)	90.4	91.4	84.0	88.6
14	SK-HI Standard Deviation	17.2	17.7	19.5	18.4
15	Vitreous Kernels (%)	96	67	96	99
	Flour Extraction (%)				
16	Tempered Wheat Basis (%)	72.6	75.7	74.4	71.3
17	Total Product Basis (%)	71.7	75.1	73.5	71.5
18	Flour (Lbs)/ Wheat (Bu)	43.8	45.7	44.9	43.0
	Flour Characteristics				
19	Flour Color Brightness (L*)	90.5	90.3	90.8	90.2
20	Flour Color Yellow Scale (b*)	7.5	8.0	7.7	10.9
21	Flour Moisture (%)	12.2	12.3	11.8	11.8
22	Flour Ash (14% mb)	0.54	0.53	0.59	0.66
23	Falling Number (Malted) (sec)	255	256	253	263
	Farinograph				
24	Water Absorption (500bu)	67.2	67.2	67.6	70.7
25	Water Absorption (14%mb)	65.2	65.2	65.2	68.2
26	Arrival Time (min)	4.9	3.9	4.5	3.5
27	Peak Time (min)	9.7	6.4	9.4	5.9
28	Dough Stability (min)	9.3	8.4	9.7	8.1
29	Mixing tolerance Index (bu)	32	24	35	26
30	Time To Breakdown (min)	14.5	11.8	13.1	11.2

Line: ND 816

	Trait	Check C 3	Line C14	Check M 3	Line M14
II. Cooperator Results					
31	**Bake Absorption (%, 14% flour mb)**	66.1	65.3	66.6	68.3
32	**Loaf Volume (% Check)**	100.0	97.4	100.0	97.2
33	**Mixing Requirement** 5=Very Long, 4=Long, 3=Medium, 2=Short, 1=Very Short	3.6	3.1	3.9	3.4
34	**Dough Characteristics** 5=Bucky-Tough, 4=Strong-Elastic, 3=Medium-Pliable, 2=Mellow-Very Pliable, 1=Weak-Short or Sticky	3.8	3.6	4.3	4.2
35	**Mixing Tolerance** 5=Much More Tolerance, 4=More Tolerance, 3=Equivalent, 2=Less Tolerance, and 1=Much Less Tolerance when compared to check	3.0	2.9	3.0	2.9
36	**Internal Crumb Color** 5=Much Brighter, 4=Brighter, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to check	3.0	3.2	3.0	2.5
37	**Internal Grain and Texture** 5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check	3.0	3.1	3.0	2.7
III. Cooperator Evaluation (37-40)	5=Much Better, 4=Better, 3=Equivalent, 2=Poorer, and 1=Much Poorer when compared to Check				
38	**Quality Trait 1-3: Protein**	3.0	2.6	3.0	3.1
39	**Quality Trait 4-22: Milling**	3.0	3.8	3.0	2.3
40	**Quality Trait 24-37: Baking**	3.0	3.3	3.0	2.8
41	**Quality Trait 1-37: Overall**	3.0	3.1	3.0	2.9

Individual Cooperator Bake Data

Glenn (Check)

Watertown, SD (B 3)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Mixing Requirement	Dough Characteristics
A	62.0	2850	5	5
B	67.0	3200	3	3
C	64.0	933	3	4
D	66.0	3104	5	5
E	65.5	2525	5	4
F	67.0	2100	3	3
G	66.0	2650	3	3
H	71.7	1025	3	4
I	66.5	1075	3	4
J	68.4	905	3	3
K	69.1	1055	3	4
L	73.1	1027	3	4
M	68.9	730	3	5
Mean	67.8	-	3.5	4.0
Std Dev	3.0	-	0.9	0.8

Casselton, ND (C 3)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Mixing Requirement	Dough Characteristics
A	61.0	2850	5	5
B	65.0	3050	3	2
C	64.0	983	4	3
D	65.0	3162	5	5
E	64.0	2625	5	4
F	65.2	2100	3	3
G	64.0	2900	3	3
H	69.6	995	3	5
I	64.2	1145	3	4
J	65.2	870	1	3
K	67.9	930	3	3
L	72.6	1050	3	4
M	66.9	788	3	4
Mean	66.1	-	3.6	3.8
Std Dev	2.9	-	1.1	0.9

Crookston, MN (K 3)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Mixing Requirement	Dough Characteristics
A	61.0	2800	5	4
B	63.0	3150	4	3
C	63.0	940	5	5
D	63.0	3045	5	5
E	62.0	2700	5	4
F	63.2	2200	3	3
G	61.0	2700	3	3
H	68.4	965	3	5
I	64.8	1210	4	4
J	64.5	920	2	3
K	65.2	950	4	4
L	70.3	973	3	4.5
M	65.8	830	4	4
Mean	64.5	-	4.0	4.0
Std Dev	2.7	-	1.0	0.8

Minot, ND (M 3)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Mixing Requirement	Dough Characteristics
A	62.0	2800	5	5
B	65.0	2850	4	2
C	64.0	920	5	5
D	65.0	3074	5	5
E	63.0	2600	5	5
F	65.2	2175	3	3
G	63.0	2750	3	3
H	70.2	1090	3	4
I	67.8	1345	4	4
J	66.6	985	3	4
K	67.5	1025	4	5
L	73.6	1060	3	4
M	68.2	790	3	5
Mean	66.6	-	3.9	4.3
Std Dev	3.2	-	0.9	1.0

(Glenn continued)

Williston, ND (W 3)				
Coop-erator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Mixing Require-ment	Dough Charact-eristics
A	64.0	2900	5	5
B	63.5	3000	5	3
C	64.0	970	5	5
D	64.0	2986	5	5
E	62.5	2600	5	5
F	65.8	2500	3	3
G	61.0	2500	3	3
H	68.1	1130	4	4
I	68.2	1185	5	3
J	64.3	1060	3	5
K	72.7	1120	5	4
L	76.3	1093	5	5
M	72.2	1004	5	3
Mean	67.1	-	4.6	4.2
Std Dev	4.6	-	0.9	1.0

Line A (AUBR30023W)

Minot, ND (M 1)

Coop-erator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Require-ment	Dough Charact-eristics	Quality Score Compared to Check (Glenn) Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	61.0	2525	90.2	5	4	3	4	4	3	3	3	3
B	63.5	2800	98.2	3	3	4	2	3	2	3	3	3
C	64.0	903	98.2	2	3	1	2	2	3	3	1	1
D	64.0	2927	95.2	4	4	2	1	2	2	3	2	2
E	63.5	2450	94.2	4	3	2	3	1	-	-	1	1
F	61.7	2175	100.0	2	3	3	2	3	3	2	3	3
G	61.0	2650	96.4	1	2	2	3	3	3	3	3	2
H	67.8	955	87.6	3	4	1	2	3	2	3	2	2
I	63.9	1215	90.3	2	3	1	2	3	1	3	3	2
J	65.1	905	91.9	3	5	1	2	2	3	2	1	2
K	65.1	855	83.4	3	4	2	3	2	2	2	2	2
L	71.6	1030	97.2	3	4	2	3	3	3	3	3	3
M	66.7	662	83.8	2.5	4	3	3.5	4	3	1.5	1	1.8
Mean	64.8	-	93.6	3.0	3.7	2.2	2.6	2.8	2.6	2.7	2.3	2.2
Std Dev	2.9	-	5.5	1.0	0.8	1.0	0.8	0.9	0.7	0.6	0.9	0.7

Williston, ND (W 1)

Coop-erator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Require-ment	Dough Charact-eristics	Quality Score Compared to Check (Glenn) Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	63.0	2900	100.0	5	5	3	3	3	3	3	3	3
B	62.0	2850	95.0	5	5	2	2	2	2	2	2	2
C	64.0	928	95.7	4	5	2	2	3	3	2	2	2
D	62.0	3162	105.9	5	5	3	2	3	2	2	3	3
E	62.5	2575	99.0	5	3	3	1	1	-	-	1	1
F	64.7	2675	107.0	3	3	3	4	4	2	3	4	4
G	60.0	2750	110.0	5	4	4	4	3	3	3	1	2
H	67.2	1090	96.5	5	5	3	2	3	2	2	2	2
I	63.2	1120	94.5	4	3	2	2	4	2	1	3	2
J	63.7	1025	96.7	4	4	3	2.5	2	3	2	2	2.3
K	69.3	950	84.8	5	4	3	3	2	3	3	3	3
L	73.4	1108	101.4	4	4	2	4	5	2	3	4	4
M	70.4	850	84.7	5	3	3	3.5	3.5	2	1.5	1.5	1.7
Mean	65.5	-	98.9	4.7	4.2	2.8	2.8	3.1	2.5	2.4	2.5	2.6
Std Dev	3.9	-	7.6	0.7	0.9	0.6	1.0	1.1	0.5	0.7	1.0	0.9

MN07098-6

Casselton, ND (C 2)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Requirement	Dough Characteristics	Quality Score Compared to Check (Glenn) Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	60.0	2800	98.2	2	2	2	3	3	2	4	1	2
B	61.0	3000	98.4	4	3	3	4	4	1	5	4	4
C	62.0	910	92.6	3	3	2	3	4	2	3	2	2
D	61.0	2868	90.7	4	4	2	3	3	2	3	2	2
E	60.0	2625	100.0	4	3	2	3	2	-	-	2	2
F	61.0	2100	100.0	2	3	3	3	3	2	2	3	3
G	65.0	2950	101.7	3	3	3	3	3	2	3	3	3
H	64.6	900	90.5	4	4	2	2	2	1	4	2	2
I	61.0	1070	93.4	3	3	2	2	4	1	5	3	2
J	61.5	790	90.8	2	3	3	3	2	2	4	1	2.3
K	63.1	900	96.8	3	3	2	3	3	2	3	3	3
L	66.7	1025	97.6	3	4	4	3	4	4	4	4	4
M	64.8	736	93.4	2	4	3	3	3.5	2	2	1	1.7
Mean	62.6	-	96.1	3.1	3.3	2.6	3.0	3.2	2.0	3.6	2.5	2.6
Std Dev	2.2	-	4.0	0.8	0.6	0.7	0.5	0.8	0.8	1.0	1.0	0.8

Crookston, MN (K 2)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Requirement	Dough Characteristics	Quality Score Compared to Check (Glenn) Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	60.0	2700	96.4	2	2	1	3	4	2	2	2	2
B	60.5	3100	98.4	3	1	3	2	2	2	3	3	3
C	63.0	915	97.3	3	3	3	3	3	3	2	2	2
D	60.0	3104	101.9	5	5	3	4	3	2	2	3	2
E	60.0	2700	100.0	4	3	2	1	1	-	-	3	3
F	60.4	2175	98.9	3	3	4	3	2	2	2	3	3
G	59.0	2550	94.4	2	2	2	2	3	2	4	2	2
H	65.5	920	95.3	4	5	2	2	3	2	2	2	2
I	61.7	1105	91.3	3	4	3	2	2	1	1	2	1
J	61.1	870	94.6	3	3	2	2	2	3	2	2	2.3
K	64.2	880	92.6	4	4	3	2	3	2	2	3	2
L	67.9	968	99.5	3	4	3	3	3	3	2	3	3
M	65.0	766	92.3	3	3	2	3	3	3	1	1	1.7
Mean	62.4	-	96.8	3.3	3.4	2.7	2.6	2.8	2.4	2.2	2.5	2.3
Std Dev	2.7	-	3.3	0.8	1.2	0.8	0.8	0.8	0.6	0.8	0.7	0.6

ND818 (Elgin)

Watertown, SD (B 4)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Requirement	Dough Characteristics	Quality Score Compared to Check (Glenn): Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	62.0	2700	94.7	5	5	3	3	4	3	3	4	3
B	66.5	3350	104.7	4	3	3	2	2	3	3	2	3
C	64.0	890	95.4	2	4	1	3	1	3	2	1	1
D	66.0	2956	95.2	5	5	3	4	2	3	3	2	2
E	66.5	2575	102.0	4	3	3	3	1	-	-	2	2
F	66.7	2275	108.3	4	4	4	4	4	3	3	4	4
G	66.0	2700	101.9	3	3	3	3	3	3	3	3	3
H	71.0	1025	100.0	3	3	3	3	3	3	3	3	3
I	66.2	1000	93.0	3	4	3	2	2	3	3	2	2
J	68.1	840	92.8	2	2	3	2	2	3	4	2	3
K	68.6	1015	96.2	3	4	2	3	4	3	3	3	3
L	71.7	1078	105.0	3	4	3	4	4	3	3	3	3
M	67.8	660	90.4	2	5	3	3	3	3	3	3	3
Mean	67.4	-	99.1	3.4	3.9	3.0	3.1	2.8	3.0	3.1	2.8	2.8
Std Dev	2.6	-	5.6	1.0	0.9	0.7	0.7	1.1	0.0	0.4	0.9	0.8

Casselton, ND (C 4)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Requirement	Dough Characteristics	Quality Score Compared to Check (Glenn): Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	61.0	2750	96.5	3	3	2	2	3	3	4	2	2
B	65.0	3250	106.6	3	3	3	4	2	2	5	3	3
C	63.0	875	89.0	2	3	2	2	2	3	2	2	2
D	65.0	2809	88.8	2	1	1	2	1	2	4	1	1
E	64.5	2525	96.2	3	3	1	1	3	-	-	3	3
F	65.2	2225	106.0	3	1	2	2	2	2	2	4	4
G	64.0	2800	96.6	3	3	3	3	3	3	3	3	3
H	69.2	930	93.5	3	3	2	3	3	2	4	3	3
I	64.6	1050	91.7	3	1	2	1	3	2	5	1	2
J	65.0	910	104.6	2	2	2	2.5	3	3	3	3	3
K	65.2	910	97.8	3	4	2	2	2	2	4	2	2
L	69.5	1052	100.2	2	3.5	3	3	4	3	4	3	3
M	66.1	628	79.7	2	4	3.5	3	3.5	3	1	1	1.7
Mean	65.5	-	97.3	2.7	2.8	2.3	2.5	2.8	2.5	3.6	2.5	2.6
Std Dev	2.2	-	7.6	0.5	1.1	0.8	0.9	0.8	0.5	1.2	1.0	0.8

(ND 818 continued)

Crookston, MN (K 4)												
		Loaf Volume				Quality Score Compared to Check (Glenn)						
Coop-erator	Bake Absorption (%, 14% mb)	(cc)	(% of Check)	Mixing Require-ment	Dough Charact-eristics	Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	62.0	2600	92.9	1	1	1	2	3	4	3	2	2
B	65.5	3450	109.5	3	3	3	2	2	4	3	3	3
C	64.0	895	95.2	2	3	1	2	2	4	2	2	2
D	65.0	3074	101.0	5	5	3	3	2	4	4	3	3
E	65.5	2575	95.4	5	3	3	1	1	-	-	1	1
F	65.3	2150	97.7	4	3	3	2	2	4	2	3	3
G	63.0	2500	92.6	2	2	2	2	2	4	4	3	2
H	69.1	1010	104.7	3	2	2	3	3	5	3	3	3
I	64.3	1020	84.3	3	3	1	1	1	4	3	1	1
J	66.4	925	100.5	2	2	2	2.5	3	3	4	3	3.3
K	65.0	880	92.6	3	4	2	2	2	4	3	2	3
L	71.1	1065	109.5	3	4	3	3	3	4	5	3	3
M	67.6	644	77.6	2	4	3	3	3	3	3	1.5	2.5
Mean	66.0	-	98.0	3.1	3.2	2.3	2.3	2.3	4.0	3.4	2.5	2.6
Std Dev	2.4	-	9.1	1.2	1.1	0.8	0.7	0.7	0.5	0.9	0.8	0.8

Minot, ND (M 4)												
		Loaf Volume				Quality Score Compared to Check (Glenn)						
Coop-erator	Bake Absorption (%, 14% mb)	(cc)	(% of Check)	Mixing Require-ment	Dough Charact-eristics	Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	62.0	2900	103.6	5	5	3	3	3	3	3	3	3
B	66.5	3000	105.3	4	2	3	4	4	3	3	4	3
C	64.0	908	98.7	4	5	3	3	2	3	3	3	3
D	66.0	3104	101.0	5	5	3	2	2	3	3	3	3
E	65.0	2600	100.0	5	5	3	3	3	-	-	3	3
F	66.4	2200	101.1	3	3	3	2	2	4	3	4	4
G	64.0	2600	94.5	2	2	2	2	3	3	1	1	2
H	70.2	1070	98.2	2	3	3	3	3	3	3	3	3
I	66.9	1315	97.8	3	4	3	3	5	3	2	4	4
J	67.7	945	95.9	2	2	3	3	3	3	3	2	2.7
K	66.9	880	85.9	3	4	2	3	2	3	2	2	2
L	73.8	1060	100.0	3	4.5	3	3	4	3	2	3	3
M	68.2	714	90.4	2.5	5	3	3	3.5	3	2	3	2.7
Mean	67.1	-	98.9	3.5	4.0	2.9	2.9	3.1	3.1	2.6	3.1	3.0
Std Dev	3.0	-	5.3	1.1	1.3	0.4	0.6	0.9	0.3	0.7	0.9	0.6

(ND 818 continued)

Williston, ND (W 4)												
		Loaf Volume				Quality Score Compared to Check (Glenn)						
Coop-erator	Bake Absorption (%, 14% mb)	(cc)	(% of Check)	Mixing Require-ment	Dough Charact-eristics	Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	65.0	2775	95.7	5	5	3	2	2	3	3	2	2
B	69.0	3100	103.3	5	3	3	3	2	4	2	3	3
C	64.0	890	91.8	5	5	1	2	2	3	2	1	1
D	66.0	3015	101.0	5	5	3	3	4	4	2	4	4
E	68.5	2600	100.0	5	5	3	1	1	-	-	1	1
F	71.5	2550	102.0	3	3	3	3	2	4	2	3	3
G	66.0	2350	94.0	4	5	5	2	2	3	3	1	2
H	74.0	1180	104.4	3	3	2	3	3	4	2	3	3
I	71.1	1095	92.4	3	2	2	2	5	4	2	3	3
J	69.5	1110	104.7	2	3	1	2	4	3	2	1	2
K	72.5	1005	89.7	4	4	2	3	2	4	2	3	3
L	78.6	1243	113.7	3	4	2	4	4	3	3	4	4
M	73.8	754	75.1	3	4	2	3	3.5	3	2	2	2.3
Mean	70.5	-	99.4	4.0	4.1	2.6	2.7	3.0	3.5	2.3	2.5	2.7
Std Dev	4.2	-	9.5	1.1	1.0	1.1	0.8	1.2	0.5	0.5	1.1	1.0

MT0832 (Duclair)

Minot, ND (M 5)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Requirement	Dough Characteristics	Quality Score Compared to Check (Glenn): Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	62.0	2800	100.0	5	5	3	3	4	3	3	3	3
B	64.0	3200	112.3	3	2	3	4	4	3	2	3	3
C	64.0	875	95.1	3	3	2	3	2	3	1	2	2
D	65.0	3045	99.1	5	5	3	3	3	4	2	3	3
E	65.0	2550	98.1	5	4	3	3	1	-	-	1	1
F	63.9	2100	96.6	3	3	3	2	2	4	2	2	2
G	61.0	2450	89.1	2	1	1	2	2	3	2	2	2
H	68.2	990	90.8	3	2	2	3	4	3	2	4	4
I	66.8	1300	96.7	2	4	3	2	3	4	2	3	3
J	64.7	950	96.4	1	2	2	2	2	3	2	2	2.3
K	66.3	860	83.9	3	3	3	3	2	4	2	2	3
L	64.4	1105	104.2	3	4	3	4	4	4	2	3	4
M	68.3	652	82.5	2.5	4	3	3	3.5	3	1	2	2
Mean	65.2	-	96.9	3.3	3.4	2.8	2.9	3.0	3.5	2.0	2.6	2.8
Std Dev	2.1	-	8.0	1.2	1.2	0.7	0.7	1.0	0.5	0.5	0.8	0.9

Williston, ND (W 5)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Requirement	Dough Characteristics	Quality Score Compared to Check (Glenn): Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	63.0	2900	100.0	5	5	3	3	3	3	3	3	3
B	63.5	3050	101.7	5	3	3	3	3	3	4	3	3
C	64.0	943	97.2	4	5	3	3	3	3	2	3	3
D	64.0	2986	100.0	5	5	3	3	3	2	3	3	3
E	64.5	2650	101.9	5	5	3	1	1	-	-	2	2
F	66.9	2200	88.0	2	4	2	2	1	2	2	2	2
G	61.0	2350	94.0	3	5	5	2	2	3	3	2	2
H	68.9	1060	93.8	4	3	1	3	3	2	4	3	2
I	66.0	1090	92.0	3	2	3	2	3	2	4	2	3
J	65.2	1000	94.3	2	2	1	2.5	2.5	2	3	1	2
K	67.9	975	87.1	4	4	3	3	2	3	3	3	3
L	74.9	1260	115.3	3	4	2	4	5	2	3	5	5
M	70.7	754	75.1	3.5	4	1.5	3	3.5	2.5	3	0.5	2
Mean	66.6	-	97.1	3.9	4.1	2.7	2.8	2.8	2.5	3.2	2.7	2.8
Std Dev	3.7	-	9.5	1.1	1.1	1.1	0.7	1.1	0.5	0.7	1.1	0.9

Line B (AUBR31117W)

Minot, ND (M 6)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Requirement	Dough Characteristics	Quality Score Compared to Check (Glenn): Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	62.0	2600	92.9	5	4	3	2	3	3	3	3	3
B	64.5	3000	105.3	3	2	3	4	3	3	2	3	3
C	64.0	845	91.8	2	3	1	2	2	3	1	1	1
D	63.0	2897	94.2	4	4	2	2	2	4	2	2	2
E	63.5	2375	91.3	5	2	3	1	1	-	-	1	1
F	63.4	2125	97.7	3	2	2	2	1	3	1	2	2
G	61.0	2550	92.7	1	1	1	2	2	4	3	1	2
H	68.3	960	88.1	2	3	1	2	3	4	1	2	3
I	65.7	1175	87.4	3	4	1	2	5	4	2	4	3
J	65.0	920	93.4	2	2	1	3	4	3	1	1	1.7
K	66.0	820	80.0	3	4	2	3	2	4	3	2	3
L	71.1	1000	94.3	2	4	2	3	2	4	3	2	2
M	68.6	618	78.2	2	4	3	2.5	3.5	3	1.5	1	1.8
Mean	65.4	-	92.4	3.0	3.2	2.0	2.5	2.7	3.5	2.0	2.0	2.3
Std Dev	2.9	-	7.0	1.2	1.1	0.9	0.7	1.2	0.5	0.9	1.0	0.7

Williston, ND (W 6)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Requirement	Dough Characteristics	Quality Score Compared to Check (Glenn): Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	60.0	2650	91.4	5	5	3	3	4	3	3	3	3
B	61.0	2750	91.7	4	4	2	3	3	1	4	3	3
C	64.0	838	86.4	3	4	1	3	2	2	4	1	2
D	61.0	2868	96.0	5	5	3	4	3	2	4	2	2
E	62.0	2550	98.1	5	5	3	3	3	-	-	2	2
F	64.2	2225	89.0	2	4	2	2	1	1	2	2	2
G	59.0	2300	92.0	3	5	5	3	2	2	3	2	2
H	67.1	905	80.1	4	4	1	3	2	1	3	2	1
I	59.6	920	77.6	3	2	2	3	4	1	4	2	2
J	65.0	850	80.2	4	5	1	2.5	1.5	1	3	1	1.7
K	65.6	825	73.7	4	4	3	4	2	2	3	2	2
L	71.8	948	86.7	3	4	3	3	3	1	3	4	4
M	65.8	714	71.1	4	4	1.5	3.5	3.5	1	4.5	0	1.8
Mean	63.9	-	86.9	3.9	4.4	2.5	3.2	2.8	1.5	3.5	2.2	2.3
Std Dev	3.6	-	8.5	0.9	0.8	1.1	0.5	0.9	0.7	0.7	1.0	0.7

SD4178

Watertown, SD (B 7)

Coop-erator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Require-ment	Dough Charact-eristics	Quality Score Compared to Check (Glenn) Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	61.0	2875	100.9	5	5	3	3	4	3	4	4	4
B	62.0	3000	93.8	3	3	3	4	3	2	5	3	3
C	64.0	925	99.1	4	3	3	3	2	3	4	3	3
D	61.0	3104	100.0	5	5	3	4	2	2	4	2	2
E	62.5	2625	104.0	5	4	3	3	3	-	-	4	4
F	62.0	2225	106.0	2	3	3	4	4	2	4	4	4
G	61.0	2700	101.9	4	4	3	3	3	3	4	3	4
H	66.9	965	94.1	3	5	4	4	3	2	4	4	3
I	66.2	1075	100.0	4	4	2	4	4	2	4	4	3
J	63.3	870	96.1	3	3	4	2.5	2	2	4	3	3
K	66.7	965	91.5	4	4	2	3	4	2	4	3	3
L	71.8	1030	100.3	3	4	3	3	3	2	4	3	3
M	67.2	762	104.4	4	3	4	3	4	2	3	3	2.7
Mean	64.6	-	100.0	3.9	3.9	3.2	3.4	3.3	2.3	4.1	3.4	3.3
Std Dev	3.3	-	4.4	0.9	0.8	0.6	0.6	0.8	0.5	0.4	0.6	0.6

Casselton, ND (C 7)

Coop-erator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Require-ment	Dough Charact-eristics	Quality Score Compared to Check (Glenn) Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	60.0	2700	94.7	2	2	2	2	3	3	3	1	2
B	60.0	3200	104.9	2	4	3	3	3	1	4	3	3
C	63.0	870	88.5	2	2	1	1	1	2	2	1	1
D	60.0	2809	88.8	4	4	2	3	2	2	3	2	2
E	61.0	2625	100.0	3	3	1	1	2	-	-	2	2
F	60.0	2100	100.0	2	3	3	2	2	2	2	3	3
G	58.0	2600	89.7	1	1	2	3	3	2	3	3	2
H	66.0	905	91.0	3	1	1	3	3	1	4	3	2
I	62.3	1070	93.4	2	2	1	2	2	1	4	2	1
J	59.8	785	90.2	1	2	1	3	2	2	3	1	2
K	62.8	845	90.9	3	1	2	2	3	2	3	3	3
L	68.0	947	90.2	2	4	3	3	3	3	3	3	3
M	64.6	646	82.0	2	3	3	3	3.5	2	2	0.5	1.5
Mean	62.3	-	93.5	2.3	2.6	2.0	2.5	2.6	2.0	3.1	2.3	2.2
Std Dev	2.9	-	6.0	0.8	1.1	0.9	0.8	0.7	0.7	0.7	1.0	0.7

Line C (BR2306)

Minot, ND (M 8)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Requirement	Dough Characteristics	Quality Score Compared to Check (Glenn): Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	62.0	2650	94.6	5	5	3	3	3	3	3	3	3
B	66.0	3150	110.5	2	2	3	4	3	3	1	3	2
C	64.0	870	94.6	3	4	2	3	3	3	2	2	2
D	66.0	2986	97.1	5	5	2	4	3	3	3	3	3
E	65.0	2525	97.1	5	3	3	4	2	-	-	1	1
F	65.9	2250	103.4	3	3	3	2	2	3	2	3	3
G	64.0	2450	89.1	1	1	1	2	2	3	1	3	2
H	70.7	1065	97.7	3	3	2	4	4	3	2	4	3
I	66.4	1240	92.2	3	5	3	2	3	2	1	3	2
J	67.4	960	97.5	2	3	1	2	3	3	1	3	2.3
K	67.1	895	87.3	3	4	2	3	3	3	2	3	3
L	72.7	998	94.2	3	4	3	3	3	3	2	2	3
M	67.5	680	86.1	2.5	4	3	3	3.5	3	1.5	2	2.2
Mean	66.9	-	96.3	3.3	3.8	2.5	3.1	3.0	3.0	1.9	2.8	2.5
Std Dev	2.8	-	6.5	1.2	1.2	0.8	0.8	0.6	0.3	0.7	0.8	0.6

Williston, ND (W 8)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Requirement	Dough Characteristics	Quality Score Compared to Check (Glenn): Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	62.0	2450	84.5	3	3	2	2	2	3	3	2	2
B	61.0	2850	95.0	3	3	3	4	4	2	2	3	2
C	64.0	828	85.4	2	3	1	2	2	3	3	1	2
D	61.0	2574	86.2	5	4	2	3	2	1	2	2	2
E	62.5	2400	92.3	3	3	1	2	1	-	-	1	1
F	64.0	2225	89.0	2	4	2	2	2	2	1	2	2
G	59.0	2300	92.0	1	5	5	3	2	3	2	2	2
H	66.9	880	77.9	3	2	1	3	2	2	2	2	2
I	62.5	1010	85.2	2	2	1	2	3	1	2	2	1
J	62.5	805	75.9	2	2	1	2	1.5	2	2	1	1.7
K	65.1	775	69.2	3	3	1	4	2	4	3	2	2
L	74.3	930	85.1	2	4	1	3	3	2	3	2	2
M	67.9	624	62.2	3	3	1.5	3.5	4	2	2.5	0	1.5
Mean	64.5	-	84.8	2.8	3.3	1.8	2.8	2.5	2.4	2.4	1.8	1.8
Std Dev	3.9	-	9.5	1.0	0.9	1.2	0.8	0.9	0.9	0.6	0.8	0.4

ND 819

Casselton, ND (C 9)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Requirement	Dough Characteristics	Quality Score Compared to Check (Glenn): Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	61.0	2950	103.5	3	3	2	3	4	3	4	3	3
B	67.5	3650	119.7	4	2	2	4	4	3	4	4	4
C	64.0	943	95.9	2	3	2	3	3	3	2	2	2
D	66.0	3162	100.0	4	4	2	5	2	3	3	3	3
E	64.5	2700	102.9	4	3	2	4	3	-	-	5	5
F	67.3	2375	113.1	3	4	4	4	2	2	3	5	4
G	65.0	2600	89.7	2	2	2	3	3	4	3	3	2
H	71.7	1010	101.5	3	2	2	4	4	3	4	4	4
I	63.6	1065	93.0	2	2	2	3	3	2	4	2	2
J	67.3	1005	115.5	1	2	3	4	4	3	4	4	3.7
K	66.0	910	97.8	3	4	2	2	3	2	4	3	3
L	70.6	1105	105.2	3	4	3	4	5	3	5	4	4
M	66.4	661	83.9	2	5	3	3	3	3	3	2.5	2.8
Mean	66.7	-	103.2	2.9	3.2	2.4	3.7	3.4	2.9	3.7	3.5	3.4
Std Dev	2.8	-	10.2	0.9	1.0	0.7	0.8	0.9	0.6	0.8	1.0	0.9

Minot, ND (M 9)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Requirement	Dough Characteristics	Quality Score Compared to Check (Glenn): Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	62.0	2850	101.8	5	5	3	3	3	3	3	3	3
B	68.0	3200	112.3	3	3	3	4	3	3	2	3	3
C	64.0	900	97.8	3	4	3	3	3	3	3	3	3
D	66.0	3162	102.9	5	5	3	2	3	4	3	3	3
E	66.5	2525	97.1	5	4	3	4	1	-	-	1	1
F	68.0	2100	96.6	3	3	3	3	2	4	3	2	2
G	66.0	2600	94.5	1	2	2	3	3	4	2	4	3
H	72.7	995	91.3	2	3	2	2	2	3	2	2	2
I	66.0	1320	98.1	2	5	4	3	3	4	2	3	3
J	69.2	1010	102.5	1	3	2	3	4	3	2	4	3
K	68.0	925	90.2	3	4	2	3	3	4	3	3	3
L	73.9	1013	95.6	2	4	3	2	2	3	2	2	2
M	68.1	677	85.7	2	5	4	3	3.5	3	2	3	2.7
Mean	68.0	-	98.4	3.0	4.0	2.9	3.0	2.9	3.5	2.5	2.9	2.7
Std Dev	3.2	-	6.7	1.4	1.0	0.7	0.6	0.8	0.5	0.5	0.8	0.6

11 Fx Mn (LCS Breakaway)

Watertown, SD (B10)

