

Wheat Quality Council
Hard Spring Wheat Technical Committee
2017 Crop



February 20-22, 2018

Kansas City, MO

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Sponsored by the Wheat Quality Council
February 20-22, 2018
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Wheat Quality Council

Hard Spring Wheat Technical Committee

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.

Nine experimental lines of hard spring wheat were grown at up to six locations in 2017 and evaluated for kernel, milling, and bread baking quality against the check variety Glenn. To avoid any bias in the test procedures, code numbers were assigned to the experimental lines and maintained throughout the growing and harvesting of the plots and the milling and baking trials. Wheat samples were milled and analyzed at the USDA Hard Red Spring and Durum Wheat Quality Laboratory (WQL), Fargo, ND. Flour samples were shipped to independent laboratories and tested for bread baking quality.

From this report:

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

The results relate only to test samples that were volunteered for testing in the 2017 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.

The 2017 Wheat Quality Testing Program

Source of Wheat

Source/Breeding Program	SWQAC Code #	Identification
WestBred	1	WB9719
South Dakota State University	2	SD4465
WestBred	3	WB9616CLP
Limagrain	4	LCS Rebel
University of Minnesota	5	MN13288-1
Syngenta	6	SY Rockford
WestBred	7	WB9479
South Dakota State University	8	SD4579
North Dakota State University	9	Glenn (Check)
WestBred	10	WB9590

Field Plot Locations and Procedures

Coordinators: Steve Sebesta, Ph.D., Director and Gonzalo Rojas-Cifuentes, Ph.D., Assistant Director, Foundation Seedstocks, Department of Plant Sciences, North Dakota State University.

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

- Northeast Research Station (Watertown), South Shore, SD
South Dakota State University, Brookings, SD – Jack Ingemansen;
- Agronomy Seed Farm, Casselton, ND – Brian Otteson;
- Northern Agricultural Research Center, Havre, MT – Peggy Lamb;
- Northwest Research and Outreach Center, Crookston, MN – Mark Hanson;
- North Central Agricultural Experiment Station, Minot, ND – Eric Eriksmoen;
- Williston Research Extension Center, Williston, ND – Kyle Dragseth.

Wheat was seeded in large-scale plots of ½ acre in size to approximate commercial production. Cultural practices such as tillage and weed control common to each area were used. Consideration was also given to germination, seed size, and planting depth to provide stand uniformity. Based on soil test results from each locations, 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.

Field Production Data

Variable	Watertown	Casselton	Havre	Crookston	Minot	Williston
Planting Date	4/24/2017	5/6/2017	5/1/2017	5/15/2017	4/28/2017	5/10/2017
Harvest Date	8/31/2017	8/23/2017	8/7/2017	8/23/2017	8/17/2017	8/17/2017
Fertilizer (lb/A)						
N	250	170	100	171	125	89
P	192	31	20	4 ppm	54	225 ppm
K	257	558	10	179 ppm	436	282 ppm
Herbicide(rate/A)						
Broadleaf	Wolverine 1.7 pt.	Bronate 1 pt.	Bromac 24 oz.	Bromac 1 pt.	Goldsky 1 pt.	Goldsky 16 oz.
Grass		Puma 0.5 pt	*	Axial XL 16 oz.	Goldsky 1 pt.	
Fungicide	Folicur 4 oz.	Prosaro 6.5 oz.	*	*	*	Tilt 3 oz.

*No application.

CLIMATOLOGICAL DATA						
Average Temperature (°F) / Precipitation (in.)						
Month	Watertown	Casselton	Havre	Crookston	Minot	Williston
April	43.9 / 1.94	43.6 / 1.25	44.4 / 0.25	42.8 / 0.79	43.0 / 0.47	45.3 / 0.48
May	55.2 / 1.39	56.1 / 0.97	54.3 / 0.45	55.0 / 0.94	56.0 / 0.63	58.3 / 0.89
June	66.6 / 5.00	66.8 / 4.78	63.8 / 1.57**	65.5 / 3.41	64.0 / 2.04	66.3 / 1.29
July	71.4 / 1.66	70.3 / 0.95	73.6 / 0.14	68.9 / 1.42	72.0 / 0.45	70.0 / 1.27
August	63.8 / 6.01	65.2 / 3.16	67.3 / 0.12	65.4 / 0.77	64.0 / 2.54	65.0 / 2.81

*Data not available.

**Includes a single day 0.98" rain event.

YIELD DATA						
Yield (bu/acre) / Test Weight (lb/bu) / % Moisture						
SWQAC Code #	Watertown	Casselton	Havre	Crookston	Minot	Williston
1	*	*	28.7 / 60.3 / 9.5	*	45.0 / 58.8 / 11.0	** / 55.2 / 12.7
2	57.9 / 57.0 / 12.0	72.3 / 60.0 / 12.0	*	72.0 / 62.0 / 13.5	*	*
3	*	*	24.8 / 57.1 / 9.5	*	*	** / 56.4 / 12.2
4	43.8 / 57.0 / 12.3	73.3 / 62.0 / 12.7	28.0 / 59.4 / 9.5	78.0 / 64.0 / 14.3	62.0 / 59.5 / 11.0	** / 55.3 / 12.3
5	*	72.1 / 58.0 / 12.0	30.4 / 58.3 / 9.3	75.0 / 60.0 / 12.9	*	*
6	*	*	30.6 / 57.4 / 9.4	*	66.0 / 57.4 / 11.0	** / 54.6 / 11.7
7	61.8 / 57.0 / 11.8	86.7 / 60.0 / 11.6	*	72.0 / 62.0 / 12.9	58.0 / 59.4 / 11.0	** / 54.5 / 11.3
8	53.5 / 57.5 / 12.4	74.6 / 61.0 / 12.1	*	66.0 / 61.0 / 13.5	*	*
9	57.1 / 60.4 / 12.4	74.9 / 60.0 / 12.0	22.4 / 60.4 / 9.5	64.0 / 61.0 / 13.5	38.0 / 60.4 / 11.0	** / 56.0 / 12.3
10	64.3 / 55.9 / 11.8	81.8 / 61.0 / 12.5	26.2 / 58.4 / 9.4	71.0 / 62.0 / 12.7	44.0 / 58.5 / 11.0	** / 55.0 / 12.1
Site Totals	6	7	7	7	6	7

*Not increased at this site.

** Data not available

Climate, Disease, and Field Conditions

Notes on production related to climate condition, diseases (scab, etc.), and field conditions that could affect grain quality.

	Watertown	Casselton	Havre	Crookston	Minot	Williston
At Planting	Good planting conditions with adequate moisture.	Very dry at planting, some uneven emergence.	Dry.	Started out with adequate moisture for emergence.	Good soil moisture.	Seeded on lentil ground with very limited soil moisture.
During Growth	Good growing conditions until the middle of June.	Plentiful rains in June.	Dry.	Dry weather conditions.	Good stand establishment. Lack of precipitation and warm temperatures caused moderate moisture stress.	Very dry and above average wind.
At Flowering	Very dry at the end of June during flowering. No <i>Fusarium</i> problems.	Mostly dry; some rains after flowering.	Dry and hot.	Normal weather conditions.	No issues.	Dry; no fungicide was applied at flowering due to lack of moisture and low dew point.
During Maturation	Normal filling period with ample moisture for grain fill.	Very dry	Dry and hot.	Very dry weather.	No issues.	Dry; resulted in high protein and low test weights.
At Harvest	Excessive rain at the end of July through August, which delayed harvest and discolored the grain.	Occasional rains.	Dry. No weed or disease problems throughout the year. No precipitation was a major issue.	No lodging present at harvest.	Delayed harvest due to rainfall, which also caused grain bleaching.	All entries were standing well and thrashed easily. Low yields, low test weights, and high protein. The entries were subjected to drought stress throughout the growing season. All the yields were shipped in their entirety.

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Description of 2017 Hard Spring Wheat Lines

SWQAC #1 – WB9719

WB9719 is a hard red spring wheat variety released by WestBred. It is above average yielding and average in grain protein, making it a well-balanced variety. WB9719 is of medium plant height and is a medium-late maturing variety. The straw strength for WB9719 is very good, similar to SY Ingmar and SY Soren. WB9719 is well adapted to high stress environments from moisture or temperature. The disease package for WB9719 is characterized by better scab tolerance than WB-Mayville, exceptional yellow rust resistance, and medium-susceptibility to both bacterial leaf streak and tan spot. WB9719 has very good milling and baking end-use quality.

SWQAC #2 – SD4465

SD4465 is an F₄ derived line selected from the population SD4078/SD4027. Over the years 2014 through 2016, SD4465 has been found to have good yield potential as well as slightly better than average test weight and average protein concentration. Its level of FHB resistance appears to be average or slightly below average, however, its BLS resistance is slightly better than average. Bread loaf volume is also similar to average. Due to lack of plant height uniformity, SD4465 has been discarded.

SWQAC #3 – WB9616CLP

WB9616CLP is a hard red spring wheat variety released by WestBred. It is a two-gene clearfield tolerant variety for use with the clearfield system of weed management. It has average yield and grain protein, exceptional for a clearfield line. It is a medium-late maturing line with medium-short plant height. Standability for WB9616CLP is very good in Montana. WB9616CLP is well adapted to Montana. The disease package for WB9616CLP is characterized by very good resistance to bacterial leaf streak and strip rust, similar scab susceptibility ratings to WB-Mayville, medium-susceptibility to tan spot, and no resistance to wheat stem sawfly.

SWQAC #4 – LCS Rebel

LCS Rebel is a hard red spring wheat marketed by Limagrain Cereal Seeds. LCS Rebel was selected for a consistent combination of top end yield potential and 14%+ levels of protein content. The disease resistance package for this new release is highlighted by resistance to current races of stripe and stem rust. LCS Rebel is adapted to all growing regions in North Dakota and Minnesota, and performed very well across all Montana crop zones in 2017.

SWQAC #5 – MN13288-1

MN13288-1 (Linkert/Sabin) is an early-mid maturity hard red spring wheat that has relatively high grain yield and protein and has good overall disease resistance, including Fusarium head blight resistance equivalent to the most resistant current varieties. Straw strength is average. MN13288-1 is resistant to preharvest sprouting and has exhibited good end-use quality characteristics.

SWQAC #6 – SY Rockford

SY Rockford is a hard red spring wheat bred and developed by Syngenta Crop Protection, LLC for the Northern Plains and is best adapted for Montana and the Western areas of North and South Dakota. SY Rockford was selected from the cross of two Agripro experimental lines 02S0262-2-5 and 01S0236-6. It has medium heading, later than SY Ingmar but earlier than Jenna, with high test weight. It is a standard semidwarf hollow stemmed variety, similar in height to 'Freyr'. Straw strength is good, similar to SY Rowyn. It is resistant to stem rust and intermediate to leaf rust. Tolerance to leaf spotting diseases has been very good; however, it is susceptible to Bacterial Leaf Streak. It is moderately resistant to FHB. Protein levels have been moderate slightly higher than 'SY Rowyn'. Overall, bread making characteristics are acceptable.

SWQAC #7 – WB9479

WB9479 is a hard red spring wheat variety released by WestBred. It has very similar attributes to the line WB-Mayville. It has well above average grain protein, with average to above average yield, making it a well-balanced variety for yield and protein. It has very strong straw, with standability similar to WB-Mayville, though lower than Linkert. The height of WB9479 is medium short and maturity is medium. WB9479 has better scab tolerance than WB-Mayville, exceptional yellow rust resistance, and is medium-susceptible to bacterial leaf streak and tan spot. The milling and baking quality for WB9479 is exceptional.

SWQAC #8 – SD4579

SD4579 is an F₄ derived line developed from the population SD4201/SD4178. SD4178 was released as 'Prevail' in 2013. SD4579 features a combination of grain yield potential, test weight, and protein concentration that are all above average. Its height, heading date, and level of FHB resistance are all within the range of acceptability. Its level of resistance to Fusarium Damaged Kernels is, however, significantly better than average. Its BLS resistance level is not high, though not significantly below average. Due to poorer than expected performance in 2016, SD4579 has been discarded.

SWQAC #10 – WB9590

WB9590 is a hard red spring wheat variety released by WestBred. It is of short plant height and is of medium maturity. It has exceptional yield potential similar to Prosper, and average to above average grain protein, making it a well-balanced variety. WB9590 has very good straw strength, similar to SY Ingmar or SY Soren. It is broadly adapted across the Northern Plains and Montana. WB9590 has better scab tolerance than WB-Mayville, very good yellow rust resistance, and is medium-susceptible to bacterial leaf streak and tan spot. The milling and baking quality for WB9590 is good to very good.

Wheat Production Sites

SWQAC Code #	Entry	Source	Production Sites					
			Watertown	Casselton	Havre	Crookston	Minot	Williston
1	WB9719	WestBred			X		X	X
2	SD4465	SDSU	X	X		X		
3	WB9616CLP	WestBred			X			X
4	LCS Rebel	Limagrain	X	X	X	X	X	X
5	MN13288-1	UMN		X	X	X		
6	SY Rockford	Syngenta			X		X	X
7	WB9479	WestBred	X	X		X	X	X
8	SD4579	SDSU	X	X		X		
9	Glenn	NDSU	X	X	X	X	X	X
10	WB9590	WestBred	X	X	X	X	X	X

Grain Cleaning and Milling Procedures

Wheat (approximately 1.5 bu/line) was cleaned in a Carter-Day Bulldog seed cleaner that was equipped with two rotating indent cylinders (#24 – coarse; #16 – fine), a sizer cylinder (#5), vibrator, and air aspiration.

Cleaned wheat (70 lbs) was tempered to 16.5% moisture content and conditioned for approximately 24 hours before milling. Milling was performed on the Buhler MLU-202 following AACC method 26-21A. Feed rate was set at approximately 130 g/min.

Flour blending: Six mill streams were blended to straight grade flour. Cumulative ash content was calculated based on product basis milling yield (14% moisture basis).

Milling streams blended to straight grade – 1st Break (1 BK), 2nd Break (2 BK), 3rd Break (3 BK), 1st Reduction (1 R), 2nd Reduction (2 R), and 3rd Reduction (3 R).

Calculation of flour extraction:

- Tempered wheat basis (TWB, %): straight grade flour extraction percentage of tempered wheat (14% mb);
- Total product basis (TPB, %): straight grade flour percentage of the total mill product (14% mb);
- Pounds of straight grade flour / bushel wheat (FWB): estimated pounds of straight grade flour (14% mb) per bushel of wheat sample.

Methods of Analysis

- Wheat Market Value Score;
- DON levels - analyzed by NDSU, Department of Plant Sciences (gas chromatography method, J. AOAC Int. 79:472, 1996);
- Test weight (AACCI Method 55-10);
- Wheat and flour protein (AACCI Method 46-30 – combustion method);
- Wheat and flour ash (AACCI Method 08-01);
- Kernel Size (Sieving according to USDA-ARS WQL);
- Wheat and flour Falling Number (Perten Falling Number System);
- Single kernel characteristics (Perten Single Kernel Characterization System – SKCS):
 - Mean and standard deviation values were calculated from 300 kernels.

- Vitreous kernel content (DHV analysis by FGIS Grain Testing Service, Fargo, ND);
- Flour color (Minolta Colorimeter, L^* and b^* values);
- Polymeric to monomeric protein ratio (TPP/TMP) and high-molecular weight glutenin composition (HMW-GS) – analyzed by Michael Tilley/Sushma Prakash, USDA-ARS-CGAHR, Manhattan, KS (J. Cereal Sci. 18:23, 1993; J. Cereal Sci. 46:157, 2007);
- Flour extraction: % Total product basis (TPB), % tempered wheat basis (TWB), and estimated pounds straight grade flour/bushel wheat;
- Farinograph (AACCI Method 54-21, Brabender Computerized Farinograph system with 50 g mixing bowl):
 - Water absorption: 500 BU and 14% mb;
 - 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 minutes 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 Method 54-40A, mixograph with 35 g mixing bowl):
 - Water absorption (14% mb) = Protein (14% mb) x 1.5 + 43.6 (The Mixograph Handbook, 1997).
- Extensograph (AACCI Method 54-10 with modifications):
 - Flour (100 g, 14% mb), 2.0% NaCl (U.S.P.), and water (farinograph absorption - 2%) were mixed to optimum development in a pin mixer (National Mfg. Co.);
 - Dough was scaled to 150 g, rounded, molded, placed in extensograph 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 = 400 BU;
 - Extensograph parameters:

- Energy (cm²): area under the curve;
- Resistance to extension (BU): height of the curve 50 mm after the beginning of torque increase;
- Extensibility (cm): total length of the curve at the baseline;
- Maximum resistance (BU): maximum curve height;
- Ratio number: quotient of resistance to extension 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 seconds. Bleach was not added to the flour. Each cooperator test baked the flour according to their standard method using straight dough, sponge and dough, or other test bake methods. Cooperator data were returned to the WQL for compilation of results.

Bake Cooperators

- ADM Milling – Overland Park, KS;
- Ardent Mills – Denver, CO;
- Bay State Milling – Winona, MN;
- General Mills – Minneapolis, MN;
- Grain Craft – Wichita, KS;
- Limagrain Cereal Seeds LLC – Fort Collins, CO;
- North Dakota Mill – Grand Forks, ND;
- North Dakota State University, Department of Plant Sciences – Fargo, ND;
- Syngenta – Berthoud, CO;
- USDA-ARS Hard Red Spring & Durum Wheat Quality Laboratory – Fargo, ND;
- USDA-ARS Hard Winter Wheat Quality Laboratory – Manhattan, KS;
- USDA-ARS Western Wheat Quality Laboratory – Pullman, WA;
- Wheat Marketing Center – Portland, OR.

The Wheat Quality Council acknowledges the dedication and sacrifice of time by those individuals who are involved in test baking hard spring wheat samples. Your efforts are well appreciated by wheat breeders, commercial flour millers and bakers, and wheat marketing personnel who inspire the overall industry to improve the quality of U.S. wheat.