Coop-erator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Require-ment	Dough Charact-eristics	Quality Score Compared to Check (Glenn): Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	62.0	2600	91.2	5	5	3	3	4	3	3	3	3
B	65.0	3250	101.6	3	3	3	4	3	3	3	3	3
C	64.0	905	97.0	2	3	3	3	2	3	3	2	2
D	65.0	2986	96.2	5	5	3	3	2	3	3	2	2
E	65.5	2600	103.0	4	3	2	3	2	-	-	4	4
F	65.1	2200	104.8	3	3	4	3	2	3	3	4	3
G	63.0	2500	94.3	3	3	2	2	3	3	3	2	3
H	70.1	1025	100.0	3	3	3	2	3	3	3	2	2
I	65.5	1000	93.0	2	4	2	2	1	3	3	1	2
J	67.6	870	96.1	3	3	3	3	3	3	4	3	3.3
K	68.1	910	86.3	3	3	2	3	2	3	3	2	3
L	72.1	1080	105.2	3	4	2	4	3	3	3	3	3
M	68.7	668	91.5	2	4	3	3	4	3	3	3	3
Mean	66.6	-	97.8	3.3	3.6	2.8	3.0	2.8	3.0	3.1	2.8	2.9
Std Dev	2.9	-	5.7	1.0	0.8	0.6	0.6	0.9	0.0	0.3	0.9	0.6

Casselton, ND (C10)

Coop-erator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Require-ment	Dough Charact-eristics	Quality Score Compared to Check (Glenn): Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	60.0	2750	96.5	2	2	2	3	3	3	3	2	2
B	62.0	3100	101.6	3	3	3	3	2	2	3	3	3
C	64.0	860	87.5	2	2	1	3	3	3	3	2	2
D	61.0	2986	94.4	5	5	3	4	3	2	3	2	2
E	62.5	2625	100.0	3	3	1	2	3	-	-	3	3
F	62.0	2200	104.8	2	3	3	3	2	2	4	4	4
G	60.0	2600	89.7	3	3	2	3	3	4	3	3	3
H	66.4	935	94.0	3	3	3	3	4	2	3	3	2
I	62.4	975	85.2	2	3	1	2	2	2	3	2	1
J	61.4	815	93.7	1	2	3	3	2	3	3	2	2.7
K	63.7	940	101.1	3	4	2	2	2	2	3	2	2
L	69.3	1052	100.2	3	4	3	3	3	3	3	3	3
M	64.9	625	79.3	2	4	4	3	3.5	3	3	1	2.3
Mean	63.3	-	95.7	2.8	3.3	2.5	2.9	2.8	2.6	3.1	2.6	2.6
Std Dev	2.6	-	7.4	1.0	0.9	1.0	0.6	0.7	0.7	0.3	0.8	0.8

(11 Fx Mn continued)

Crookston, MN (K10)												
		Loaf Volume				Quality Score Compared to Check (Glenn)						
Coop-erator	Bake Absorption (%, 14% mb)	(cc)	(% of Check)	Mixing Require-ment	Dough Charact-eristics	Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	62.0	2850	101.8	1	1	1	2	3	4	2	2	2
B	62.5	3450	109.5	3	3	3	3	3	4	3	3	3
C	64.0	938	99.8	2	3	2	3	2	4	3	2	2
D	63.0	3074	101.0	5	5	3	3	2	4	3	3	3
E	63.0	2700	100.0	5	3	3	2	2	-	-	4	4
F	62.3	2175	98.9	3	3	4	2	2	4	1	3	3
G	60.0	2500	92.6	1	1	2	2	2	5	3	2	1
H	67.3	965	100.0	2	3	1	3	3	5	3	3	3
I	65.2	1075	88.8	3	3	1	2	1	4	2	2	2
J	63.0	895	97.3	1	2	1	2	2	4	4	3	3.7
K	65.8	960	101.1	3	4	2	2	4	4	2	4	4
L	69.9	1035	106.4	3	4	3	3	4	4	2	3.5	4
M	67.5	722	87.0	2	3	2	3	3	3	4	1	2.7
Mean	64.6	-	99.8	2.8	3.1	2.3	2.5	2.7	4.2	2.8	2.9	3.0
Std Dev	2.7	-	6.3	1.3	1.1	1.0	0.5	0.9	0.5	0.9	0.9	0.9

Minot, ND (M10)												
		Loaf Volume				Quality Score Compared to Check (Glenn)						
Coop-erator	Bake Absorption (%, 14% mb)	(cc)	(% of Check)	Mixing Require-ment	Dough Charact-eristics	Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	62.0	2725	97.3	5	5	3	3	3	3	3	3	3
B	66.0	3050	107.0	3	3	3	4	4	3	2	4	3
C	64.0	885	96.2	3	3	3	3	4	3	3	3	3
D	66.0	3104	101.0	5	5	3	3	2	3	3	2	3
E	64.5	2525	97.1	5	4	3	3	2	-	-	1	1
F	66.0	2150	98.9	3	3	3	2	3	4	2	2	3
G	64.0	2800	101.8	2	3	3	3	4	4	1	4	3
H	70.7	1080	99.1	3	3	1	3	2	3	2	2	2
I	67.4	1245	92.6	2	5	3	3	1	3	2	2	2
J	67.4	995	101.0	2	3	1	3	3.5	3	2	3	2.7
K	67.1	910	88.8	3	4	2	3	3	3	3	3	3
L	72.7	1045	98.6	3	4	3	4	3	3	2	3	3
M	68.0	693	87.7	2	4	3	3	3.5	3	3	2.5	2.8
Mean	67.0	-	98.3	3.3	3.8	2.8	3.2	3.1	3.2	2.5	2.8	2.8
Std Dev	2.9	-	5.3	1.1	0.8	0.8	0.5	0.9	0.4	0.7	0.9	0.6

(11 Fx Mn continued)

Williston, ND (W10)												
		Loaf Volume				Quality Score Compared to Check (Glenn)						
Coop-erator	Bake Absorption (%, 14% mb)	(cc)	(% of Check)	Mixing Require-ment	Dough Charact-eristics	Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	64.0	2800	96.6	5	5	3	3	3	3	3	3	3
B	65.5	3400	113.3	4	3	3	4	3	3	3	3	3
C	64.0	888	91.5	3	4	2	2	3	3	3	2	2
D	66.0	2956	99.0	5	5	3	3	3	2	3	3	3
E	65.5	2525	97.1	5	4	3	2	1	-	-	2	2
F	68.0	2250	90.0	2	4	2	3	2	3	2	2	2
G	63.0	2350	94.0	3	5	5	3	3	3	3	2	2
H	70.6	1065	94.2	3	3	1	3	4	3	3	3	3
I	67.3	1025	86.5	3	3	2	2	2	2	3	1	2
J	66.5	1010	95.3	3	4	1	2.5	3	3	3	1	2.3
K	69.6	925	82.6	3	4	2	3	-	3	3	3	3
L	73.1	1098	100.5	3	4	2	3	4	3	3	3	3
M	71.3	715	71.2	3	3	2	3.5	4	3	3.5	0.5	2.3
Mean	67.6	-	95.1	3.6	4.0	2.5	2.9	3.1	2.9	3.0	2.3	2.6
Std Dev	3.1	-	9.9	1.0	0.8	1.0	0.6	0.9	0.4	0.3	0.9	0.5

ND 812

Casselton, ND (C11)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Requirement	Dough Characteristics	Quality Score Compared to Check (Glenn): Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	61.0	2825	99.1	2	2	2	3	2	3	4	2	2
B	65.0	3000	98.4	3	3	2	3	2	3	5	3	4
C	64.0	935	95.1	2	2	2	3	2	3	3	2	2
D	65.0	3045	96.3	4	4	2	3	2	3	3	2	2
E	65.5	2650	101.0	4	3	2	3	3	-	-	4	4
F	65.2	2225	106.0	2	3	3	3	2	2	2	4	4
G	63.0	2550	87.9	2	2	2	2	3	4	3	2	2
H	69.8	985	99.0	3	3	2	4	4	2	4	4	3
I	64.2	1100	96.1	2	3	1	2	2	2	5	2	2
J	65.4	900	103.4	1	2	2	2.5	3	3	4	3	3.3
K	65.4	910	97.8	3	4	2	2	3	2	4	3	3
L	69.5	1040	99.0	3	4	3	3	3	3	4	3	3
M	66.4	660	83.8	2	4	3.5	3	3	3	3	1	2.3
Mean	65.7	-	98.3	2.7	3.1	2.3	2.9	2.7	2.8	3.8	2.8	2.9
Std Dev	2.3	-	5.9	0.9	0.8	0.6	0.6	0.7	0.6	0.9	0.9	0.8

Minot, ND (M11)

Cooperator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Requirement	Dough Characteristics	Quality Score Compared to Check (Glenn): Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	62.0	2750	98.2	5	5	3	3	3	3	3	3	3
B	66.0	3050	107.0	4	3	3	3	3	3	1	3	2
C	64.0	928	100.9	4	4	3	3	4	3	3	3	3
D	66.0	3162	102.9	5	5	3	4	2	3	2	3	3
E	64.5	2600	100.0	5	5	3	4	3	-	-	3	3
F	66.2	2150	98.9	3	3	3	2	2	3	3	1	2
G	64.0	2800	101.8	2	3	3	4	4	4	1	4	3
H	70.3	980	89.9	3	3	3	2	2	3	1	2	2
I	68.0	1290	95.9	3	4	2	3	4	3	1	4	3
J	66.8	1010	102.5	2	3	3	3	4	3	2	4	3
K	67.5	915	89.3	3	4	2	3	4	3	3	4	4
L	75.5	1038	97.9	3	4	3	4	3	3	1	3	3
M	67.8	726	91.9	2.5	4	3	3	3	3	2.5	3	2.8
Mean	67.2	-	99.0	3.5	3.9	2.9	3.3	3.3	3.1	2.0	3.3	2.9
Std Dev	3.4	-	5.3	1.1	0.8	0.4	0.7	0.8	0.3	0.9	0.9	0.6

MN06028

Casselton, ND (C12)

Coop-erator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Require-ment	Dough Charact-eristics	Quality Score Compared to Check (Glenn) Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	61.0	2900	101.8	5	5	3	3	2	3	4	3	3
B	63.5	3100	101.6	5	3	3	4	3	3	4	4	4
C	64.0	940	95.6	5	4	4	3	3	3	4	3	3
D	63.0	3104	98.2	5	5	3	4	4	3	3	4	4
E	63.5	2675	101.9	5	4	3	3	3	-	-	4	4
F	63.3	2225	106.0	2	1	2	2	2	3	5	4	4
G	61.0	2600	89.7	4	4	2	3	3	5	3	3	3
H	67.4	990	99.5	4	3	4	4	3	3	4	3	3
I	65.2	1200	104.8	4	4	3	4	4	3	5	4	4
J	63.6	875	100.6	1	3	5	3	2	3	4	3	3.3
K	64.7	980	105.4	4	4	4	2	3	4	4	3	4
L	71.4	1030	98.1	4	4	4	4	4	3	4	4	4
M	67.0	748	94.9	3	4	4	3	3.5	3	3	3	3
Mean	64.8	-	100.7	4.2	3.9	3.5	3.3	3.1	3.3	4.0	3.5	3.6
Std Dev	2.8	-	4.6	1.3	1.0	0.9	0.7	0.7	0.6	0.7	0.5	0.5

Crookston, MN (K12)

Coop-erator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Require-ment	Dough Charact-eristics	Quality Score Compared to Check (Glenn) Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	62.0	2800	100.0	5	5	3	2	3	4	3	3	3
B	63.0	3250	103.2	4	4	2	3	4	5	3	4	4
C	64.0	893	95.0	5	5	2	3	3	4	3	2	2
D	63.0	3162	103.8	5	5	3	4	2	4	3	3	3
E	63.0	2575	95.4	5	5	3	2	3	-	-	3	3
F	62.9	2150	97.7	3	3	3	4	3	5	5	3	3
G	61.0	2600	96.3	5	5	3	3	3	5	3	3	4
H	67.7	955	99.0	4	5	5	3	2	5	3	2	2
I	68.0	1155	95.5	5	4	4	3	3	5	2	3	3
J	63.7	890	96.7	3	3	6	3	2.5	5	2	3	3.3
K	67.3	930	97.9	4	4	3	2	5	4	2	5	5
L	73.4	1083	111.3	4	4.5	5	3	5	4	2	4	4
M	68.3	846	101.9	5	4	3	3	3	4	3	5	4
Mean	65.5	-	99.9	4.5	4.5	3.6	3.0	3.3	4.5	2.9	3.4	3.4
Std Dev	3.5	-	4.6	0.8	0.7	1.2	0.6	0.9	0.5	0.8	0.9	0.8

03S0257-3 (SY Rowyn)

Watertown, SD (B13)

Coop-erator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Require-ment	Dough Charact-eristics	Quality Score Compared to Check (Glenn) Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	62.0	3100	108.8	5	5	3	3	3	3	3	3	3
B	64.0	3300	103.1	5	3	3	4	4	3	3	4	3
C	64.0	1010	108.3	4	5	4	3	3	3	2	4	4
D	64.0	3162	101.9	5	5	3	4	3	3	3	3	3
E	63.5	2600	103.0	5	5	3	3	4	-	-	4	4
F	63.8	2300	109.5	3	3	4	4	5	3	5	4	4
G	62.0	3000	113.2	5	4	4	3	3	3	3	3	4
H	68.0	1070	104.4	4	5	5	2	1	3	2	1	2
I	66.8	1170	108.8	4	5	4	4	3	3	2	4	4
J	65.6	925	102.2	5	5	5	3	3	3	3	3	3
K	68.2	1025	97.2	5	3	3	3	3	3	3	3	3
L	73.8	1128	109.8	4	4	4	3	4	3	3	4	4
M	68.4	816	111.8	4	3	2	3	4	4	3	5	4
Mean	66.0	-	107.1	4.6	4.3	3.8	3.3	3.5	3.1	3.0	3.7	3.6
Std Dev	3.3	-	4.7	0.7	0.9	0.9	0.6	0.9	0.3	0.8	1.0	0.7

Casselton, ND (C13)

Coop-erator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Require-ment	Dough Charact-eristics	Quality Score Compared to Check (Glenn) Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	60.0	3100	108.8	5	5	3	3	2	2	4	3	3
B	60.5	3000	98.4	4	3	3	3	3	1	5	3	3
C	62.0	945	96.1	5	5	4	3	3	2	2	3	3
D	60.0	3104	98.2	5	5	3	3	3	2	3	3	2
E	60.5	2700	102.9	5	4	3	1	3	-	-	2	2
F	60.5	2275	108.3	3	3	3	3	3	2	4	4	4
G	59.0	2750	94.8	4	4	3	4	4	3	3	4	4
H	65.2	925	93.0	4	5	4	3	4	1	4	3	2
I	63.1	1220	106.6	4	4	3	3	3	1	5	3	3
J	61.1	885	101.7	2	3	5	3	2.5	2	3	3	2.7
K	64.4	950	102.2	4	4	4	2	4	2	4	4	3
L	69.0	995	94.8	4	4	4	3	3	4	4	3	4
M	65.2	808	102.5	3	3	3.5	3	3.5	2	1	2.5	1.8
Mean	62.6	-	101.3	4.2	4.1	3.5	3.0	3.3	2.1	3.7	3.2	3.0
Std Dev	2.9	-	5.3	0.9	0.8	0.6	0.7	0.6	0.9	1.2	0.6	0.8

(03S0257-3 continued)

Crookston, MN (K13)												
		Loaf Volume				Quality Score Compared to Check (Glenn)						
Coop-erator	Bake Absorption (%, 14% mb)	(cc)	(% of Check)	Mixing Require-ment	Dough Charact-eristics	Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	60.0	3100	110.7	5	4	3	2	3	3	3	3	3
B	60.5	2950	93.7	4	3	3	2	3	3	2	3	3
C	63.0	945	100.5	5	5	4	3	4	3	2	4	4
D	60.0	3104	101.9	5	5	3	3	2	3	2	2	2
E	60.0	2725	100.9	5	5	3	1	3	-	-	3	3
F	60.4	2150	97.7	3	3	3	3	4	4	5	3	3
G	59.0	2800	103.7	5	5	4	4	4	3	3	4	4
H	64.7	955	99.0	5	5	5	2	3	2	4	2	2
I	62.9	1235	102.1	5	5	4	2	3	3	4	3	3
J	62.0	860	93.5	4	5	6	2	2	3	4	2	3
K	65.5	930	97.9	5	4	3	2	3	3	2	3	3
L	70.5	945	97.1	4	4.5	4	3	3	3	3	3	3
M	65.7	836	100.7	5	4	3	3	3	3	2	4	3
Mean	62.9	-	100.5	4.8	4.5	3.8	2.6	3.2	3.1	3.1	3.1	3.1
Std Dev	3.3	-	4.5	0.7	0.8	0.9	0.8	0.6	0.4	1.0	0.7	0.6

ND 816

Casselton, ND (C14)

Coop-erator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Require-ment	Dough Charact-eristics	Quality Score Compared to Check (Glenn): Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	60.0	2800	98.2	5	4	3	3	2	3	4	3	3
B	65.0	3000	98.4	4	3	3	3	3	2	5	3	3
C	64.0	928	94.4	2	3	3	3	3	3	3	3	3
D	65.0	2986	94.4	5	5	3	3	4	2	3	4	3
E	63.0	2650	101.0	4	3	2	3	3	-	-	4	4
F	65.2	2200	104.8	2	3	3	3	2	2	3	4	4
G	63.0	2600	89.7	2	2	2	3	3	4	3	3	2
H	69.3	980	98.5	2	3	2	4	4	2	4	4	3
I	63.9	1095	95.6	3	4	2	3	3	2	5	3	3
J	65.2	865	99.4	1	3	3	3	3	3	4	3	3.3
K	65.2	890	95.7	3	4	3	2	2	2	4	2	2
L	69.2	1042	99.2	3	4	4	4	4	3	4	4	4
M	65.8	692	87.8	2	4	3.5	3	3	3	3	1	2.3
Mean	65.3	-	97.4	3.1	3.6	2.9	3.2	3.1	2.6	3.8	3.3	3.1
Std Dev	2.4	-	4.5	1.3	0.8	0.6	0.5	0.7	0.7	0.8	0.9	0.7

Minot, ND (M14)

Coop-erator	Bake Absorption (%, 14% mb)	Loaf Volume (cc)	Loaf Volume (% of Check)	Mixing Require-ment	Dough Charact-eristics	Quality Score Compared to Check (Glenn): Mixing Tolerance	Internal Crumb Color	Internal Grain and Texture	Protein	Milling	Baking	Overall
A	62.0	2750	98.2	5	5	3	3	3	3	3	3	3
B	68.0	3150	110.5	2	4	4	2	2	3	2	3	3
C	64.0	883	96.0	4	5	2	2	4	3	3	3	3
D	66.0	3104	101.0	5	5	3	1	2	3	3	2	3
E	66.0	2550	98.1	5	4	3	5	2	-	-	3	3
F	68.2	2125	97.7	2	2	2	2	2	3	2	1	2
G	66.0	2700	98.2	2	3	3	3	3	4	2	4	3
H	72.7	1040	95.4	3	3	2	1	2	3	2	1	1
I	68.2	1205	89.6	4	5	4	1	4	3	2	3	3
J	69.2	1000	101.5	2	3	2	2	2	3	1	3	2.3
K	70.5	905	88.3	3	4	2	2	2	3	3	3	3
L	72.6	980	92.5	3	4	3	3	3	3	1	2	3
M	68.2	694	87.8	2.5	5	4	3.5	3.5	3	2.5	3	2.8
Mean	68.3	-	97.2	3.4	4.2	2.9	2.5	2.7	3.1	2.3	2.8	2.8
Std Dev	3.1	-	6.2	1.2	1.0	0.8	1.1	0.8	0.3	0.7	0.9	0.6

Appendix

Source of Wheat

Source – Breeding Program	Code #	Identification
World Wide Wheat (W3)	1	Line A (AUBR30023W)
University of Minnesota (UMN)	2	MN07098-6
North Dakota State University (NDSU)	4	ND818 (Elgin)
Montana State University (MTSU)	5	MT0832 (Duclair)
World Wide Wheat (W3)	6	Line B (AUBR31117W)
South Dakota State University (SDSU)	7	SD4178
World Wide Wheat (W3)	8	Line C (BR2306)
North Dakota State University (NDSU)	9	ND819
Limagrain Cereal Seeds	10	11 Fx Mn (LCS Breakaway)
North Dakota State University (NDSU)	11	ND812
University of Minnesota (UMN)	12	MN06028
Syngenta Seeds Inc.	13	03S0257-3 (SY Rowyn)
North Dakota State University (NDSU)	14	ND816
North Dakota State University (NDSU)	3	Glenn (Check)

Field Plot Locations and Procedures

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

Dale Williams (NDSU Foundation seed), Coordinator

- Northeast Research Farm (Watertown), South Shore, SD 57263
  South Dakota State Univ., Brookings, 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 & Chad Anderson
- Williston Agricultural Experiment Station, Williston, ND- Sanford Qvale

Wheat was seeded in large-scale plots of 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

			Production Sites				
Entry #	Entry	Source	Watertown (B)	Casselton (C)	Crookston (K)	Minot (M)	Williston (W)
1	Line A (AUBR30023W)	W3				X	X
2	MN07098-6	UMN		X	X		
4	ND 818 (Elgin)	NDSU	X	X	X	X	X
5	MT0832 (Duclair)	MTSU				X	X
6	Line B (AUBR31117W)	W3				X	X
7	SD4178	SDSU	X	X			
8	Line C (BR2306)	W3				X	X
9	ND 819	NDSU		X		X	
10	11 Fx Mn (LCS Breakaway)	Limagrain	X	X	X	X	X
11	ND 812	NDSU		X		X	
12	MN06028	UMN		X	X		
13	03S0257-3 (SY Rowyn)	Syngenta	X	X	X		
14	ND 816	NDSU		X		X	
3	Glenn (Check)	NDSU	X	X	X	X	X

Field Production Data

Variable	Location				
	Watertown	Casselton	Crookston	Minot	Williston
Planting Date	4/30/2012	4/25/2012	4/26/2012	5/17/2012	5/15/2012
Harvest Date	8/9/2012	8/1/2012	8/1/2012	9/3/2012	8/27/2012
Fertilizer (lb/A)					
N	150	200	275	150	140
P	100	50	0	50	0
K	100	0	0	0	0
Herbicide/rate/ac					
Broadleaf	MCPA Amine 1 pt.	Bronate 1 pt	Bronate 1 pt	1pt/ac GoldSky+	Wolverine 1.75pt
Grass	*	Axial XL 16 oz	Axial XL 16 oz	.3oz Harmony SG	*
Fungicide	*	None	None	Tilt 4oz at 4 leaf and 6 oz Headline at flower	Tilt 3 oz

* = No Application .

Climatologic Data

Month	Average Temperature (^{0}F)/Precipitation (in)				
	Watertown	Casselton	Crookston	Minot	Williston
April	48/2.53	50 / 1.78	46.3/1.31	44.4/2.8	49.5/1.65
May	58.2/1.90	59.8 / 1.58	58.0/1.03	54.0/1.90	56.7/2.12
June	68/2.74	68.7 / 2.11	67.4/2.56	64.1/2.98	65.8/2.39
July	75.2/0.44	76.2 / 0.86	75.0/2.29	72.9/.88	76.5/2.42
August	67.7/0.49	na	*	68.0/1.06	71.4/0.77

* = Not Applicable

Yield Data

Entry #	Yield (bu/acre) / Test Wt / % Moisture				
	Watertown	Casselton	Crookston	Minot	Williston (yield only)
SWQAC 1	*	*	*	**	less than 10
SWQAC 2	*	64.6 / 61 / 11.3	47/57/12.67	*	*
SWQAC 3	41.9/ 58.3 /13.0	68.1 / 62 / 12.0	46/61/12.88	**	less than 10
SWQAC 4	45.9/54.8 /13.7	73.3 / 59 / 11.5	40/57/12.88	**	about 20+
SWQAC 5	*	*	*	**	less than 15
SWQAC 6	*	*	*	**	about 20+
SWQAC 7	54.6/56.9 /13.1	77.8 / 60 / 11.6	*	*	*
SWQAC 8	*	*	*	**	20
SWQAC 9	*	69.5 / 59.5 / 11.4	*	**	*
SWQAC 10	42.1/ 56.5/12.7	74.2 / 60.5 / 11.8	44/60/12.47	**	17
SWQAC 11	*	74.2 / 62 / 12.1	*	**	*
SWQAC 12	*	79.9 / 61 / 11.8	47/59/12.26	*	*
SWQAC 13	46.2/55.3/12.1	80.6 / 58 / 11.2	48/59/12.67	*	*
SWQAC 14	*	78.5 / 61 / 12.3	*	**	*
Site Totals	5	10	6	10	7

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

Climate, Disease, Field Conditions

Notes on Production Related to Climatic Conditions, Disease (Scab, etc.), and Field Conditions That Could Affect Grain Quality

Watertown, SD

At Planting	Good Seedbed, Normal Conditions
During Growth	Good early growth, moderate tillering with the later planting
At Flowering	Very dry conditions, no measurable disease pressure
During Maturation	Last measurable rain was June 20th. Dry conditions hampered seed fill.
At Harvest	Extremely dry conditions. No problems with sprouting, but many shriveled kernels because of the drought.

Casselton, ND

At Planting	Moist seed bed with slight dry surface. Gentle 0.4" rain came 2-3 days after planting.
During Growth	Borderline dry all season
At Flowering	Very light dews / no heavy rains
During Maturation	Dry
At Harvest	Dry. Season: 3.88" below normal for rain during May thru July. 4.5 degrees F above average temperature for April thru July.

Crookston, MN

At Planting	Below normal moisture at planting
During Growth	Drought conditions continue, although crop looks good.
At Flowering	Dry and hot.
During Maturation	Temperatures continue to be in the upper 80's and dry conditions. Crop looks clean of any disease, we may have normal yields even though rain has been below normal.
At Harvest	No weather or other problems at harvest.

Williston, ND

At Planting	Conditions good. Adequate moisture with good planting conditions.
During Growth	Timely rains. Crop progressing nicely.
At Flowering	One week of extreme heat and no moisture. Moisture stress starting.
During Maturation	Dry. Stools burned off and did not mature. Crop extremely stressed.
At Harvest	Hot and dry. Good harvest conditions.

Description of 2012 Hard Spring Wheat Lines

SWQAC #1- Line A (AUBR30023W)

AUBR30023W is a hard white spring bread wheat, developed by World Wide Wheat L.L.C. (W3), using the male sterile facilitated recurrent selection (MSFRS) population breeding methodology. It originated as a single F2 head selection out of a quality hard white W3 population group in 2001 in W3's Australia nursery. Generation advancement continued as single head selection through the F5 generation.

AUBR30023W has been tested in replicated yield trials since 2003 at several W3 global locations with much success. The line possesses: 1) a high yielding potential under adequate and/or moderate moisture conditions, and 2) it is resistant to stripe rust.

AUBR30023W demonstrates erect growth at the juvenile stage with green color at the boot stage. At maturity, the head is dense, tapering in shape, curved, and awned. The glumes are white in color, with wanting shoulders and acuminate beak. The seed of AUBR30023W is elliptical in shape with rounded cheek, small brush size and short in length. Seed crease is narrow and shallow.

AUBR30023W has been identified as a 'superwhite variety' and may be found suitable for whole wheat products.

SWQAC #2- MN7098-6

MN07098-6 (SD3696/Ulen sel) has been a consistent top yielder with good adaptation across the entire state. MN07098-6 has higher grain protein than the varieties that have higher yield. MN07098-6 is moderately resistant to important diseases including Fusarium head blight, bacterial leaf streak, and leaf rust.

SWQAC #4- ND818 (Elgin)

ND 818 is a hard red spring wheat (HRSW) line that is released in 2013 by the NSDSU-AES under the name of **'Elgin'**. Elgin was selected from a 3-way cross involving an NDSU cultivar release (1999) 'Reeder', NDSU experimental line ND721, and SDSU released cultivar 'Walworth'. Reeder has been a major cultivar grown in Western ND and MT. It is a cultivar well adapted to stressed environments. ND721 trace its parents to 'Glupro' a high protein cultivar derived from T. dicoccoides, a source of resistance to Fusarium head blight (FHB) or scab. Therefore, Elgin has a medium resistance to FHB. Walworth is a SDSU cultivar released in 2001 for its high yield. Elgin has very good resistance to other foliar diseases including stem and leaf rusts. Particularly, its reaction to the new emerging leaf rust race (Lr21) is medium. Compared to Glenn and Barlow, Elgin is a very high yielding cultivar with relatively high protein (close to Glenn). It is a medium early cultivar with medium straw strength conventional height. Elgin has average test weigh and overall very good milling and baking properties.

SWQAC #5- MT0832 (Duclair)

'Duclair' hard red spring wheat (*Triticum aestivum* L.) (Reg. No. CV-1060, PI 660981) was developed by the Montana Agricultural Experiment Station and released in 2011. The objective for the development of Duclair was to provide a solid-stemmed, semidwarf cultivar for areas infested by the wheat stem sawfl y (*Cephus cinctus* Nort.). Duclair was developed through initial generations of single seed descent of F2 seed from a 'Choteau'/MT0249 cross. Progeny lines

were selected to have solid stems from Choteau, and extended green leaf duration from MT0249. Duclair was tested as MT0832 at sites across Montana in 2008, 2009, and 2010. Stem solidity of Duclair is similar to the solid-stemmed cultivar 'Fortuna' and slightly less than 'Choteau'. Duclair has shown good yield potential throughout Montana and its height is more desirable for dry conditions than Choteau. Duclair has grain protein levels similar to other hard red spring wheat cultivars and acceptable milling and baking characteristics. Duclair will be of interest to wheat growers in sawfly-infested areas of Montana and adjoining regions.

SWQAC #6- Line B (AUBR31117W)

AUBR31117W is a hard white spring bread wheat, developed by World Wide Wheat L.L.C. (W3), using the male sterile facilitated recurrent selection (MSFRS) population breeding methodology. It originated as a single F2 head selection out of a quality hard white W3 population group in 2001 in W3's Australian nursery. Single head selection continued through the F5 generation.

AUBR31117W has been tested in replicated yield trials since 2003 at several W3 global locations with much success. The line possesses 1) a high yielding potential under adequate and/or moderate moisture conditions and, 2) it is moderately resistance to stripe rust.

AUBR31117W demonstrates erect growth at the juvenile stage with green color at the boot stage. At maturity, the head is dense, tapering in shape, slightly curved, and awned. The glumes are white in color, with wanting shoulders and acuminate beak. The seed of AUBR31117W is elliptical in shape with rounded cheek, small brush size and short in length. Seed crease is narrow and mid-deep.

AUBR31117W possesses high gluten strength characteristics which makes it an excellent choice for millers looking to reduce costs in the bread making process. The reduced use of added gluten represents a significant benefit for the baked products industry. Additionally, AUBR31117W has been identified as a 'superwhite variety' and may be found suitable for whole wheat products.

SWQAC #7- SD4178

SD4178 is an experimental hard red spring wheat breeding line presently being considered for release. If released, it should be available to Registered seed producers in spring 2014. It is an F_4 line derivation from wi

thin the cross SD3720/MN98389-A. Its first year of testing in the Advanced Yield Trial was 2009. Over years 2010-2011, grain production of SD4178 (43.8 bu/ac) was statistically similar to Traverse (42.2) and Faller (45.1). Test weight (56.3 lb/bu) was significantly less than Brick and Select, but significantly greater than Faller and Traverse. Protein concentration (15.3%) was similar to Brick and Traverse, but significantly less than Select. Loaf volume in 2010 (197.6 ml) was, however, significantly greater than Traverse and similar to both Brick and Select. Similar to Advance, SD4178 is relatively short in stature (~32 inches). Other characteristics associated with SD4178 seem within the range of acceptability.

SWQAC #8- Line C (BR2306)

BR2306 is a hard red spring bread wheat, developed by World Wide Wheat L.L.C. (W3), using the male sterile facilitated recurrent selection (MSFRS) population breeding methodology. It originated as a single F2 head selection out of a hard red W3 population group in 2003 at W3's Arizona nursery. Generation advancement continued as single head selection through the F5 generation.

BR2306 has been tested in replicated yield trials at several W3 global locations with much success. The line possesses: 1) a good yielding potential under adequate and/or moderate moisture conditions, and 2) is moderately susceptible to stripe rust.
BR2306 demonstrates erect growth at the juvenile stage and green color at the boot stage. At maturity, the head is dense, tapering in shape, slightly curved, and awned. The glumes are white in color, with wanting shoulders and acuminate beak. The seed of BR2306 is elliptical in shape with rounded cheek, medium brush size and medium in length. Seed crease is narrow and mid-deep.