Quality Data of 2017 Hard Spring Wheat Lines

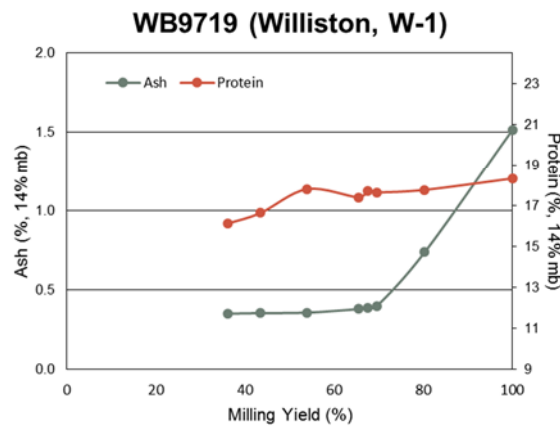
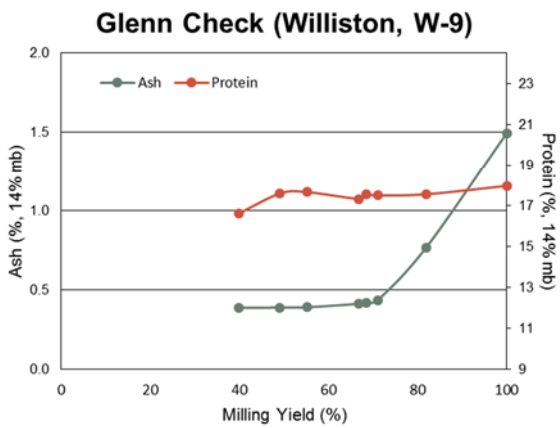
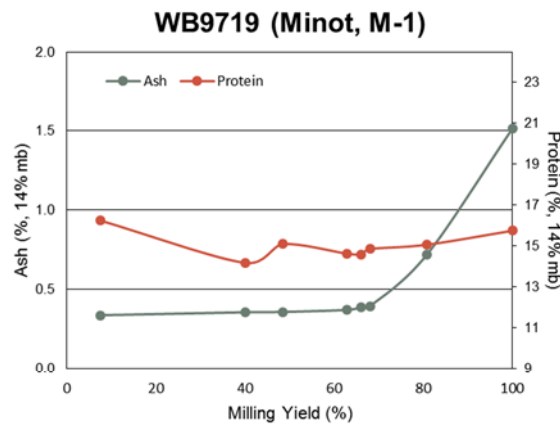
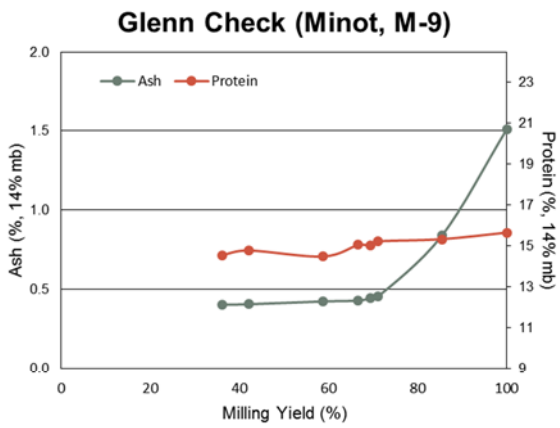
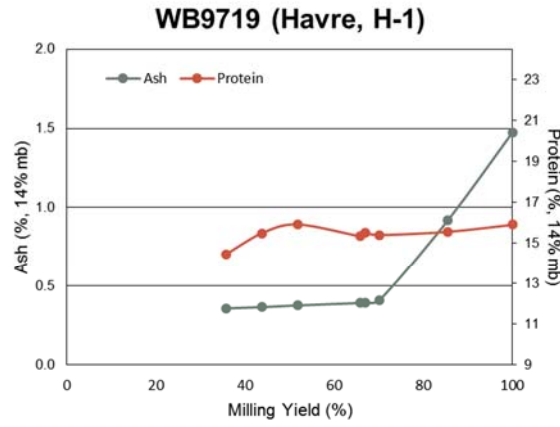
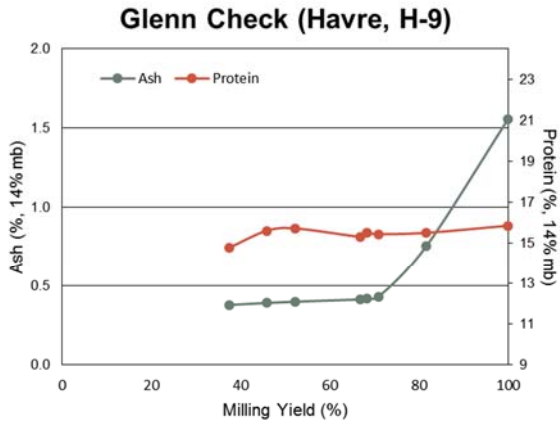
SWQAC #1 – WB9719

Quality Trait	Havre		Minot		Williston		
	Glenn H-9	H-1	Glenn M-9	M-1	Glenn W-9	W-1	
I. USDA-ARS WQL Data							
1	Wheat Protein (% , 12% mb)	16.2	15.9	16.2	15.8	18.6	18.3
2	Flour Protein (% , 14% mb)	15.5	15.1	15.2	15.0	17.4	17.4
3	Market Value (Score 1-6)	4.5	4.5	4.9	4.8	4.0	4.1
4	Market Value (Score 1-10)	10.0	10.0	10.0	10.0	10.0	10.0
5	DON (ppm)	nd	nd	nd	nd	nd	nd
6	Test Weight (lb/bu)	61.8	61.1	63.1	62.2	58.7	59.4
7	1000 Kernel Weight (g)	24.5	25.0	32.4	35.3	24.1	25.0
8	Kernel Size, % Large	4	26	62	80	6	24
9	Kernel Size, % Small	26	21	7	4	38	22
10	Wheat Moisture (%)	8.9	9.1	10.7	10.2	10.3	11.0
11	Wheat Ash (% , 14% mb)	1.47	1.39	1.48	1.42	1.45	1.43
12	Wheat Falling Number (sec)	405	418	372	363	404	389
13	SKCS Hardness Index	70.8	70.5	85.2	71.2	70.2	70.1
14	Vitreous Kernels (%)	92	96	78	69	96	82
Flour Extraction (%)							
15	Tempered Wheat Basis (%)	70.6	70.8	70.7	67.6	71.1	69.3
16	Total Product Basis (%)	71.0	70.2	71.2	68.0	71.0	69.6
17	Flour/Bu Wheat (lbs)	44.3	43.3	44.7	43.1	42.1	41.4
Flour Quality							
18	Flour Color Brightness (<i>L</i> *)	90.0	89.6	89.7	89.6	89.5	89.7
19	Flour Color Yellowness (<i>b</i> *)	8.6	9.0	8.3	8.0	8.7	8.8
20	Flour Moisture (%)	13.8	12.5	13.0	13.7	13.4	13.7
21	Flour Ash (% , 14% mb)	0.45	0.43	0.47	0.38	0.43	0.42
22	Flour Falling Number (Malted) (sec)	247	247	250	249	249	249
Farinograph							
23	Water Absorption (% , 500 BU)	64.5	67.0	66.3	67.3	66.1	67.7
24	Water Absorption (% , 14% mb)	64.3	66.1	65.0	66.5	66.2	67.9
25	Arrival Time (min)	5.7	4.8	4.5	5.4	8.0	16.0
26	Peak Time (min)	10.8	11.4	10.5	9.4	25.5	32.4
27	Dough Stability (min)	19.7	12.3	25.4	10.3	34.0	30.0
28	Mixing Tolerance Index (MTI) (BU)	12	33	9	22	5	6
29	Time To Breakdown (TTB) (min)	25.3	15.5	29.9	16.5	42.6	48.0
II. Cooperator Results							
30	Bake Absorption (Average %)	67.1	68.1	67.5	68.4	69.3	70.0
31	Loaf Volume (% of Check)		94.3		97.1		94.5

SWQAC #1 – WB9719

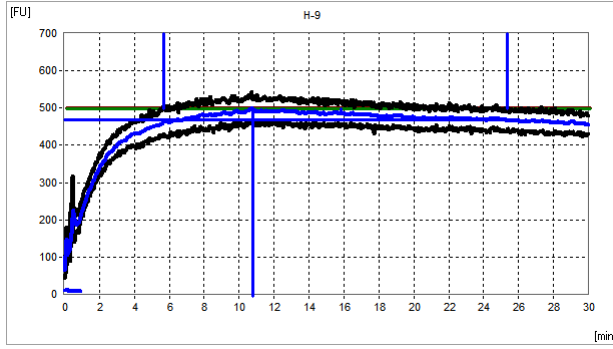
Quality Trait	Havre		Minot		Williston			
	Glenn H-9	H-1	Glenn M-9	M-1	Glenn W-9	W-1		
II. Cooperator Results								
32	Mixing Requirement 9 = Very Long 7 = Long 5 = Medium 3 = Short 1 = Very Short		6.1	5.2	6.2	4.8	7.5	7.5
33	Dough Characteristics 9 = Bucky – Tough 7 = Strong – Elastic 5 = Medium – Pliable 3 = Mellow – Very Pliable 1 = Weak – Short or Sticky		6.6	6.0	7.0	5.5	7.4	6.9
34	Mixing Tolerance 9 = Much More Tolerance Than Check 7 = More Tolerance Than Check 5 = Tolerance Equivalent To Check 3 = Less Tolerance Than Check 1 = Much Less Tolerance Than Check			4.2		3.5		4.6
35	Internal Crumb Color 9 = Much Brighter Than Check 7 = Brighter Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			4.7		5.1		5.0
36	Internal Grain and Texture 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			5.2		4.9		5.2
III. Cooperator Evaluation								
	Quality Traits 1-2: Protein 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			4.8		4.6		5.0
	Quality Traits 3-22: Milling 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			5.2		4.0		4.3
	Quality Traits 23-36: Baking 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			4.7		4.8		4.8
	Quality Traits 1-36: Overall Comparison 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			4.7		4.4		4.6

Cumulative Ash and Protein Curves

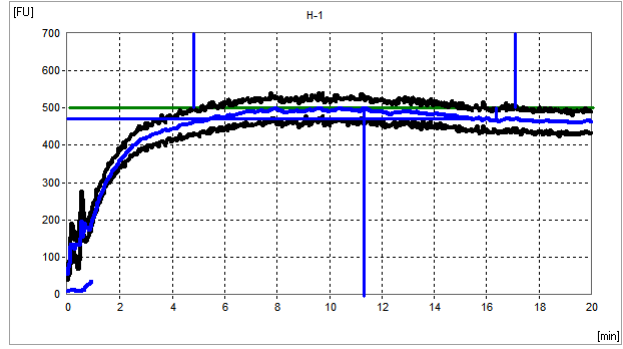


Farinograms

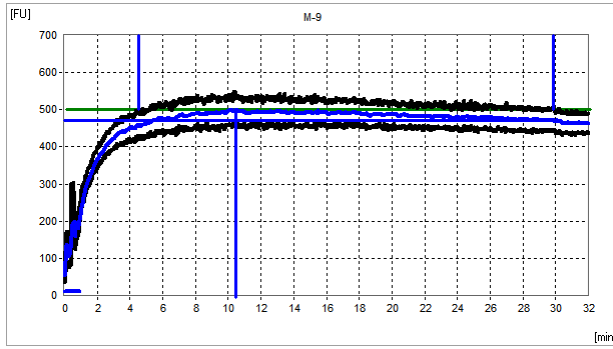
Glenn Check (Havre, H-9)



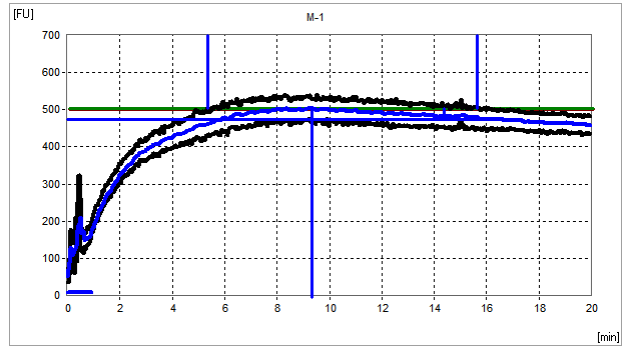
WB9719 (Havre, H-1)



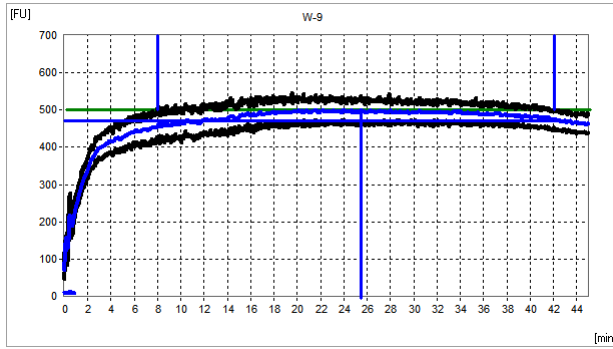
Glenn Check (Minot, M-9)



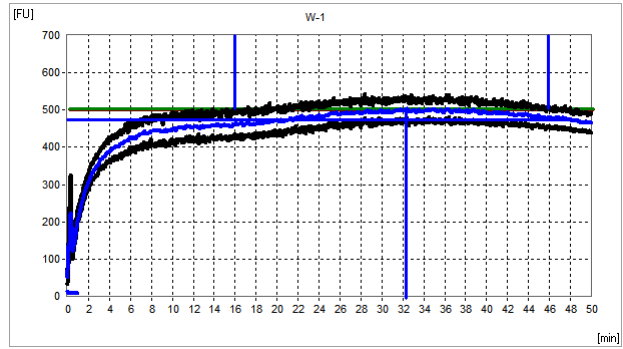
WB9719 (Minot, M-1)



Glenn Check (Williston, W-9)

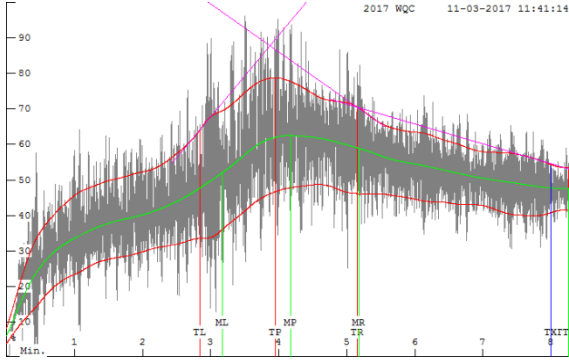


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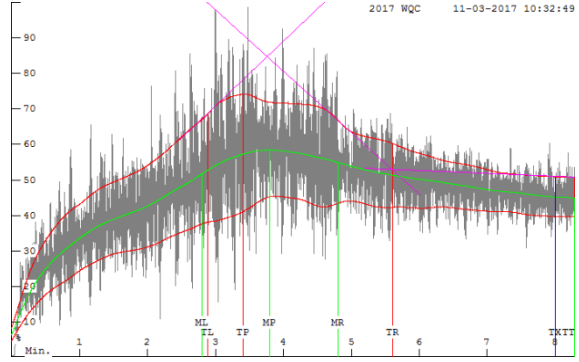


Mixograms

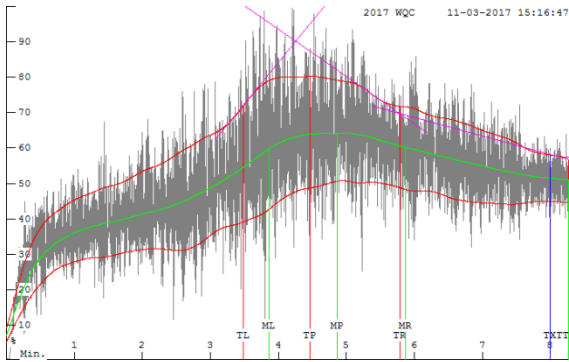
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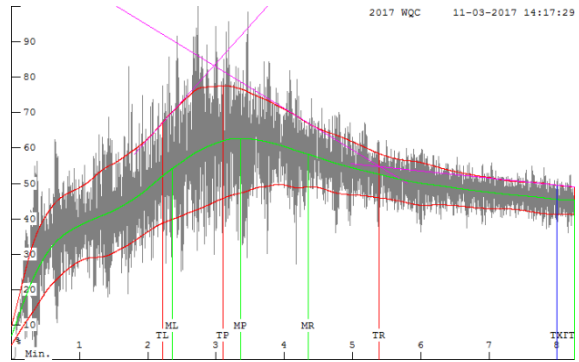
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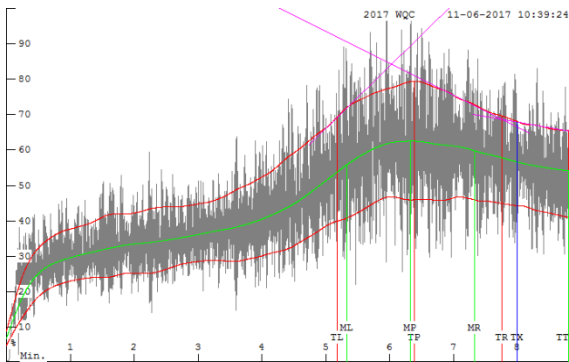
Glenn Check (Minot, M-9)



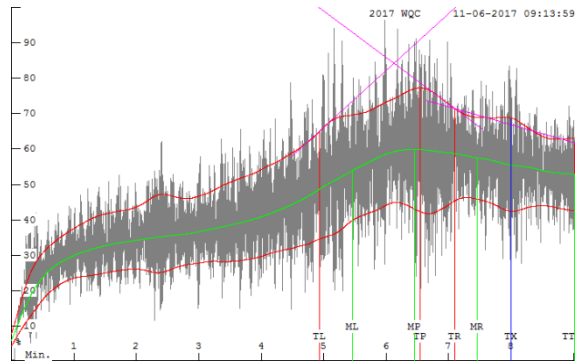
WB9719 (Minot, M-1)



Glenn Check (Williston, W-9)

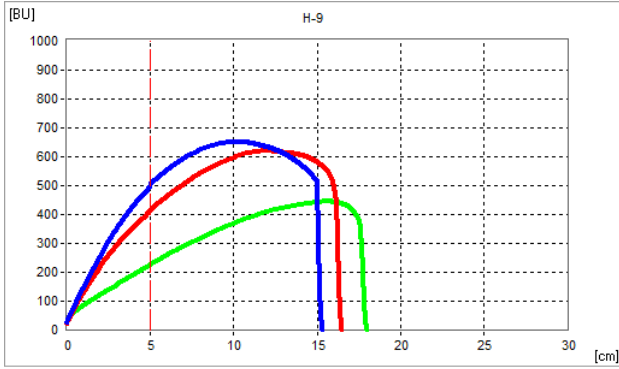


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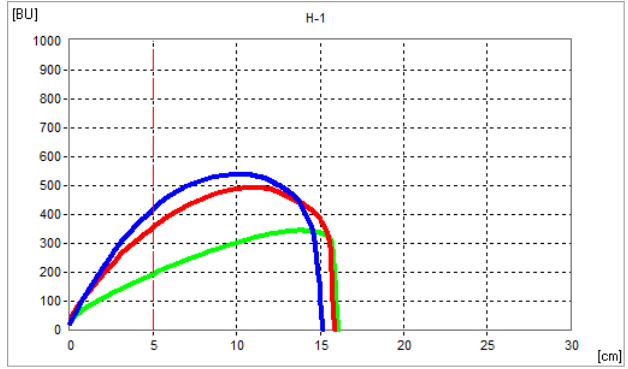


Extensograms

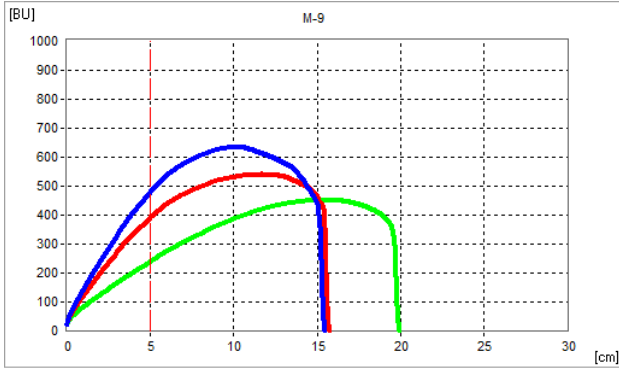
Glenn Check (Havre, H-9)



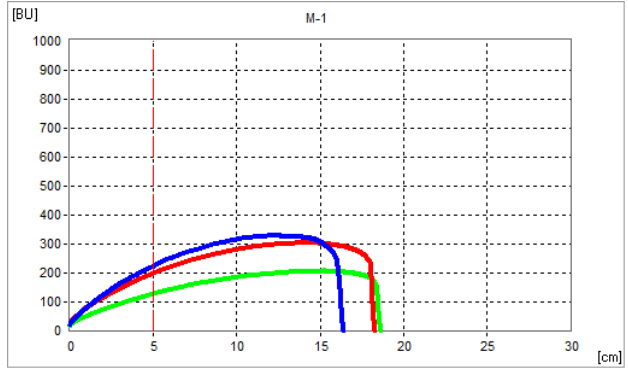
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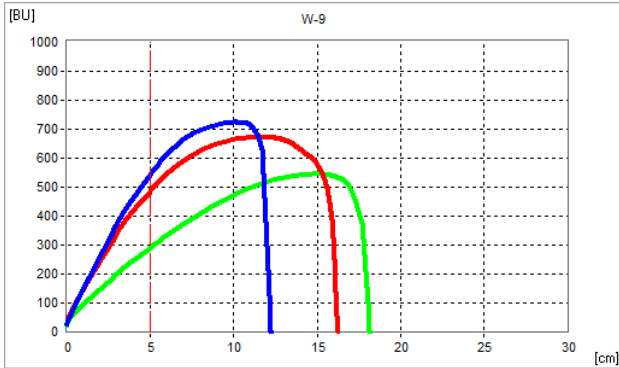
Glenn Check (Minot, M-9)



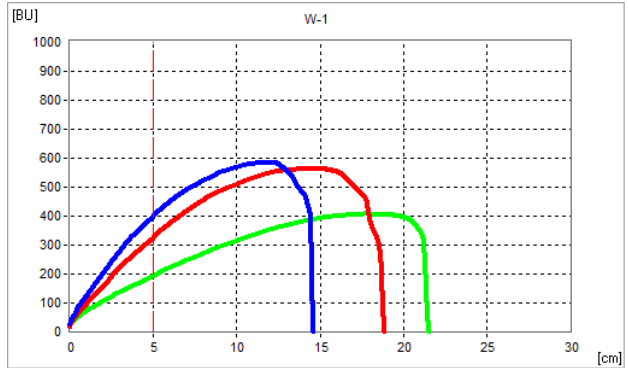
WB9719 (Minot, M-1)



Glenn Check (Williston, W-9)



WB9719 (Williston, W-1)



— 45 min; — 90 min; — 135 min

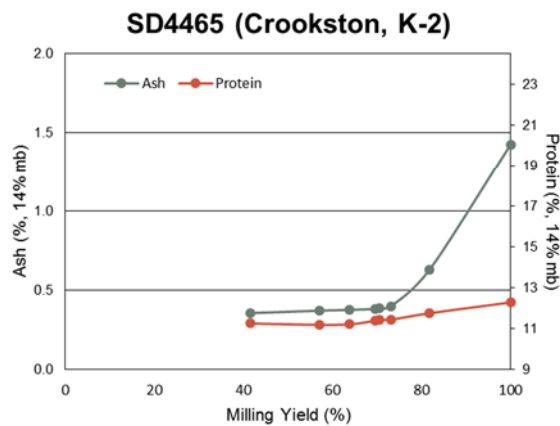
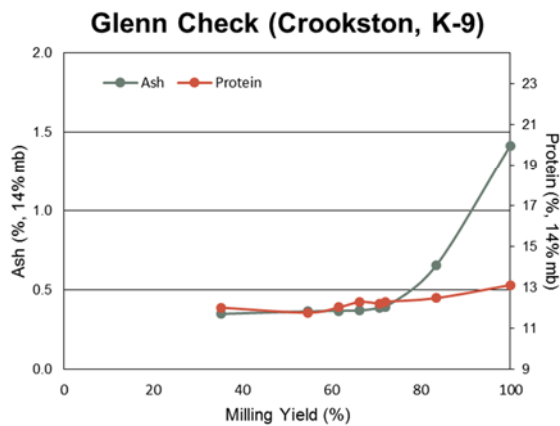
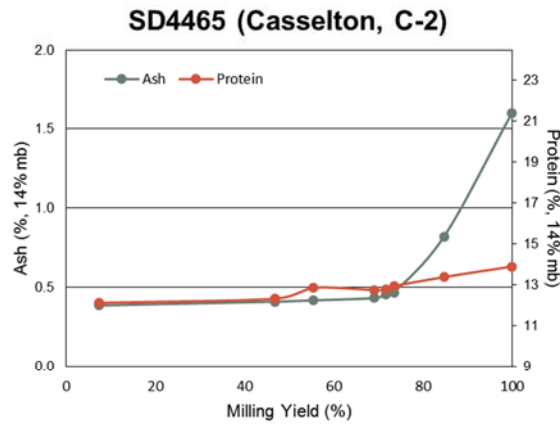
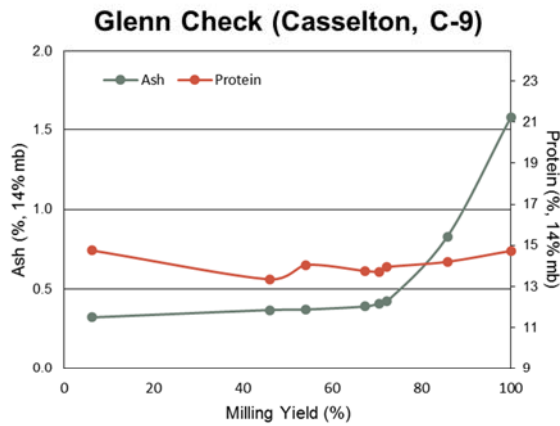
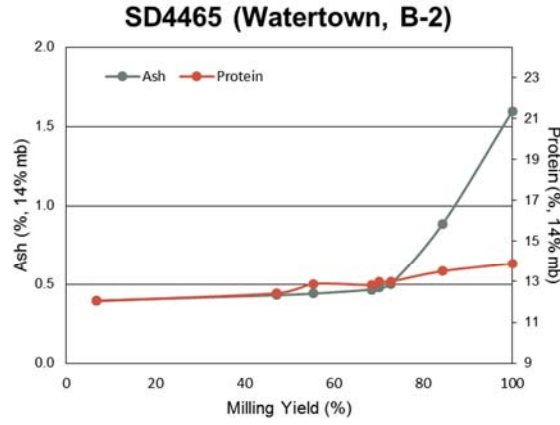
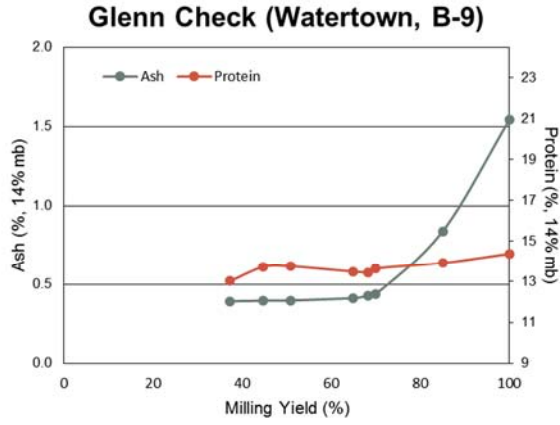
SWQAC #2 – SD4465

Quality Trait	Watertown		Casselton		Crookston		
	Glenn	B-2	Glenn	C-2	Glenn	K-2	
	B-9	B-2	C-9	C-2	K-9	K-2	
I. USDA-ARS WQL Data							
1	Wheat Protein (% , 12% mb)	14.4	13.9	14.8	14.1	13.1	12.6
2	Flour Protein (% , 14% mb)	13.5	12.8	13.9	13.0	12.2	11.5
3	Market Value (Score 1-6)	4.3	2.9	4.2	4.0	4.4	4.0
4	Market Value (Score 1-10)	10.0	8.0	10.0	8.6	10.0	8.8
5	DON (ppm)	nd	nd	nd	nd	nd	nd
6	Test Weight (lb/bu)	62.6	58.3	64.2	61.4	65.3	62.2
7	1000 Kernel Weight (g)	32.9	32.1	32.7	33.3	33.7	31.8
8	Kernel Size, % Large	61	60	66	65	70	47
9	Kernel Size, % Small	7	8	5	6	7	12
10	Wheat Moisture (%)	10.5	10.7	10.5	10.7	10.1	9.6
11	Wheat Ash (% , 14% mb)	1.42	1.53	1.55	1.50	1.36	1.41
12	Wheat Falling Number (sec)	365	335	344	373	404	413
13	SKCS Hardness Index	76.6	71.2	81.9	74.6	88.1	83.9
14	Vitreous Kernels (%)	28	19	91	45	88	62
Flour Extraction (%)							
15	Tempered Wheat Basis (%)	69.1	72.2	73.1	73.5	71.8	72.7
16	Total Product Basis (%)	70.0	72.8	72.2	73.6	71.9	73.1
17	Flour/Bu Wheat (lbs)	43.7	42.2	47.5	45.5	47.3	46.2
Flour Quality							
18	Flour Color Brightness (<i>L</i> *)	89.8	89.4	89.6	89.7	90.5	90.5
19	Flour Color Yellowness (<i>b</i> *)	7.8	8.6	8.2	9.2	8.5	10.0
20	Flour Moisture (%)	13.6	13.1	13.3	13.0	13.3	13.8
21	Flour Ash (% , 14% mb)	0.46	0.49	0.43	0.48	0.43	0.42
22	Flour Falling Number (Malted) (sec)	246	260	259	254	249	249
Farinograph							
23	Water Absorption (% , 500 BU)	64.3	63.3	66.8	64.5	64.6	62.2
24	Water Absorption (% , 14% mb)	63.7	62.1	65.9	63.1	63.7	61.8
25	Arrival Time (min)	2.5	2.4	2.4	3.5	1.8	2.9
26	Peak Time (min)	4.7	6.2	6.3	6.5	5.0	5.7
27	Dough Stability (min)	9.4	8.5	8.7	6.2	9.7	6.6
28	Mixing Tolerance Index (MTI) (BU)	22	34	33	51	23	37
29	Time To Breakdown (TTB) (min)	11.1	10.6	11.0	9.3	11.0	9.6
II. Cooperator Results							
30	Bake Absorption (Average %)	65.8	64.9	67.6	65.2	65.7	63.3
31	Loaf Volume (% of Check)		96.0		96.5		97.0

SWQAC #2 – SD4465

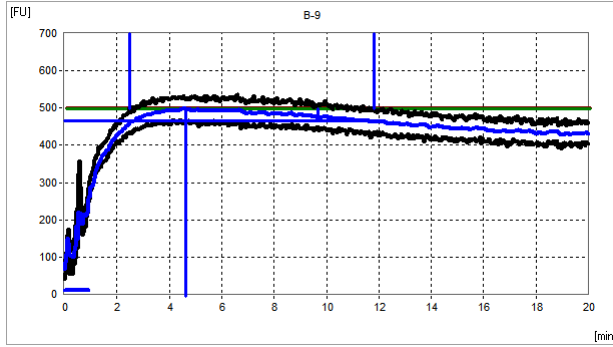
Quality Trait	Watertown		Casselton		Crookston			
	Glenn B-9	B-2	Glenn C-9	C-2	Glenn K-9	K-2		
II. Cooperator Results								
32	Mixing Requirement 9 = Very Long 7 = Long 5 = Medium 3 = Short 1 = Very Short		6.8	6.4	5.5	4.7	6.6	4.6
33	Dough Characteristics 9 = Bucky – Tough 7 = Strong – Elastic 5 = Medium – Pliable 3 = Mellow – Very Pliable 1 = Weak – Short or Sticky		7.1	6.7	5.8	5.1	6.8	5.0
34	Mixing Tolerance 9 = Much More Tolerance Than Check 7 = More Tolerance Than Check 5 = Tolerance Equivalent To Check 3 = Less Tolerance Than Check 1 = Much Less Tolerance Than Check			5.0		3.8		3.8
35	Internal Crumb Color 9 = Much Brighter Than Check 7 = Brighter Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			5.2		4.8		4.6
36	Internal Grain and Texture 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			5.6		5.2		5.4
III. Cooperator Evaluation								
	Quality Traits 1-2: Protein 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			4.1		3.6		3.9
	Quality Traits 3-22: Milling 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			6.2		5.0		5.2
	Quality Traits 23-36: Baking 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			5.2		4.8		4.7
	Quality Traits 1-36: Overall Comparison 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			5.2		4.5		4.4

Cumulative Ash and Protein Curves

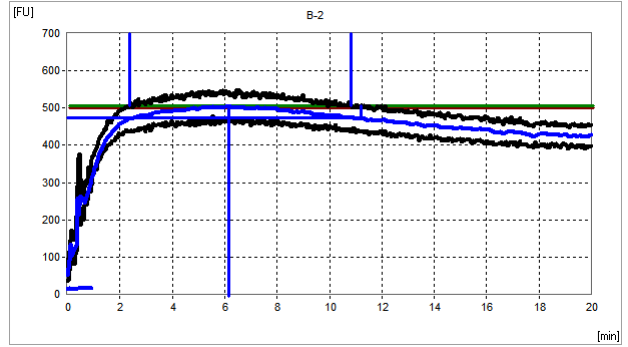


Farinograms

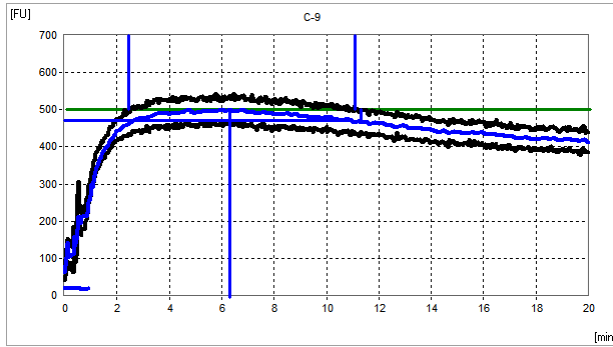
Glenn Check (Watertown, B-9)



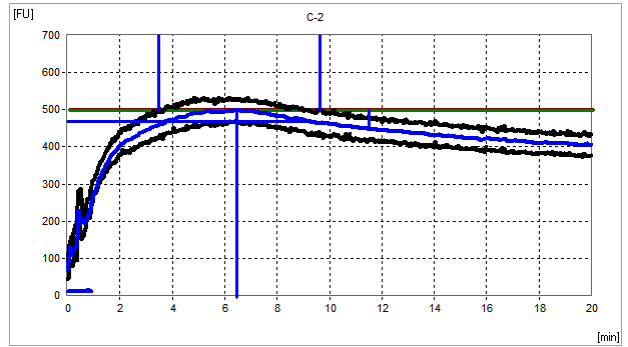
SD4465 (Watertown, B-2)



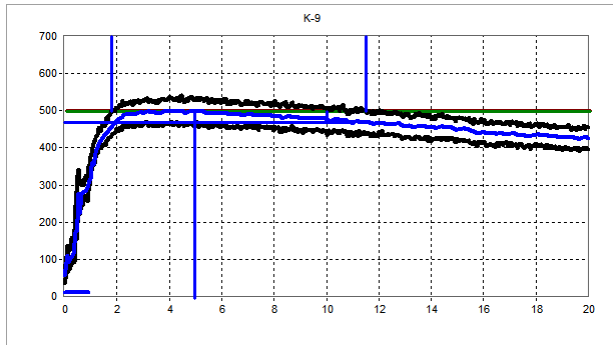
Glenn Check (Casselton, C-9)



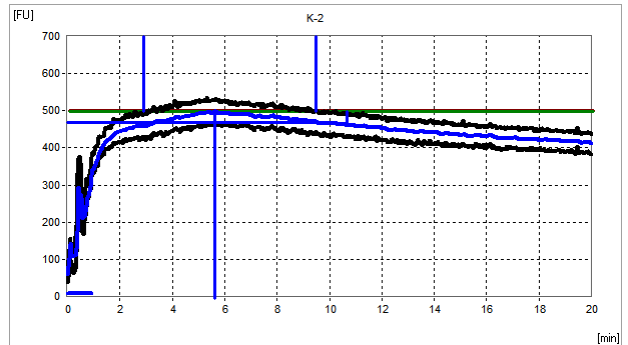
SD4465 (Casselton, C-2)



Glenn Check (Crookston, K-9)

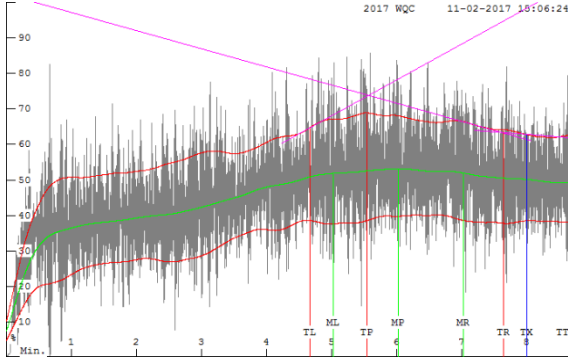


SD4465 (Crookston, K-2)

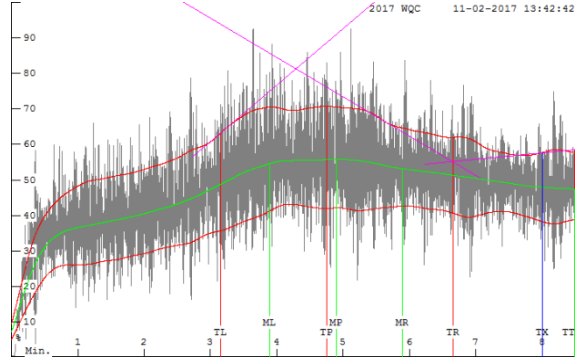


Mixograms

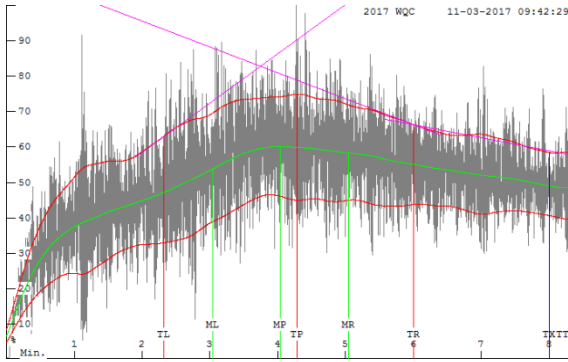
Glenn Check (Watertown, B-9)



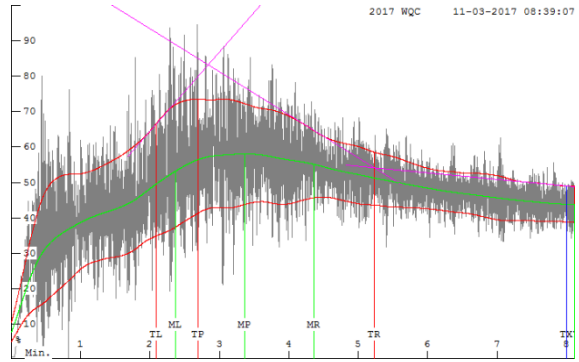
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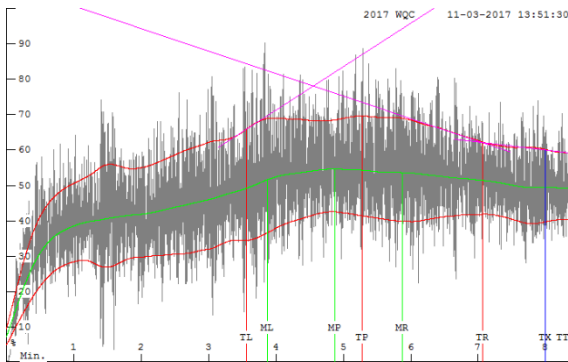
Glenn Check (Casselton, C-9)