SWQAC #9- ND819

ND819 is a HRSW line that developed by the NDSU spring wheat breeding program. ND819 was selected from a cross involving two NDSU experimental lines (ND744 and ND72). ND744 is sister line of Glenn, released in 2005 and has been the leading cultivar in ND from 2007 to 2011. NDSU experimental line ND721 is a widely adapted line. ND721 trace its parents to 'Glupro' a high protein cultivar derived from T. dicoccoides, a source of resistance to Fusarium head blight (FHB) or scab. ND819 has excellent disease resistance package including foliar diseases such as stem and leaf rusts. Its reaction to the new emerging leaf rust race (Lr21) is medium. Compared to Glenn and Barlow, ND819 has high yield, similar to Barlow and Faller but superior to Glenn. Protein of ND819 is similar to Glenn and Barlow but higher than Faller. Its test weight is average, similar to Barlow, higher than Faller but lower than Glenn. In general, milling and baking properties of ND819 are good. ND819 is short (semi-dwarf to conventional) and medium early.

SWQAC #10- 11 Fx Mn (LCS Breakaway)

11FXMn (LCS Breakaway), the most recent HRSW release from Limagrain Cereal Seeds, is entering into its second year of wide spread availability across the Northern Plains. LCS Breakaway has a shorter height (4" shorter than Glenn), excellent straw strength and an earlier maturity. Test weight averages for the last two seasons have been right at 60 lbs/bu. LCS Breakaway is a higher protein variety with good potential for yield. 2012 testing showed resistance to the current strains of Leaf Rust, and moderate resistance to Fusarium. Resistance to other foliar diseases is intermediate to moderate.

SWQAC #11- ND812

ND812 is a hard red spring wheat (HRSW) developed by the NDSU HRSW breeding program. It was selected from a cross involving two NDSU experimental lines (ND721 and ND 2849). NDSU experimental line ND721 is a widely adapted line. ND721 trace its parents to 'Glupro' a high protein cultivar derived from T. dicoccoides, a source of resistance to Fusarium head blight (FHB) or scab whereas ND2849 is a line selected from a cross deigned to introgress scab (FHB) resistance from Chinese source Sumai3. Therefore, ND812 has a medium resistance to FHB. ND812 is also very resistant to major races of foliar diseases including stem and leaf rusts. However, its reaction to the new emerging leaf rust race (Lr21) is medium susceptible to medium resistant. Compared to Barlow, Glenn and Faller, the top leading cultivars in ND in 2012, ND812 has good yield level higher than Glenn but slightly lower than Barlow and Faller with overall, above average milling and baking properties. Test weight is good higher than both

Barlow and Faller but lower than Glenn. Protein of ND812 is close to that of Glenn and Barlow but higher than Faller. It is a medium early line with medium straw strength and conventional height.

SWQAC #12- MN06028

MN06028 is a mid maturity hard red spring wheat with excellent straw strength, high grain protein content, and competitive grain yields. The pedigree of MN06028 isMN97695-4/Ada sel. MN06028 has moderate resistance to Fusarium head blight and prevalent races of leaf rust. MN06028 is resistant to preharvest sprouting and has exhibited good end-use quality characteristics.

SWQAC #13- 03S0257-3 (SY Rowyn)

SY Rowyn is a hard red spring wheat variety developed by Syngenta Seeds, Inc. It has medium-early maturity and very good test weight. It is a standard semidwarf, slightly taller than Kelby. Straw strength is very good, between Kelby and SY Soren. It is resistant to stem rust and moderately resistant to leaf rust. Protection to leaf spotting diseases has been good. Tolerance to FHB has been intermediate. Protein levels have been medium-low, slightly higher than Faller. Overall breadmaking characteristics are very good. SY Rowyn is broadly adapted to the spring wheat growing areas of the Northern Plains. Certified seed will be available for the 2014 season.

SWQAC #14- ND816

ND816 is a HRSW line that developed by the NDSU spring wheat breeding program. ND816 was selected from a cross involving an NDSU cultivar release (2005) 'Glenn' and NDSU experimental line ND2831. Glenn has been the leading cultivar in ND from 2007 to 2011. It is a cultivar well adapted to the US spring wheat region with very high quality attributes. ND2831 trace its parent toND2709, another NDSU experimental line with resistance to Fusarium head blight (FHB) or scab from Chinese cultivar 'Sumai3'. ND816 has therefore, a medium resistance to FHB. ND816 has very good resistance to other foliar diseases including stem and leaf rusts. Particularly, its reaction to the new emerging leaf rust race (Lr21) is medium. Overall, Compared to Barlow, Glenn and Faller, the top leading cultivars in ND in 2012, ND816 yield performance is similar to Barlow and Faller but superior to Glenn. Protein of ND816 is similar to Glenn and Barlow but higher than Faller. Test weight similar to Barlow, higher than Faller and lower than Glenn. Milling and baking properties are in general good. It is a medium early line with medium straw strength and conventional height.

Cleaning and Milling Procedure

Wheat (approximately 2 bu/line) 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. Majority of samples (group B, C, K, and M) were milled on Miag mill and other samples (group W) were milled on a Buhler Experimental Mill.

Buhler mill: Cleaned wheat was tempered to 16.5 % moisture content and conditioned ~20 hours. The tempered wheat was milled in Buhler Experimental MLU 202 Mill, at an average feed rate of 100 g/min. Flour from three break (B1, B2, B3) and three reduction (R1, R2, and R3) sections of the mill were combined to patent flour.

Miag Multomat (Small Scale) Milling - Cleaned wheat was tempered to 16.0-16.5 % moisture content and conditioned approximately 20 hours before milling. Milling was performed on the Miag Multomat, which consists of 3 breaks, 5 reductions, and a bran duster. Feed rate was set at 850 to 900 grams per minute. The mill was warmed up and adjusted using KSU mill mix, after which approximately 90 lbs of individual sample were milled. Break rollers were adjusted to the following releases through a U.S. 20 S.S. sieve: first break- 42%; second break -52%; and third break- clean-up (50-55 %).

Miag Mill Streams

#	Stream	Product
1	1 BK	Straight grade flour (Patent)
2	2 BK	
3	GRADER	
4	3 BK	
5	1 M	
6	2 M	
7	3 M	
8	1 M Red	
9	4 M	
10	5 M	
11	Bran Flour	
12	Filter Flour	
13	BK Short	Feed
14	Red Dog	
15	Red Short	
16	Filter bran	
17	Bran	

Calculation of flour extraction

- Total Product Basis (TPB, %): patent flour percentage of the total mill product on a 14 % moisture basis (mb)
- Tempered Wheat Basis (TWB, %): patent flour extraction percentage of tempered wheat (14 % mb)
- Pounds of Straight Grade Flour/Bushel Wheat (FBW): estimated pounds of patent flour (14 % mb) produced from a standard bushel of wheat (60 pound on 13.5 % mb)

Methods of Analyses

Test Weight (AACCI Method 55-10)

Wheat and Flour Protein (AACCI Method 46-30 – Nitrogen combustion method)

Protein molecular weight distribution – a size exclusion high performance liquid chromatography was performed to evaluate protein composition (Ohm, J. B. et al, 2009. Size-Exclusion HPLC of Protein Using a Narrow-Bore Column for Evaluation of Breadmaking Quality of Hard Spring Wheat Flours. Cereal Chem. 86:463–469).

Wheat and Flour Ash (AACCI Method 08-01- Oven method)

Single Kernel Characteristics: kernel hardness index, weight, and diameter values were measured by Single Kernel Characterization System (Perten). Mean and standard deviation values were calculated from data of 300 kernels.

Kernel Size: sieving according to USDA/ARS WQL (Shuey W. C. 1960. A wheat sizing technique for predicting flour milling yield. *Cereal Sci Today* 5:71–72, 75.)

Wheat Falling Number (Perten Falling Number Instrument)

Vitreous Kernel Content : DHV analyses by FGIS grain testing service (Grain Inspection Handbook—Book II. Grain Grading Procedures. Grain Inspection, Packers and Stockyards Administration: Washington, DC. USDA. 1997.)

Mycotoxin (Deoxynivalenol, DON): analysis was done on ground wheat using a gas chromatograph with an electron capture detector as described in J. Assoc. Official Anal.Chem 79,472 (1996). (Analytical work was done at NDSU Hard Spring Wheat Quality Lab.)

Flour Color (Minolta Colorimeter L* and b* values)

Flour starch damage: Megazyme Int. Inc. assay kit (Megazyme International Inc., Wicklow, Ireland) was used to measure the level of starch damage according to AACCI approved method 76-31.01. Samples of wheat flour (0.1g) were weighed into reaction tubes and incubated with α-amylase at 40°C for exactly ten minutes. The reaction was stopped using 0.2% sulfuric acid and the samples were filtered. Amyloglucosidase was added to an aliquot (0.1ml) of each sample and the samples were incubated at 40°C for ten minutes. GOPOD was added to each sample and allowed to incubate at 40°C for an additional 20 minutes. The absorbance was read at 492nm and the percent starch damage was calculated on an “as is” basis. (Analytical work was done at NDSU Hard Spring Wheat Quality Lab.).

Farinograph: Farinograph was performed by AACCI Method 54-21 using a Brabender Computerized Farinograph system with a 50 g mixing bowl on constant flour weight (50 g, 14 % mb).

- Water Absorption: amount of water required to center curve peak on the 500 BU line, expressed on 14 percent moisture basis.
- 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: AACCI standard mixograph procedure (Method 54-40A) was performed using a 35 g mixograph. Water absorption was calculated by following equation: Water absorption (%, 14% flour mb) = Protein (14% mb) x 1.5 + 43.6 (The Mixograph Handbook, 1997)

Extensograph: AACCI Method 54-10 was modified as follows: (a) 100 gram of flour (14 % mb), 2.0 percent sodium chloride (U.S.P.) and water (equal to farinograph absorption minus 2 %) was mixed to optimum development in a National pin dough mixer; (b) dough was scaled to 150 g, rounded, moulded, placed in extensigraph holders, and rested for 45, 90, and 135 minutes at 30°C and 78 % relative humidity. The dough was then stretched as described in the procedure referenced above. For conversion purposes, 500 g equals 400 B.U.

- Extensibility: total length of the curve at the base line in centimeters.
- Maximum resistance: maximum curve height, reported in Brabender units (BU).
- Area: the area under the curve is measured and reported in square centimeters.
- Resistance to extension at 50 mm: height of the curve 50 mm after beginning of torque increase in BU.
- Ratio number: quotient of resistance to extension (50 mm) and extensibility
- Ratio number (max.): Quotient of maximum resistance and extensibility

Test Bake Procedures

Samples of flour were shipped to 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 methods. Cooperator data were returned to the WQL for compilation of results. One minimum value was excluded when calculating mean evaluation values to decrease bias in scoring.

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 test weight, 1000 kernel weight, falling number, 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.

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, Nebraska
General Mills, Inc., Minneapolis, Minnesota
North Dakota State Mill, Grand Forks, North Dakota
North Dakota State University, Department of Cereal Science, Fargo, North Dakota
Syngenta, Berthoud CO
USDA/ARS Hard Red Spring & Durum Wheat Quality Laboratory, Fargo, North Dakota
USDA/ARS Hard Winter Wheat Quality Laboratory, Manhattan, Kansas
USDA/ARS Western Wheat Quality Laboratory, Pullman, Washington
Wheat Marketing Center, Portland, Oregon

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 Test Weight (TW), 1000 Kernel Weight (KWT), Falling Number (FN), Wheat Protein (WP), and Wheat Ash (WA) 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

	Score	Test Weight (TW) (Lb/Bu)	1000 Kernel Weight (KWT) (g)	Falling Number (FN) (Sec)	Wheat Protein (WP) (%, 12% mb)	Wheat Ash (WA) (%, 14% mb)
	6	63	39	425	16.5	1.35
	5	62	36	400	15.5	1.45
	4	61	33	375	14.5	1.55
Target Value	3	60	30	350	13.5	1.65
	2	59	26	325	12.5	1.75
	1	58	22	300	11.5	1.85
	0	57	18	275	10.5	1.95
Variation(+/-) from Target Value:		1	3g up, 4g down	25	1.0	0.10

Wheat Marketing Score =[(TW*2) + (1000 KWT*2) + (FN*2) + (WP*3) + WA)]/10

Wheat Marketing Score – Method #2

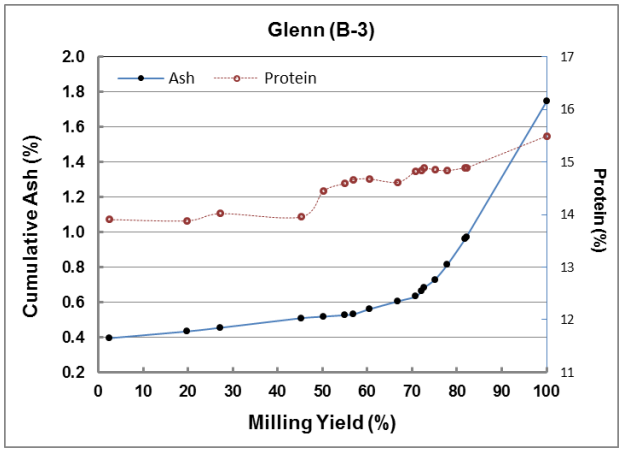
Rules for score calculation -Difference (Diff)= Entered line value - Check value

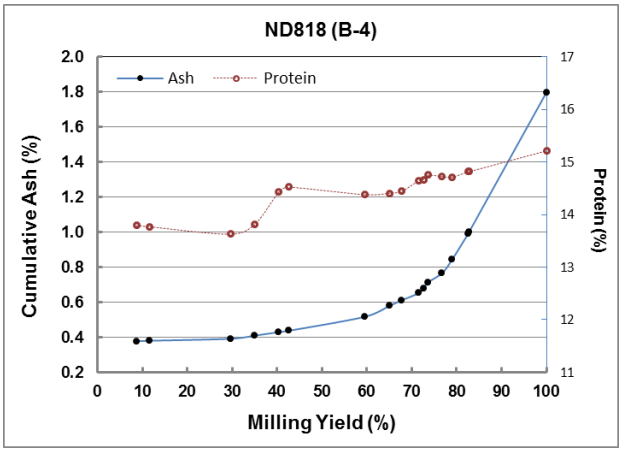
Component Score	Wheat Protein (WP) (%, 12% mb)	Test Weight (TW) (Lb/Bu)	Falling Number (FN) (Sec)	1000 Kernel Weight (KWT) (g)	Wheat Ash (WA) (%, 14% mb)
0	Diff > 6.0	Diff > 10	Diff < -125	Diff > 20	Diff > 0.5
2	5.0 < Diff ≤ 6.0	8 < Diff ≤ 10	-125 ≤ Diff < -100	16 < Diff ≤ 20	0.4 < Diff ≤ 0.5
4	4.0 < Diff ≤ 5.0	6 < Diff ≤ 8	-100 ≤ Diff < -75	12 < Diff ≤ 16	0.3 < Diff ≤ 0.4
6	3.0 < Diff ≤ 4.0	4 < Diff ≤ 6	-75 ≤ Diff < -50	8 < Diff ≤ 12	0.2 < Diff ≤ 0.3
8	2.0 < Diff ≤ 3.0	2 < Diff ≤ 4	-50 ≤ Diff < -25	4 < Diff ≤ 8	0.1 < Diff ≤ 0.2
10	-0.5 ≤ Diff ≤ 2.0	-1 ≤ Diff ≤ 2	Diff ≥ -25	-2 ≤ Diff ≤ 4	Diff ≤ 0.1
8	-1.0 ≤ Diff < -0.5	-2 ≤ Diff < -1	-	-4 ≤ Diff < -2	-
6	-1.5 ≤ Diff < -1.0	-3 ≤ Diff < -2	-	-6 ≤ Diff < -4	-
4	-2.0 ≤ Diff < -1.5	-4 ≤ Diff < -3	-	-8 ≤ Diff < -6	-
2	-2.5 ≤ Diff < -2.0	-5 ≤ Diff < -4	-	-10 ≤ Diff < -8	-
0	Diff < -2.5	Diff < -5	-	Diff < -10	-
Weighting	0.3	0.2	0.2	0.2	0.1

Wheat Marketing Score = (WP*0.3) + (TW*0.2) + (FN*0.2) + (1000 KWT*0.2) + (WA*0.1)

Cumulative Ash Curves

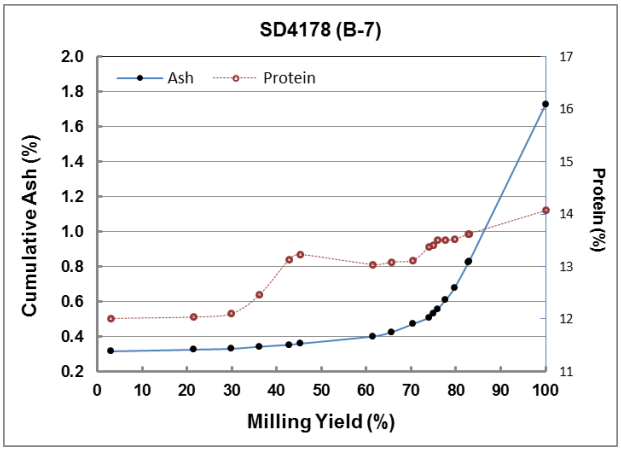
Watertown Cumulative Ash Curves (Group B)

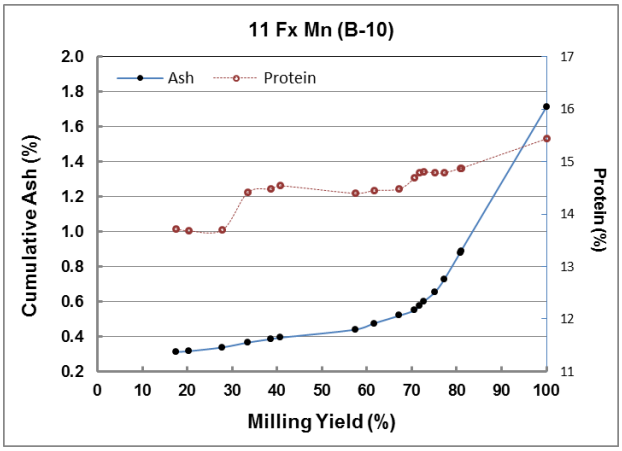




Cumulative Ash:	Glenn (B-3)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
1 M Red	2.5	0.40	13.9	2.5	0.40	13.9
2 M	17.3	0.44	13.9	19.8	0.43	13.9
1 M	7.5	0.51	14.4	27.3	0.45	14.0
3 M	18.0	0.59	13.9	45.2	0.51	14.0
2 BK	5.0	0.60	18.9	50.2	0.52	14.4
1 BK	4.7	0.62	16.1	54.9	0.53	14.6
GRADER	1.9	0.63	16.8	56.8	0.53	14.7
Filter FLR	3.6	1.03	14.9	60.4	0.56	14.7
4 M	6.4	1.03	14.0	66.8	0.60	14.6
3 BK	3.9	1.08	18.4	70.8	0.63	14.8
5 M	1.3	2.38	15.4	72.1	0.66	14.8
Bran FLR	0.6	2.95	21.2	72.7	0.68	14.9
Filter Bran	2.4	2.16	13.8	75.1	0.73	14.9
Red Dog	2.7	3.10	14.4	77.8	0.81	14.8
Bk SHT	4.0	3.82	15.9	81.8	0.96	14.9
Red SHT	0.3	4.71	14.3	82.1	0.97	14.9
Bran	17.9	5.29	18.3	100.0	1.75	15.5
Wheat		1.71	16.1			
Patent Flour		0.69	15.1			

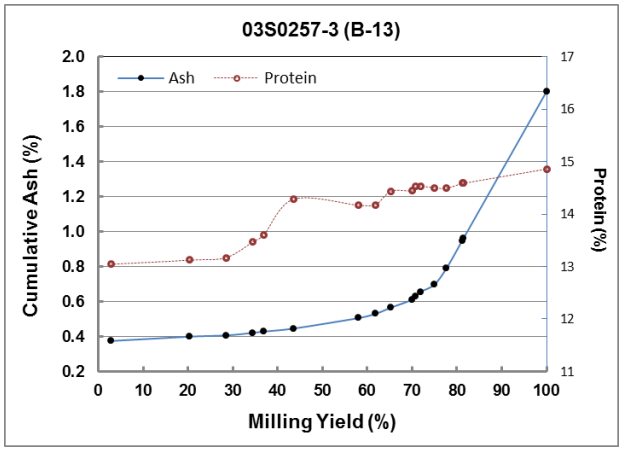
Cumulative Ash:	ND818 (B-4)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
1 M	8.6	0.38	13.8	8.6	0.38	13.8
1 M Red	2.9	0.39	13.7	11.6	0.38	13.8
2 M	18.1	0.40	13.5	29.7	0.39	13.6
1 BK	5.3	0.51	14.9	35.0	0.41	13.8
2 BK	5.4	0.56	18.4	40.4	0.43	14.4
GRADER	2.1	0.58	16.2	42.6	0.44	14.5
3 M	17.0	0.72	14.0	59.6	0.52	14.4
4 M	5.5	1.25	14.7	65.0	0.58	14.4
Filter FLR	2.7	1.38	15.3	67.7	0.61	14.4
3 BK	3.9	1.38	18.2	71.6	0.65	14.6
5 M	1.0	2.57	16.0	72.6	0.68	14.7
Bran FLR	1.0	3.20	20.8	73.6	0.71	14.8
Filter Bran	3.1	2.01	14.1	76.7	0.77	14.7
Red Dog	2.2	3.49	14.3	79.0	0.84	14.7
Bk SHT	3.6	4.24	17.1	82.6	0.99	14.8
Red SHT	0.2	5.04	14.9	82.8	1.00	14.8
Bran	17.2	5.62	17.1	100.0	1.80	15.2
Wheat		1.70	15.8			
Patent Flour		0.55	14.9			





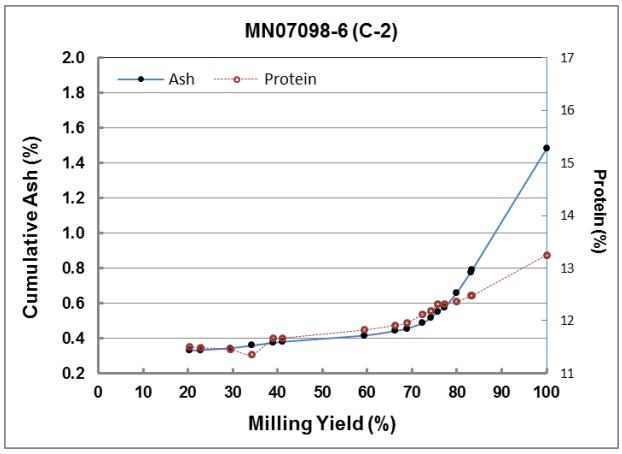
Cumulative Ash:	SD4178 (B-7)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
1 M Red	3.0	0.32	12.0	3.0	0.32	12.0
2 M	18.4	0.33	12.0	21.5	0.32	12.0
1 M	8.4	0.34	12.3	29.9	0.33	12.1
1 BK	6.2	0.40	14.2	36.1	0.34	12.5
2 BK	6.6	0.41	16.8	42.8	0.35	13.1
GRADER	2.4	0.47	14.9	45.2	0.36	13.2
3 M	16.3	0.52	12.5	61.5	0.40	13.0
Filter FLR	4.1	0.78	13.8	65.6	0.42	13.1
4 M	4.9	1.12	13.6	70.5	0.47	13.1
3 BK	3.5	1.21	18.5	74.0	0.51	13.4
5 M	0.9	2.47	16.1	74.9	0.53	13.4
Bran FLR	1.0	2.49	21.0	75.9	0.56	13.5
Filter Bran	1.8	2.81	13.2	77.7	0.61	13.5
Red Dog	2.0	3.41	14.2	79.7	0.68	13.5
Bk SHT	3.1	4.53	16.2	82.8	0.82	13.6
Red SHT	0.1	4.67	14.4	83.0	0.83	13.6
Bran	17.0	6.09	16.2	100.0	1.73	14.1
Wheat		1.69	14.8			
Patent Flour		0.60	13.8			

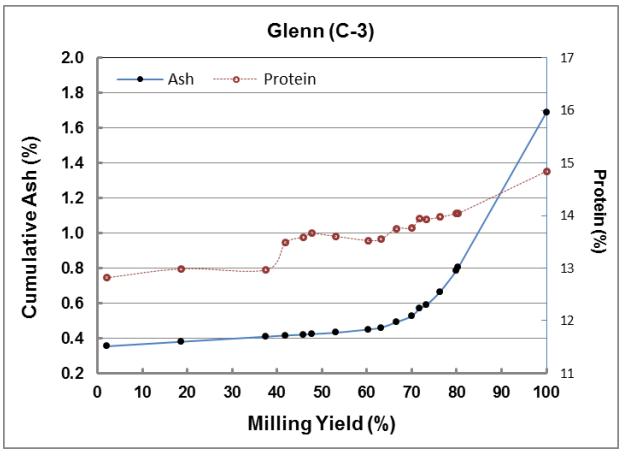
Cumulative Ash:	11 Fx Mn (B-10)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
2 M	17.5	0.31	13.7	17.5	0.31	13.7
1 M Red	2.7	0.34	13.5	20.3	0.32	13.7
1 M	7.6	0.40	13.7	27.8	0.34	13.7
2 BK	5.6	0.50	18.0	33.4	0.37	14.4
1 BK	5.2	0.51	14.9	38.7	0.39	14.5
GRADER	2.1	0.54	15.7	40.8	0.39	14.5
3 M	16.6	0.55	14.0	57.4	0.44	14.4
Filter FLR	4.2	0.97	15.2	61.6	0.47	14.5
4 M	5.7	1.00	14.8	67.3	0.52	14.5
3 BK	3.4	1.13	18.9	70.7	0.55	14.7
Bran FLR	1.0	2.32	20.9	71.7	0.57	14.8
5 M	1.0	2.46	16.5	72.7	0.60	14.8
Filter Bran	2.4	2.23	14.2	75.1	0.65	14.8
Red Dog	2.0	3.36	14.7	77.2	0.72	14.8
Bk SHT	3.6	4.22	16.8	80.8	0.88	14.9
Red SHT	0.2	4.66	15.1	81.0	0.89	14.9
Bran	19.0	5.22	17.8	100.0	1.71	15.4
Wheat		1.72	16.1			
Patent Flour		0.57	15.0			



Cumulative Ash:	03S0257-3 (B-13)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
1 M Red	2.8	0.37	13.0	2.8	0.37	13.0
2 M	17.6	0.40	13.1	20.4	0.40	13.1
1 M	8.1	0.42	13.3	28.4	0.41	13.2
1 BK	6.1	0.49	14.9	34.5	0.42	13.5
GRADER	2.4	0.53	15.5	36.9	0.43	13.6
2 BK	6.7	0.54	18.0	43.6	0.45	14.3
3 M	14.5	0.69	13.8	58.1	0.51	14.2
Filter FLR	3.7	0.90	14.3	61.8	0.53	14.2
3 BK	3.5	1.20	19.0	65.3	0.57	14.4
4 M	4.7	1.23	14.5	70.0	0.61	14.4
Bran FLR	0.9	2.29	21.3	70.9	0.63	14.5
5 M	1.0	2.44	15.4	71.9	0.66	14.5
Filter Bran	3.1	1.66	13.7	75.0	0.70	14.5
Red Dog	2.8	3.39	14.3	77.7	0.79	14.5
Bk SHT	3.4	4.45	16.7	81.2	0.95	14.6
Red SHT	0.2	4.78	14.7	81.4	0.96	14.6
Bran	18.6	5.49	16.0	100.0	1.80	14.9
Wheat		1.68	15.9			
Patent Flour		0.63	14.7			

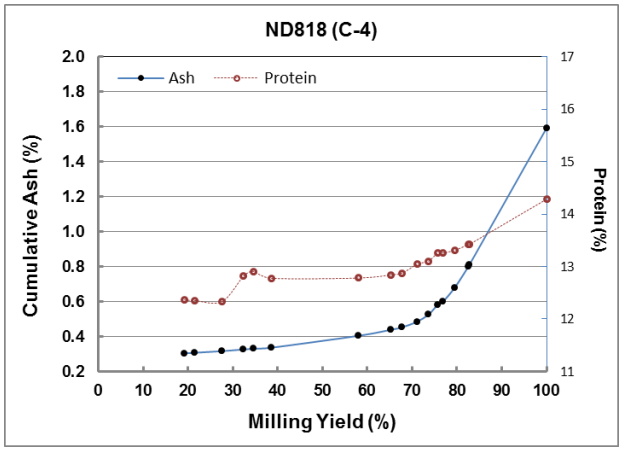
Casselton Cumulative Ash Curves (Group C)

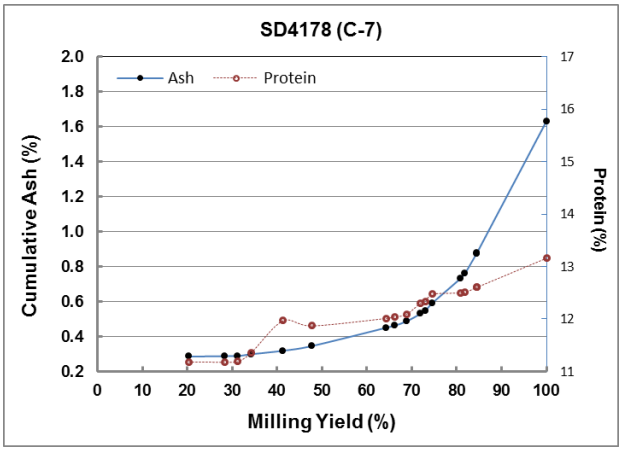




Cumulative Ash:	MN07098-6 (C-2)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
2 M	20.3	0.33	11.5	20.3	0.33	11.5
1 M Red	2.4	0.35	11.3	22.7	0.33	11.5
1 M	6.7	0.38	11.4	29.4	0.34	11.5
1 BK	4.8	0.45	10.7	34.2	0.36	11.4
2 BK	4.8	0.48	13.8	39.0	0.37	11.7
GRADER	2.0	0.50	11.8	41.1	0.38	11.7
3 M	18.4	0.50	12.2	59.4	0.42	11.8
4 M	6.8	0.66	12.7	66.3	0.44	11.9
Filter FLR	2.5	0.81	12.9	68.8	0.45	12.0
3 BK	3.5	1.08	15.4	72.3	0.49	12.1
5 M	1.9	1.77	14.7	74.2	0.52	12.2
Bran FLR	1.6	2.15	18.0	75.8	0.55	12.3
Filter Bran	1.4	1.83	12.4	77.2	0.58	12.3
Red Dog	2.6	3.00	13.8	79.9	0.66	12.4
Bk SHT	3.3	3.74	15.1	83.1	0.78	12.5
Red SHT	0.3	4.21	13.3	83.4	0.79	12.5
Bran	16.6	4.96	17.2	100.0	1.48	13.3
Wheat		1.44	13.2			
Patent Flour		0.55	12.2			

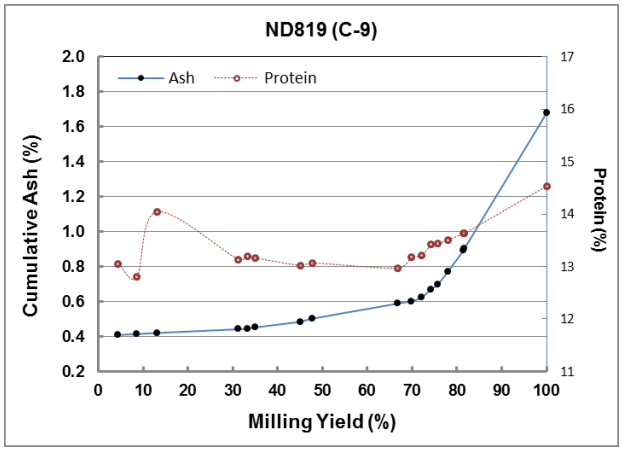
Cumulative Ash:	Glenn (C-3)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
1 M Red	2.0	0.35	12.8	2.0	0.35	12.8
2 M	16.7	0.38	13.0	18.7	0.38	13.0
3 M	18.8	0.44	12.9	37.5	0.41	13.0
2 BK	4.3	0.47	18.0	41.8	0.42	13.5
1 BK	4.1	0.47	14.7	45.9	0.42	13.6
GRADER	1.9	0.49	15.4	47.7	0.42	13.7
1 M	5.4	0.51	13.1	53.1	0.43	13.6
4 M	7.2	0.58	12.9	60.3	0.45	13.5
Filter FLR	2.8	0.68	14.1	63.1	0.46	13.5
3 BK	3.4	1.06	17.5	66.5	0.49	13.8
5 M	3.4	1.19	13.9	69.9	0.53	13.8
Bran FLR	1.8	2.25	20.8	71.7	0.57	13.9
Filter Bran	1.6	1.60	13.5	73.3	0.59	13.9
Red Dog	3.0	2.48	15.0	76.3	0.66	14.0
Bk SHT	3.7	3.30	15.4	80.0	0.79	14.0
Red SHT	0.4	4.49	14.7	80.4	0.81	14.0
Bran	19.6	5.32	18.1	100.0	1.69	14.8
Wheat		1.47	14.6			
Patent Flour		0.54	13.8			