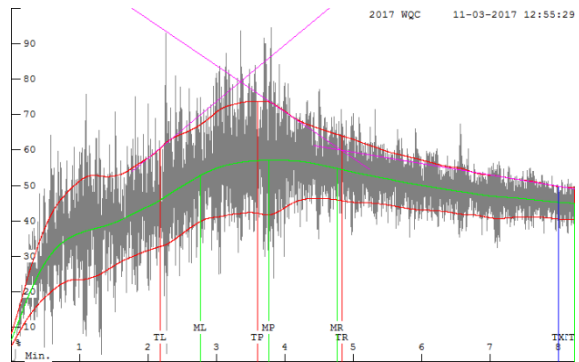
SD4465 (Casselton, C-2)



Glenn Check (Crookston, K-9)

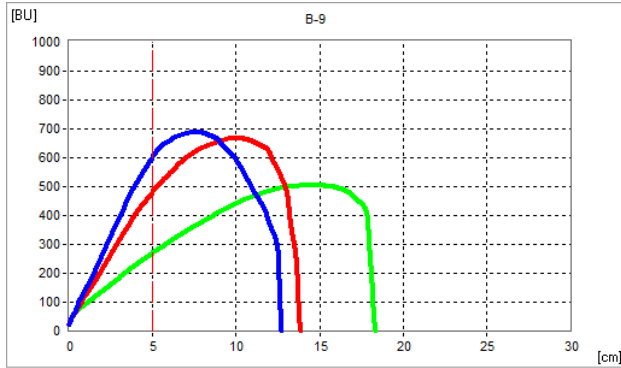


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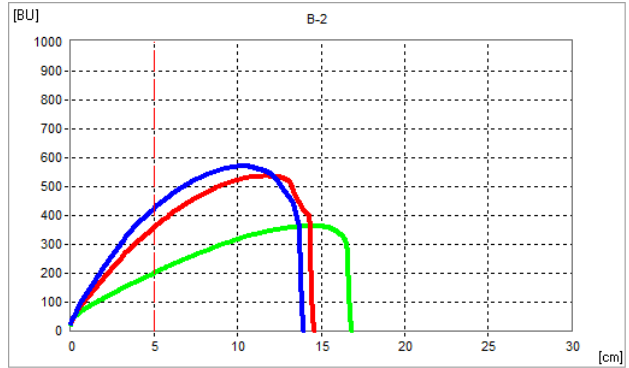


Extensograms

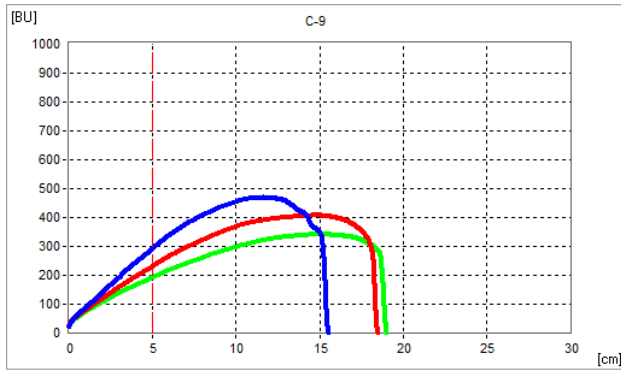
Glenn Check (Watertown, B-9)



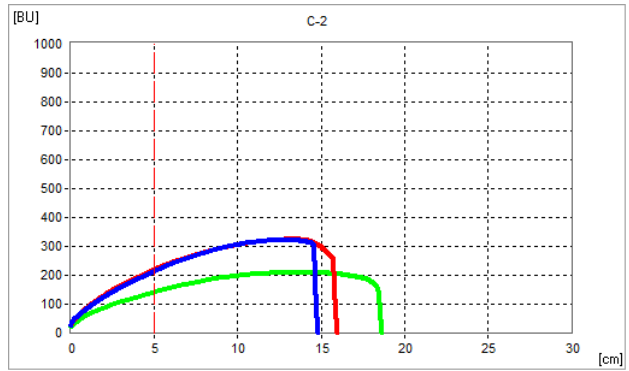
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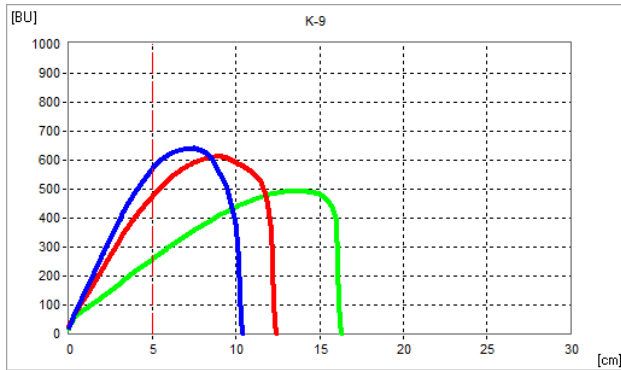
Glenn Check (Casselton, C-9)



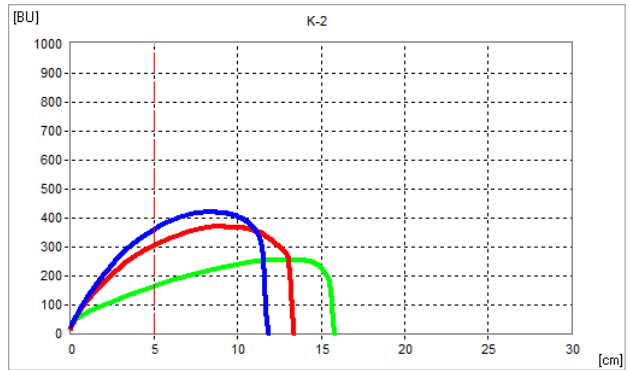
SD4465 (Casselton, C-2)



Glenn Check (Crookston, K-9)



SD4465 (Crookston, K-2)



— 45 min; — 90 min; — 135 min

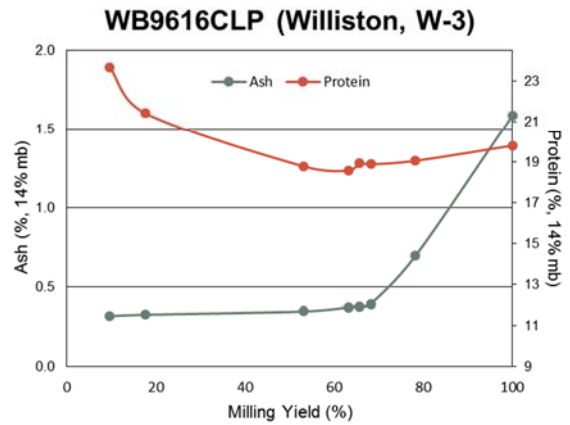
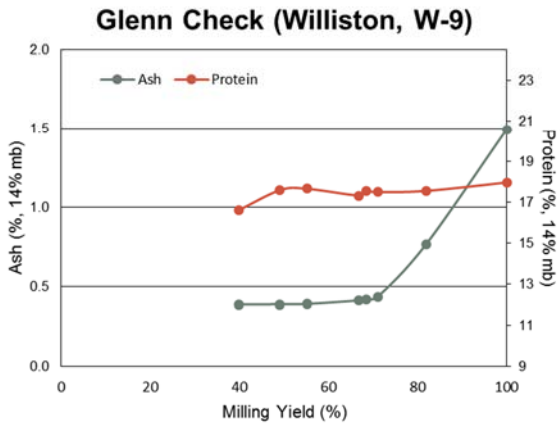
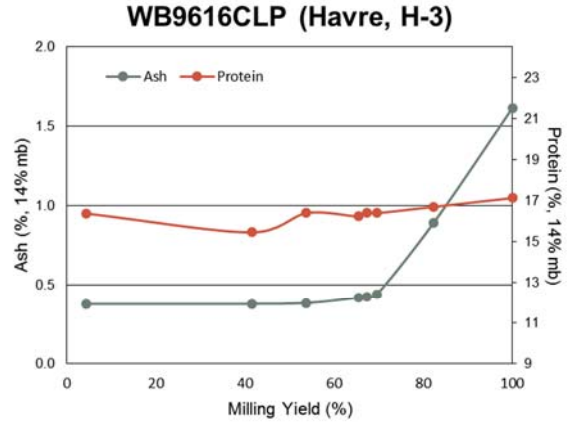
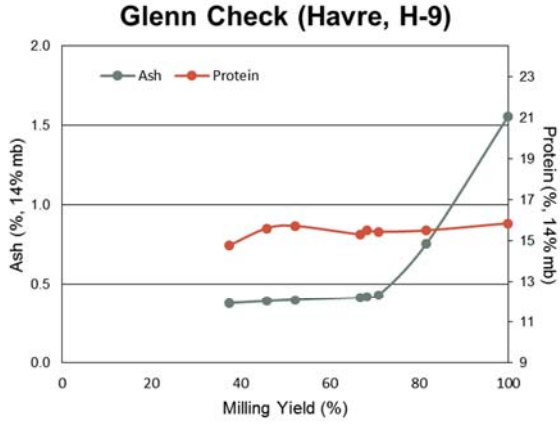
SWQAC #3 – WB9616CLP

Quality Trait	Havre		Williston		
	Glenn H-9	H-3	Glenn W-9	W-3	
I. USDA-ARS WQL Data					
1	Wheat Protein (% , 12% mb)	16.2	17.2	18.6	20.3
2	Flour Protein (% , 14% mb)	15.5	16.4	17.4	18.6
3	Market Value (Score 1-6)	4.5	3.7	4.0	3.4
4	Market Value (Score 1-10)	10.0	8.4	10.0	8.8
5	DON (ppm)	nd	nd	nd	nd
6	Test Weight (lb/bu)	61.8	58.0	58.7	58.6
7	1000 Kernel Weight (g)	24.5	21.0	24.1	26.2
8	Kernel Size, % Large	4	4	6	14
9	Kernel Size, % Small	26	33	38	22
10	Wheat Moisture (%)	8.9	9.2	10.3	10.7
11	Wheat Ash (% , 14% mb)	1.47	1.57	1.45	1.49
12	Wheat Falling Number (sec)	405	448	404	327
13	SKCS Hardness Index	70.8	71.6	70.2	66.2
14	Vitreous Kernels (%)	92	96	96	90
Flour Extraction (%)					
15	Tempered Wheat Basis (%)	70.6	69.7	71.1	68.1
16	Total Product Basis (%)	71.0	69.6	71.0	68.2
17	Flour/Bu Wheat (lbs)	44.3	40.8	42.1	40.3
Flour Quality					
18	Flour Color Brightness (<i>L</i> *)	90.0	90.3	89.5	90.2
19	Flour Color Yellowness (<i>b</i> *)	8.6	7.7	8.7	7.1
20	Flour Moisture (%)	13.8	13.2	13.4	13.6
21	Flour Ash (% , 14% mb)	0.45	0.42	0.43	0.42
22	Flour Falling Number (Malted) (sec)	247	254	249	253
Farinograph					
23	Water Absorption (% , 500 BU)	64.5	63.9	66.1	66.1
24	Water Absorption (% , 14% mb)	64.3	63.1	66.2	65.3
25	Arrival Time (min)	5.7	3.7	8.0	10.6
26	Peak Time (min)	10.8	10.5	25.5	31.5
27	Dough Stability (min)	19.7	30.3	34.0	29.9
28	Mixing Tolerance Index (MTI) (BU)	12	11	5	5
29	Time To Breakdown (TTB) (min)	25.3	34.9	42.6	42.1
II. Cooperator Results					
30	Bake Absorption (Average %)	67.1	66.8	69.3	69.8
31	Loaf Volume (% of Check)		102.6		93.5

SWQAC #3 – WB9616CLP

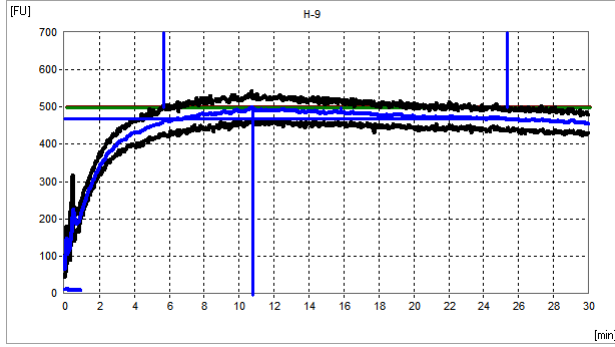
Quality Trait	Havre		Williston		
	Glenn	H-3	Glenn	W-3	
	H-9	H-3	W-9	W-3	
II. Cooperator Results					
32	Mixing Requirement 9 = Very Long 7 = Long 5 = Medium 3 = Short 1 = Very Short	6.1	7.2	7.5	7.2
33	Dough Characteristics 9 = Bucky – Tough 7 = Strong – Elastic 5 = Medium – Pliable 3 = Mellow – Very Pliable 1 = Weak – Short or Sticky	6.6	7.2	7.4	7.0
34	Mixing Tolerance 9 = Much More Tolerance Than Check 7 = More Tolerance Than Check 5 = Tolerance Equivalent To Check 3 = Less Tolerance Than Check 1 = Much Less Tolerance Than Check		5.8		4.6
35	Internal Crumb Color 9 = Much Brighter Than Check 7 = Brighter Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check		5.2		5.6
36	Internal Grain and Texture 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check		4.6		4.9
III. Cooperator Evaluation					
	Quality Traits 1-2: Protein 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check		6.5		6.0
	Quality Traits 3-22: Milling 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check		4.0		3.6
	Quality Traits 23-36: Baking 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check		5.2		4.0
	Quality Traits 1-36: Overall Comparison 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check		4.8		4.1

Cumulative Ash and Protein Curves

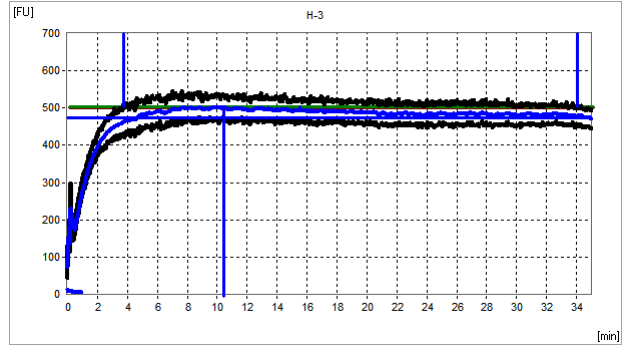


Farinograms

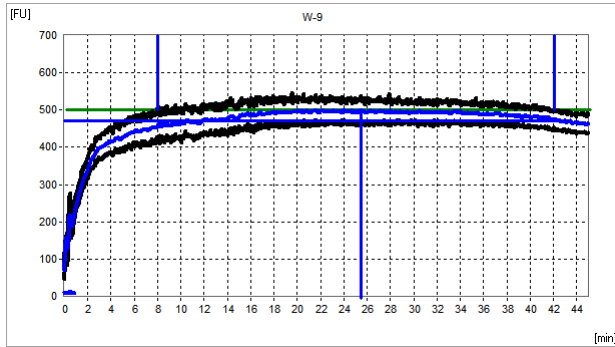
Glenn Check (Havre, H-9)



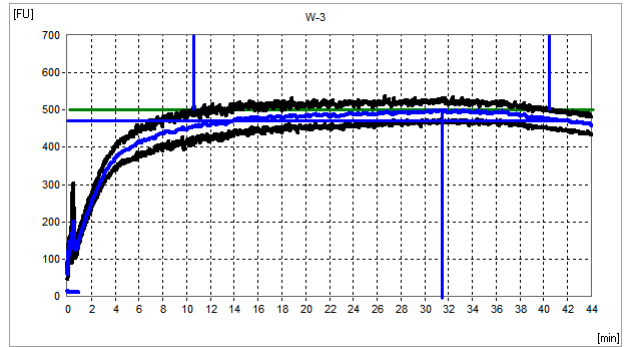
WB9616CLP (Havre, H-3)



Glenn Check (Williston, W-9)

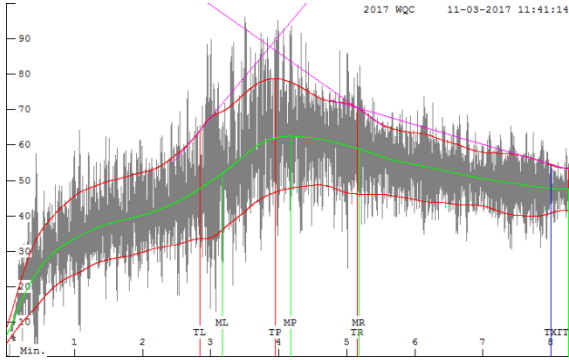


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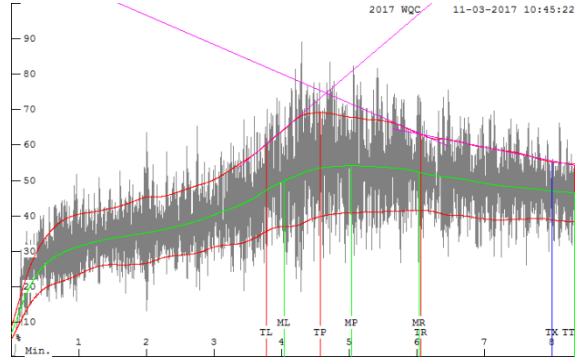


Mixograms

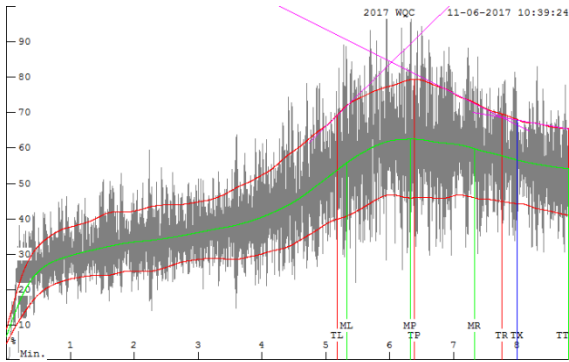
Glenn Check (Havre, H-9)



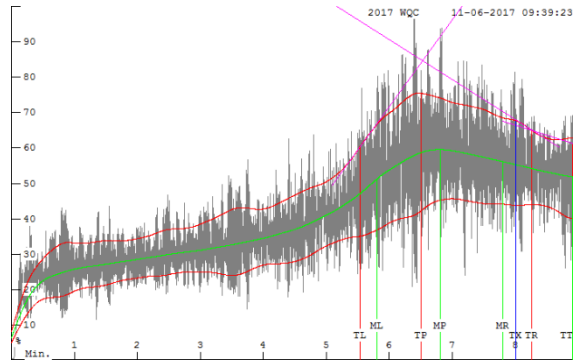
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Glenn Check (Williston, W-9)