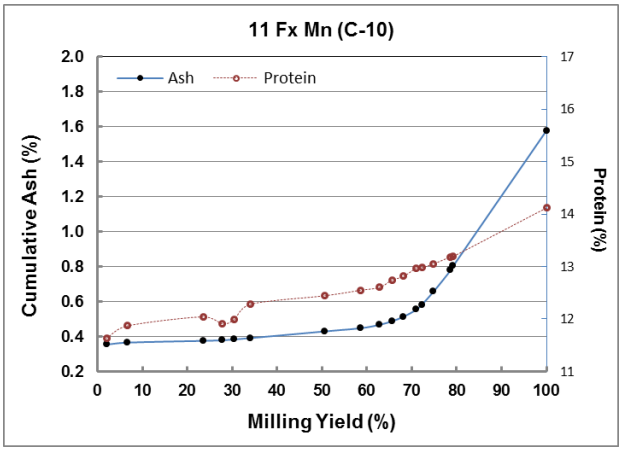




Cumulative Ash:	ND818 (C-4)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
2 M	19.2	0.30	12.4	19.2	0.30	12.4
1 M Red	2.3	0.33	12.3	21.5	0.31	12.4
1 M	6.1	0.35	12.3	27.5	0.32	12.3
2 BK	4.9	0.38	15.6	32.4	0.33	12.8
GRADER	2.2	0.38	14.2	34.6	0.33	12.9
1 BK	4.0	0.39	11.6	38.6	0.34	12.8
3 M	19.4	0.54	12.8	58.0	0.40	12.8
4 M	7.2	0.71	13.3	65.2	0.44	12.8
Filter FLR	2.6	0.83	13.8	67.8	0.45	12.9
3 BK	3.3	1.14	16.5	71.1	0.48	13.0
5 M	2.6	1.66	14.8	73.7	0.53	13.1
Bran FLR	2.1	2.59	18.9	75.7	0.58	13.3
Filter Bran	1.1	1.68	12.9	76.8	0.60	13.3
Red Dog	2.7	3.01	14.8	79.5	0.68	13.3
Bk SHT	3.1	3.93	16.3	82.6	0.80	13.4
Red SHT	0.2	4.61	14.8	82.8	0.81	13.4
Bran	17.2	5.35	18.4	100.0	1.59	14.3
Wheat		1.55	13.9			
Patent Flour		0.62	13.3			

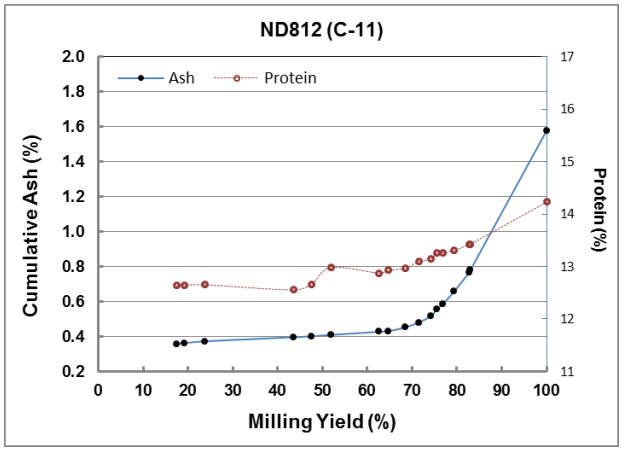
Cumulative Ash:	SD4178 (C-7)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
2 M	20.3	0.29	11.2	20.3	0.29	11.2
1 M	8.0	0.30	11.2	28.3	0.29	11.2
1 M Red	3.0	0.30	11.3	31.3	0.29	11.2
GRADER	2.9	0.41	13.1	34.2	0.30	11.4
2 BK	7.1	0.42	14.9	41.3	0.32	12.0
1 BK	6.3	0.52	11.2	47.7	0.35	11.9
3 M	16.7	0.75	12.4	64.4	0.45	12.0
Filter FLR	1.8	0.87	13.0	66.2	0.46	12.0
4 M	2.6	1.11	13.3	68.8	0.49	12.1
3 BK	3.2	1.47	16.9	71.9	0.53	12.3
5 M	1.1	1.68	14.5	73.0	0.55	12.3
Bran FLR	1.6	2.66	18.8	74.6	0.59	12.5
Filter Bran	6.2	2.41	12.7	80.8	0.73	12.5
Red Dog	1.1	3.14	13.3	81.9	0.76	12.5
Bk SHT	2.6	4.46	15.8	84.4	0.87	12.6
Red SHT	0.1	4.71	14.1	84.5	0.88	12.6
Bran	15.5	5.74	16.2	100.0	1.63	13.2
Wheat		1.43	13.3			
Patent Flour		0.57	12.5			

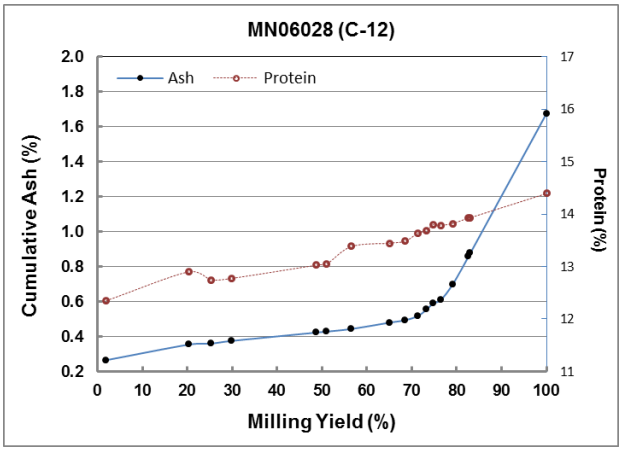




Cumulative Ash:	ND819 (C-9)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
1 M	4.4	0.41	13.1	4.4	0.41	13.1
1 BK	4.2	0.42	12.5	8.6	0.41	12.8
2 BK	4.5	0.43	16.4	13.1	0.42	14.0
2 M	18.2	0.46	12.5	31.2	0.44	13.1
GRADER	2.0	0.50	14.2	33.2	0.44	13.2
1 M Red	1.7	0.58	12.5	34.9	0.45	13.2
4 M	10.2	0.60	12.5	45.1	0.48	13.0
Filter FLR	2.7	0.79	13.9	47.8	0.50	13.1
3 M	18.9	0.81	12.7	66.7	0.59	13.0
3 BK	3.1	0.89	17.5	69.8	0.60	13.2
5 M	2.3	1.31	14.3	72.2	0.62	13.2
Bran FLR	2.1	2.26	20.8	74.2	0.67	13.4
Filter Bran	1.4	2.05	14.4	75.7	0.70	13.4
Red Dog	2.3	3.24	15.9	78.0	0.77	13.5
Bk SHT	3.4	3.59	16.3	81.4	0.89	13.6
Red SHT	0.3	5.01	15.4	81.7	0.90	13.6
Bran	18.3	5.13	18.6	100.0	1.68	14.5
Wheat		1.53	14.6			
Patent Flour		0.55	13.5			

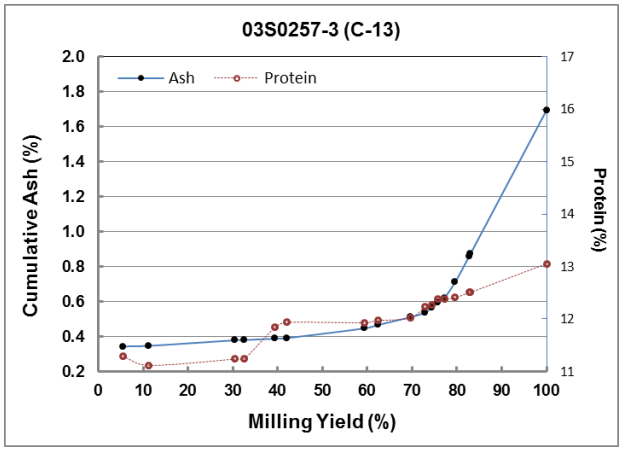
Cumulative Ash:	11 Fx Mn (C-10)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
1 M Red	2.0	0.35	11.6	2.0	0.35	11.6
1 M	4.7	0.37	12.0	6.7	0.37	11.9
2 M	16.8	0.38	12.1	23.5	0.38	12.0
1 BK	4.3	0.40	11.2	27.8	0.38	11.9
GRADER	2.6	0.44	12.8	30.4	0.38	12.0
2 BK	3.7	0.46	14.7	34.1	0.39	12.3
3 M	16.6	0.51	12.8	50.6	0.43	12.4
4 M	7.9	0.56	13.2	58.5	0.45	12.5
Filter FLR	4.3	0.74	13.3	62.8	0.47	12.6
3 BK	2.8	0.94	15.9	65.6	0.49	12.7
5 M	2.6	1.17	14.6	68.2	0.51	12.8
Bran FLR	2.9	1.51	16.8	71.0	0.55	13.0
Filter Bran	1.2	2.25	13.4	72.2	0.58	13.0
Red Dog	2.6	2.72	15.0	74.8	0.66	13.1
Bk SHT	3.8	3.18	15.8	78.7	0.78	13.2
Red SHT	0.5	4.21	14.1	79.2	0.80	13.2
Bran	20.8	4.53	17.7	100.0	1.58	14.1
Wheat		1.48	14.2			
Patent Flour		0.57	13.0			

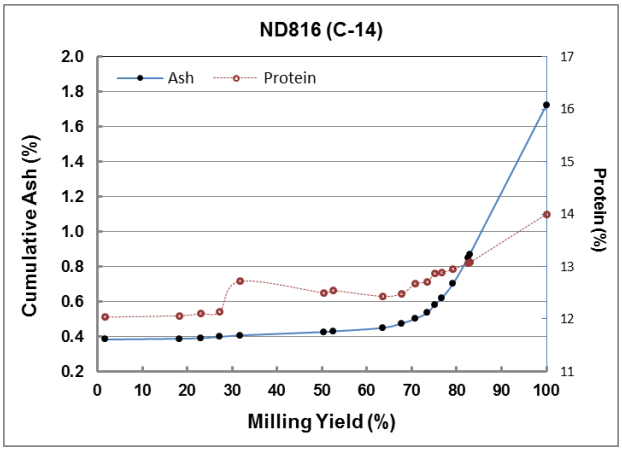




Cumulative Ash:	ND812 (C-11)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
2 M	17.5	0.36	12.6	17.5	0.36	12.6
1 M Red	1.7	0.41	12.7	19.2	0.36	12.6
1 M	4.6	0.42	12.7	23.8	0.37	12.7
3 M	19.6	0.42	12.4	43.5	0.40	12.6
1 BK	4.0	0.46	13.8	47.5	0.40	12.7
2 BK	4.4	0.50	16.5	51.9	0.41	13.0
4 M	10.8	0.51	12.4	62.7	0.43	12.9
GRADER	1.9	0.52	14.6	64.6	0.43	12.9
Filter FLR	4.0	0.84	13.6	68.6	0.45	13.0
3 BK	2.9	1.10	16.1	71.5	0.48	13.1
5 M	2.7	1.50	14.2	74.2	0.52	13.1
Bran FLR	1.3	2.75	20.1	75.5	0.56	13.3
Filter Bran	1.4	2.32	13.5	76.9	0.59	13.3
Red Dog	2.5	2.81	14.7	79.4	0.66	13.3
Bk SHT	3.3	3.34	16.1	82.7	0.76	13.4
Red SHT	0.3	4.80	14.7	83.0	0.78	13.4
Bran	17.0	5.47	18.2	100.0	1.58	14.2
Wheat		1.48	14.2			
Patent Flour		0.54	13.4			

Cumulative Ash:	MN06028 (C-12)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
1 M Red	1.9	0.27	12.4	1.9	0.27	12.4
2 M	18.3	0.36	13.0	20.3	0.35	12.9
1 M	5.0	0.38	12.1	25.3	0.36	12.7
1 BK	4.5	0.46	12.9	29.8	0.37	12.8
3 M	18.8	0.50	13.4	48.6	0.42	13.0
GRADER	2.4	0.54	13.6	51.1	0.43	13.1
2 BK	5.5	0.59	16.5	56.6	0.44	13.4
4 M	8.6	0.72	13.9	65.1	0.48	13.4
Filter FLR	3.4	0.75	14.2	68.5	0.49	13.5
3 BK	2.9	1.11	17.3	71.4	0.52	13.6
5 M	2.0	1.93	15.4	73.3	0.56	13.7
Bran FLR	1.4	2.34	19.8	74.7	0.59	13.8
Filter Bran	1.8	1.51	13.3	76.5	0.61	13.8
Red Dog	2.6	3.26	14.8	79.1	0.70	13.8
Bk SHT	3.6	4.43	16.3	82.7	0.86	13.9
Red SHT	0.4	4.88	14.7	83.0	0.88	13.9
Bran	17.0	5.58	16.6	100.0	1.68	14.4
Wheat		1.66	14.9			
Patent Flour		0.58	14.0			

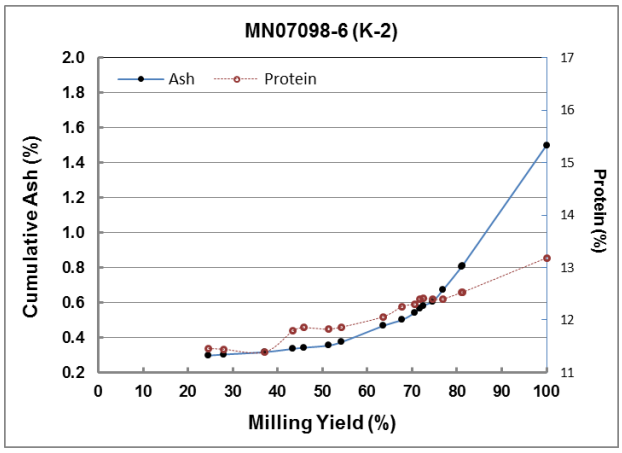


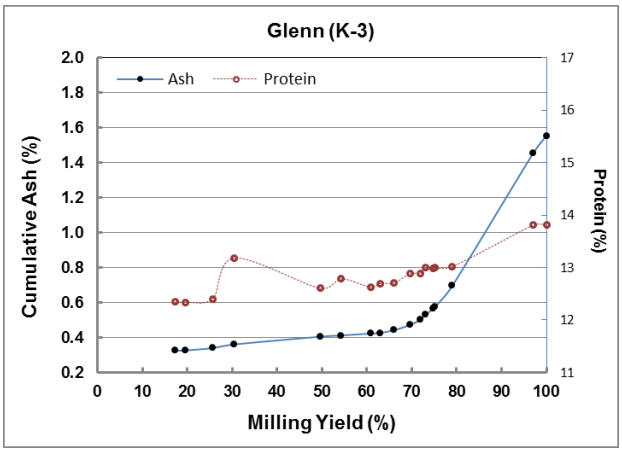


Cumulative Ash:	03S0257-3 (C-13)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
1 M	5.5	0.34	11.3	5.5	0.34	11.3
1 BK	5.8	0.35	10.9	11.3	0.35	11.1
2 M	19.2	0.40	11.3	30.5	0.38	11.2
1 M Red	2.1	0.40	11.3	32.5	0.38	11.2
2 BK	6.8	0.42	14.7	39.4	0.39	11.8
GRADER	2.7	0.44	13.3	42.1	0.39	11.9
3 M	17.3	0.58	11.9	59.4	0.45	11.9
Filter FLR	3.1	0.85	12.8	62.5	0.47	12.0
4 M	7.1	0.90	12.4	69.6	0.51	12.0
3 BK	3.3	1.08	16.8	72.9	0.54	12.2
5 M	1.4	1.99	14.3	74.3	0.56	12.3
Bran FLR	1.4	2.29	18.3	75.7	0.60	12.4
Filter Bran	1.5	1.88	12.1	77.2	0.62	12.4
Red Dog	2.4	3.58	13.3	79.6	0.71	12.4
Bk SHT	3.2	4.61	15.0	82.8	0.86	12.5
Red SHT	0.3	5.01	13.4	83.0	0.87	12.5
Bran	17.0	5.71	15.7	100.0	1.70	13.1
Wheat		1.53	13.2			
Patent Flour		0.58	12.6			

Cumulative Ash:	ND816 (C-14)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
1 M Red	1.7	0.38	12.0	1.7	0.38	12.0
2 M	16.5	0.39	12.1	18.2	0.39	12.1
1 BK	4.8	0.40	12.2	23.0	0.39	12.1
1 M	4.2	0.44	12.3	27.2	0.40	12.1
2 BK	4.5	0.46	16.2	31.7	0.41	12.7
3 M	18.8	0.46	12.1	50.5	0.43	12.5
GRADER	2.0	0.52	13.7	52.4	0.43	12.5
4 M	11.1	0.54	11.9	63.5	0.45	12.4
Filter FLR	4.3	0.86	13.3	67.8	0.48	12.5
3 BK	3.1	1.09	16.8	70.9	0.50	12.7
5 M	2.6	1.46	13.8	73.5	0.54	12.7
Bran FLR	1.6	2.65	20.2	75.1	0.58	12.9
Filter Bran	1.6	2.44	13.7	76.7	0.62	12.9
Red Dog	2.5	3.18	14.7	79.2	0.70	12.9
Bk SHT	3.4	4.36	15.9	82.5	0.85	13.1
Red SHT	0.3	5.32	15.0	82.9	0.87	13.1
Bran	17.1	5.87	18.5	100.0	1.72	14.0
Wheat		1.61	14.3			
Patent Flour		0.53	13.0			

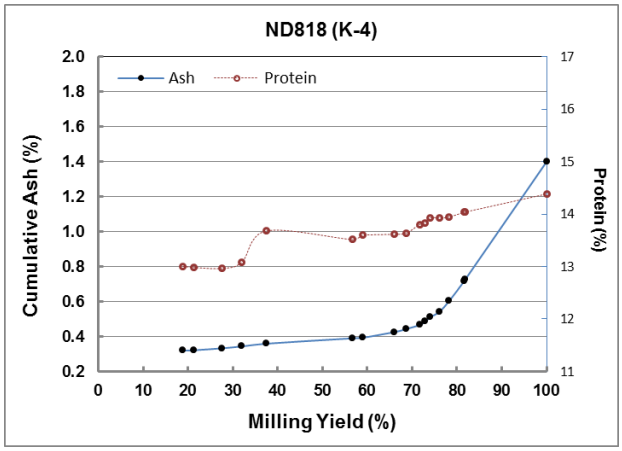
Crookston Cumulative Ash Curves (Group K)

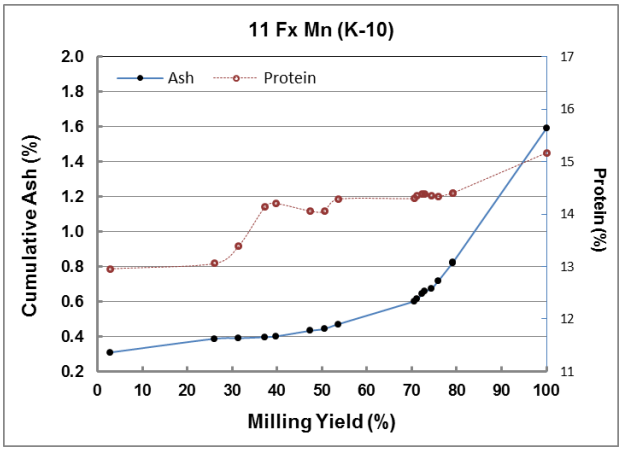




Cumulative Ash:	MN07098-6 (K-2)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
2 M	24.6	0.30	11.5	24.6	0.30	11.5
1 M Red	3.5	0.34	11.3	28.0	0.30	11.4
1 M	9.1	0.36	11.2	37.1	0.32	11.4
2 BK	6.3	0.45	14.2	43.4	0.34	11.8
GRADER	2.4	0.46	12.9	45.8	0.34	11.9
1 BK	5.5	0.46	11.6	51.3	0.35	11.8
Filter FLR	3.0	0.72	12.6	54.2	0.37	11.9
3 M	9.3	1.01	13.2	63.5	0.47	12.1
3 BK	4.2	1.02	15.2	67.7	0.50	12.3
4 M	2.8	1.51	13.5	70.5	0.54	12.3
Bran FLR	1.2	2.01	17.8	71.7	0.56	12.4
5 M	0.7	2.25	14.2	72.4	0.58	12.4
Filter Bran	2.2	1.43	11.9	74.6	0.61	12.4
Red Dog	2.3	2.82	12.5	76.9	0.67	12.4
Bk SHT	4.2	3.24	14.8	81.0	0.80	12.5
Red SHT	0.1	3.88	13.2	81.2	0.81	12.5
Bran	18.8	4.48	16.0	100.0	1.50	13.2
Wheat		1.31	13.3			
Patent Flour		0.55	12.5			

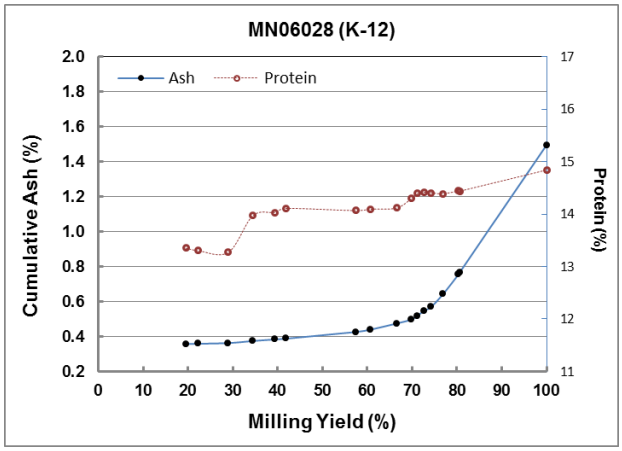
Cumulative Ash:	Glenn (K-3)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
2 M	17.4	0.32	12.3	17.4	0.32	12.3
1 M Red	2.3	0.34	12.3	19.7	0.33	12.3
1 M	6.0	0.38	12.6	25.6	0.34	12.4
2 BK	4.9	0.47	17.3	30.5	0.36	13.2
3 M	19.1	0.48	11.7	49.6	0.41	12.6
1 BK	4.6	0.49	14.8	54.2	0.41	12.8
4 M	6.7	0.51	11.3	60.9	0.42	12.6
GRADER	2.0	0.51	15.0	62.9	0.43	12.7
Filter FLR	3.2	0.78	12.9	66.1	0.44	12.7
3 BK	3.5	1.03	16.3	69.6	0.47	12.9
5 M	2.3	1.37	12.9	71.8	0.50	12.9
Bran FLR	1.2	2.30	19.3	73.0	0.53	13.0
Filter Bran	1.7	2.02	12.9	74.8	0.56	13.0
Red SHT	0.3	2.75	13.2	75.1	0.57	13.0
Bk SHT	3.9	3.03	13.5	79.0	0.70	13.0
Bran	18.1	4.78	17.3	97.1	1.46	13.8
Red Dog	2.9	4.81	13.7	100.0	1.55	13.8
Wheat		1.58	13.8			
Patent Flour		0.51	13.2			

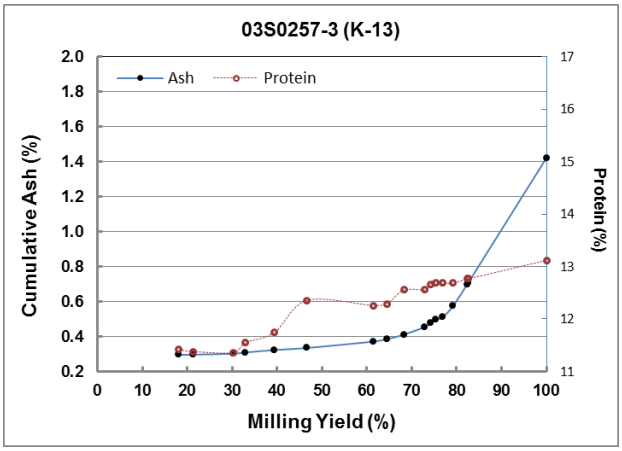




Cumulative Ash:	ND818 (K-4)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
2 M	18.9	0.32	13.0	18.9	0.32	13.0
1 M Red	2.5	0.33	12.8	21.3	0.32	13.0
1 M	6.3	0.37	12.9	27.6	0.33	13.0
1 BK	4.4	0.41	13.8	32.0	0.34	13.1
2 BK	5.5	0.45	17.2	37.5	0.36	13.7
3 M	19.2	0.45	13.2	56.7	0.39	13.5
GRADER	2.3	0.48	15.6	59.0	0.39	13.6
4 M	7.1	0.70	13.7	66.1	0.43	13.6
Filter FLR	2.6	0.88	14.2	68.7	0.44	13.6
3 BK	3.0	0.99	17.6	71.7	0.47	13.8
5 M	1.2	1.63	15.5	72.9	0.49	13.8
Bran FLR	1.2	2.08	20.1	74.1	0.51	13.9
Filter Bran	2.0	1.70	13.6	76.1	0.54	13.9
Red Dog	2.2	2.78	14.7	78.3	0.60	13.9
Bk SHT	3.3	3.36	16.2	81.6	0.72	14.0
Red SHT	0.2	4.04	15.2	81.9	0.73	14.0
Bran	18.1	4.44	15.9	100.0	1.40	14.4
Wheat		1.33	14.9			
Patent Flour		0.47	14.2			

Cumulative Ash:	11 Fx Mn (K-10)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
1 M Red	2.8	0.31	13.0	2.8	0.31	13.0
2 M	23.3	0.40	13.1	26.1	0.39	13.1
1 BK	5.3	0.40	15.0	31.4	0.39	13.4
2 BK	5.9	0.43	18.1	37.3	0.40	14.1
GRADER	2.5	0.47	15.1	39.8	0.40	14.2
1 M	7.5	0.60	13.3	47.3	0.43	14.1
Filter FLR	3.2	0.60	13.9	50.5	0.44	14.1
3 BK	3.1	0.91	18.1	53.6	0.47	14.3
3 M	16.9	1.02	14.3	70.5	0.60	14.3
Bran FLR	0.8	1.89	20.2	71.3	0.61	14.4
4 M	1.1	2.46	15.5	72.4	0.64	14.4
5 M	0.5	2.74	15.5	72.9	0.66	14.4
Filter Bran	1.5	1.44	12.8	74.4	0.67	14.4
Red Dog	1.4	2.91	13.4	75.8	0.72	14.3
Bk SHT	3.3	3.28	16.0	79.1	0.82	14.4
Red SHT	0.0	3.85	14.5	79.1	0.82	14.4
Bran	20.9	4.50	18.1	100.0	1.59	15.2
Wheat		1.33	15.2			
Patent Flour		0.44	14.3			

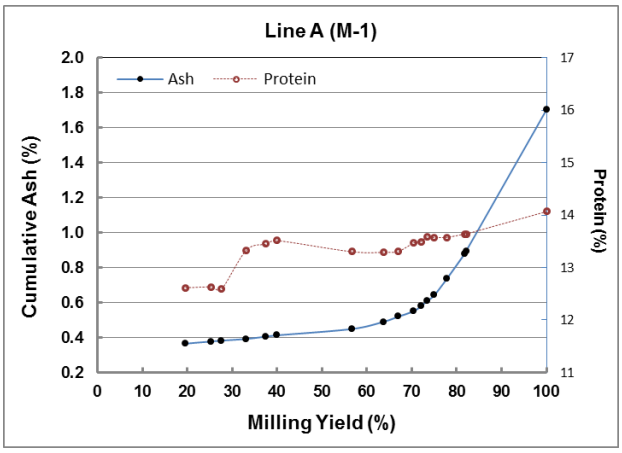


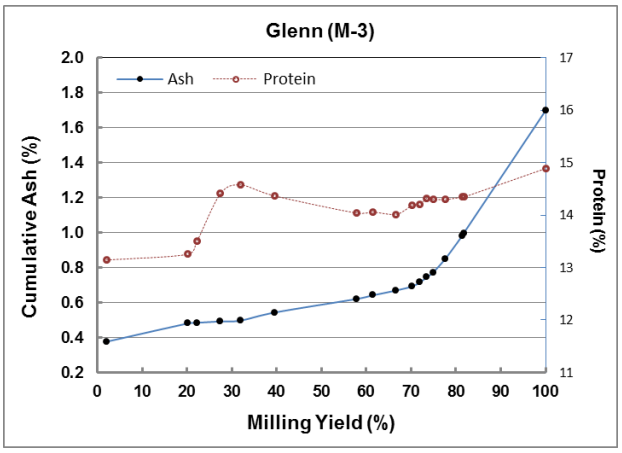


Cumulative Ash:	MN06028 (K-12)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
2 M	19.5	0.36	13.4	19.5	0.36	13.4
1 M Red	2.7	0.37	13.0	22.2	0.36	13.3
1 M	6.7	0.38	13.2	29.0	0.36	13.3
2 BK	5.5	0.44	17.7	34.4	0.37	14.0
1 BK	4.9	0.45	14.5	39.4	0.38	14.0
GRADER	2.4	0.46	15.4	41.8	0.39	14.1
3 M	15.7	0.53	14.0	57.5	0.43	14.1
Filter FLR	3.2	0.67	14.6	60.7	0.44	14.1
4 M	5.8	0.84	14.4	66.5	0.47	14.1
3 BK	3.3	0.95	17.9	69.8	0.50	14.3
Bran FLR	1.3	1.66	19.6	71.1	0.52	14.4
5 M	1.5	1.88	15.7	72.6	0.55	14.4
Filter Bran	1.6	1.61	13.8	74.2	0.57	14.4
Red Dog	2.7	2.68	13.9	76.9	0.64	14.4
Bk SHT	3.5	3.27	15.6	80.3	0.76	14.4
Red SHT	0.3	4.03	13.7	80.7	0.77	14.4
Bran	19.3	4.53	16.5	100.0	1.50	14.8
Wheat		1.44	15.2			
Patent Flour		0.54	14.8			

Cumulative Ash:	03S0257-3 (K-13)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
2 M	18.1	0.30	11.4	18.1	0.30	11.4
1 M Red	3.2	0.30	11.1	21.3	0.30	11.4
1 M	8.8	0.32	11.3	30.2	0.30	11.4
GRADER	2.8	0.39	13.6	33.0	0.31	11.6
1 BK	6.4	0.39	12.7	39.4	0.32	11.7
2 BK	7.3	0.40	15.7	46.7	0.33	12.4
3 M	14.7	0.49	11.9	61.4	0.37	12.3
Filter FLR	3.1	0.66	12.9	64.5	0.38	12.3
3 BK	3.7	0.87	17.1	68.2	0.41	12.6
4 M	4.7	1.08	12.6	73.0	0.45	12.6
Bran FLR	1.3	1.72	19.0	74.2	0.48	12.7
5 M	1.1	1.74	14.5	75.4	0.50	12.7
Filter Bran	1.6	1.28	12.3	76.9	0.51	12.7
Red Dog	2.3	2.71	12.8	79.2	0.57	12.7
Bk SHT	3.1	3.80	14.8	82.3	0.70	12.8
Red SHT	0.2	3.89	13.3	82.5	0.71	12.8
Bran	17.5	4.81	14.8	100.0	1.42	13.1
Wheat		1.35	13.4			
Patent Flour		0.49	13.1			

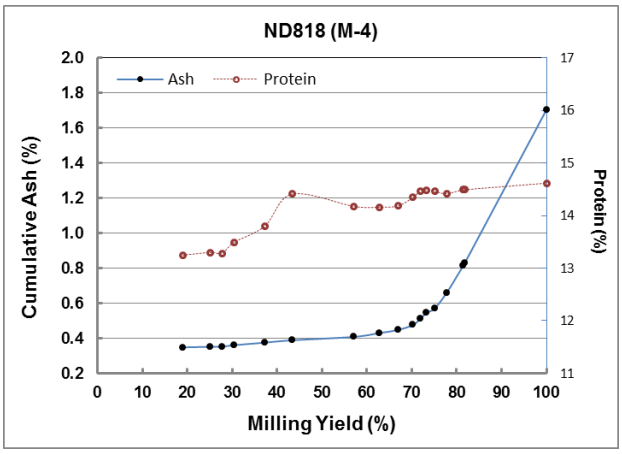
Minot Cumulative Ash Curves (Group M)