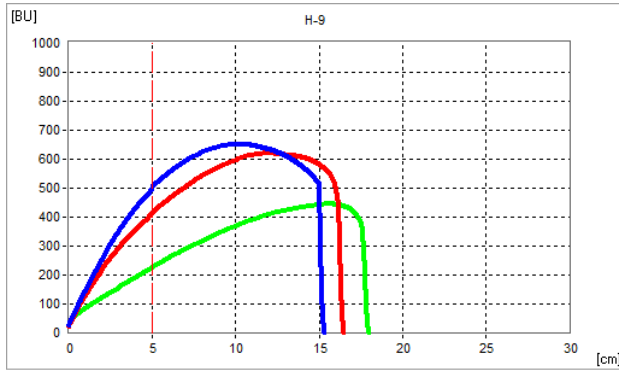


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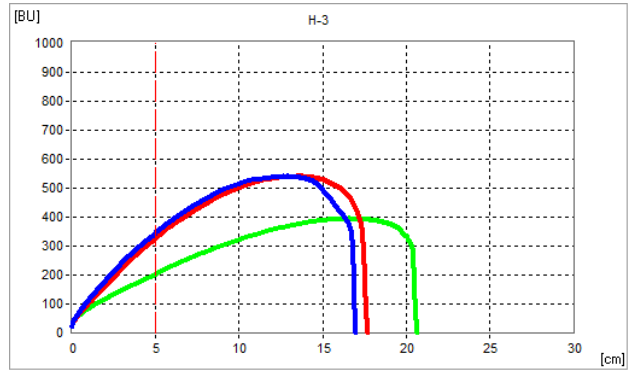


Extensograms

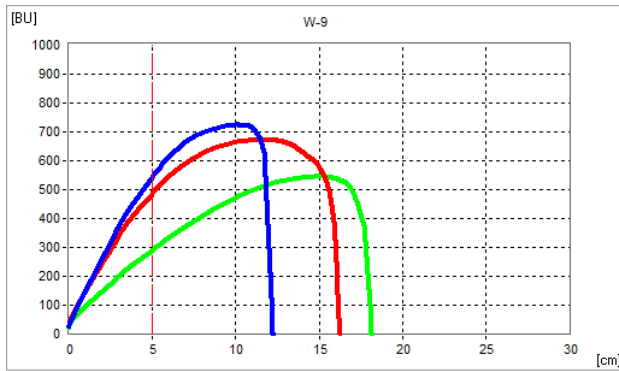
Glenn Check (Havre, H-9)



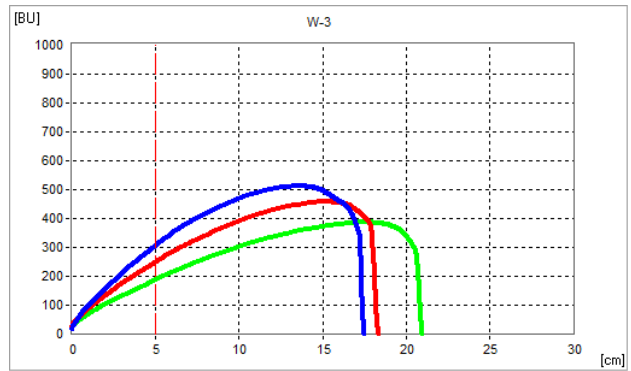
WB9616CLP (Havre, H-3)



Glenn Check (Williston, W-9)



WB9616CLP (Williston, W-3)



— 45 min; — 90 min; — 135 min

SWQAC #4 – LCS Rebel

Quality Trait	Watertown		Casselton		Havre		Crookston		Minot		Williston		
	Glenn B-9	B-4	Glenn C-9	C-4	Glenn H-9	H-4	Glenn K-9	K-4	Glenn M-9	M-4	Glenn W-9	W-4	
I. USDA-ARS WQL Data													
1	Wheat Protein (% , 12% mb)	14.4	14.3	14.8	13.9	16.2	16.2	13.1	12.4	16.2	15.0	18.6	19.6
2	Flour Protein (% , 14% mb)	13.5	13.2	13.9	12.9	15.5	15.2	12.2	11.3	15.2	14.0	17.4	18.3
3	Market Value (Score 1-6)	4.3	3.1	4.2	4.3	4.5	4.4	4.4	4.5	4.9	3.8	4.0	2.9
4	Market Value (Score 1-10)	10.0	8.0	10.0	9.4	10.0	9.6	10.0	9.4	10.0	7.2	10.0	8.4
5	DON (ppm)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
6	Test Weight (lb/bu)	62.6	59.9	64.2	63.3	61.8	60.0	65.3	64.5	63.1	61.3	58.7	57.3
7	1000 Kernel Weight (g)	32.9	34.6	32.7	34.0	24.5	25.2	33.7	36.8	32.4	35.2	24.1	24.0
8	Kernel Size, % Large	61	72	66	68	4	11	70	75	62	67	6	12
9	Kernel Size, % Small	7	7	5	5	26	26	7	5	7	6	38	34
10	Wheat Moisture (%)	10.5	10.8	10.5	10.6	8.9	8.9	10.1	10.2	10.7	9.9	10.3	10.7
11	Wheat Ash (% , 14% mb)	1.42	1.45	1.55	1.38	1.47	1.37	1.36	1.27	1.48	1.34	1.45	1.42
12	Wheat Falling Number (sec)	365	275	344	357	405	434	404	404	372	277	404	306
13	SKCS Hardness Index	76.6	65.1	81.9	73.7	70.8	69.2	88.1	77.6	85.2	71.0	70.2	69.4
14	Vitreous Kernels (%)	28	33	91	56	92	97	88	71	78	62	96	98
Flour Extraction (%)													
15	Tempered Wheat Basis (%)	69.1	73.2	73.1	75.1	70.6	72.9	71.8	76.3	70.7	73.5	71.1	71.5
16	Total Product Basis (%)	70.0	73.9	72.2	75.9	71.0	73.1	71.9	76.4	71.2	74.1	71.0	71.7
17	Flour/Bu Wheat (lbs)	43.7	43.8	47.5	45.0	44.3	44.2	47.3	49.5	44.7	46.1	42.1	41.3
Flour Quality													
18	Flour Color Brightness (L*)	89.8	89.6	89.6	89.9	90.0	90.1	90.5	90.6	89.7	90.3	89.5	89.7
19	Flour Color Yellowness (b*)	7.8	7.6	8.2	8.6	8.6	8.6	8.5	8.9	8.3	8.0	8.7	8.7
20	Flour Moisture (%)	13.6	12.8	13.3	13.0	13.8	13.4	13.3	13.4	13.0	13.5	13.4	13.6
21	Flour Ash (% , 14% mb)	0.46	0.45	0.43	0.41	0.45	0.39	0.43	0.39	0.47	0.40	0.43	0.42
22	Flour Falling Number (Malted) (sec)	246	269*	259	252	247	245	249	256	250	250	249	250
Farinograph													
23	Water Absorption (% , 500 BU)	64.3	65.0	66.8	64.9	64.5	65.6	64.6	63.4	66.3	64.7	66.1	67.4
24	Water Absorption (% , 14% mb)	63.7	63.4	65.9	63.4	64.3	65.0	63.7	62.7	65.0	63.8	66.2	66.5
25	Arrival Time (min)	2.5	2.4	2.4	2.7	5.7	5.8	1.8	2.2	4.5	4.2	8.0	9.8
26	Peak Time (min)	4.7	5.2	6.3	7.0	10.8	13.2	5.0	6.8	10.5	10.4	25.5	32.3
27	Dough Stability (min)	9.4	8.1	8.7	8.3	19.7	14.4	9.7	9.0	25.4	15.4	34.0	41.8
28	Mixing Tolerance Index (MTI) (BU)	22	27	33	38	12	27	23	30	9	19	5	8
29	Time To Breakdown (TTB) (min)	11.1	10.6	11.0	10.6	25.3	18.6	11.0	11.2	29.9	18.5	42.6	51.9

*Flour not malted.

SWQAC #4 – LCS Rebel

Quality Trait	Watertown		Casselton		Havre		Crookston		Minot		Williston		
	Glenn B-9	B-4	Glenn C-9	C-4	Glenn H-9	H-4	Glenn K-9	K-4	Glenn M-9	M-4	Glenn W-9	W-4	
II. Cooperator Results													
30	Bake Absorption (Average %)	65.8	66.2	67.6	65.9	67.1	67.6	65.7	64.3	67.5	66.9	69.3	70.5
31	Loaf Volume (% of Check)		97.8		98.4		98.4		99.3		99.7		96.2
32	Mixing Requirement*	6.8	6.3	5.5	5.5	6.1	6.2	6.6	5.5	6.2	6.4	7.5	8.1
33	Dough Characteristics**	7.1	6.7	5.8	6.3	6.6	6.8	6.8	6.2	7.0	6.9	7.4	7.5
34	Mixing Tolerance†		5.2		5.1		5.2		4.8		4.5		5.4
35	Internal Crumb Color††		4.8		4.8		5.3		4.8		5.5		5.0
36	Internal Crumb Texture‡		5.0		4.8		5.2		5.6		5.5		4.5
III. Cooperator Evaluation‡													
	Quality Traits 1-2: Protein		4.9		3.6		4.8		3.6		3.5		6.1
	Quality Traits 3-22: Milling		6.4		6.5		6.4		7.8		6.2		5.0
	Quality Traits 23-36: Baking		4.9		5.3		5.5		4.9		5.1		4.8
	Quality Traits 1-36: Overall Comparison		5.3		5.2		5.7		5.5		5.3		4.9

*9 = Very long; 7 = Long; 5 = Medium; 3 = Short; 1 = Very short.

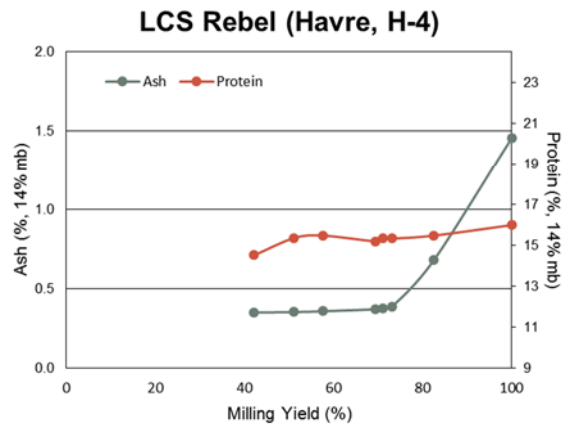
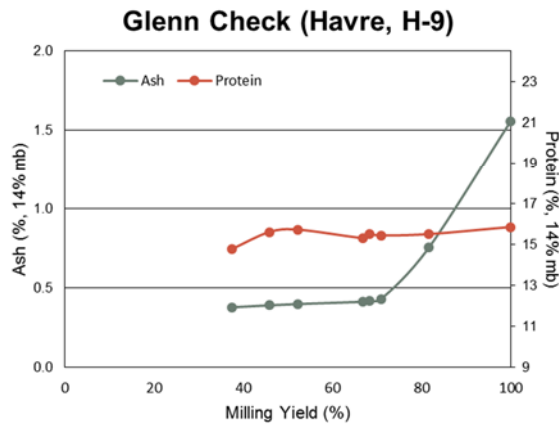
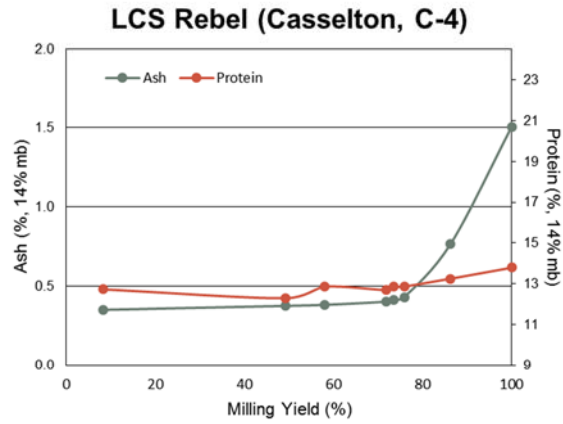
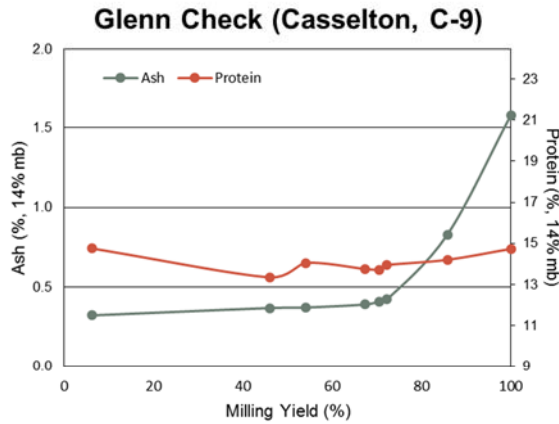
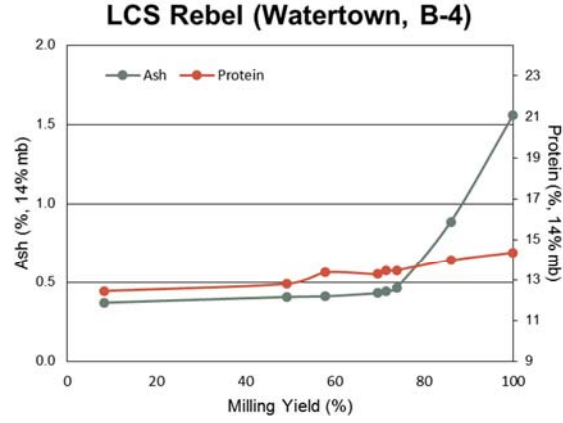
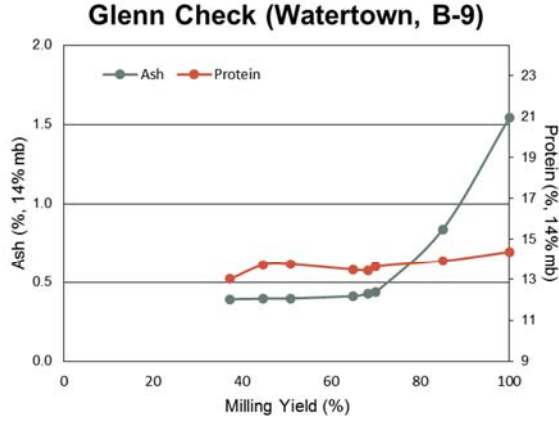
**9 = Bucky – Tough; 7 = Strong – Elastic; 5 = Medium – Pliable; 3 = Mellow – Very Pliable; 1 = Weak – Short or Sticky.

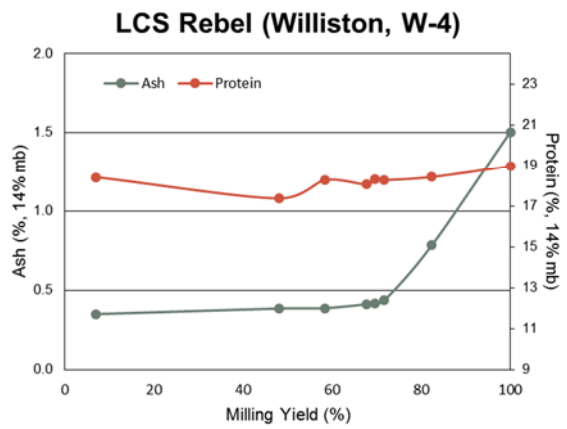
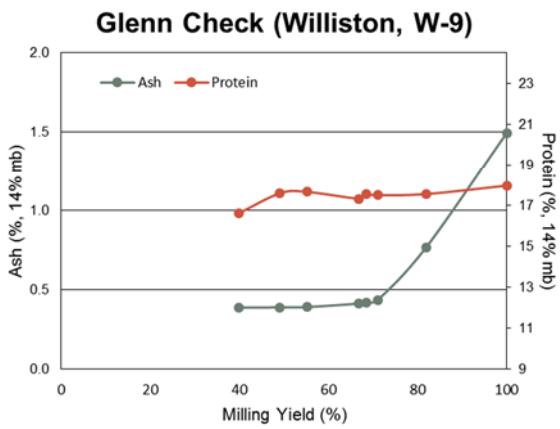
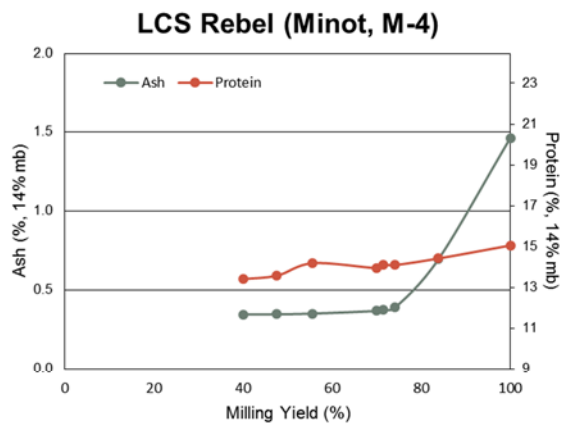
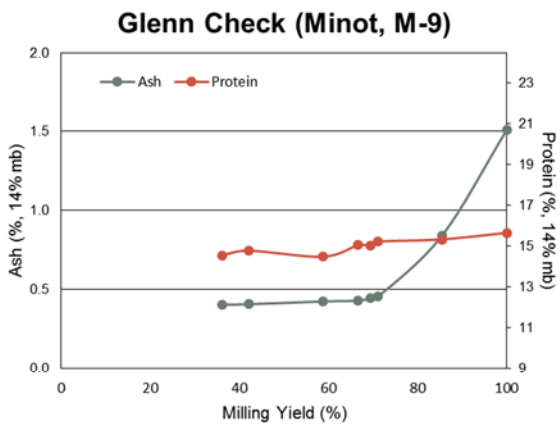
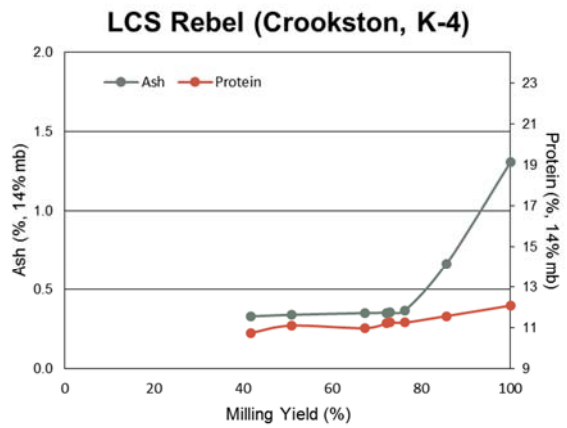
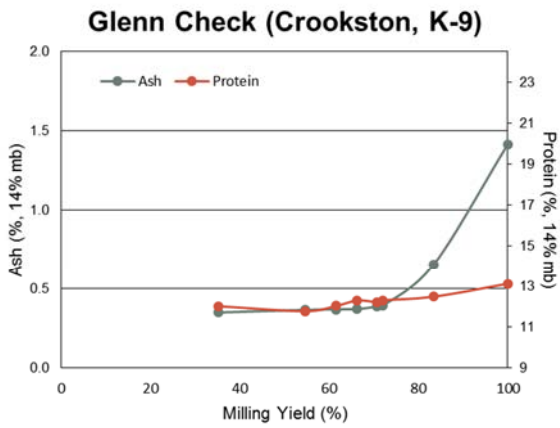
†9 = Much More Tolerance Than Check; 7 = More Tolerance Than Check; 5 = Tolerance Equivalent To Check; 3 = Less Tolerance Than Check; 1 = Much Less Tolerance Than Check.

††9 = Much Brighter Than Check; 7 = Brighter Than Check; 5 = Equivalent To Check; 3 = Poorer Than Check; 1 = Much Poorer Than Check.

‡9 = Much Better Than Check; 7 = Better Than Check; 5 = Equivalent To Check; 3 = Poorer Than Check; 1 = Much Poorer Than Check.