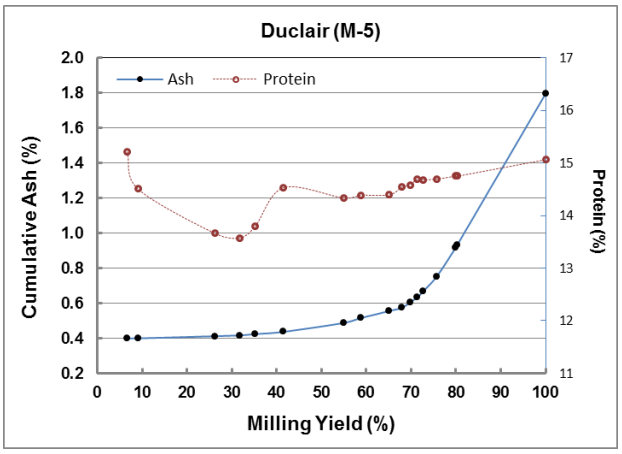




Cumulative Ash:	Line A (M-1)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
2 M	19.6	0.37	12.6	19.6	0.37	12.6
1 M	5.7	0.42	12.7	25.3	0.38	12.6
1 M Red	2.3	0.43	12.1	27.6	0.38	12.6
2 BK	5.5	0.44	17.1	33.1	0.39	13.3
1 BK	4.4	0.50	14.3	37.5	0.41	13.4
GRADER	2.3	0.53	14.6	39.9	0.41	13.5
3 M	16.7	0.54	12.8	56.6	0.45	13.3
4 M	7.1	0.82	13.2	63.7	0.49	13.3
Filter FLR	3.3	1.09	13.7	67.0	0.52	13.3
3 BK	3.4	1.16	16.6	70.4	0.55	13.5
5 M	1.6	1.84	14.7	72.0	0.58	13.5
Bran FLR	1.4	2.15	18.3	73.4	0.61	13.6
Filter Bran	1.6	2.13	12.9	75.0	0.64	13.6
Red Dog	2.8	3.26	13.7	77.8	0.73	13.6
Bk SHT	4.0	3.69	14.9	81.8	0.88	13.6
Red SHT	0.3	4.92	14.0	82.1	0.89	13.6
Bran	17.9	5.41	16.0	100.0	1.70	14.1
Wheat		1.76	14.3			
Patent Flour		0.66	13.6			

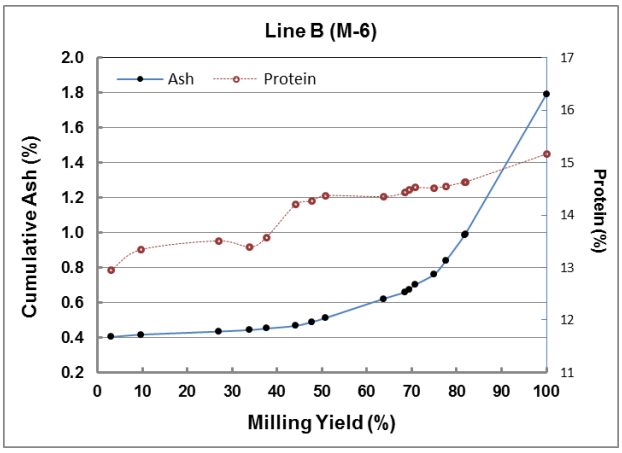
Cumulative Ash:	Glenn (M-3)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
1 M Red	2.0	0.38	13.1	2.0	0.38	13.1
3 M	18.2	0.49	13.3	20.2	0.48	13.3
GRADER	2.1	0.52	16.0	22.2	0.48	13.5
2 BK	5.2	0.52	18.2	27.4	0.49	14.4
1 BK	4.5	0.53	15.6	31.9	0.50	14.6
4 M	7.6	0.74	13.5	39.5	0.54	14.4
2 M	18.3	0.79	13.3	57.8	0.62	14.0
Filter FLR	3.6	0.97	14.4	61.5	0.64	14.1
1 M	5.2	1.00	13.5	66.7	0.67	14.0
3 BK	3.5	1.12	17.4	70.2	0.69	14.2
5 M	1.7	1.65	14.8	71.9	0.71	14.2
Bran FLR	1.6	2.10	20.0	73.5	0.74	14.3
Filter Bran	1.4	2.23	13.4	74.9	0.77	14.3
Red Dog	2.7	2.99	14.1	77.6	0.85	14.3
Bk SHT	3.8	3.69	15.3	81.4	0.98	14.3
Red SHT	0.3	4.63	14.2	81.7	1.00	14.3
Bran	18.3	4.84	17.3	100.0	1.70	14.9
Wheat		1.58	14.8			
Patent Flour		0.59	14.5			

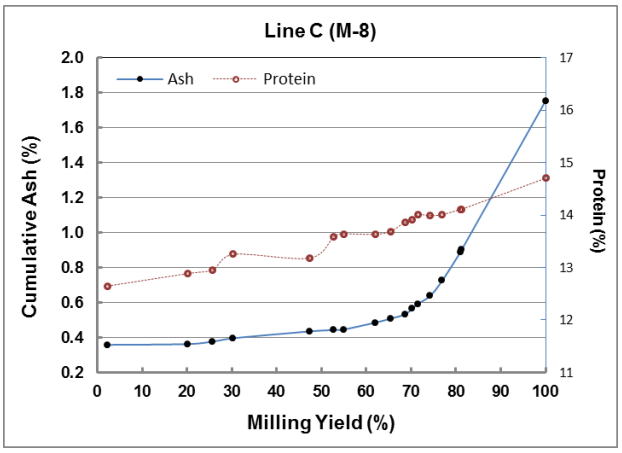




Cumulative Ash:	ND818 (M-4)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
2 M	18.9	0.35	13.2	18.9	0.35	13.2
1 M	6.2	0.36	13.5	25.2	0.35	13.3
1 M Red	2.5	0.37	13.1	27.7	0.35	13.3
GRADER	2.7	0.44	15.7	30.4	0.36	13.5
1 BK	6.8	0.44	15.2	37.2	0.38	13.8
2 BK	6.1	0.47	18.1	43.4	0.39	14.4
3 M	13.8	0.47	13.4	57.1	0.41	14.2
4 M	5.6	0.65	14.0	62.7	0.43	14.2
Filter FLR	4.2	0.72	14.6	67.0	0.45	14.2
3 BK	3.3	1.05	17.6	70.3	0.48	14.3
Bran FLR	1.6	2.11	19.7	71.9	0.51	14.5
5 M	1.5	2.16	15.6	73.3	0.55	14.5
Filter Bran	1.7	1.65	13.2	75.1	0.57	14.5
Red Dog	2.7	3.14	13.3	77.7	0.66	14.4
Bk SHT	3.7	4.08	16.1	81.4	0.81	14.5
Red SHT	0.3	4.41	14.3	81.7	0.83	14.5
Bran	18.3	5.63	15.2	100.0	1.70	14.6
Wheat		1.55	14.9			
Patent Flour		0.59	14.7			

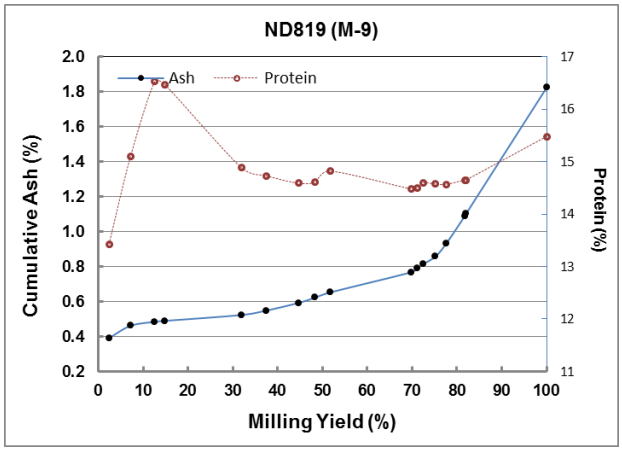
Cumulative Ash:	Duclair (M-5)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
1 BK	6.6	0.40	15.2	6.6	0.40	15.2
1 M Red	2.4	0.40	12.6	9.1	0.40	14.5
2 M	17.2	0.42	13.2	26.3	0.41	13.7
1 M	5.5	0.44	13.2	31.7	0.42	13.6
GRADER	3.5	0.49	15.8	35.2	0.42	13.8
2 BK	6.3	0.51	18.7	41.5	0.44	14.5
3 M	13.5	0.64	13.7	55.0	0.49	14.3
Filter FLR	3.8	0.92	15.1	58.8	0.52	14.4
4 M	6.3	0.93	14.5	65.1	0.56	14.4
3 BK	2.8	1.00	17.9	68.0	0.57	14.5
5 M	1.8	1.79	16.0	69.8	0.61	14.6
Bran FLR	1.7	1.85	19.5	71.4	0.63	14.7
Filter Bran	1.2	2.56	13.8	72.7	0.67	14.7
Red Dog	3.1	2.80	15.0	75.7	0.75	14.7
Bk SHT	4.2	3.86	15.8	80.0	0.92	14.8
Red SHT	0.4	4.59	14.4	80.3	0.93	14.7
Bran	19.7	5.31	16.3	100.0	1.80	15.1
Wheat		1.80	15.0			
Patent Flour		0.68	14.9			

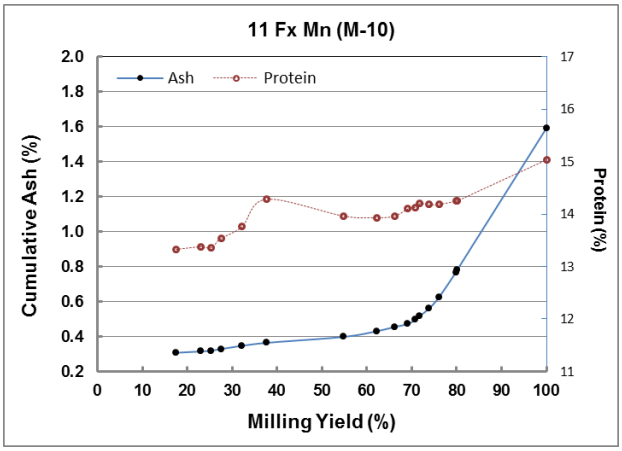




Cumulative Ash:	Line B (M-6)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
1 M Red	3.0	0.40	13.0	3.0	0.40	13.0
1 BK	6.6	0.42	13.5	9.7	0.42	13.3
2 M	17.2	0.44	13.6	26.9	0.43	13.5
1 M	7.0	0.48	12.9	33.9	0.44	13.4
GRADER	3.7	0.53	15.3	37.6	0.45	13.6
2 BK	6.4	0.56	17.8	44.1	0.47	14.2
Filter FLR	3.6	0.75	15.1	47.7	0.49	14.3
3 BK	3.1	0.87	16.0	50.7	0.51	14.4
3 M	13.1	1.05	14.3	63.8	0.62	14.4
4 M	4.8	1.15	15.4	68.6	0.66	14.4
Bran FLR	0.9	1.94	18.2	69.4	0.67	14.5
5 M	1.3	2.08	17.2	70.7	0.70	14.5
Filter Bran	4.3	1.77	14.5	75.0	0.76	14.5
Red Dog	2.6	3.09	15.5	77.6	0.84	14.6
Bk SHT	4.2	3.68	16.1	81.8	0.98	14.6
Red SHT	0.2	4.55	15.0	81.9	0.99	14.6
Bran	18.1	5.42	17.6	100.0	1.79	15.2
Wheat		1.72	15.4			
Patent Flour		0.73	14.9			

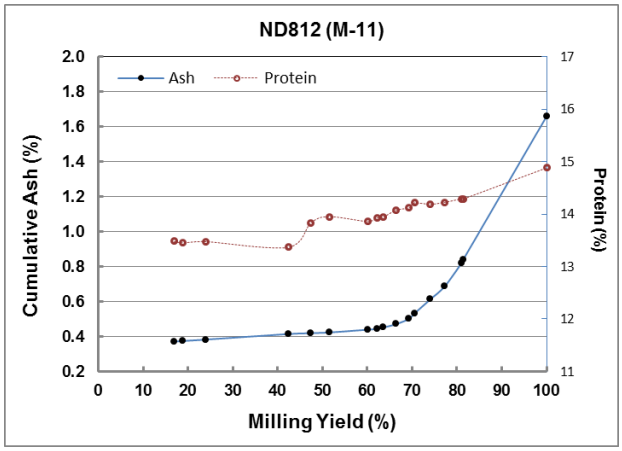
Cumulative Ash:	Line C (M-8)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
1 M Red	2.3	0.36	12.6	2.3	0.36	12.6
2 M	17.9	0.36	12.9	20.2	0.36	12.9
1 M	5.5	0.43	13.2	25.7	0.38	13.0
1 BK	4.5	0.50	14.9	30.3	0.40	13.3
3 M	17.2	0.51	13.1	47.4	0.44	13.2
2 BK	5.3	0.51	17.2	52.7	0.44	13.6
GRADER	2.2	0.52	14.9	55.0	0.45	13.6
4 M	7.0	0.79	13.6	61.9	0.48	13.6
Filter FLR	3.4	0.92	14.7	65.4	0.51	13.7
3 BK	3.2	1.02	17.3	68.6	0.53	13.9
5 M	1.6	1.99	16.0	70.2	0.57	13.9
Bran FLR	1.3	2.04	19.4	71.5	0.59	14.0
Filter Bran	2.7	1.83	13.6	74.2	0.64	14.0
Red Dog	2.7	3.12	14.5	76.9	0.72	14.0
Bk SHT	4.1	3.98	16.0	81.0	0.89	14.1
Red SHT	0.3	4.75	14.7	81.2	0.90	14.1
Bran	18.8	5.45	17.3	100.0	1.75	14.7
Wheat		1.66	14.6			
Patent Flour		0.66	14.2			

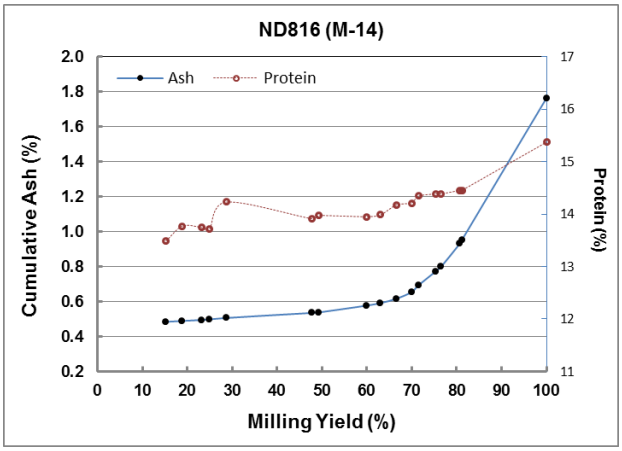




Cumulative Ash:	ND819 (M-9)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
1 M Red	2.4	0.39	13.4	2.4	0.39	13.4
1 BK	4.8	0.50	15.9	7.2	0.46	15.1
2 BK	5.4	0.51	18.4	12.5	0.48	16.5
GRADER	2.3	0.52	16.1	14.9	0.49	16.5
3 M	17.0	0.55	13.5	31.9	0.52	14.9
1 M	5.5	0.69	13.8	37.4	0.55	14.7
4 M	7.2	0.82	13.8	44.6	0.59	14.6
Filter FLR	3.7	0.98	14.9	48.3	0.62	14.6
3 BK	3.3	1.08	17.8	51.7	0.65	14.8
2 M	18.1	1.10	13.5	69.8	0.77	14.5
5 M	1.4	1.89	15.6	71.2	0.79	14.5
Bran FLR	1.2	2.20	20.6	72.4	0.81	14.6
Filter Bran	2.8	2.01	13.8	75.2	0.86	14.6
Red Dog	2.4	3.27	14.5	77.7	0.93	14.6
Bk SHT	4.1	4.04	16.2	81.8	1.09	14.7
Red SHT	0.3	4.87	14.5	82.0	1.10	14.6
Bran	18.0	5.11	19.3	100.0	1.82	15.5
Wheat		1.58	15.2			
Patent Flour		0.66	14.8			

Cumulative Ash:	11 Fx Mn (M-10)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
2 M	17.5	0.31	13.3	17.5	0.31	13.3
1 M	5.5	0.34	13.5	23.0	0.31	13.4
1 M Red	2.3	0.36	13.1	25.2	0.32	13.4
GRADER	2.3	0.43	15.5	27.5	0.33	13.5
1 BK	4.7	0.46	15.1	32.2	0.35	13.8
2 BK	5.4	0.47	17.4	37.6	0.36	14.3
3 M	17.2	0.47	13.3	54.8	0.40	14.0
4 M	7.3	0.67	13.7	62.1	0.43	13.9
Filter FLR	4.1	0.83	14.4	66.2	0.45	14.0
3 BK	3.0	0.85	17.2	69.2	0.47	14.1
5 M	1.6	1.57	15.4	70.8	0.50	14.1
Bran FLR	1.0	1.99	19.2	71.8	0.52	14.2
Filter Bran	2.0	2.03	13.5	73.8	0.56	14.2
Red Dog	2.2	2.77	14.3	76.0	0.62	14.2
Bk SHT	3.8	3.66	15.5	79.8	0.77	14.2
Red SHT	0.2	4.63	14.8	80.0	0.78	14.2
Bran	20.0	4.86	18.2	100.0	1.59	15.0
Wheat		1.52	14.9			
Patent Flour		0.54	14.4			

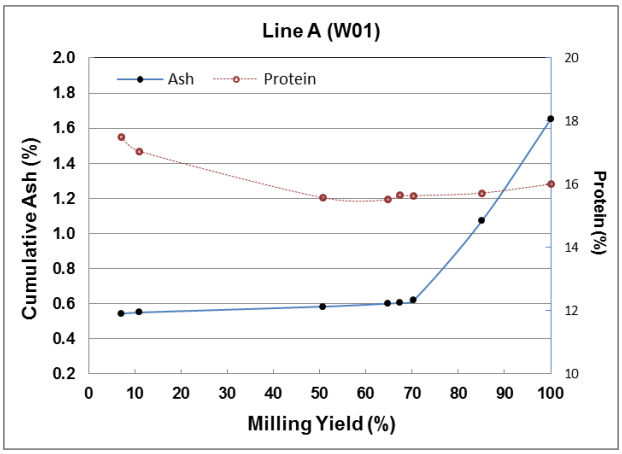


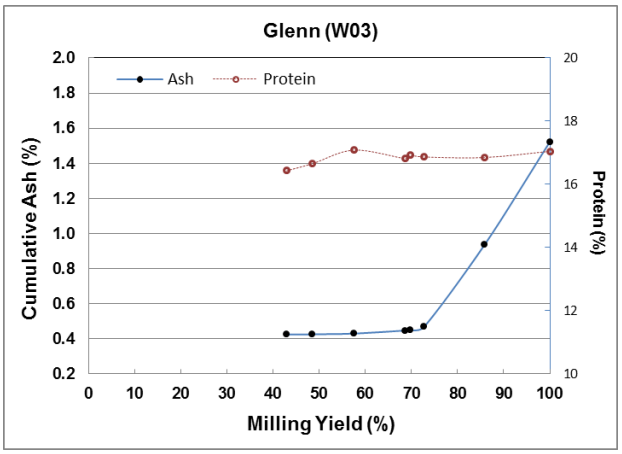


Cumulative Ash:	ND812 (M-11)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
2 M	16.9	0.37	13.5	16.9	0.37	13.5
1 M Red	2.0	0.39	13.2	18.9	0.37	13.5
1 M	5.0	0.41	13.6	23.9	0.38	13.5
3 M	18.5	0.46	13.2	42.4	0.41	13.4
2 BK	5.0	0.46	17.8	47.4	0.42	13.8
1 BK	4.1	0.47	15.3	51.5	0.42	14.0
4 M	8.7	0.53	13.3	60.1	0.44	13.9
GRADER	2.1	0.57	15.8	62.2	0.44	13.9
Filter FLR	1.3	0.83	14.6	63.5	0.45	13.9
3 BK	3.0	0.90	17.0	66.5	0.47	14.1
5 M	2.9	1.20	15.1	69.3	0.50	14.1
Bran FLR	1.1	2.33	19.9	70.5	0.53	14.2
Filter Bran	3.6	2.22	13.7	74.0	0.61	14.2
Red Dog	3.2	2.41	15.1	77.2	0.69	14.2
Bk SHT	3.7	3.55	15.6	81.0	0.82	14.3
Red SHT	0.4	4.92	14.3	81.4	0.84	14.3
Bran	18.6	5.24	17.5	100.0	1.66	14.9
Wheat		1.59	15.1			
Patent Flour		0.56	14.5			

Cumulative Ash:	ND816 (M-14)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
2 M	15.2	0.48	13.5	15.2	0.48	13.5
1 BK	3.7	0.51	15.0	18.9	0.49	13.8
1 M	4.3	0.52	13.6	23.2	0.49	13.7
1 M Red	1.7	0.54	13.2	24.9	0.50	13.7
2 BK	3.8	0.56	17.6	28.7	0.51	14.2
3 M	18.9	0.58	13.4	47.7	0.53	13.9
GRADER	1.7	0.63	15.6	49.3	0.54	14.0
4 M	10.6	0.76	13.8	60.0	0.58	14.0
Filter FLR	3.1	0.87	14.7	63.1	0.59	14.0
3 BK	3.5	1.06	17.6	66.6	0.62	14.2
5 M	3.4	1.41	14.9	70.0	0.65	14.2
Bran FLR	1.5	2.46	20.4	71.5	0.69	14.3
Red Dog	3.9	2.25	15.1	75.3	0.77	14.4
Filter Bran	1.2	2.51	14.5	76.6	0.80	14.4
Bk SHT	4.2	3.36	15.7	80.8	0.93	14.5
Red SHT	0.4	4.77	14.6	81.2	0.95	14.5
Bran	18.8	5.26	19.3	100.0	1.76	15.4
Wheat		1.60	15.2			
Patent Flour		0.66	14.6			

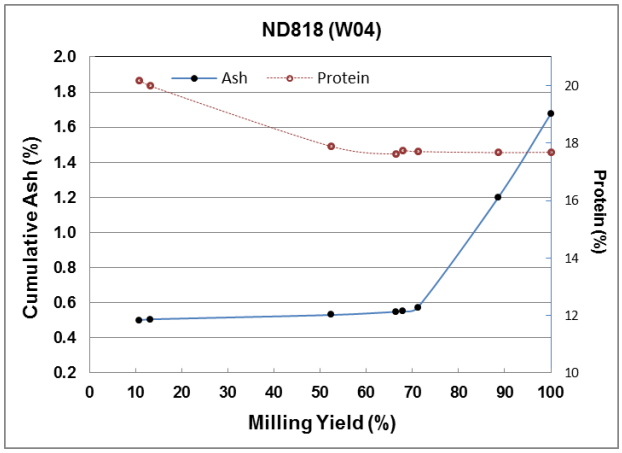
Williston Cumulative Ash Curves (Group W)

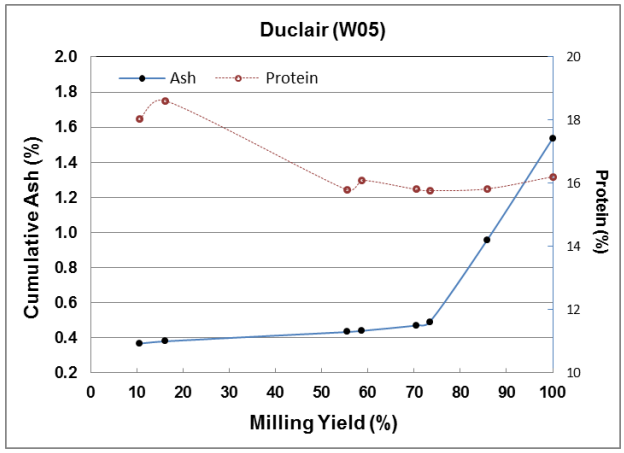




Cumulative Ash:	Line A (W01)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
B2	7.0	0.54	17.5	7.0	0.54	17.5
B1	3.9	0.56	16.2	10.9	0.55	17.1
R1	39.7	0.59	15.2	50.6	0.58	15.6
R2	14.1	0.66	15.3	64.7	0.60	15.5
B3	2.5	0.75	19.1	67.3	0.61	15.7
R3	3.1	0.95	15.5	70.4	0.62	15.6
Short	14.7	3.23	16.1	85.1	1.07	15.7
Bran	14.9	4.95	17.6	100.0	1.65	16.0
Wheat		1.61	16.4			
Patent Flour		0.65	15.8			

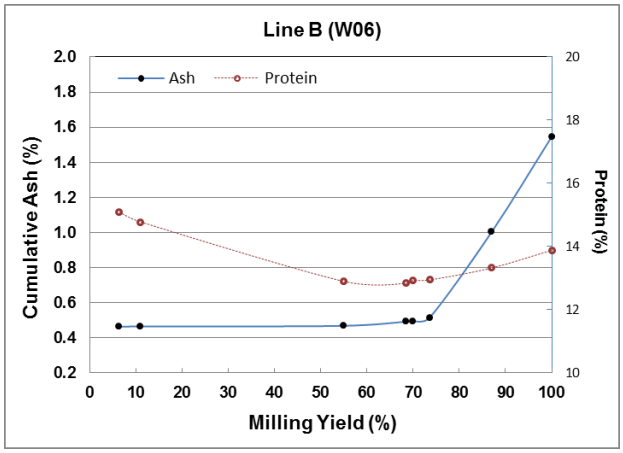
Cumulative Ash:	Glenn (W03)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
R1	42.9	0.43	16.4	42.9	0.43	16.4
B1	5.6	0.44	18.4	48.5	0.43	16.7
B2	9.0	0.45	19.4	57.5	0.43	17.1
R2	11.2	0.54	15.5	68.6	0.45	16.8
B3	1.1	0.62	22.8	69.8	0.45	16.9
R3	3.0	0.89	15.7	72.7	0.47	16.9
Short	13.1	3.53	16.8	85.9	0.94	16.9
Bran	14.1	5.08	18.2	100.0	1.52	17.0
Wheat		1.52	17.6			
Patent Flour		0.52	17.0			

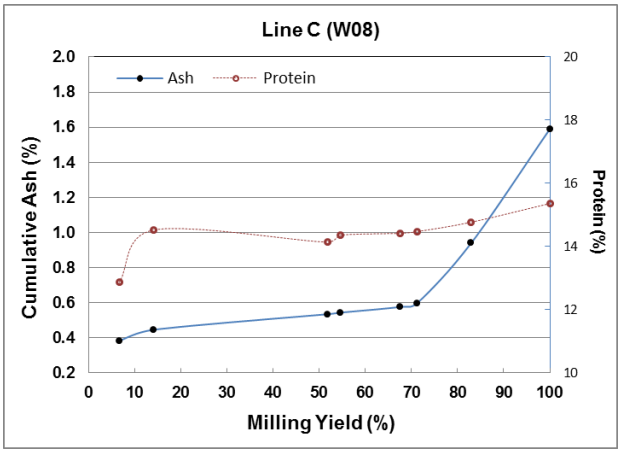




Cumulative Ash:	ND818 (W04)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
B2	10.8	0.50	20.2	10.8	0.50	20.2
B1	2.3	0.53	19.0	13.1	0.51	20.0
R1	39.3	0.54	17.2	52.4	0.53	17.9
R2	14.1	0.62	16.6	66.5	0.55	17.6
B3	1.4	0.70	23.2	67.9	0.55	17.7
R3	3.3	1.02	17.1	71.1	0.57	17.7
Short	17.4	3.75	17.5	88.6	1.20	17.7
Bran	11.4	5.38	17.8	100.0	1.68	17.7
Wheat		1.56	18.4			
Patent Flour		0.53	17.9			

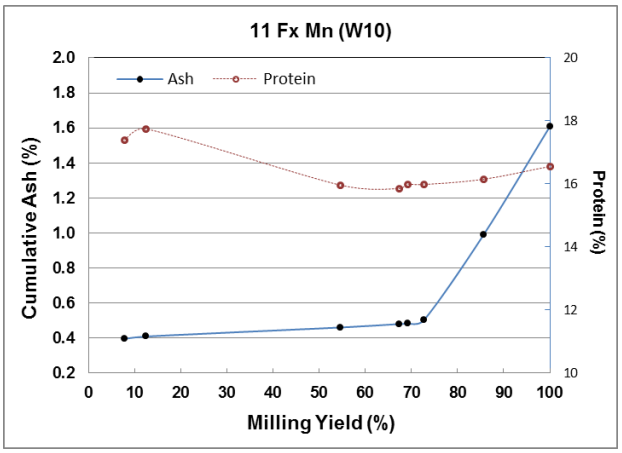
Cumulative Ash:	Duclair (W05)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
B1	10.6	0.37	18.0	10.6	0.37	18.0
B2	5.5	0.40	19.7	16.1	0.38	18.6
R1	39.4	0.46	14.6	55.5	0.43	15.8
B3	3.1	0.56	21.6	58.6	0.44	16.1
R2	11.8	0.62	14.4	70.4	0.47	15.8
R3	3.0	0.97	14.8	73.4	0.49	15.8
Short	12.4	3.71	16.2	85.8	0.96	15.8
Bran	14.2	5.04	18.5	100.0	1.54	16.2
Wheat		1.55	16.4			
Patent Flour		0.54	16.0			





Cumulative Ash:	Line B (W06)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
B2	6.3	0.46	15.1	6.3	0.46	15.1
B1	4.6	0.47	14.3	10.9	0.47	14.8
R1	43.9	0.47	12.4	54.9	0.47	12.9
R2	13.5	0.59	12.6	68.4	0.49	12.8
B3	1.6	0.64	17.1	70.0	0.50	12.9
R3	3.5	0.90	13.2	73.5	0.52	12.9
Short	13.5	3.68	15.4	87.0	1.00	13.3
Bran	13.0	5.17	17.6	100.0	1.55	13.9
Wheat		1.55	13.9			
Patent Flour		0.50	13.1			

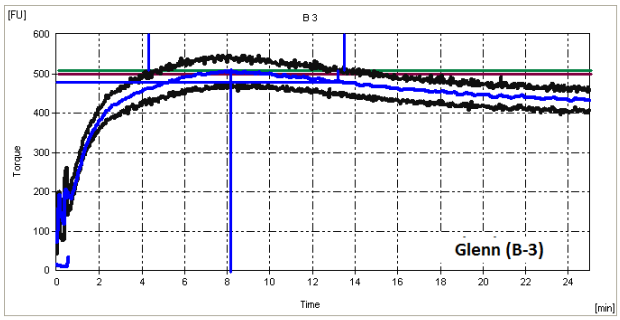
Cumulative Ash:	Line C (W08)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
B1	6.6	0.38	12.9	6.6	0.38	12.9
B2	7.5	0.50	16.0	14.0	0.45	14.5
R1	37.7	0.57	14.0	51.8	0.54	14.1
B3	2.8	0.71	18.4	54.6	0.54	14.4
R2	12.9	0.71	14.7	67.5	0.58	14.4
R3	3.7	1.00	15.4	71.2	0.60	14.5
Short	11.7	3.02	16.6	82.9	0.94	14.8
Bran	17.1	4.75	18.2	100.0	1.59	15.4
Wheat		1.67	15.8			
Patent Flour		0.60	14.7			

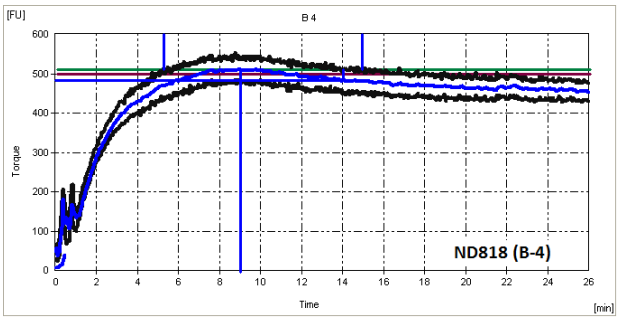


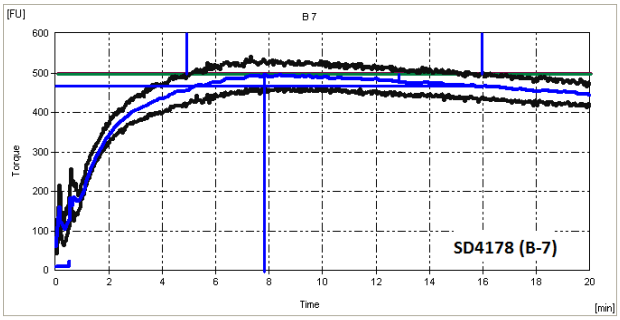
Cumulative Ash:	11 Fx Mn (W10)					
Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
B1	7.7	0.40	17.4	7.7	0.40	17.4
B2	4.7	0.43	18.3	12.5	0.41	17.7
R1	42.1	0.48	15.4	54.5	0.46	16.0
R2	12.7	0.56	15.4	67.3	0.48	15.9
B3	1.9	0.61	20.8	69.1	0.48	16.0
R3	3.5	0.86	15.8	72.7	0.50	16.0
Short	12.9	3.72	17.1	85.6	0.99	16.2
Bran	14.4	5.28	19.0	100.0	1.61	16.6
Wheat		1.54	17.1			
Patent Flour		0.51	16.4			