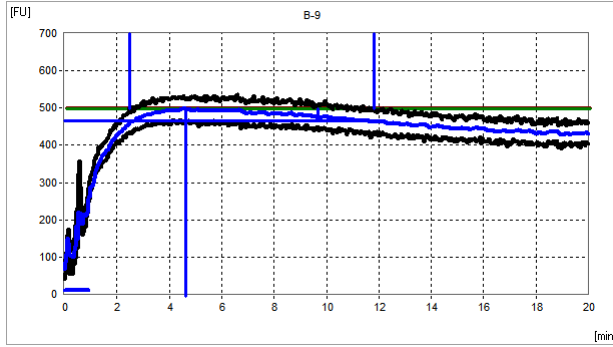
Cumulative Ash and Protein Curves



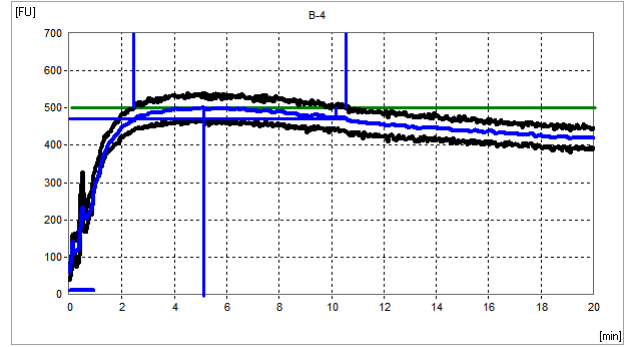


Farinograms

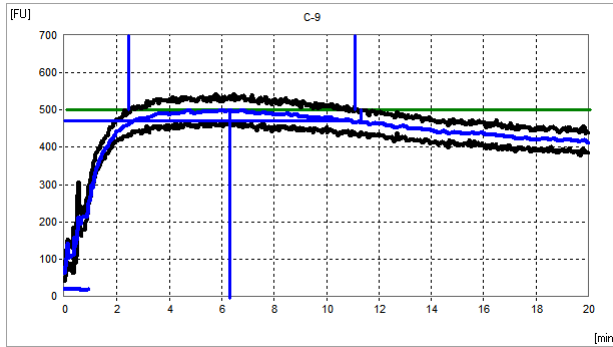
Glenn Check (Watertown, B-9)



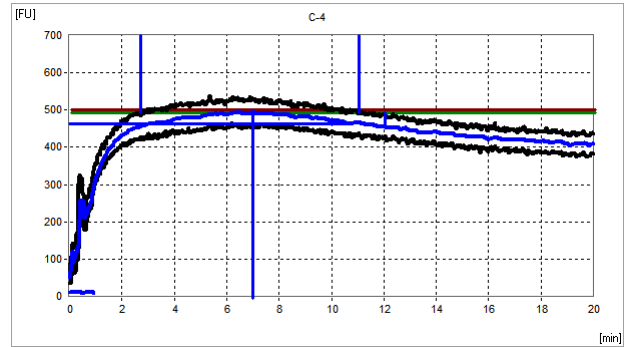
LCS Rebel (Watertown, B-4)



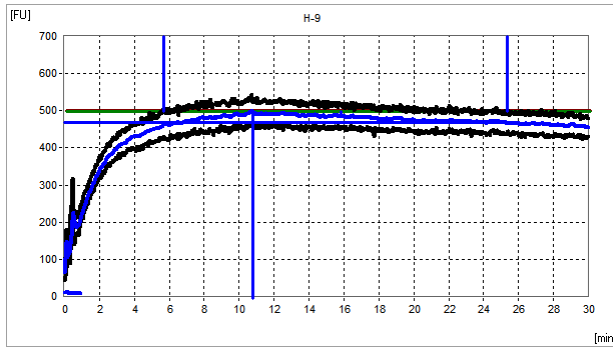
Glenn Check (Casselton, C-9)



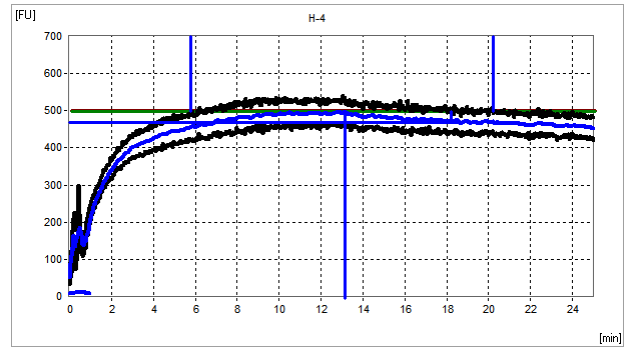
LCS Rebel (Casselton, C-4)



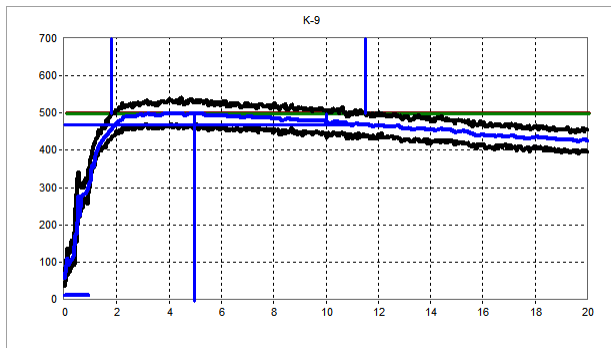
Glenn Check (Havre, H-9)



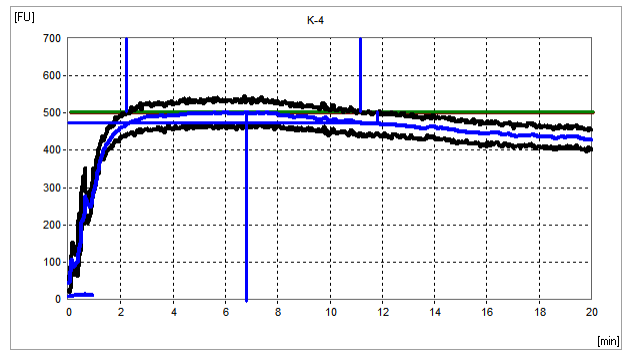
LCS Rebel (Havre, H-4)



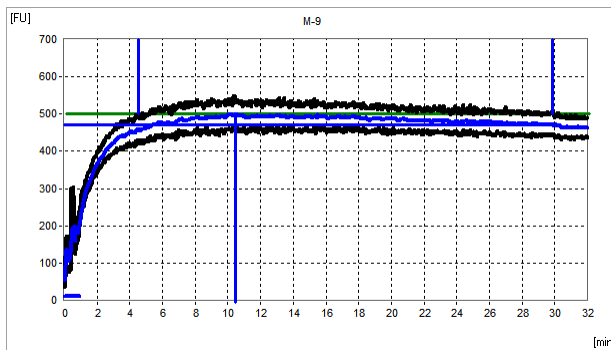
Glenn Check (Crookston, K-9)



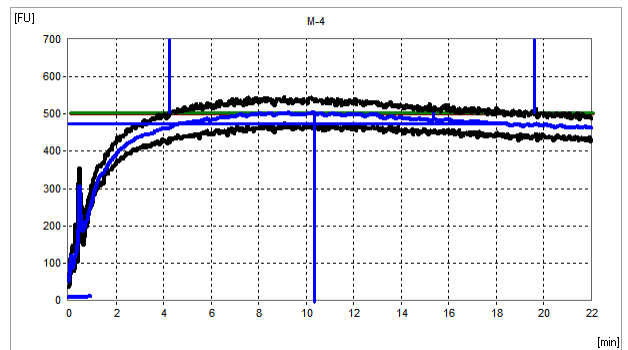
LCS Rebel (Crookston, K-4)



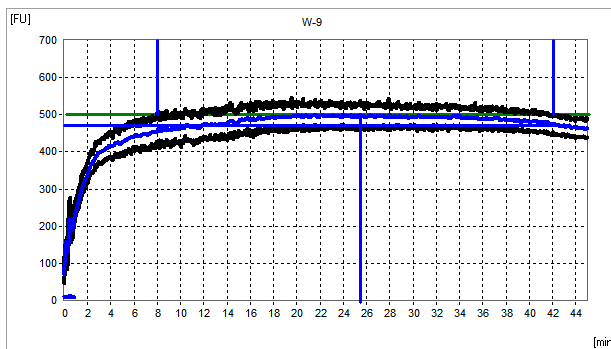
Glenn Check (Minot, M-9)



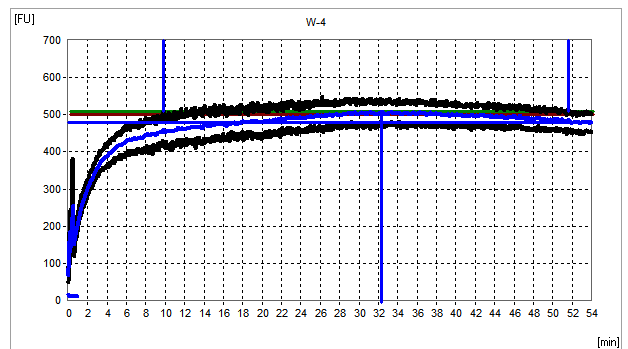
LCS Rebel (Minot, M-4)



Glenn Check (Williston, W-9)

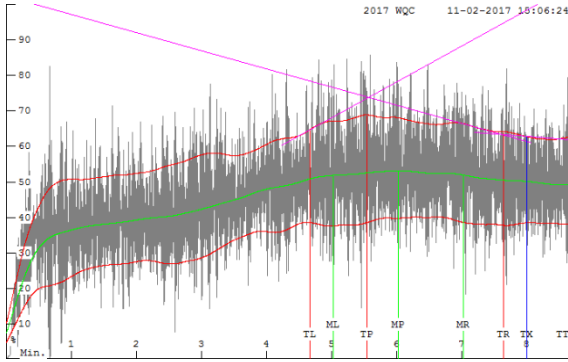


LCS Rebel (Williston, W-4)

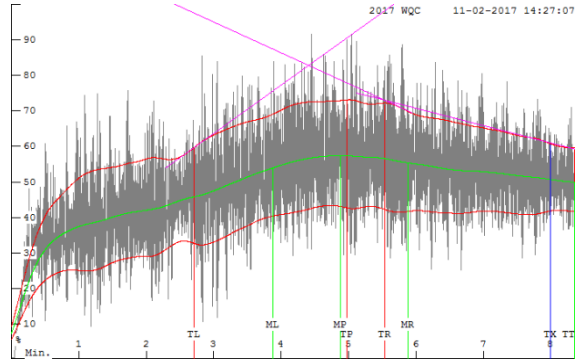


Mixograms

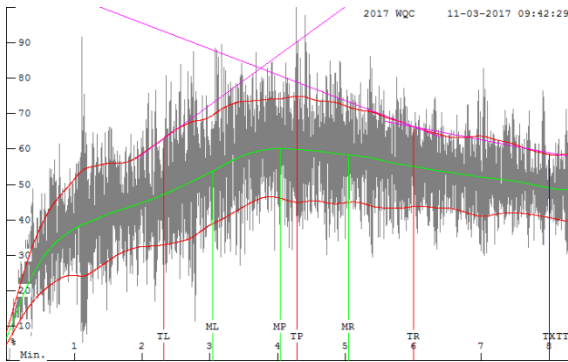
Glenn Check (Watertown, B-9)



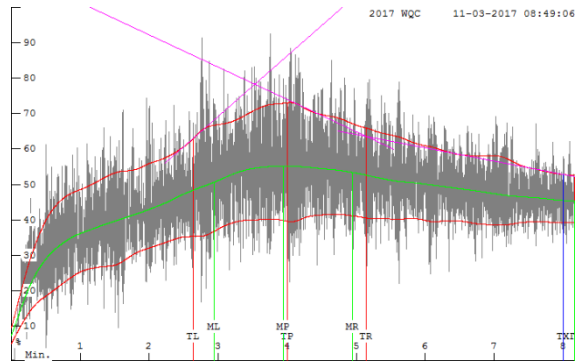
LCS Rebel (Watertown, B-4)



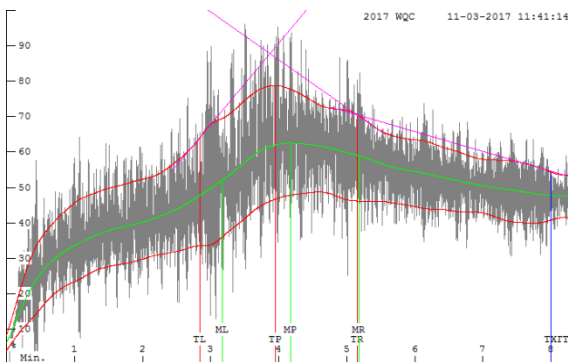
Glenn Check (Casselton, C-9)



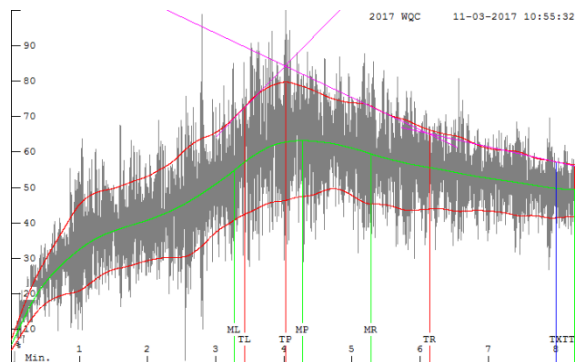
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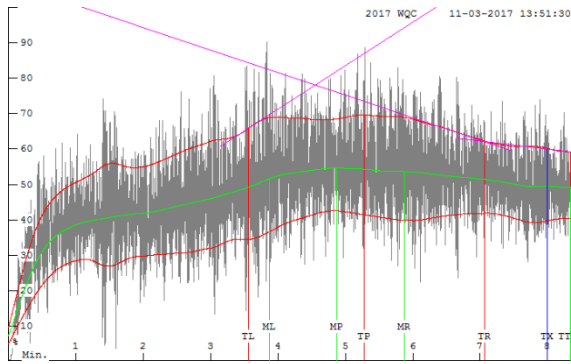
Glenn Check (Havre, H-9)



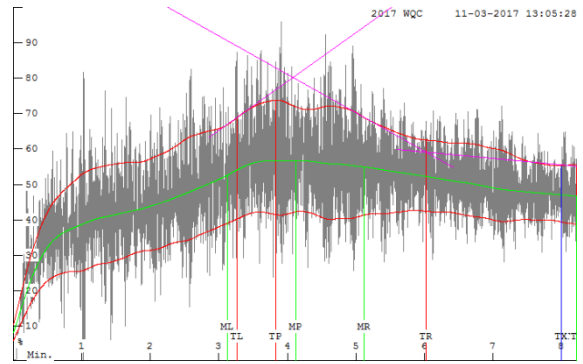
LCS Rebel (Havre, H-4)



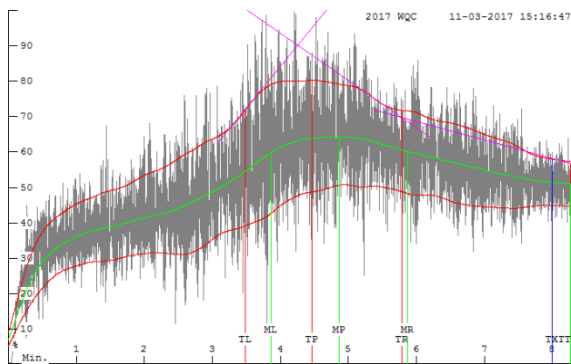
Glenn Check (Crookston, K-9)



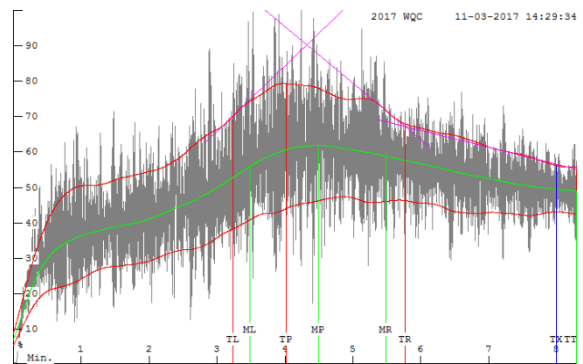
LCS Rebel (Crookston, K-4)



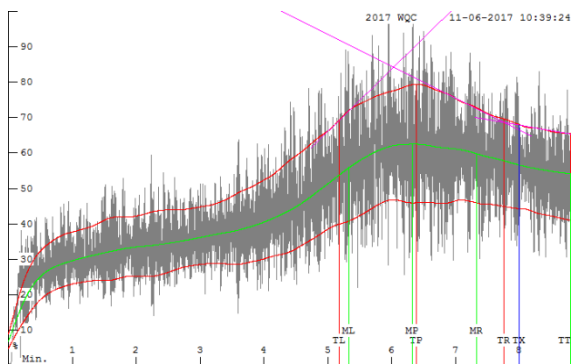
Glenn Check (Minot, M-9)



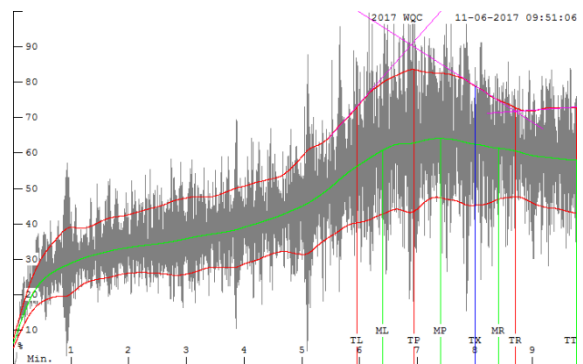
LCS Rebel (Minot, M-4)



Glenn Check (Williston, W-9)

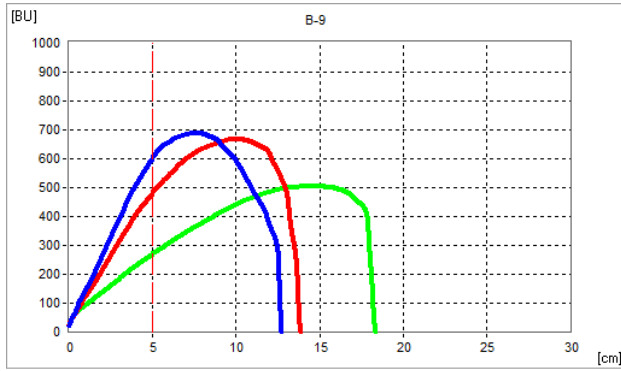


LCS Rebel (Williston, W-4)

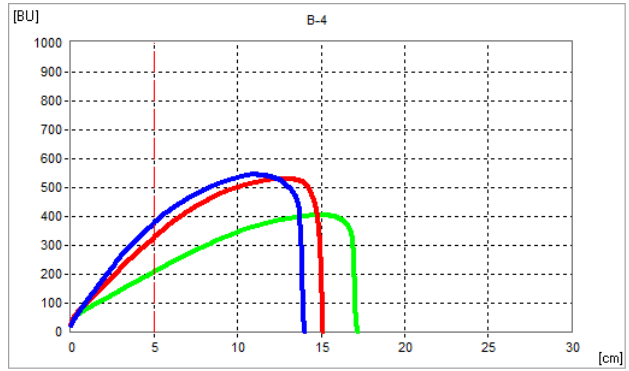


Extensograms

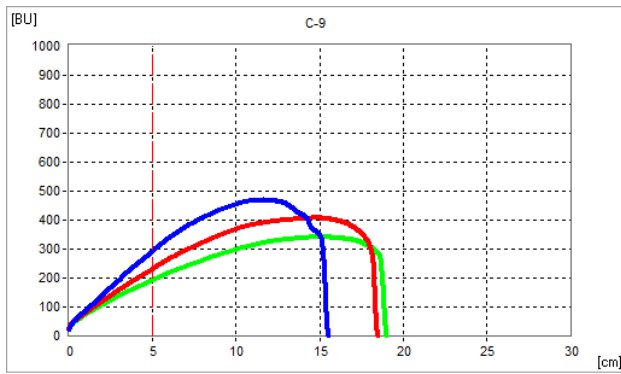
Glenn Check (Watertown, B-9)