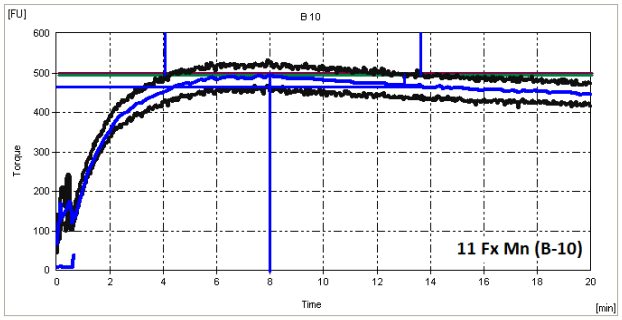
Farinograms

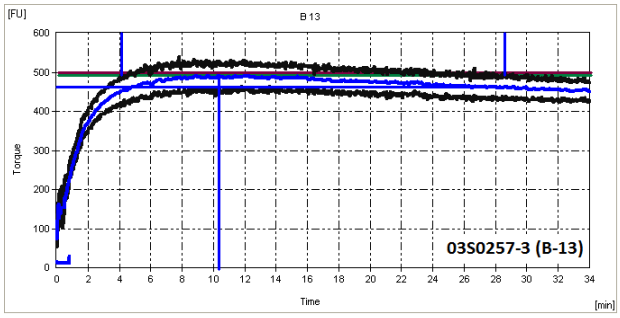
Watertown (Group B)



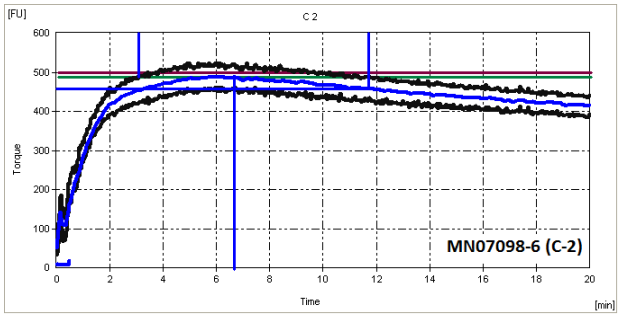


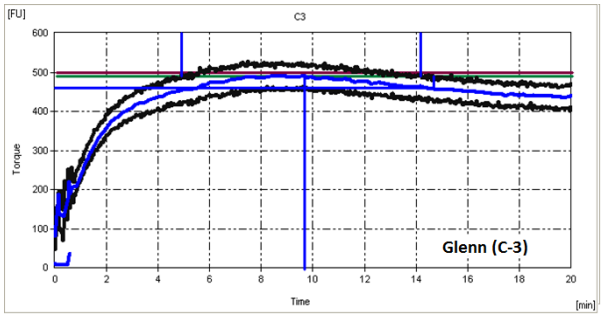


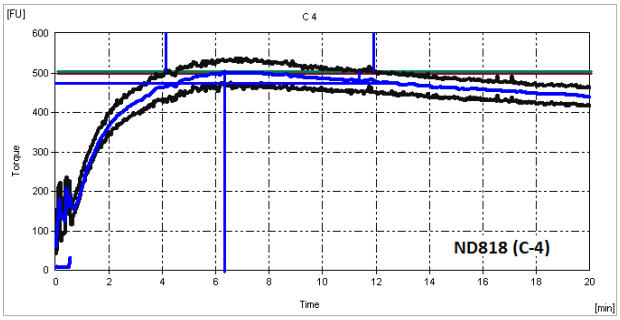


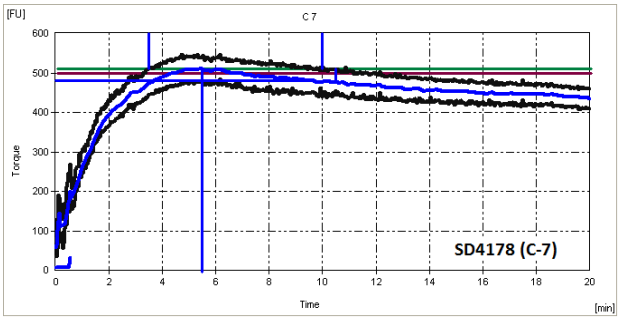


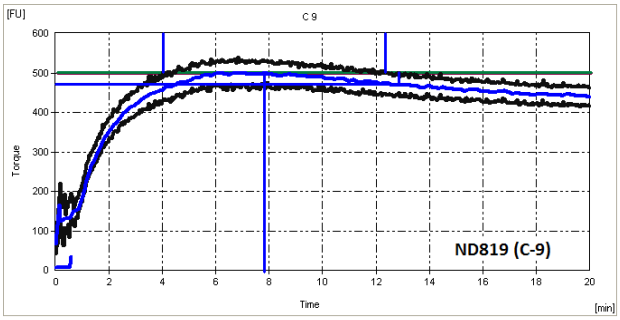
Casselton (Group C)

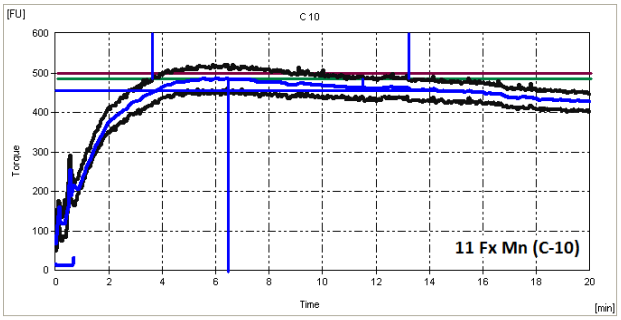


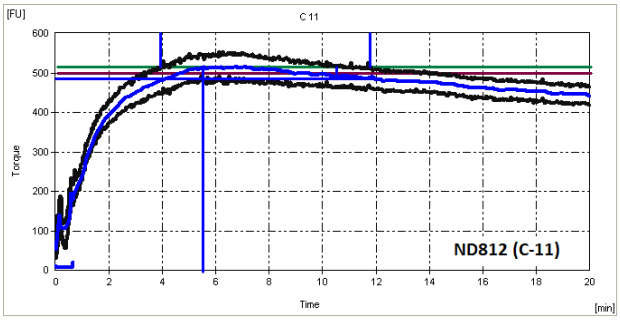


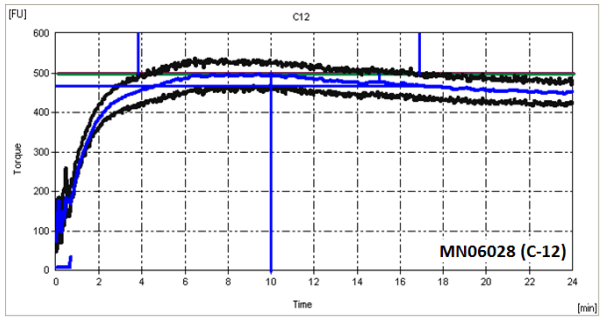


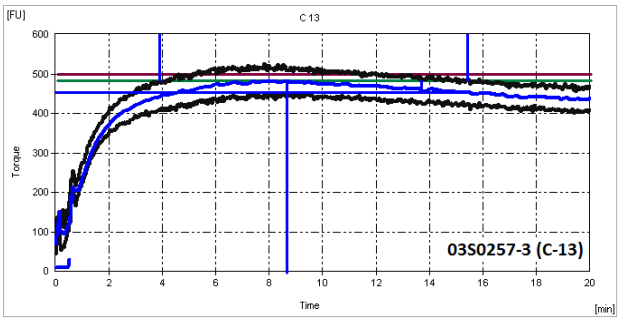


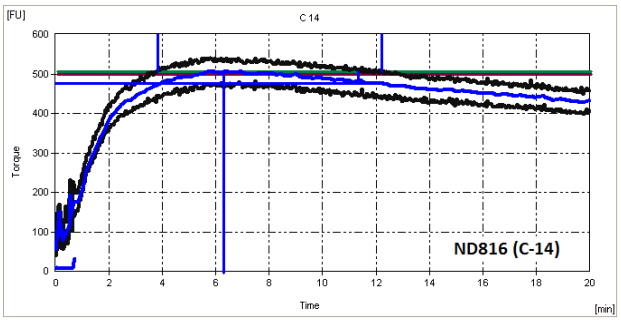




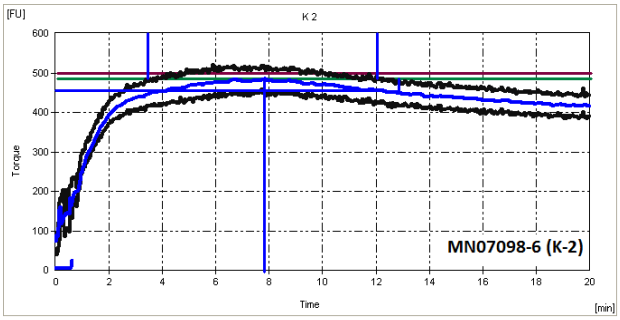


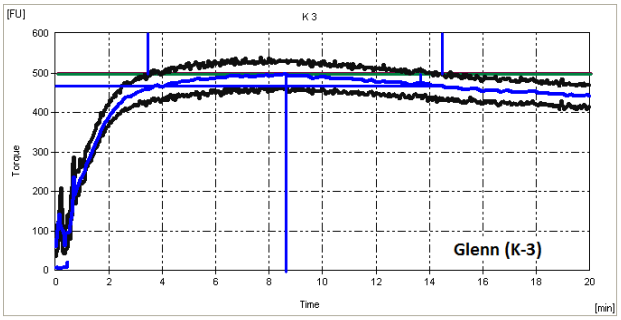


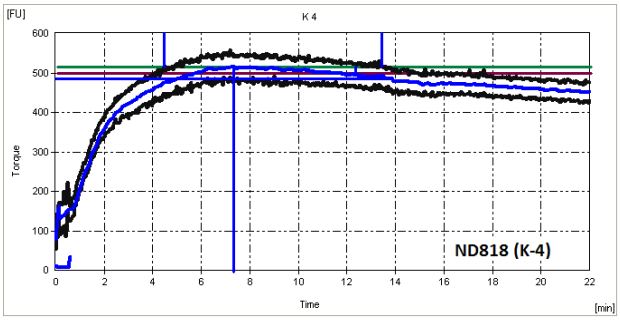


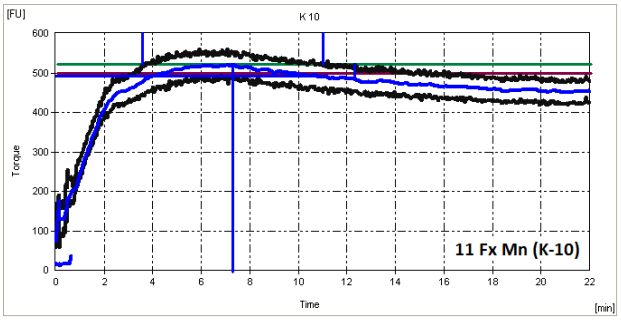


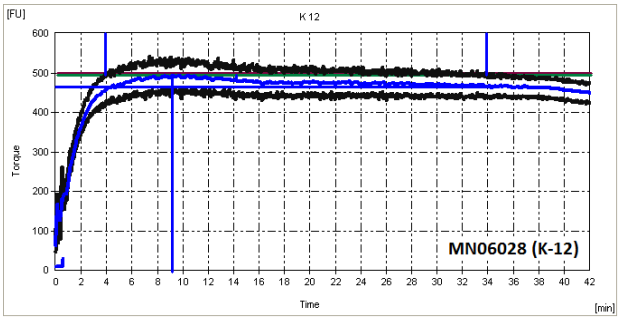
Crookston (Group K)

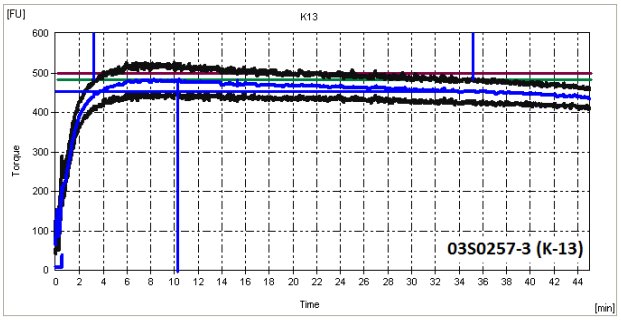




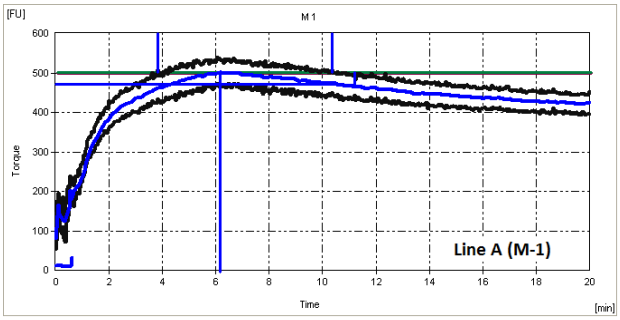


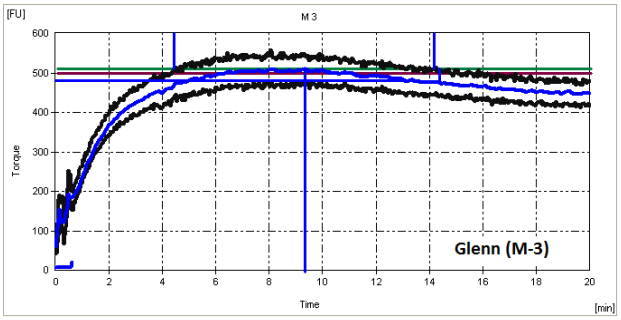


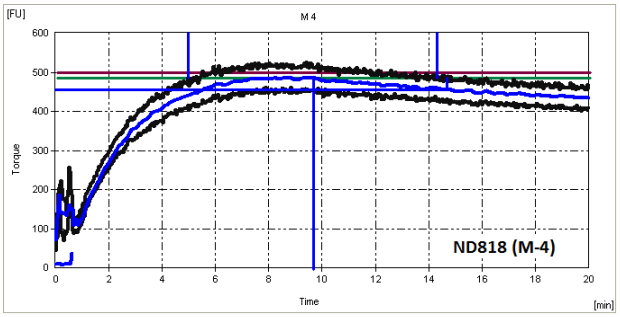


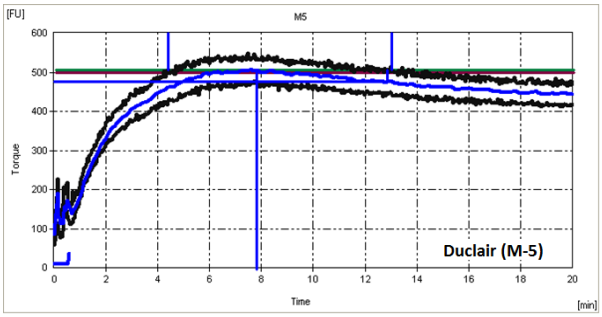


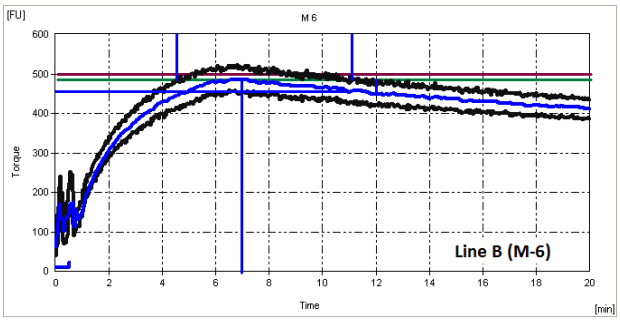
Minot (Group M)

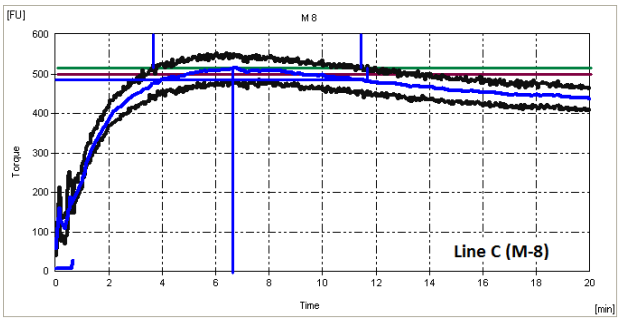


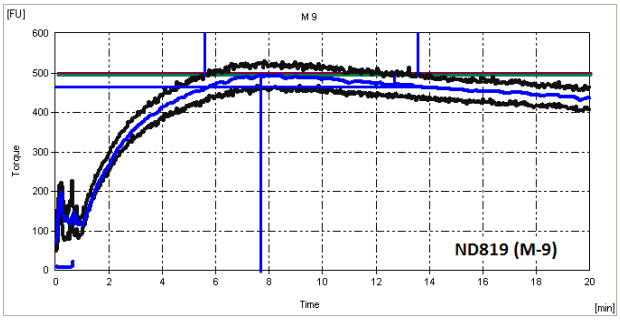


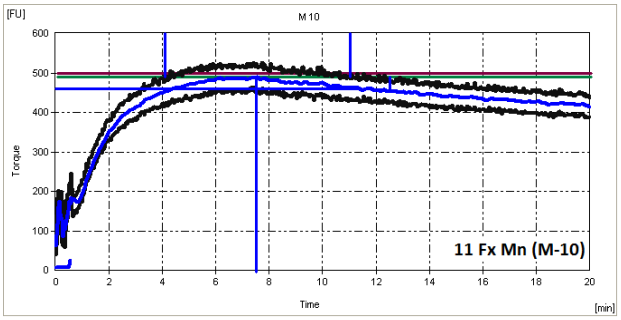


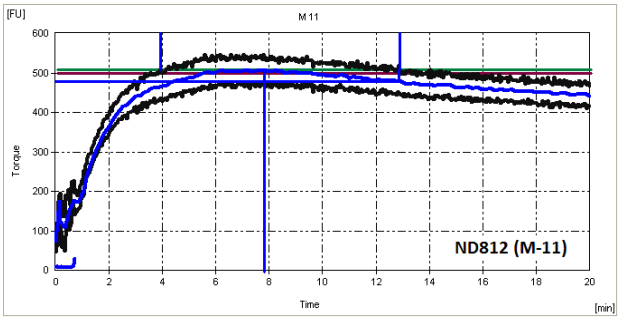


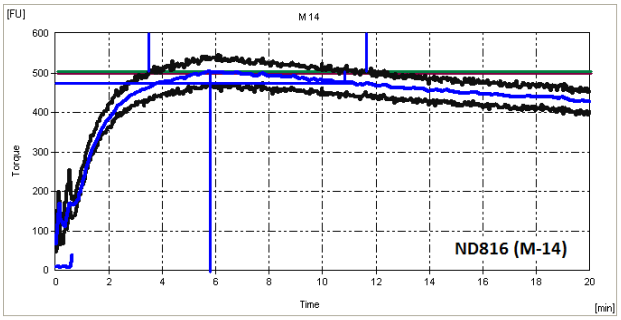




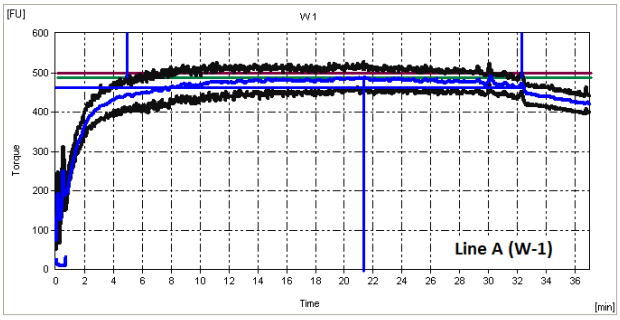


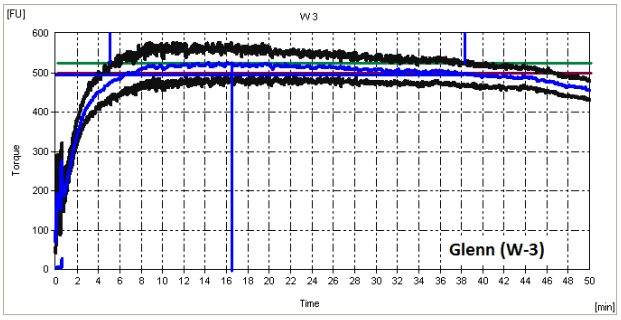


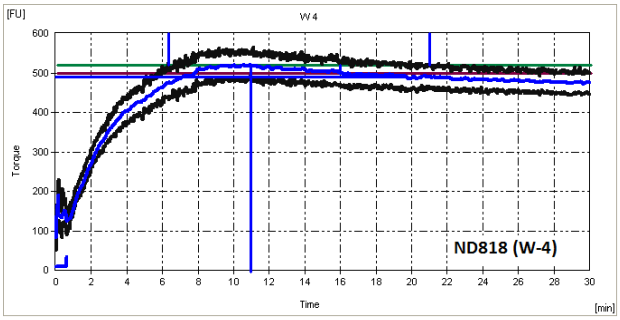


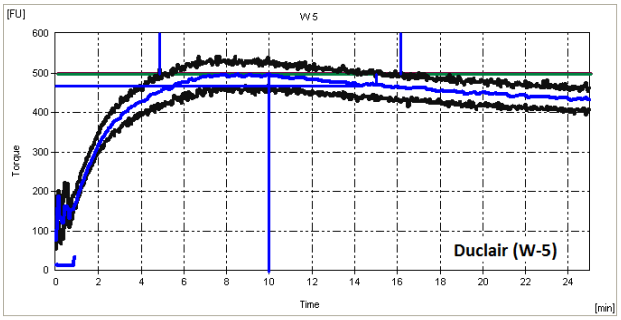


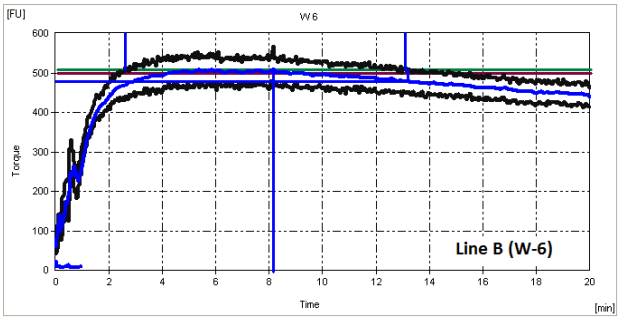
Williston (Group W)

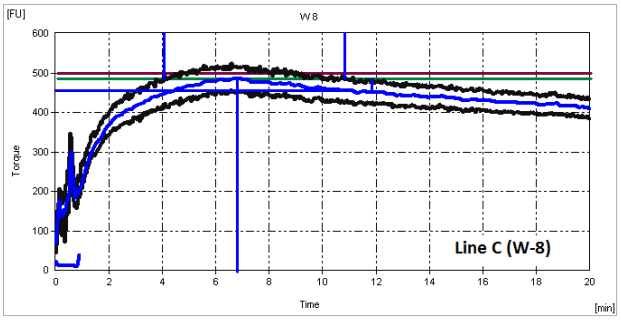


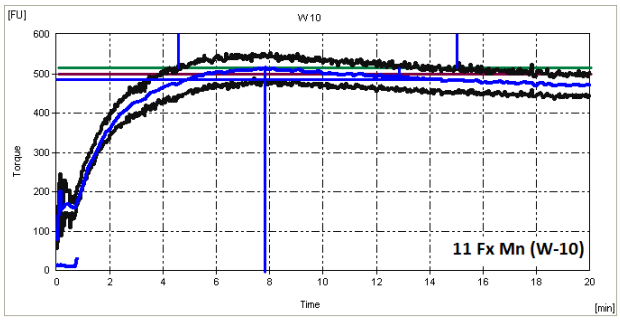






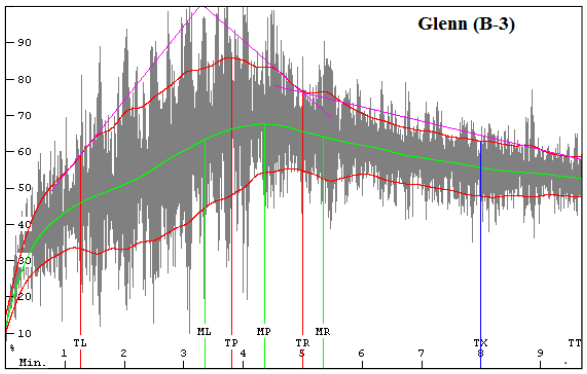


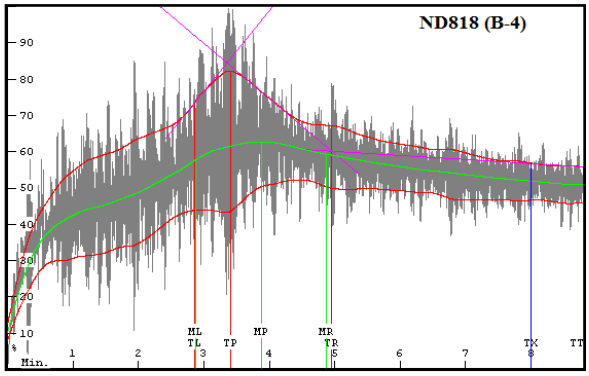


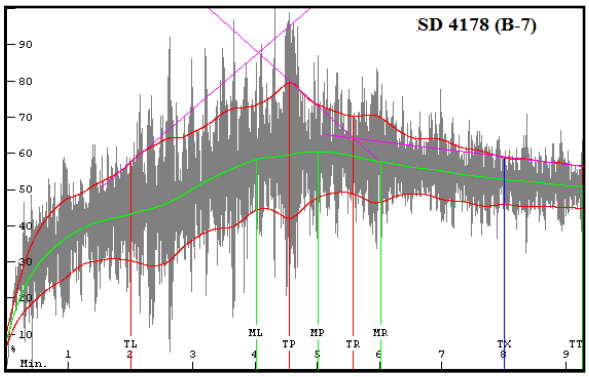


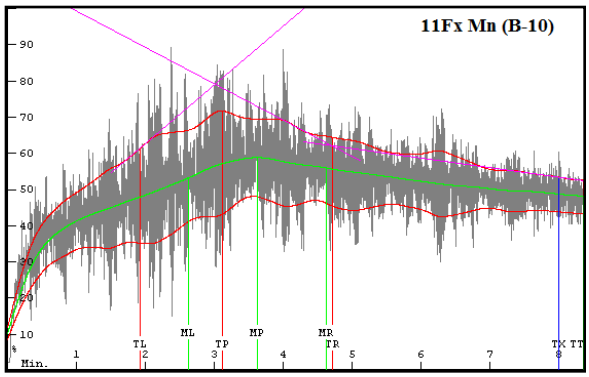
Mixograms

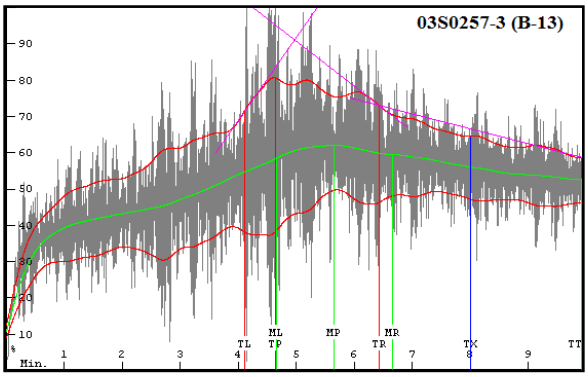
Watertown (Group B)



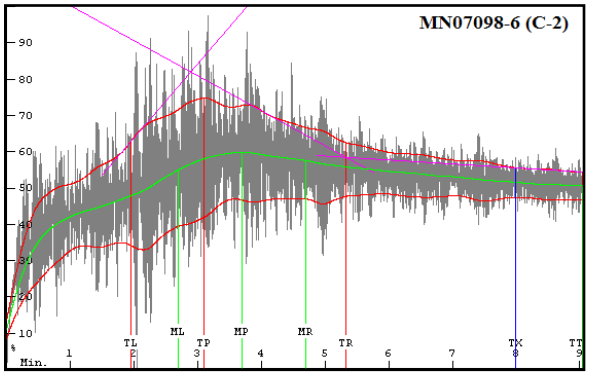


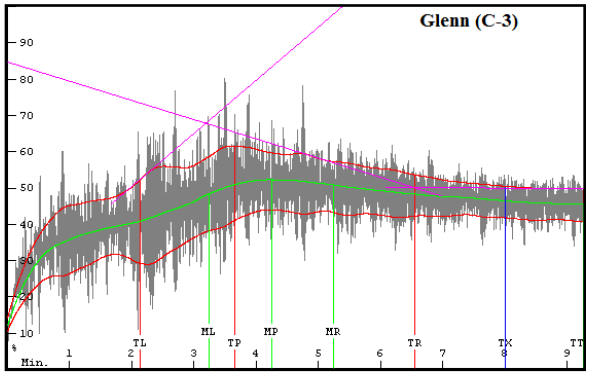


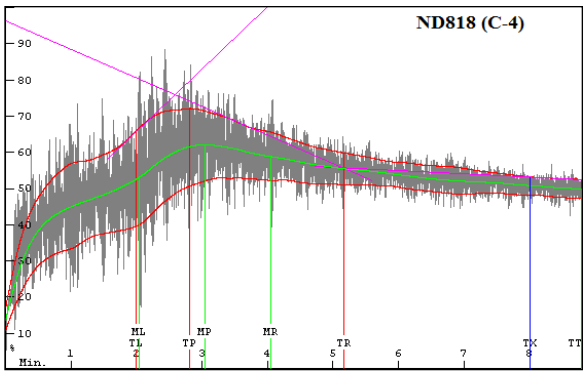


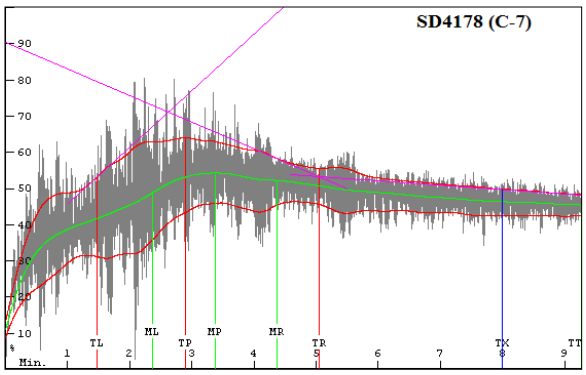


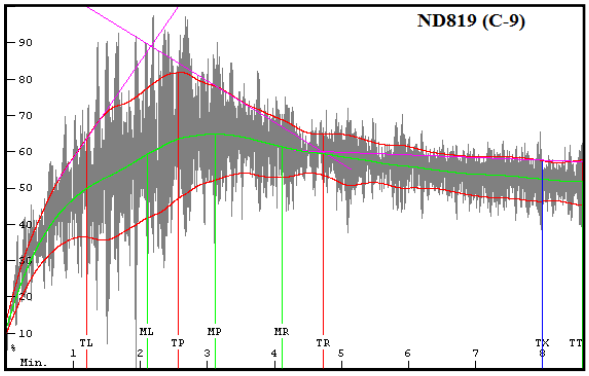
Casselton (Group C)