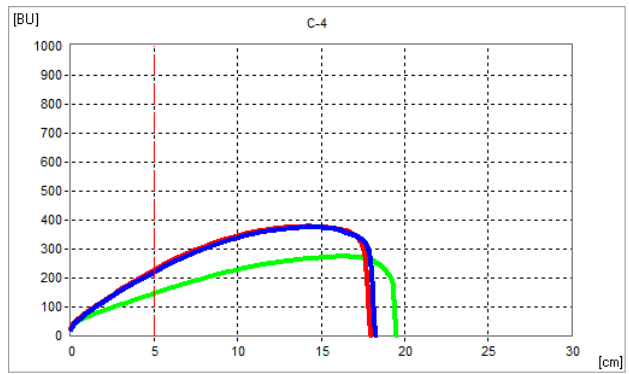
LCS Rebel (Watertown, B-4)



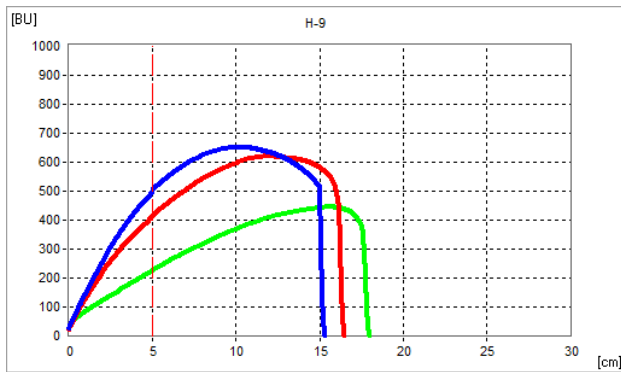
Glenn Check (Casselton, C-9)



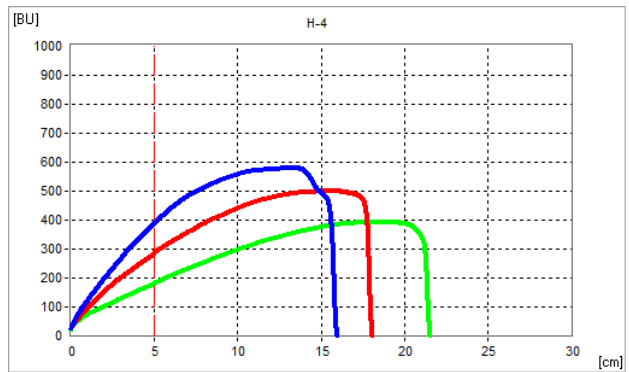
LCS Rebel (Casselton, C-4)



Glenn Check (Havre, H-9)

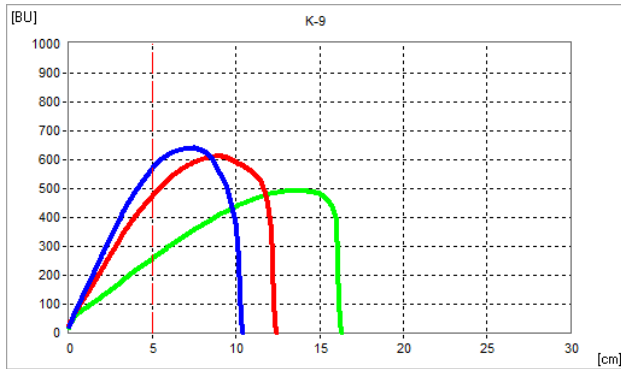


LCS Rebel (Havre, H-4)

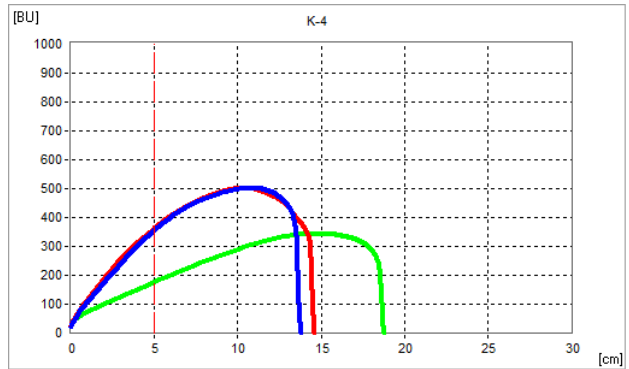


— 45 min; — 90 min; — 135 min

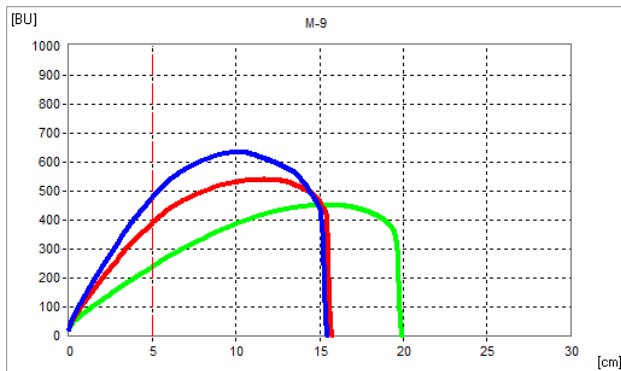
Glenn Check (Crookston, K-9)



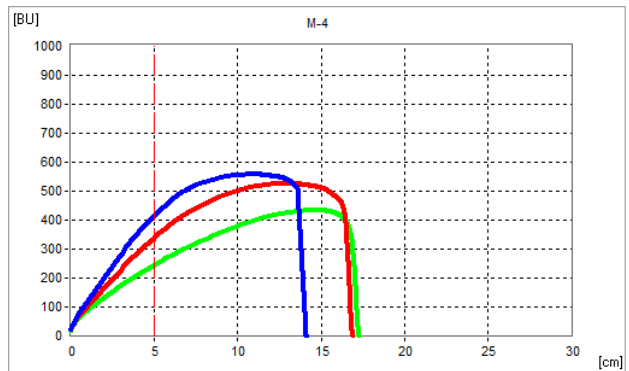
LCS Rebel (Crookston, K-4)



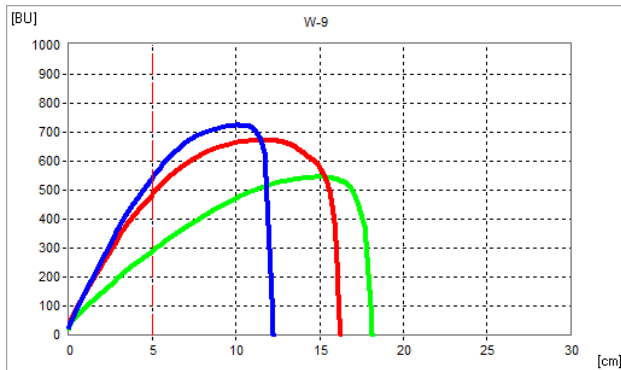
Glenn Check (Minot, M-9)



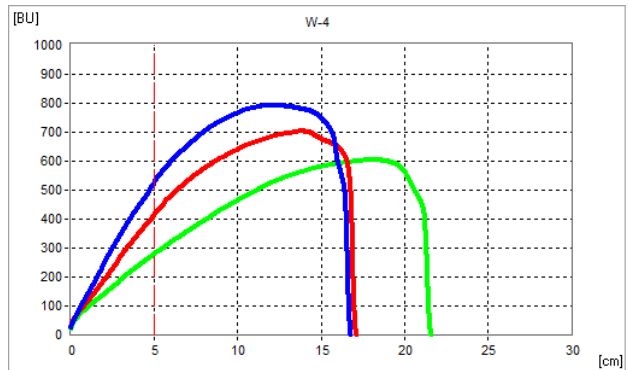
LCS Rebel (Minot, M-4)



Glenn Check (Williston, W-9)



LCS Rebel (Williston, W-4)



— 45 min; — 90 min; — 135 min

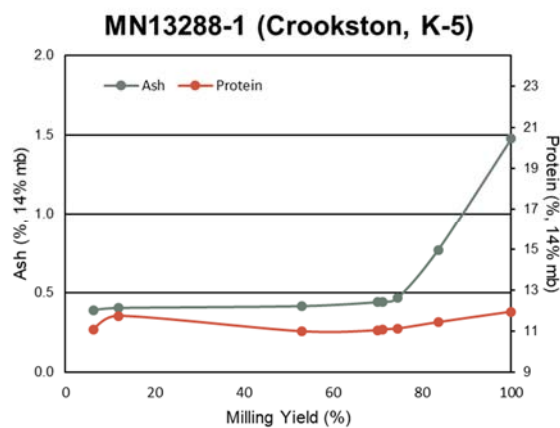
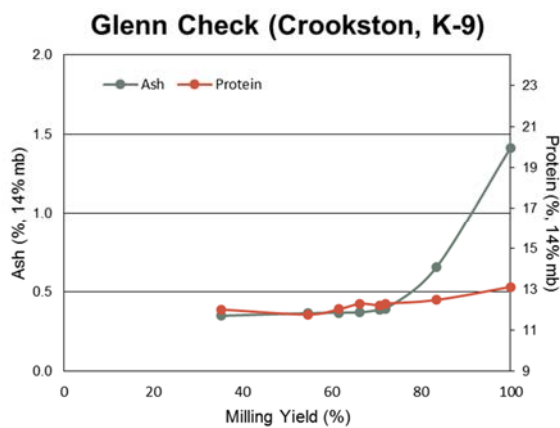
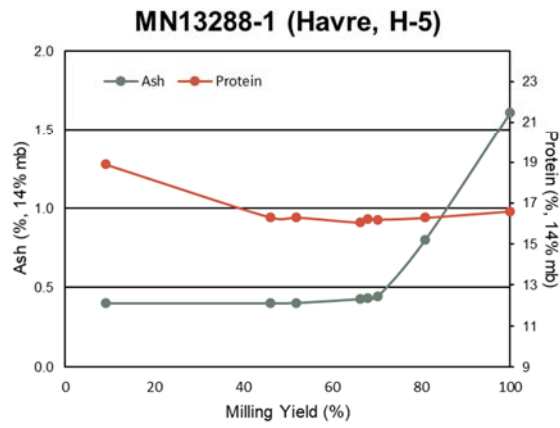
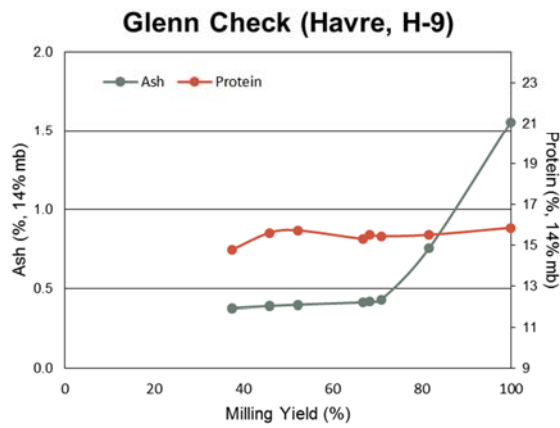
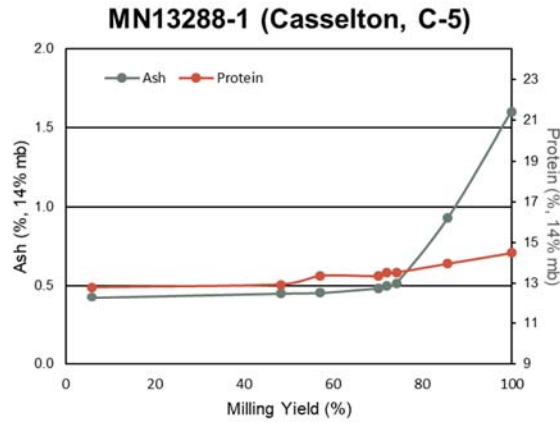
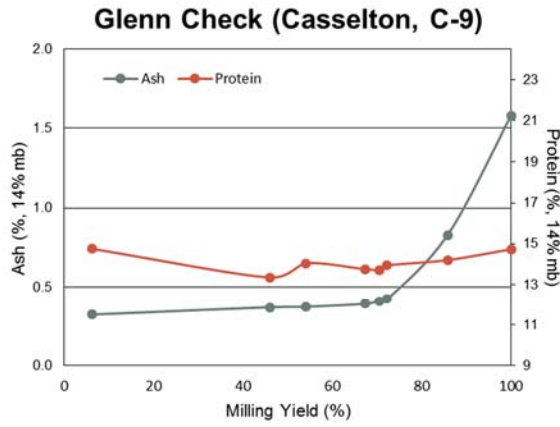
SWQAC #5 – MN13288-1

Quality Trait	Casselton		Havre		Crookston		
	Glenn		Glenn		Glenn		
	C-9	C-5	H-9	H-5	K-9	K-5	
I. USDA-ARS WQL Data							
1	Wheat Protein (% , 12% mb)	14.8	14.6	16.2	16.6	13.1	12.0
2	Flour Protein (% , 14% mb)	13.9	13.4	15.5	16.2	12.2	11.1
3	Market Value (Score 1-6)	4.2	4.0	4.5	4.1	4.4	4.0
4	Market Value (Score 1-10)	10.0	8.4	10.0	8.8	10.0	7.6
5	DON (ppm)	nd	nd	nd	nd	nd	nd
6	Test Weight (lb/bu)	64.2	60.4	61.8	58.0	65.3	62.0
7	1000 Kernel Weight (g)	32.7	30.6	24.5	27.8	33.7	32.8
8	Kernel Size, % Large	66	46	4	8	70	62
9	Kernel Size, % Small	5	14	26	30	7	8
10	Wheat Moisture (%)	10.5	10.1	8.9	8.9	10.1	9.5
11	Wheat Ash (% , 14% mb)	1.55	1.49	1.47	1.50	1.36	1.42
12	Wheat Falling Number (sec)	344	401	405	513	404	424
13	SKCS Hardness Index	81.9	78.7	70.8	66.5	88.1	82.2
14	Vitreous Kernels (%)	91	42	92	88	88	64
Flour Extraction (%)							
15	Tempered Wheat Basis (%)	73.1	73.4	70.6	69.8	71.8	74.5
16	Total Product Basis (%)	72.2	74.2	71.0	70.2	71.9	74.5
17	Flour/Bu Wheat (lbs)	47.5	45.1	44.3	41.2	47.3	47.0
Flour Quality							
18	Flour Color Brightness (<i>L</i> *)	89.6	89.6	90.0	90.1	90.5	90.5
19	Flour Color Yellowness (<i>b</i> *)	8.2	8.8	8.6	8.4	8.5	8.7
20	Flour Moisture (%)	13.3	13.3	13.8	14.0	13.3	13.4
21	Flour Ash (% , 14% mb)	0.43	0.50	0.45	0.43	0.43	0.46
22	Flour Falling Number (Malted) (sec)	259	250	247	250	249	251
Farinograph							
23	Water Absorption (% , 500 BU)	66.8	61.6	64.5	62.1	64.6	59.7
24	Water Absorption (% , 14% mb)	65.9	60.6	64.3	62.3	63.7	58.9
25	Arrival Time (min)	2.4	2.4	5.7	3.6	1.8	1.6
26	Peak Time (min)	6.3	6.7	10.8	9.2	5.0	3.4
27	Dough Stability (min)	8.7	9.7	19.7	35.9	9.7	8.2
28	Mixing Tolerance Index (MTI) (BU)	33	29	12	6	23	17
29	Time To Breakdown (TTB) (min)	11.0	11.8	25.3	41.0	11.0	9.5
II. Cooperator Results							
30	Bake Absorption (Average %)	67.6	64.1	67.1	66.0	65.7	61.4
31	Loaf Volume (% of Check)		99.9		101.2		96.3

SWQAC #5 – MN13288-1

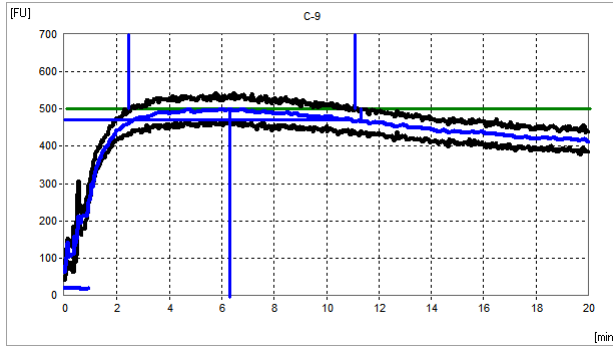
Quality Trait	Casselton		Havre		Crookston			
	Glenn C-9	C-5	Glenn H-9	H-5	Glenn K-9	K-5		
II. Cooperator Results								
32	Mixing Requirement 9 = Very Long 7 = Long 5 = Medium 3 = Short 1 = Very Short		5.5	6.5	6.1	6.7	6.6	6.1
33	Dough Characteristics 9 = Bucky – Tough 7 = Strong – Elastic 5 = Medium – Pliable 3 = Mellow – Very Pliable 1 = Weak – Short or Sticky		5.8	6.9	6.6	7.2	6.8	6.4
34	Mixing Tolerance 9 = Much More Tolerance Than Check 7 = More Tolerance Than Check 5 = Tolerance Equivalent To Check 3 = Less Tolerance Than Check 1 = Much Less Tolerance Than Check		5.5		5.6		4.7	
35	Internal Crumb Color 9 = Much Brighter Than Check 7 = Brighter Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check		5.4		5.4		5.1	
36	Internal Grain and Texture 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check		5.7		5.2		4.9	
III. Cooperator Evaluation								
	Quality Traits 1-2: Protein 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check		4.7		5.8		3.2	
	Quality Traits 3-22: Milling 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check		4.8		4.5		6.2	
	Quality Traits 23-36: Baking 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check		5.5		5.1		4.5	
	Quality Traits 1-36: Overall Comparison 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check		5.4		5.2		4.7	

Cumulative Ash and Protein Curves

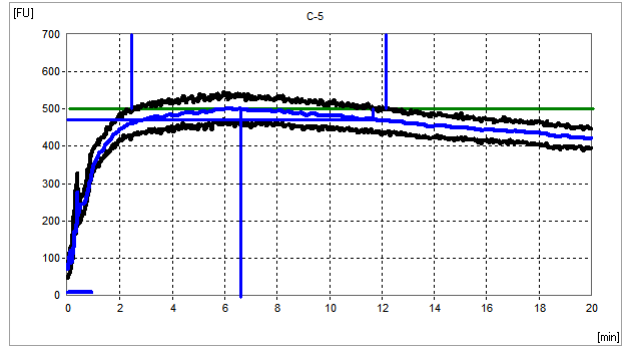


Farinograms

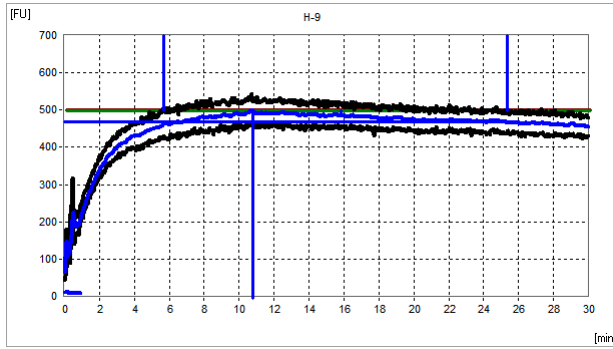
Glenn Check (Casselton, C-9)