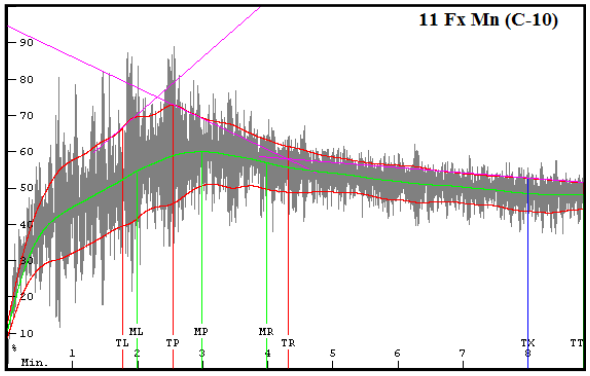


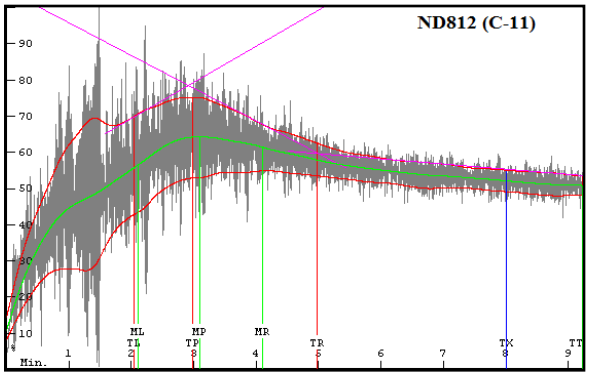


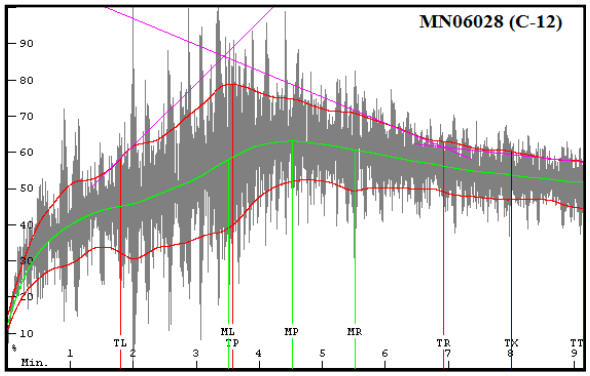


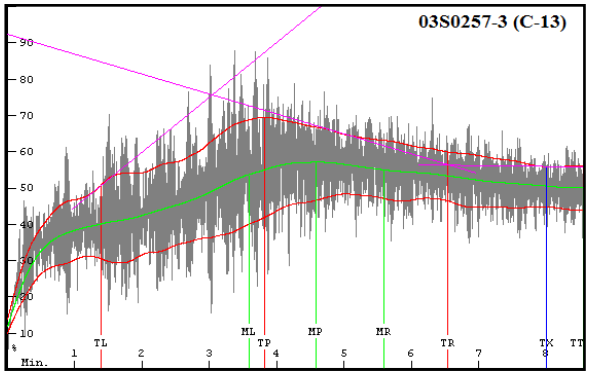


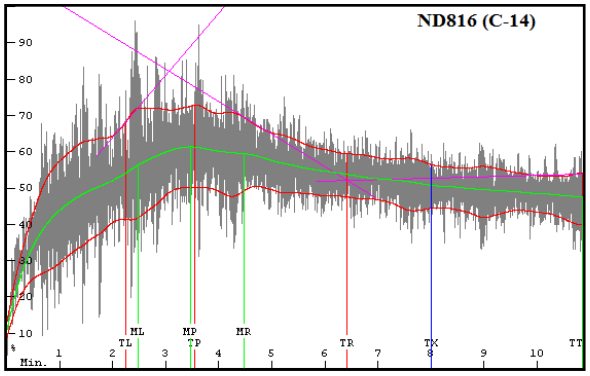




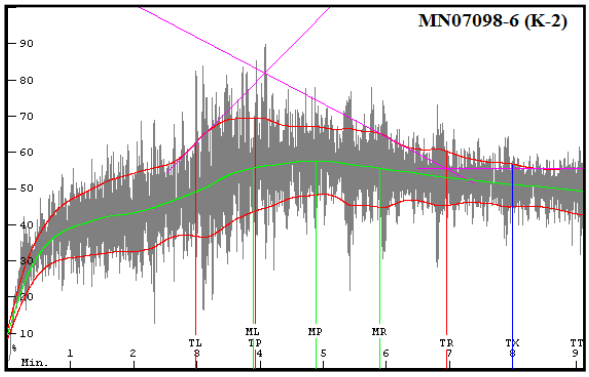


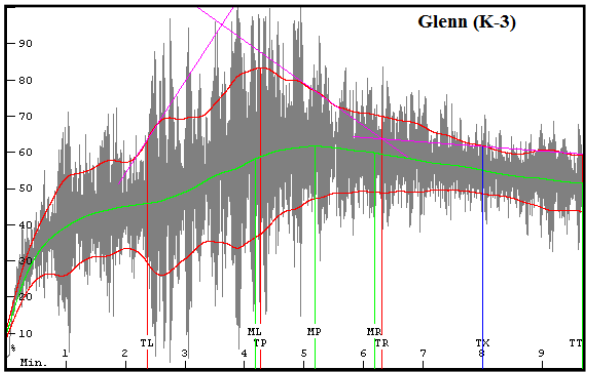


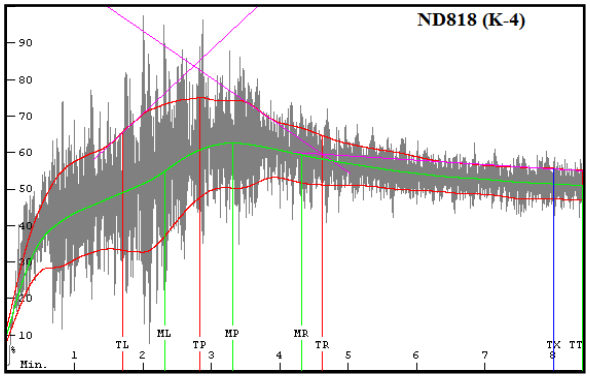


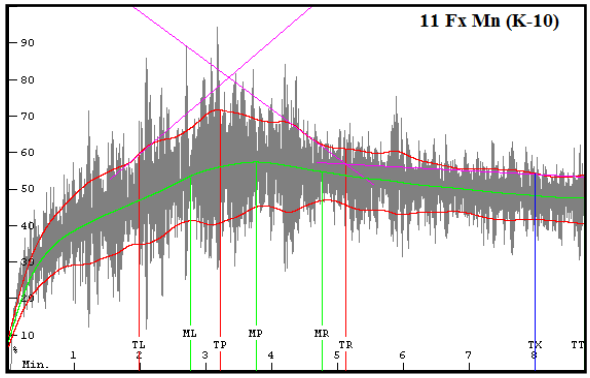


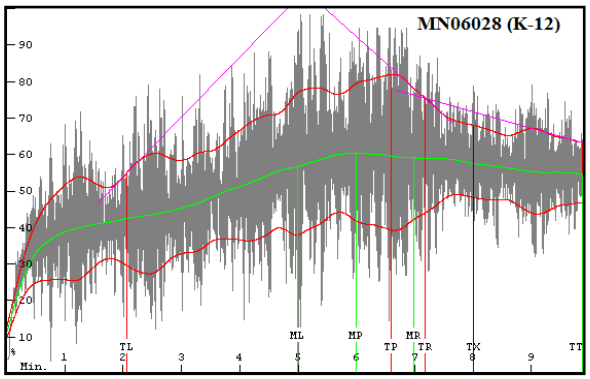
Crookston (Group K)

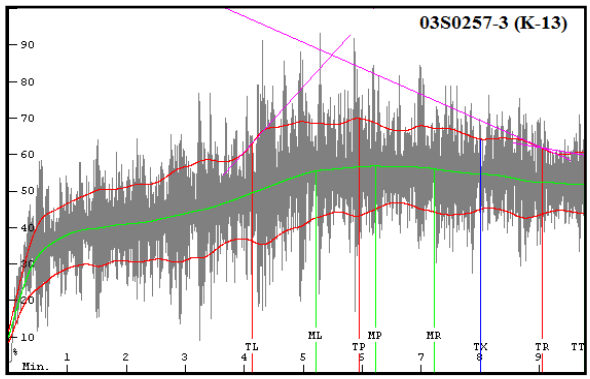




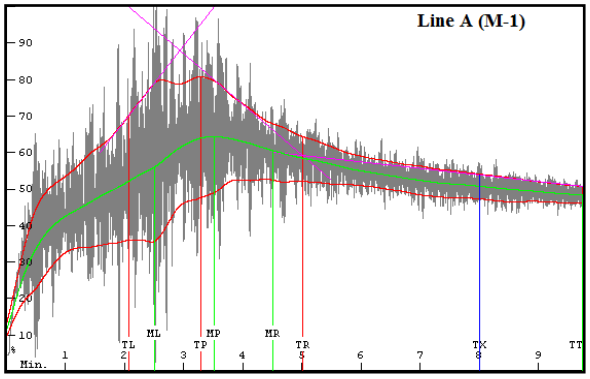


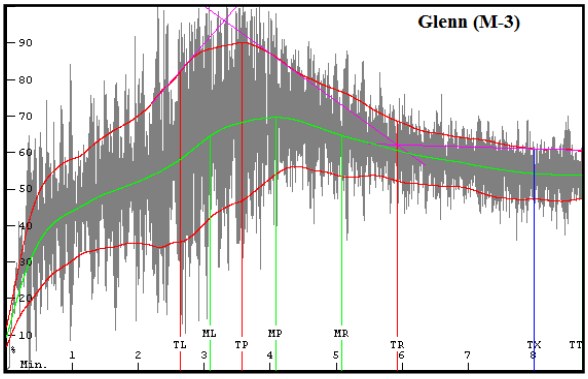


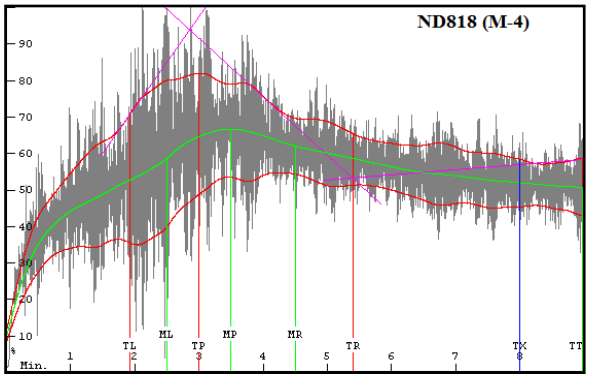


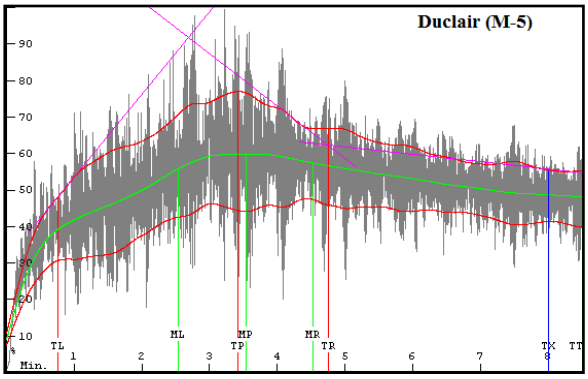


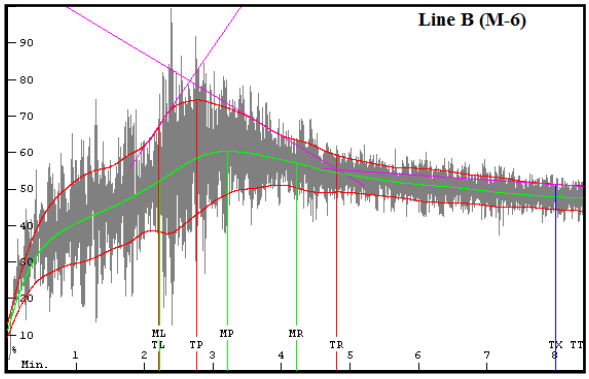
Minot (Group M)

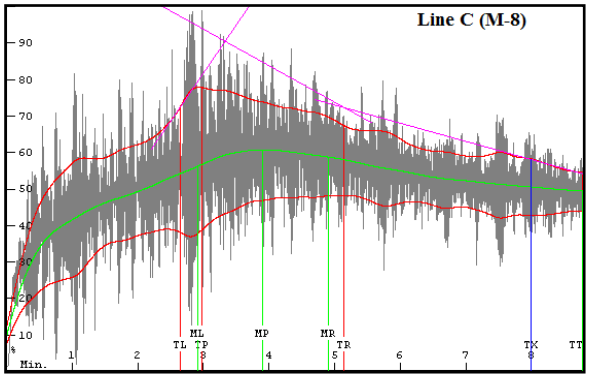


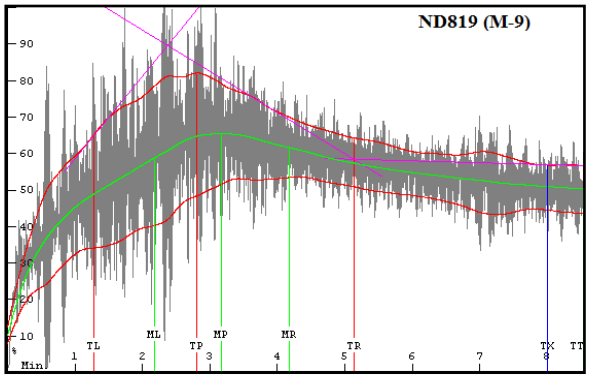


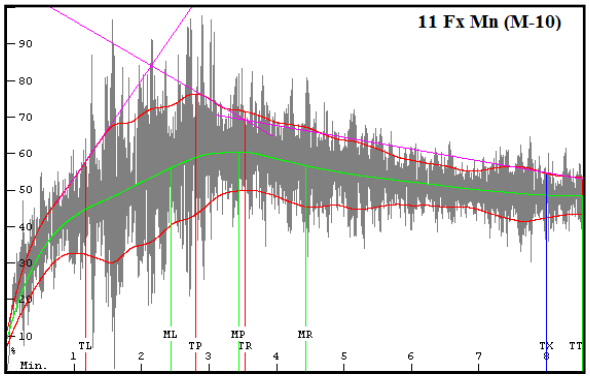


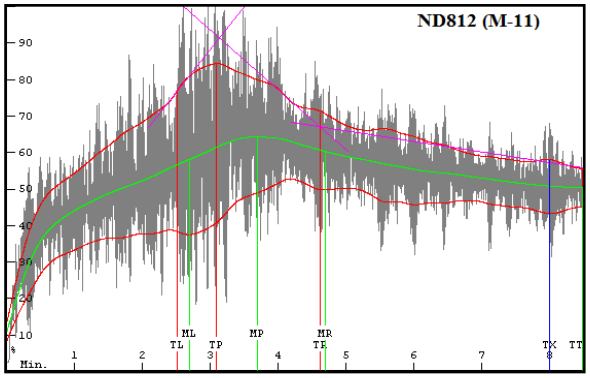


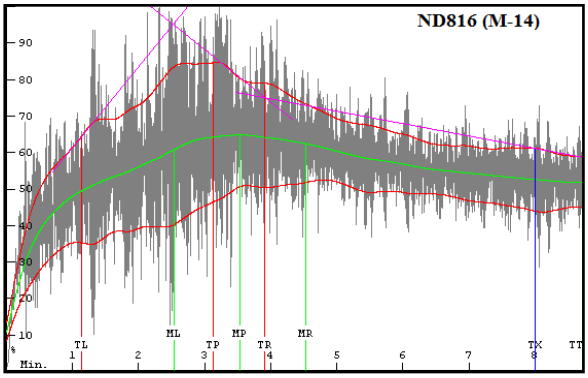




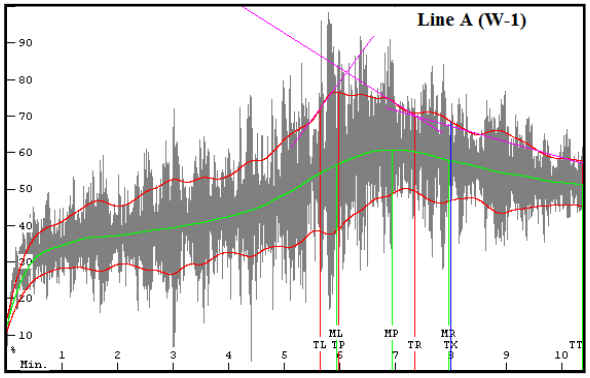


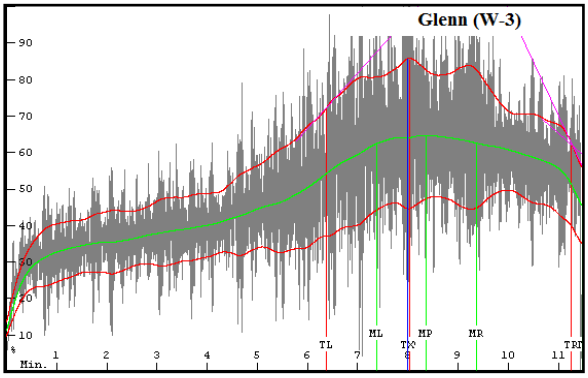


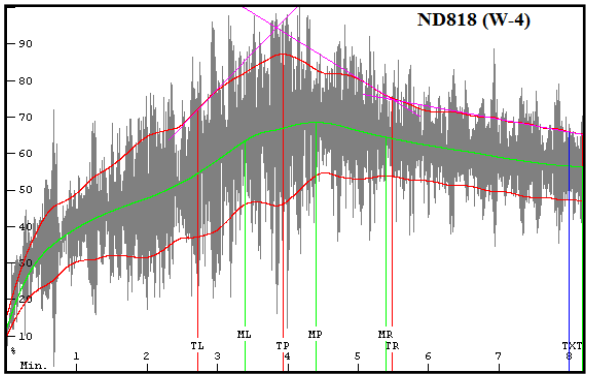


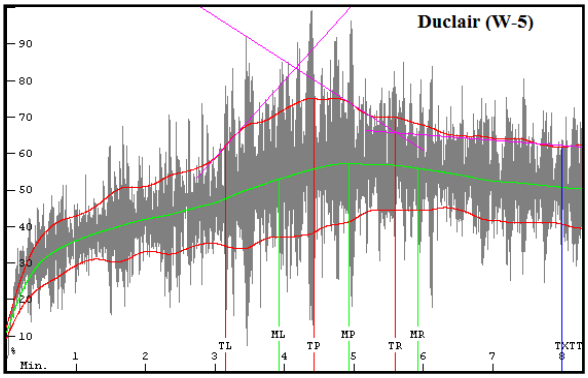


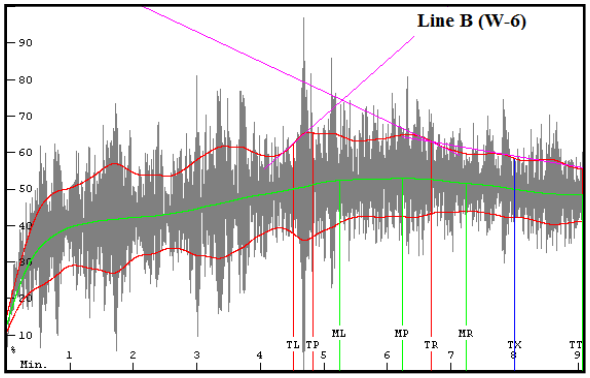
Williston (Group W)

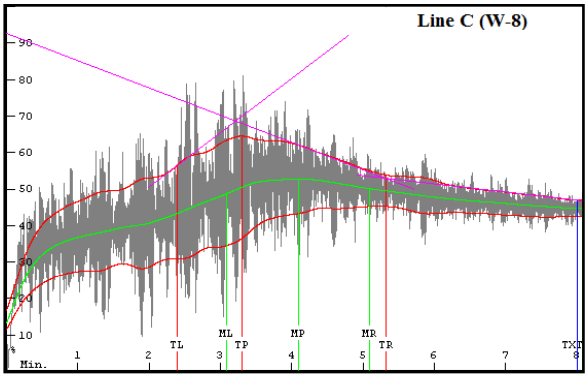


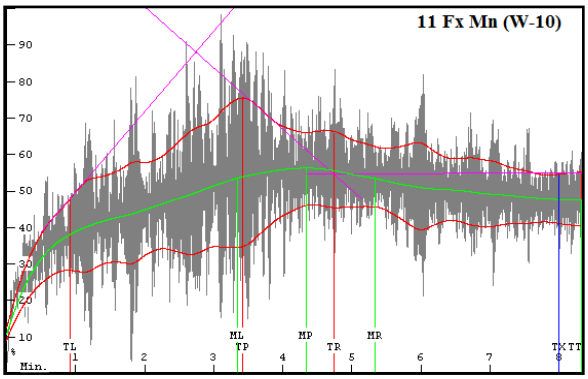







Line B (W-6)
90
80
70
60
50
40
30
20
10
%
Min.
1
2
3
4
5
6
7
8
9
TL
TP
ML
MP
TR
MR
TX
TT


Line C (W-8)
90
80
70
60
50
40
30
20
10
%
Min.
1
2
3
4
5
6
7
8
TL
ML
TP
MP
MR
TR
TXT


11 Fx Mn (W-10)
90
80
70
60
50
40
30
20
10
%
Min.
1
2
3
4
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TL
ML
TP
MP
TR
MR
TX
TT

Protein and Wheat Kernel Characteristics by Location

Entry ID	Protein (12% mb)		Market Score		Test Weight (lb/bu)	1000 Kernel Weight (g)	Kernel Size		Wheat Ash (14% mb) (%)	Wheat Falling No (sec)
	Wheat (%)	Flour (%)	M1 (1 to 6)	M2 (1 to 10)			Large (%)	Small (%)		
Watertown, SD										
Glenn (B3, Check)	16.5	15.4	4.4	10.0	62.2	21.4	28	18	1.71	445
ND818 (B4)	16.2	15.3	3.6	8.4	57.6	24.9	17	22	1.70	472
SD4178 (B7)	15.1	14.1	3.7	7.2	59.1	27.0	14	29	1.69	458
11 Fx Mn (B10)	16.4	15.3	3.8	8.8	58.2	24.4	16	27	1.72	471
03S0257-3 (B13)	16.2	15.1	3.4	8.0	57.0	22.2	8	36	1.68	545
Casselton, ND										
MN07098-6 (C2)	13.5	12.5	4.1	8.4	62.0	28.3	38	17	1.44	461
Glenn (C3, Check)	14.9	14.2	4.8	10.0	64.0	29.8	55	11	1.47	433
ND818 (C4)	14.2	13.6	3.7	7.8	59.5	28.7	43	14	1.55	508
SD4178 (C7)	13.6	12.8	4.1	7.6	60.6	31.3	43	18	1.43	462
ND 819 (C9)	15.0	13.8	4.4	8.8	60.9	30.9	58	10	1.53	454
11 Fx Mn (C10)	14.6	13.3	4.5	9.6	62.0	30.2	57	12	1.48	467
ND 812 (C11)	14.6	13.8	4.6	9.6	62.4	30.1	53	12	1.48	457
MN06028 (C12)	15.3	14.3	4.9	9.0	62.4	34.2	65	8	1.66	494
03S0257-3 (C13)	13.5	12.8	3.6	6.8	59.9	27.3	38	18	1.53	482
ND 816 (C14)	14.6	13.3	4.4	9.4	62.2	30.3	61	10	1.61	445
Crookston, MN										
MN07098-6 (K2)	13.6	12.8	4.0	8.4	61.0	27.4	27	21	1.31	485
Glenn (K3, Check)	14.1	13.5	4.4	10.0	64.2	29.9	52	12	1.58	420
ND818 (K4)	15.3	14.5	4.2	8.0	59.4	27.6	37	15	1.33	479
11 Fx Mn (K10)	15.5	14.6	5.0	9.2	62.1	30.9	54	11	1.33	590
MN06028 (K12)	15.5	15.1	4.9	9.2	61.4	33.9	46	11	1.44	517
03S0257-3 (K13)	13.7	13.4	3.8	8.0	59.9	26.2	26	24	1.35	503
Minot, ND										
Line A (M1)	14.7	14.0	2.8	8.6	59.5	28.2	41	17	1.76	324
Glenn (M3, Check)	15.1	14.8	4.1	10.0	61.4	27.5	43	15	1.58	395
ND818 (M4)	15.3	15.0	3.7	8.8	58.1	27.0	35	17	1.55	442
Duclair (M5)	15.4	15.2	3.0	8.0	56.5	29.7	45	14	1.80	380
Line B (M6)	15.7	15.2	2.7	7.0	57.0	30.0	56	11	1.72	311
Line C (M8)	14.9	14.5	3.4	8.8	57.6	28.4	43	15	1.66	419
ND 819 (M9)	15.5	15.2	4.0	9.2	59.4	26.2	39	16	1.58	469
11 Fx Mn (M10)	15.2	14.8	4.2	10.0	60.8	28.0	41	19	1.52	415
ND 812 (M11)	15.4	14.8	4.0	9.6	60.1	26.5	40	16	1.59	417
ND 816 (M14)	15.5	14.9	4.2	9.6	59.7	30.1	50	13	1.60	421
Williston, ND										
Line A (W1)	16.8	16.2	3.5	7.6	55.1	21.9	4	50	1.61	435
Glenn (W3, Check)	18.0	17.4	4.0	10.0	59.0	22.6	2	37	1.52	418
ND818 (W4)	18.8	18.3	3.5	8.8	55.3	21.1	2	47	1.56	496
Duclair (W5)	16.8	16.3	3.7	8.0	56.2	24.6	5	32	1.55	490
Line B (W6)	14.3	13.4	3.6	6.6	59.0	29.7	32	12	1.55	413
Line C (W8)	16.2	15.1	2.9	5.6	57.0	29.8	44	9	1.67	316
11 Fx Mn (W10)	17.5	16.8	4.2	9.4	59.7	22.6	10	33	1.54	494

Wheat Vitreous Kernel, Single Kernel Characteristic, and Mycotoxin Data by Location

Entry ID	Vitreous Kernels	Single Kernel Characteristics[1]						Mycotoxin (DON)[2] (12% mb)
		Hardness Index		Weight (mg)		Diameter (mm)		
	(%)	Mean	SD	Mean	SD	Mean	SD	(ppm)
Watertown, SD								
Glenn (B3, Check)	99	91.2	17.9	29.3	9.2	2.58	0.28	0.0
ND818 (B4)	92	87.2	18.5	27.7	9.2	2.50	0.29	0.0
SD4178 (B7)	96	74.4	18.1	30.2	9.2	2.46	0.30	0.0
11 Fx Mn (B10)	99	82.1	18.0	28.9	9.0	2.51	0.28	0.0
03S0257-3 (B13)	92	77.6	19.7	26.3	9.0	2.40	0.29	0.0
Casselton, ND								
MN07098-6 (C2)	67	85.4	18.5	29.7	8.3	2.58	0.29	0.0
Glenn (C3, Check)	96	90.4	17.2	32.3	9.2	2.71	0.29	0.3
ND818 (C4)	89	84.4	19.0	30.7	7.7	2.58	0.29	0.0
SD4178 (C7)	52	64.0	18.0	33.3	8.9	2.61	0.30	0.3
ND 819 (C9)	75	86.0	17.9	32.7	8.3	2.69	0.32	0.4
11 Fx Mn (C10)	83	83.2	17.5	32.8	8.7	2.69	0.32	0.2
ND 812 (C11)	95	94.3	17.9	31.9	8.3	2.67	0.31	0.5
MN06028 (C12)	80	78.5	16.4	35.9	8.6	2.76	0.31	0.5
03S0257-3 (C13)	35	71.0	17.9	30.1	8.4	2.56	0.29	0.0
ND 816 (C14)	67	91.4	17.7	31.9	8.4	2.65	0.31	0.3
Crookston, MN								
MN07098-6 (K2)	89	88.1	16.9	29.5	8.8	2.56	0.28	0.0
Glenn (K3, Check)	99	92.7	18.0	33.4	9.2	2.73	0.29	0.7
ND818 (K4)	99	84.4	17.0	31.6	8.9	2.62	0.31	0.0
11 Fx Mn (K10)	98	79.9	16.6	33.2	8.9	2.66	0.30	0.0
MN06028 (K12)	100	77.6	17.4	33.2	9.1	2.65	0.30	0.4
03S0257-3 (K13)	76	70.5	15.9	30.0	9.0	2.55	0.29	0.0
Minot, ND								
Line A (M1)	98	76.5	18.4	32.4	10.7	2.58	0.34	0.9
Glenn (M3, Check)	96	84.0	19.5	30.6	9.7	2.64	0.34	0.6
ND818 (M4)	98	77.3	22.1	29.8	9.4	2.53	0.33	1.4
Duclair (M5)	92	59.3	25.1	32.2	10.2	2.58	0.34	3.5
Line B (M6)	80	56.4	29.6	32.0	10.8	2.63	0.36	3.3
Line C (M8)	98	80.3	18.9	30.6	9.9	2.58	0.35	2.4
ND 819 (M9)	98	80.9	19.8	30.4	10.8	2.58	0.34	1.0
11 Fx Mn (M10)	99	80.8	19.6	30.4	9.2	2.55	0.30	0.6
ND 812 (M11)	97	89.8	18.6	29.3	9.0	2.56	0.29	0.0
ND 816 (M14)	99	88.6	18.4	33.2	11.5	2.66	0.35	1.1
Williston, ND								
Line A (W1)	88	61.5	18.6	26.0	9.8	2.29	0.31	0.0
Glenn (W3, Check)	99	66.4	18.1	28.3	10.0	2.45	0.27	0.0
ND818 (W4)	99	64.2	20.1	25.7	9.4	2.33	0.29	0.0
Duclair (W5)	97	53.3	18.6	28.7	10.0	2.43	0.29	0.0
Line B (W6)	97	73.8	16.6	32.7	8.9	2.60	0.30	0.0
Line C (W8)	85	46.3	26.0	31.5	8.4	2.58	0.29	0.3
11 Fx Mn (W10)	98	68.7	18.9	26.4	8.5	2.42	0.29	0.0

[1]Mean and standard deviation (SD) values were calculated from data of 300 kernels.

[2]DON=Deoxynivalenol-FDA advisory level for DON content is 1 part per million (ppm) on finished wheat products, e.g. flour, bran and germ that may potentially be consumed by humans

Flour Characteristics by Location

Entry ID	Flour Extraction[1]			Damaged Starch	Flour Color				Ash	Falling Number	
	TWB (%)	TPB (%)	FBW (lbs)	(%) (14% mb)	L*	b*	L	b	(%) (14% mb)	(No Malt) (sec)	(Malted) (sec)
Watertown, SD											
Glenn (B3, Check)	72.8	72.7	43.9	7.41	89.6	7.9	86.9	7.6	0.690	473	254
ND818 (B4)	72.1	73.6	43.5	7.20	89.6	8.5	86.9	8.2	0.554	547	256
SD4178 (B7)	74.6	75.9	45.0	6.20	90.0	8.4	87.4	8.1	0.601	594	253
11 Fx Mn (B10)	73.0	72.7	44.1	6.63	89.9	8.3	87.2	8.0	0.571	578	250
03S0257-3 (B13)	72.1	71.9	43.5	6.49	89.5	9.2	86.7	8.8	0.632	631	262
Casselton, ND											
MN07098-6 (C2)	75.6	75.8	45.6	7.01	90.4	8.1	87.8	7.8	0.550	416	250
Glenn (C3, Check)	72.6	71.7	43.8	7.57	90.5	7.5	88.0	7.3	0.543	420	255
ND818 (C4)	75.0	75.7	45.3	6.89	90.1	8.1	87.5	7.8	0.616	454	252
SD4178 (C7)	72.7	74.6	43.9	5.82	89.6	7.9	86.8	7.6	0.568	476	250
ND 819 (C9)	76.2	74.2	46.0	7.76	90.4	8.1	87.9	7.8	0.553	437	245
11 Fx Mn (C10)	72.1	71.0	43.5	5.75	91.0	7.4	88.5	7.1	0.574	435	251
ND 812 (C11)	75.4	75.5	45.5	7.96	90.3	8.1	87.7	7.8	0.536	436	250
MN06028 (C12)	74.5	74.7	44.9	5.54	90.9	6.9	88.5	6.7	0.582	531	243
03S0257-3 (C13)	75.4	75.7	45.5	5.92	90.6	8.5	88.1	8.2	0.577	488	248
ND 816 (C14)	75.7	75.1	45.7	7.32	90.3	8.0	87.7	7.7	0.534	460	256
Crookston, MN											
MN07098-6 (K2)[2]	72.3	72.4	43.6	6.72	90.1	8.2	87.5	7.9	0.551	474	253
Glenn (K3, Check)	75.6	73.0	45.6	7.00	90.8	7.6	88.3	7.4	0.512	447	256
ND818 (K4)	75.7	74.1	45.7	6.19	90.9	7.9	88.5	7.7	0.474	494	248
11 Fx Mn (K10)	72.6	72.9	43.8	5.27	90.3	8.0	87.7	7.7	0.444	523	250
MN06028 (K12)	73.7	72.6	44.5	5.58	90.4	6.6	87.8	6.4	0.539	659	248
03S0257-3 (K13)	75.8	75.4	45.8	5.90	90.0	8.5	87.3	8.1	0.491	595	250
Minot, ND											
Line A (M1)	73.3	73.4	44.2	6.53	91.0	8.3	88.5	8.0	0.655	391	252
Glenn (M3, Check)	74.4	73.5	44.9	7.17	90.8	7.7	88.3	7.4	0.589	430	253
ND818 (M4)	71.7	73.3	43.2	6.40	90.9	8.1	88.4	7.8	0.587	470	251
Duclair (M5)	72.6	71.4	43.8	5.73	91.1	7.1	88.7	6.9	0.683	424	257
Line B (M6)	74.5	70.7	45.0	6.39	90.5	6.7	88.0	6.5	0.732	368	253
Line C (M8)	71.9	71.5	43.4	7.41	90.6	7.3	88.1	7.0	0.663	468	255
ND 819 (M9)	72.8	72.4	44.0	7.94	90.5	7.9	88.0	7.6	0.656	502	250
11 Fx Mn (M10)	71.8	71.8	43.4	7.53	90.8	7.8	88.3	7.5	0.541	473	253
ND 812 (M11)	70.8	70.5	42.7	7.87	89.8	8.4	87.1	8.0	0.562	480	250
ND 816 (M14)	71.3	71.5	43.0	8.66	90.2	10.9	87.6	10.3	0.661	480	263
Williston, ND											
Line A (W1)	71.0	70.4	44.1	5.99	90.3	8.8	87.8	8.5	0.653	473	256
Glenn (W3, Check)	71.7	72.7	44.5	6.41	90.1	8.0	87.4	7.7	0.517	507	252
ND818 (W4)	70.5	71.1	43.8	6.60	90.2	8.4	87.6	8.0	0.528	642	261
Duclair (W5)	72.3	73.4	44.9	6.39	90.4	7.5	87.8	7.2	0.542	581	252
Line B (W6)	72.4	73.5	45.0	7.81	90.4	6.7	87.8	6.5	0.503	479	256
Line C (W8)	70.0	71.2	43.5	6.70	91.3	6.4	88.9	6.2	0.597	306	254
11 Fx Mn (W10)	71.9	72.7	44.7	6.42	90.1	8.0	87.5	7.6	0.507	622	258

[1]TWB= Tempered wheat basis; TPB=total product basis; and FPB= flour/standard bushel of wheat.

[2]Lost about 10 lbs of stock going from 2M to 3M due to sifter choke during milling. TPB and FPB were estimated assuming 98% of milling recovery.

Farinograph Characteristics by Location

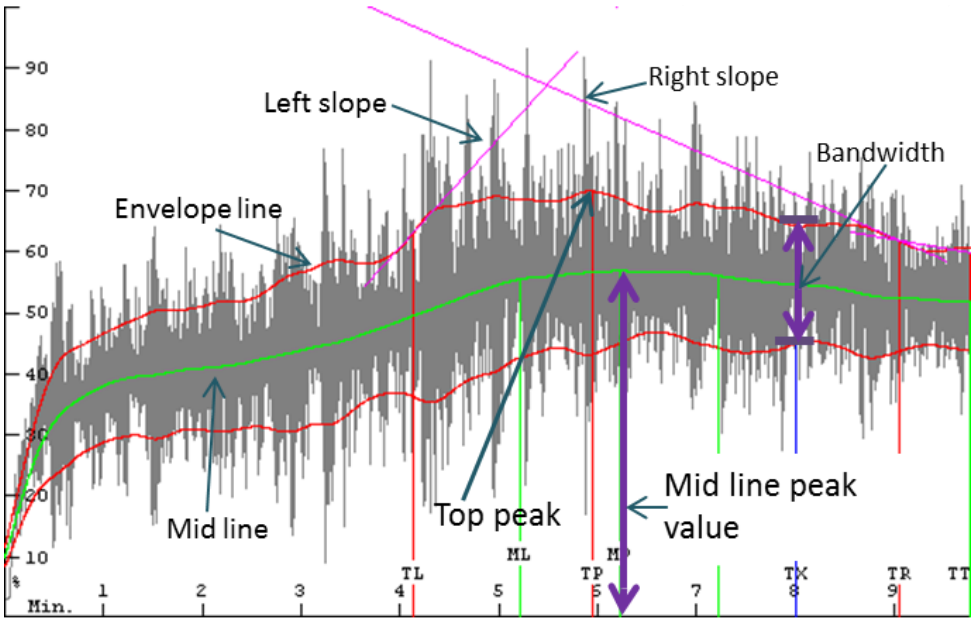
Entry ID	Water Absorption (%, 500 FU)	Water Absorption (%, 14% mb)	Arrival Time (min)	Peak Time (min)	Dough Stability (min)	Mixing Tolerance Index (FU)	Time To Breakdown (min)
Watertown, SD							
Glenn (B3, Check)	70.4	67.0	4.4	8.2	9.2	27	13.5
ND818 (B4)	70.1	66.7	5.3	9.1	9.7	29	14.1
SD4178 (B7)	65.3	62.0	4.9	7.9	11.1	18	15.7
11 Fx Mn (B10)	69.1	65.1	4.1	8.1	9.6	29	13.7
03S0257-3 (B13)	66.6	63.8	4.2	10.4	24.4	7	26.4
Casselton, ND							
MN07098-6 (C2)	63.0	61.0	3.1	6.7	8.6	30	11.4
Glenn (C3, Check)	67.2	65.2	4.9	9.7	9.3	32	14.5
ND818 (C4)	67.0	65.2	4.2	6.4	7.8	24	12.8
SD4178 (C7)	61.8	60.0	3.5	5.5	6.5	32	9.7
ND 819 (C9)	69.3	67.3	4.1	7.9	8.3	31	12.6
11 Fx Mn (C10)	63.4	62.0	3.7	6.5	9.6	21	14.3
ND 812 (C11)	67.4	65.2	4.0	5.6	7.8	26	12.0
MN06028 (C12)	65.6	63.3	3.9	10.1	13.1	20	17.1
03S0257-3 (C13)	63.1	60.5	3.9	8.7	11.5	24	15.5
ND 816 (C14)	67.2	65.2	3.9	6.4	8.4	24	11.8
Crookston, MN							
MN07098-6 (K2)	62.6	60.4	3.5	7.9	8.6	37	12.3
Glenn (K3, Check)	66.0	63.2	3.5	8.7	11.0	22	14.5
ND818 (K4)	68.4	65.3	4.5	7.4	9.0	20	13.8
11 Fx Mn (K10)	64.5	62.3	3.6	7.4	7.5	37	10.8
MN06028 (K12)	65.7	62.9	3.9	9.2	30.0	15	33.8
03S0257-3 (K13)	63.0	60.4	3.2	10.4	32.0	16	33.6
Minot, ND							
Line A (M1)	66.1	63.7	3.9	6.2	6.5	37	10.5
Glenn (M3, Check)	67.6	65.2	4.5	9.4	9.7	35	13.1
ND818 (M4)	69.7	66.4	5.0	9.7	9.3	31	14.6
Duclair (M5)	66.7	63.9	4.4	7.9	8.6	30	12.7
Line B (M6)	66.5	63.4	4.6	7.0	6.6	37	10.9
Line C (M8)	68.9	65.9	3.7	6.7	7.8	35	11.3
ND 819 (M9)	71.2	68.0	5.6	7.7	8.0	24	13.7
11 Fx Mn (M10)	68.9	66.0	4.1	7.6	6.9	36	11.4
ND 812 (M11)	68.8	66.2	4.0	7.9	9.0	29	13.0
ND 816 (M14)	70.7	68.2	3.5	5.9	8.1	26	11.2
Williston, ND							
Line A (W1)	64.7	62.0	5.0	21.4	27.4	8	32.5
Glenn (W3, Check)	65.8	63.4	5.1	16.5	33.3	11	37.9
ND818 (W4)	71.5	69.0	6.4	11.0	14.7	21	19.7
Duclair (W5)	66.7	63.5	4.9	10.0	11.3	29	14.3
Line B (W6)	64.2	61.1	2.6	8.2	10.5	29	13.2
Line C (W8)	64.0	61.1	4.1	6.9	6.8	34	11.1
11 Fx Mn (W10)	68.0	65.5	4.6	7.9	10.5	24	14.0

Mixograph Characteristics by Location

Entry ID	Water Absorption[1] (14% mb)	Envelope Peak Time (min)	Envelope Peak Value (%)	Envelope Peak Width (%)	Midline Peak Time (min)	Midline Peak Value (%)	Midline Peak Width (%)	Midline Peak Integral (%TQ*min)
Watertown, SD								
Glenn (B3, Check)	66.2	3.8	85.9	37.8	4.4	67.6	29.0	223.3
ND818 (B4)	65.9	3.4	82.2	38.6	3.9	62.7	26.2	185.1
SD4178 (B7)	64.4	4.6	79.3	37.5	5.0	60.4	25.7	228.5
11 Fx Mn (B10)	66.1	3.1	71.7	28.5	3.6	58.8	21.3	163.9
03S0257-3 (B13)	65.8	4.6	80.5	42.4	5.7	62.0	25.8	263.9
Casselton, ND								
MN07098-6 (C2)	62.0	3.1	74.7	32.9	3.7	59.8	26.0	171.2
Glenn (C3, Check)	64.3	3.7	61.6	20.3	4.3	52.3	15.7	172.0
ND818 (C4)	63.5	2.8	72.1	21.5	3.1	62.1	19.3	145.0
SD4178 (C7)	62.3	2.9	64.0	20.7	3.4	54.3	17.1	142.0
ND 819 (C9)	63.9	2.6	81.8	34.6	3.1	64.9	26.0	155.5
11 Fx Mn (C10)	63.0	2.6	72.8	27.1	3.0	60.0	18.8	140.7
ND 812 (C11)	63.7	3.0	75.2	22.3	3.1	64.3	22.1	148.6
MN06028 (C12)	64.6	3.6	78.8	38.9	4.5	63.1	22.8	213.3
03S0257-3 (C13)	62.4	3.8	69.4	27.5	4.6	57.1	20.1	201.6
ND 816 (C14)	63.2	3.5	72.8	22.5	3.5	61.3	22.3	165.1
Crookston, MN								
MN07098-6 (K2)	62.4	3.9	69.5	25.7	4.9	57.6	18.8	220.6
Glenn (K3, Check)	63.4	4.3	83.4	45.9	5.2	61.7	29.8	242.6
ND818 (K4)	64.8	2.8	75.0	27.5	3.3	62.6	24.1	156.4
11 Fx Mn (K10)	65.0	3.2	71.7	30.9	3.8	57.4	24.1	165.2
MN06028 (K12)	65.8	6.6	82.0	42.6	6.0	60.3	37.6	275.1
03S0257-3 (K13)	63.2	5.9	69.8	26.7	6.2	56.8	23.7	277.2
Minot, ND								
Line A (M1)	64.1	3.3	80.7	33.0	3.5	64.3	30.6	167.3
Glenn (M3, Check)	65.4	3.6	90.1	43.4	4.1	69.6	32.2	210.9
ND818 (M4)	65.7	3.0	82.0	33.1	3.5	66.7	25.5	173.0
Duclair (M5)	65.9	3.4	77.0	32.6	3.5	59.8	32.6	163.7
Line B (M6)	65.9	2.8	74.4	31.3	3.2	60.4	23.5	144.3
Line C (M8)	64.9	3.0	78.0	39.0	3.9	60.7	26.9	184.0
ND 819 (M9)	65.8	2.8	82.0	33.6	3.2	65.4	27.5	156.8
11 Fx Mn (M10)	65.3	2.8	76.3	33.0	3.4	60.4	22.1	160.7
ND 812 (M11)	65.4	3.1	84.3	43.6	3.7	64.2	30.9	181.7
ND 816 (M14)	65.4	3.1	84.8	38.1	3.5	64.8	29.7	182.1
Williston, ND								
Line A (W1)	68.0	6.0	76.7	37.5	7.0	60.7	25.4	297.9
Glenn (W3, Check)	69.8	8.0	85.7	41.2	8.4	64.7	35.2	366.7
ND818 (W4)	71.1	3.9	87.2	41.1	4.4	68.5	29.1	217.3
Duclair (W5)	68.3	4.4	75.1	36.8	4.9	57.2	32.8	212.8
Line B (W6)	63.1	4.8	65.5	28.5	6.2	53.0	22.4	277.1
Line C (W8)	65.6	3.3	64.5	28.0	4.1	52.7	18.8	168.5
11 Fx Mn (W10)	68.8	3.4	75.5	40.7	4.3	56.3	20.0	192.5

[1] Water absorption (%, 14% flour mb)=Protein (14% mb) x 1.5 + 43.6 (The Mixograph Handbook, 1997).

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 for left-of-peak and right-of-peak are undesirable, which indicate 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 peak. 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.)

Extensograph Data by Location - 45 min Resting

Entry ID	Energy [cm²]	Resistance (50 mm) [BU]	Extensibility [mm]	Maximum [BU]	Ratio Number	Ratio Number (Max.)
Watertown, SD						
Glenn (B3, Check)	141	271	213	511	1.27	2.40
ND818 (B4)	136	251	239	403	1.05	1.69
SD4178 (B7)	162	256	244	506	1.05	2.07
11 Fx Mn (B10)	100	229	202	361	1.13	1.79
03S0257-3 (B13)	217	351	243	684	1.45	2.82
Casselton, ND						
MN07098-6 (C2)	128	278	199	494	1.40	2.49
Glenn (C3, Check)	151	255	235	489	1.08	2.08
ND818 (C4)	105	223	218	344	1.02	1.58
SD4178 (C7)	103	229	206	361	1.11	1.75
ND 819 (C9)	112	207	226	368	0.92	1.63
11 Fx Mn (C10)	95	221	203	336	1.09	1.65
ND 812 (C11)	101	217	206	365	1.05	1.77
MN06028 (C12)	150	269	223	513	1.21	2.30
03S0257-3 (C13)	164	287	228	550	1.26	2.42
ND 816 (C14)	107	214	219	361	0.98	1.65
Crookston, MN						
MN07098-6 (K2)	155	293	216	556	1.36	2.57
Glenn (K3, Check)	177	276	235	589	1.17	2.50
ND818 (K4)	123	196	249	364	0.79	1.46
11 Fx Mn (K10)	141	268	221	476	1.21	2.15
MN06028 (K12)	210	318	245	652	1.30	2.67
03S0257-3 (K13)	213	334	237	697	1.41	2.94
Minot, ND						
Line A (M1)	140	245	229	466	1.07	2.04
Glenn (M3, Check)	165	239	251	513	0.95	2.04
ND818 (M4)	144	243	247	431	0.98	1.74
Duclair (M5)	147	247	248	432	1.00	1.75
Line B (M6)	135	236	246	402	0.96	1.63
Line C (M8)	150	265	230	488	1.15	2.12
ND 819 (M9)	130	249	228	415	1.09	1.82
11 Fx Mn (M10)	119	249	216	399	1.15	1.85
ND 812 (M11)	143	246	235	457	1.05	1.95
ND 816 (M14)	156	271	238	486	1.14	2.04
Williston, ND						
Line A (W1)	194	338	222	696	1.52	3.13
Glenn (W3, Check)	201	287	253	630	1.13	2.49
ND818 (W4)	131	220	245	403	0.90	1.64
Duclair (W5)	145	253	246	433	1.03	1.76
Line B (W6)	127	338	176	553	1.92	3.15
Line C (W8)	155	305	221	517	1.38	2.34
11 Fx Mn (W10)	156	284	241	468	1.18	1.94

Extensograph Data by Location - 90 min Resting

Entry ID	Energy [cm²]	Resistance (50 mm) [BU]	Extensibility [mm]	Maximum Resistance [BU]	Ratio Number	Ratio Number (Max.)
Watertown, SD						
Glenn (B3, Check)	143	292	206	549	1.42	2.67
ND818 (B4)	140	254	237	436	1.07	1.84
SD4178 (B7)	184	313	233	611	1.35	2.63
11 Fx Mn (B10)	103	246	203	365	1.21	1.80
03S0257-3 (B13)	224	432	217	804	1.99	3.71
Casselton, ND						
MN07098-6 (C2)	136	321	192	541	1.67	2.81
Glenn (C3, Check)	161	303	210	606	1.44	2.89
ND818 (C4)	118	239	228	368	1.05	1.61
SD4178 (C7)	100	250	194	376	1.29	1.94
ND 819 (C9)	123	226	229	402	0.99	1.76
11 Fx Mn (C10)	97	227	198	357	1.15	1.81
ND 812 (C11)	127	220	240	394	0.92	1.64
MN06028 (C12)	189	304	243	586	1.25	2.41
03S0257-3 (C13)	189	362	212	710	1.71	3.35
ND 816 (C14)	111	239	203	408	1.17	2.01
Crookston, MN						
MN07098-6 (K2)	162	326	199	665	1.64	3.35
Glenn (K3, Check)	192	355	210	717	1.69	3.42
ND818 (K4)	125	233	223	424	1.05	1.91
11 Fx Mn (K10)	138	275	213	493	1.29	2.32
MN06028 (K12)	238	443	214	876	2.07	4.09
03S0257-3 (K13)	246	429	216	916	1.98	4.24
Minot, ND						
Line A (M1)	158	273	233	523	1.17	2.24
Glenn (M3, Check)	189	315	239	591	1.32	2.47
ND818 (M4)	139	250	243	417	1.03	1.72
Duclair (M5)	148	263	235	474	1.12	2.02
Line B (M6)	159	278	244	480	1.14	1.97
Line C (M8)	152	253	247	460	1.03	1.86
ND 819 (M9)	143	236	247	442	0.96	1.79
11 Fx Mn (M10)	130	256	218	444	1.17	2.03
ND 812 (M11)	181	287	250	550	1.15	2.20
ND 816 (M14)	176	309	232	567	1.33	2.44
Williston, ND						
Line A (W1)	259	461	226	871	2.04	3.85
Glenn (W3, Check)	235	375	252	708	1.49	2.81
ND818 (W4)	154	272	243	476	1.12	1.96
Duclair (W5)	163	276	245	508	1.12	2.07
Line B (W6)	196	436	203	738	2.14	3.63
Line C (W8)	148	336	199	562	1.69	2.82
11 Fx Mn (W10)	121	292	191	477	1.53	2.50

Extensograph Data by Location - 135 min Resting

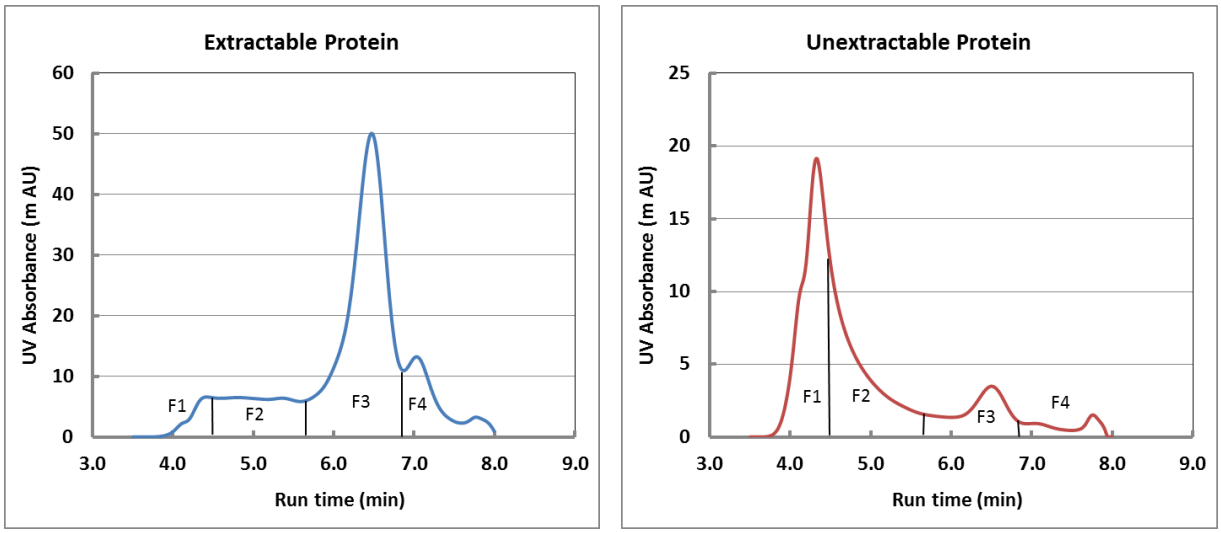
Entry ID	Energy [cm²]	Resistance (50 mm) [BU]	Extensibility [mm]	Maximum [BU]	Ratio Number	Ratio Number (Max.)
Watertown, SD						
Glenn (B3, Check)	165	320	212	609	1.51	2.88
ND818 (B4)	149	273	236	465	1.16	1.97
SD4178 (B7)	207	313	245	649	1.28	2.65
11 Fx Mn (B10)	116	227	238	353	0.95	1.48
03S0257-3 (B13)	197	433	192	822	2.25	4.28
Casselton, ND						
MN07098-6 (C2)	148	323	200	578	1.62	2.89
Glenn (C3, Check)	186	305	238	599	1.28	2.51
ND818 (C4)	105	197	224	350	0.88	1.56
SD4178 (C7)	115	248	213	388	1.16	1.82
ND 819 (C9)	123	237	224	403	1.06	1.80
11 Fx Mn (C10)	106	221	217	355	1.02	1.64
ND 812 (C11)	121	227	230	391	0.99	1.70
MN06028 (C12)	182	324	231	587	1.40	2.54
03S0257-3 (C13)	176	351	201	696	1.74	3.46
ND 816 (C14)	118	260	203	438	1.28	2.16
Crookston, MN						
MN07098-6 (K2)	183	362	205	717	1.77	3.50
Glenn (K3, Check)	223	380	217	822	1.75	3.79
ND818 (K4)	140	243	238	434	1.02	1.82
11 Fx Mn (K10)	137	268	213	491	1.26	2.31
MN06028 (K12)	275	417	238	906	1.75	3.80
03S0257-3 (K13)	218	532	189	888	2.81	4.69
Minot, ND						
Line A (M1)	165	305	227	552	1.34	2.43
Glenn (M3, Check)	188	319	235	607	1.35	2.58
ND818 (M4)	153	254	244	479	1.04	1.96
Duclair (M5)	154	250	245	492	1.02	2.01
Line B (M6)	161	259	245	501	1.06	2.04
Line C (M8)	166	277	233	544	1.19	2.34
ND 819 (M9)	133	226	241	415	0.94	1.72
11 Fx Mn (M10)	125	233	227	410	1.03	1.81
ND 812 (M11)	179	288	240	559	1.20	2.32
ND 816 (M14)	172	293	235	557	1.25	2.37
Williston, ND						
Line A (W1)	221	451	197	921	2.29	4.67
Glenn (W3, Check)	268	388	251	854	1.55	3.40
ND818 (W4)	156	281	242	477	1.16	1.97
Duclair (W5)	166	303	243	497	1.25	2.05
Line B (W6)	169	400	188	699	2.13	3.72
Line C (W8)	119	325	179	510	1.82	2.86
11 Fx Mn (W10)	128	272	212	447	1.28	2.11

Flour Protein Content and Composition

Entry ID	Protein Content (%) (14 % mb)	Composition (% Total Protein)								Ratio[1]
		SDS Buffer Extractable				SDS Buffer Unextractable				
		F1	F2	F3	F4	F1	F2	F3	F4	UPP/EPP
Watertown, SD										
Glenn (B3, Check)	15.1	3.6	12.3	48.0	13.1	9.1	8.2	3.8	1.7	1.09
ND818 (B4)	14.9	3.6	12.2	47.4	13.0	10.1	8.5	3.6	1.5	1.18
SD4178 (B7)	13.8	3.5	12.4	45.0	13.5	11.0	9.3	3.7	1.6	1.29
11 Fx Mn (B10)	15.0	3.5	12.4	47.0	12.6	10.0	9.4	3.7	1.5	1.22
03S0257-3 (B13)	14.7	3.4	11.9	47.8	13.0	11.0	7.7	3.6	1.6	1.22
Casselton, ND										
MN07098-6 (C2)	12.2	3.4	13.3	42.1	16.5	11.1	8.6	3.3	1.6	1.17
Glenn (C3, Check)	13.8	3.2	12.5	43.9	14.1	11.9	9.0	3.8	1.7	1.33
ND818 (C4)	13.3	3.2	12.6	43.3	14.6	11.7	9.1	3.8	1.7	1.32
SD4178 (C7)	12.5	3.5	13.5	42.1	15.3	11.0	8.0	4.5	2.1	1.12
ND 819 (C9)	13.5	3.2	11.8	47.2	13.5	10.1	8.7	3.9	1.6	1.25
11 Fx Mn (C10)	13.0	3.5	13.3	43.9	14.3	11.2	7.8	4.0	1.8	1.14
ND 812 (C11)	13.4	3.2	12.3	44.8	13.8	11.3	8.6	4.4	1.8	1.28
MN06028 (C12)	14.0	4.4	12.9	42.9	13.6	10.6	9.9	4.0	1.7	1.19
03S0257-3 (C13)	12.6	4.3	13.2	42.4	14.6	10.9	8.9	4.0	1.7	1.13
ND 816 (C14)	13.0	3.9	12.3	48.3	13.0	10.5	7.0	3.5	1.5	1.09
Crookston, MN										
MN07098-6 (K2)	12.5	3.8	12.9	42.6	16.1	11.6	7.8	3.5	1.7	1.16
Glenn (K3, Check)	13.2	3.6	12.1	43.1	13.6	12.7	9.0	4.2	1.8	1.38
ND818 (K4)	14.2	3.7	12.1	45.4	13.3	11.9	8.1	4.0	1.6	1.26
11 Fx Mn (K10)	14.3	3.8	12.5	44.9	13.4	11.6	8.1	4.1	1.6	1.21
MN06028 (K12)	14.8	3.4	11.5	42.0	13.3	13.5	10.2	4.4	1.7	1.59
03S0257-3 (K13)	13.1	3.5	12.0	43.2	14.0	13.0	8.6	4.1	1.6	1.39
Minot, ND										
Line A (M1)	13.6	3.3	11.1	47.1	13.3	12.1	7.4	4.1	1.6	1.36
Glenn (M3, Check)	14.5	3.4	11.8	44.6	12.2	13.9	8.4	4.2	1.6	1.47
ND818 (M4)	14.7	3.4	11.7	45.7	12.1	12.8	9.1	3.7	1.4	1.45
Duclair (M5)	14.9	5.1	12.8	47.0	11.9	10.1	7.9	3.7	1.5	1.01
Line B (M6)	14.9	4.6	12.7	48.6	11.7	10.8	6.7	3.5	1.4	1.01
Line C (M8)	14.2	4.1	12.2	48.0	11.5	11.5	7.4	3.8	1.5	1.16
ND 819 (M9)	14.8	4.0	11.8	48.8	11.1	10.9	7.3	4.7	1.5	1.16
11 Fx Mn (M10)	14.4	4.0	12.2	46.6	11.2	11.0	8.3	5.0	1.6	1.18
ND 812 (M11)	14.5	3.8	11.5	47.5	11.1	11.7	8.5	4.5	1.5	1.33
ND 816 (M14)	14.6	4.1	11.6	48.2	11.0	11.2	8.3	4.2	1.4	1.25
Williston, ND										
Line A (W1)	15.8	3.1	9.3	50.0	12.2	11.9	7.4	4.5	1.5	1.55
Glenn (W3, Check)	17.0	3.3	10.5	47.7	10.7	13.1	9.1	4.3	1.4	1.61
ND818 (W4)	17.9	3.7	11.0	48.0	10.9	12.6	8.5	4.0	1.3	1.44
Duclair (W5)	16.0	3.4	10.9	48.9	10.8	12.7	7.6	4.2	1.4	1.42
Line B (W6)	13.1	3.3	10.9	47.1	9.6	13.0	8.9	5.6	1.7	1.54
Line C (W8)	14.7	3.5	11.1	50.8	10.3	11.7	6.8	4.3	1.4	1.26
11 Fx Mn (W10)	16.4	3.5	11.0	50.9	9.5	12.6	7.2	4.1	1.3	1.37

[1]UPP/EPP= SDS buffer unextractable polymeric proteints (F1 + F2)/extractable polymeric proteins (F1 + F2)

Interpreting Protein Composition Data



Size exclusion HPLC chromatograms of SDS buffer extractable and unextractable proteins

Native (unreduced) proteins extracted from wheat flour were analyzed by size-exclusion high performance liquid chromatography (SE-HPLC) to evaluate variation in protein composition in wheat genotypes (Gupta et al. 1993; Ohm et al. 2009).

The SE-HPLC chromatograms are shown above for sodium-dodecyl sulfate (SDS) buffer extractable and unextractable proteins. Main protein components of individual fractions (F1-F4) shown in the figures have been reported to be high molecular weight polymeric proteins for F1; low molecular weight polymeric proteins for F2; gliadins for F3; and albumin and globulins for F4.

Researches using SE-HPLC have found that polymeric proteins (F1 + F2) in SDS buffer unextractable fraction (UPP) have positive effect while polymeric proteins (F1 + F2) in extractable fraction (EPP) have negative effect on dough strength (Gupta et al. 1993; Ohm et al. 2009). High molecular weight fractions (F1) of UPP have been specifically identified to have more pronounced effect on dough strength parameters (Ohm et al. 2009).

In summary, wheat genotypes that have greater ratio of UPP to EPP might have greater gluten strength.

References

Gupta, R. B., Khan, K., and MacRitchie, F. 1993. Biochemical basis of flour properties in bread wheats. I. Effect of variation in the quality and size distribution of polymeric protein. J. Cereal Sci. 18:23-41.

Ohm, J. B., Hareland, G., Simsek, S., and Seabourn, B. 2009. Size exclusion HPLC of protein using narrow-bore column for evaluation of breadmaking quality of hard spring wheat flours. Cereal Chem. 86:463-469.

Hard Red Spring Wheat Breeding Quality Target Values

	Quality Parameter	Extra Strong	Traditional Strong
Wheat	Test Weight (lb/bu) (Grading Factor)	60	60
	Protein (12% m.b.)	14.5	14.5
	Ash (14% m.b.)	<1.65	<1.65
	Vitreousness (% Dark Hard & Vitreous, DHV)	80	80
	1000 kernel weight (g)	>31	>31
	Falling Number (seconds)	400	400
	Wheat Hardness (SKCS)	80	80
	Wheat Hardness (NIR)	70	70
Milling	Flour Extraction		
	Buhler Lab Mill (%, @ 0.48 ash)	70	70
	Quadrumat Senior (%, @ 0.48 ash)	70	70
	Protein Loss (%)	<1.0	<1.0
Flour	Ash (14%m.b.)	0.48	0.48
	Color (L* value)	90	90
	Wet Gluten (%, 14% m.b. @ 13.5% protein)	36	36
Farinograph	Absorption (%)	64	64
(50 g bowl)	Peak Time (Minutes)	15	10
	Stability (Minutes)	25	15
	Classification (1-weak, 8-strong)[1]	8	6.5
Extensograph	Maximum Resistance to Extension (BU)	800	600
(45 min. stretch)	Extensibility (cm)	20	22
Mixograph	Classification (1=weak, 8=strong)[1]	8	6
Bread[2]	Loaf Volume (cc)	1050	1050
	Grain & Texture (1=poor -10 excellent)[1]	8.5	8.5

[1]Subjective ratings and classifications are from the North Dakota State University - Hard Red Spring Wheat Quality Laboratory

[2]Bread Quality based on 100g pup loaf, straight dough method, North Dakota State University - Hard Red Spring Wheat Quality Laboratory

Note: HRS Wheat Breeding Quality Targets were developed by a committee of HRS wheat breeders and quality personnel. Contact Brian Sorenson, Northern Crops Institute for more information.

HRS Wheat Breeding Quality Target Values Important Points for Use

1. Breeding Target Values are a Tool. The values shown are targets and should be seen as a tool to help breeders meet the market needs for end-use quality.
2. They reflect the surveyed quality needs of our export markets, but also meet the needs of the domestic markets.
3. Standard or check varieties and different locations are still needed due to location and yearly weather variations.
4. Target values should be compared to actual quality data on experimental lines after several years of testing at multiple locations, to help determine if the line would meet the industry needs for quality before release as a named variety.
5. These targets will be reviewed periodically and updated as needed
6. "Traditional Strong" and "Extra Strong" categories differ in their gluten strength or end-use functionality. In a 2003 survey, over 75% of our export markets prefer Hard Red Spring Wheat with quality represented by the "Traditional Strong" target values.
7. Utilization of these breeding targets by all HRS wheat breeders is essential to providing better uniformity and consistency and meeting the needs of our domestic and export markets.

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