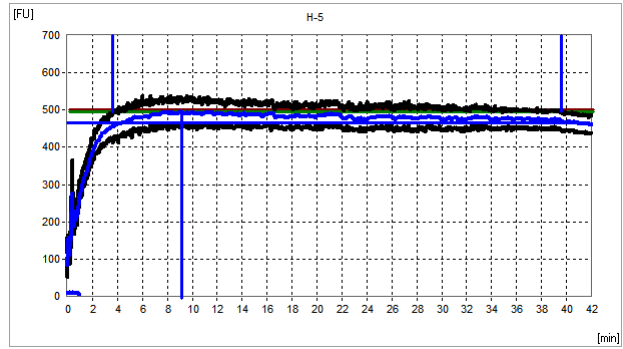
MN13288-1 (Casselton, C-5)



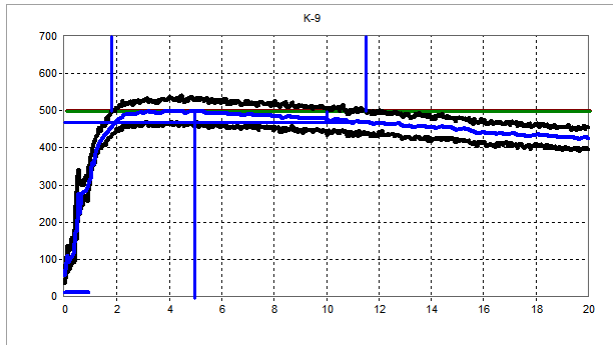
Glenn Check (Havre, H-9)



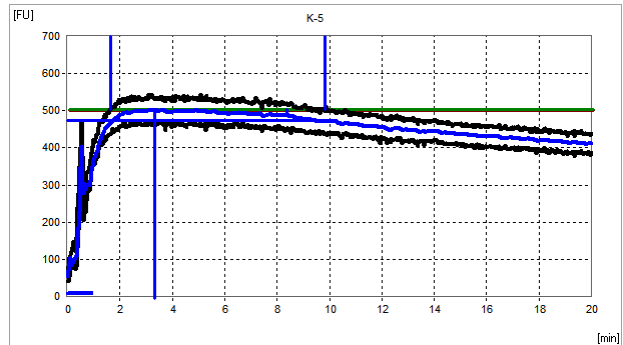
MN13288-1 (Havre, H-5)



Glenn Check (Crookston, K-9)

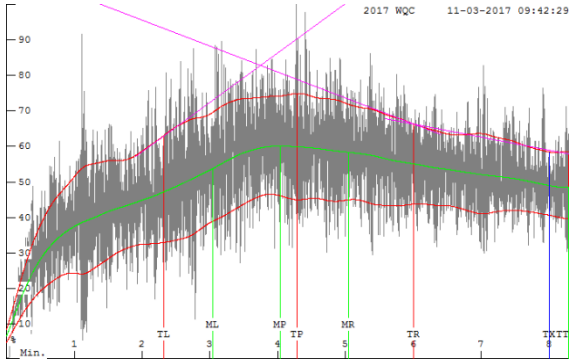


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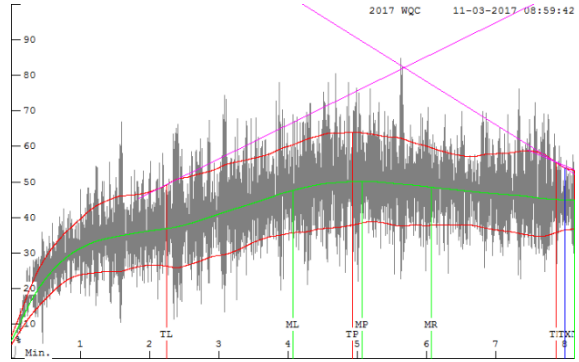


Mixograms

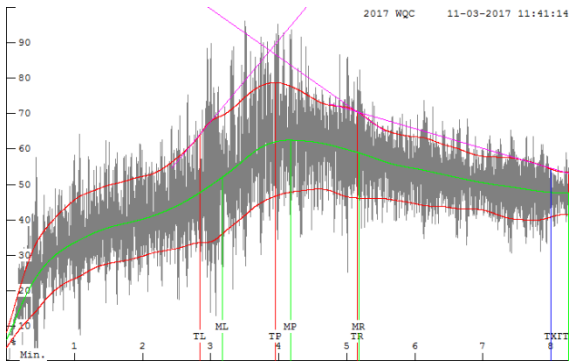
Glenn Check (Casselton, C-9)



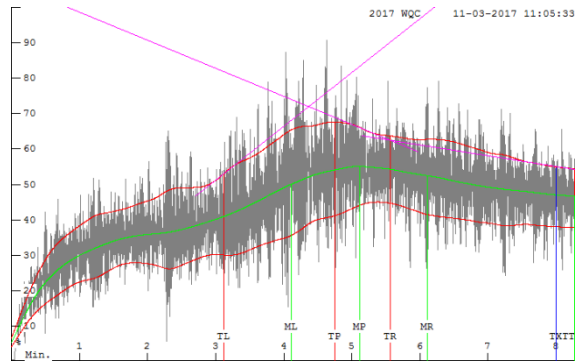
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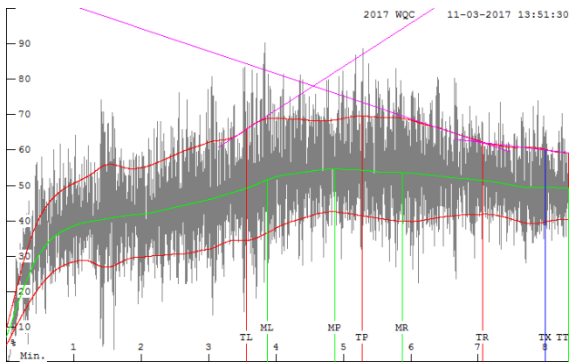
Glenn Check (Havre, H-9)



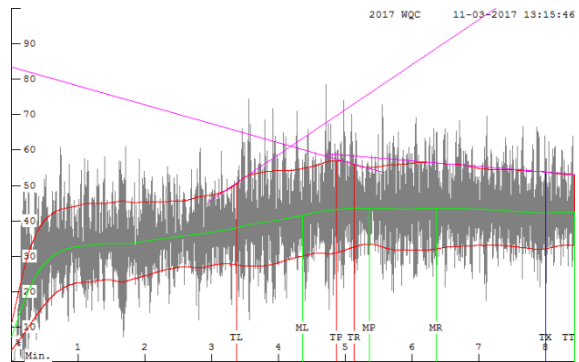
MN13288-1 (Havre, H-5)



Glenn Check (Crookston, K-9)

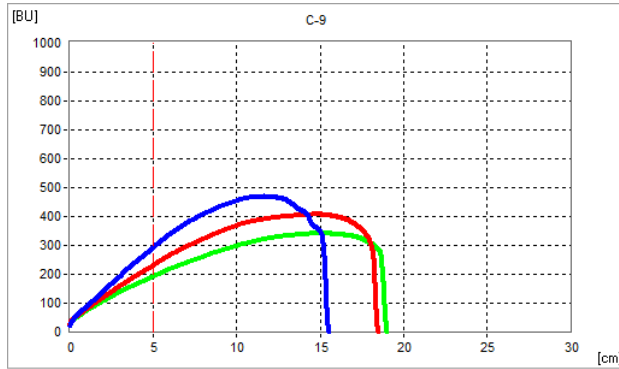


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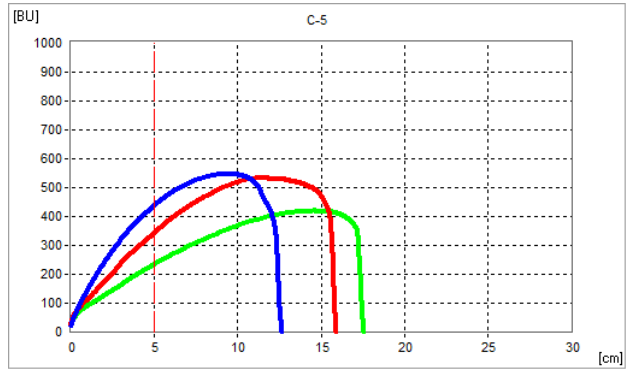


Extensograms

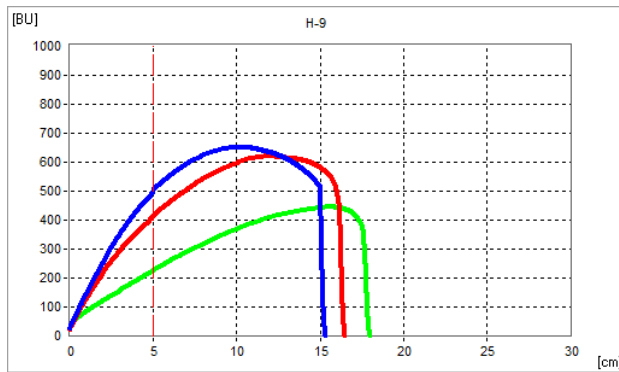
Glenn Check (Casselton, C-9)



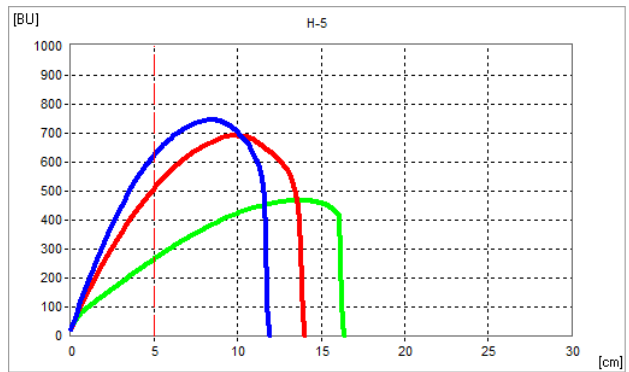
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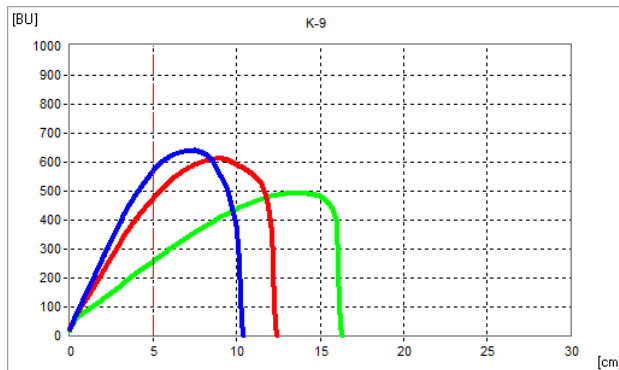
Glenn Check (Havre, H-9)



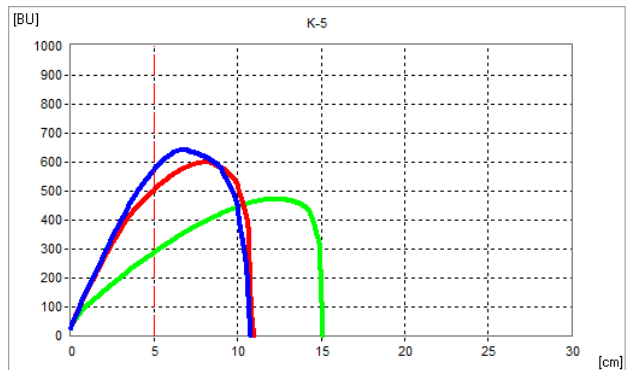
MN13288-1 (Havre, H-5)



Glenn Check (Crookston, K-9)



MN13288-1 (Crookston, K-5)



— 45 min; — 90 min; — 135 min

SWQAC #6 – SY Rockford

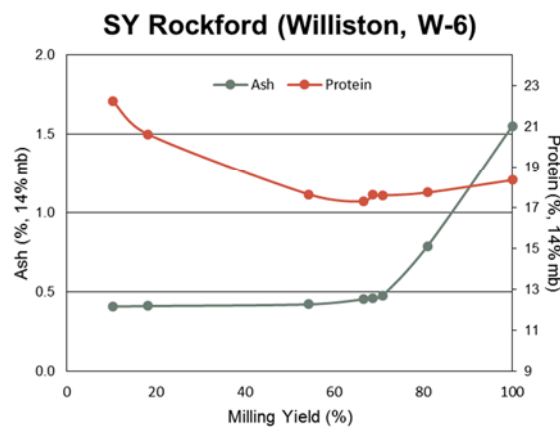
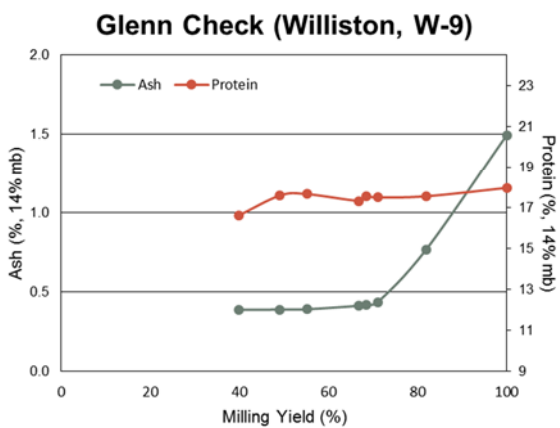
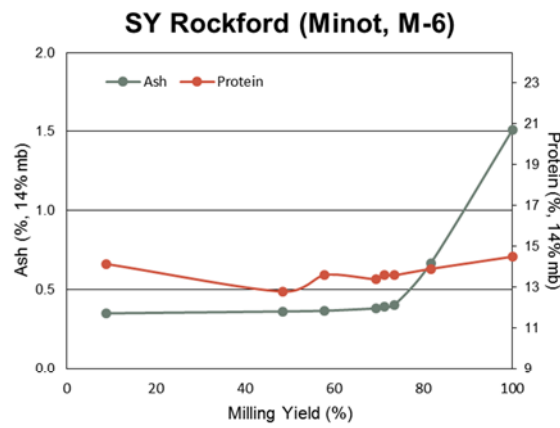
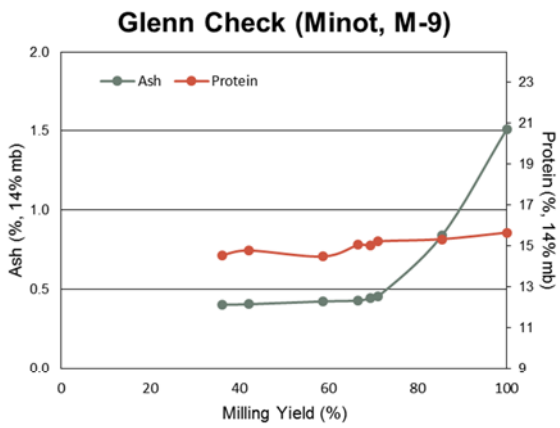
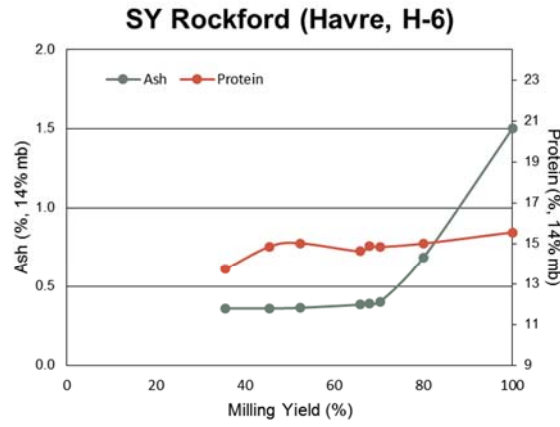
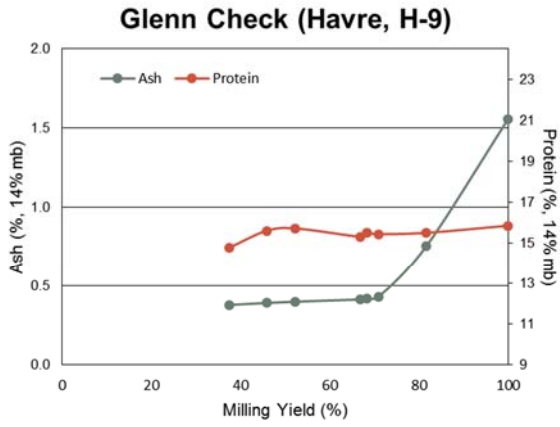
Quality Trait	Havre		Minot		Williston		
	Glenn	H-6	Glenn	M-6	Glenn	W-6	
	H-9	H-6	M-9	M-6	W-9	W-6	
I. USDA-ARS WQL Data							
1	Wheat Protein (% , 12% mb)	16.2	15.7	16.2	14.9	18.6	19.0
2	Flour Protein (% , 14% mb)	15.5	14.7	15.2	13.5	17.4	17.3
3	Market Value (Score 1-6)	4.5	3.9	4.9	4.3	4.0	3.3
4	Market Value (Score 1-10)	10.0	8.4	10.0	8.0	10.0	8.8
5	DON (ppm)	nd	nd	nd	nd	nd	nd
6	Test Weight (lb/bu)	61.8	57.7	63.1	60.2	58.7	57.1
7	1000 Kernel Weight (g)	24.5	26.8	32.4	35.1	24.1	27.4
8	Kernel Size, % Large	4	11	62	66	6	15
9	Kernel Size, % Small	26	28	7	6	38	27
10	Wheat Moisture (%)	8.9	8.7	10.7	10.3	10.3	10.4
11	Wheat Ash (% , 14% mb)	1.47	1.38	1.48	1.45	1.45	1.38
12	Wheat Falling Number (sec)	405	428	372	384	404	335
13	SKCS Hardness Index	70.8	65.6	85.2	67.2	70.2	69.0
14	Vitreous Kernels (%)	92	87	78	22	96	98
Flour Extraction (%)							
15	Tempered Wheat Basis (%)	70.6	70.1	70.7	73.7	71.1	70.7
16	Total Product Basis (%)	71.0	70.3	71.2	73.5	71.0	70.8
17	Flour/Bu Wheat (lbs)	44.3	41.1	44.7	45.3	42.1	41.0
Flour Quality							
18	Flour Color Brightness (<i>L</i> *)	90.0	90.2	89.7	90.3	89.5	89.7
19	Flour Color Yellowness (<i>b</i> *)	8.6	8.9	8.3	8.4	8.7	8.7
20	Flour Moisture (%)	13.8	13.9	13.0	13.2	13.4	13.9
21	Flour Ash (% , 14% mb)	0.45	0.41	0.47	0.40	0.43	0.47
22	Flour Falling Number (Malted) (sec)	247	249	250	245	249	250
Farinograph							
23	Water Absorption (% , 500 BU)	64.5	66.2	66.3	67.1	66.1	68.2
24	Water Absorption (% , 14% mb)	64.3	66.3	65.0	66.1	66.2	68.2
25	Arrival Time (min)	5.7	5.0	4.5	3.9	8.0	8.2
26	Peak Time (min)	10.8	10.0	10.5	7.7	25.5	19.9
27	Dough Stability (min)	19.7	15.3	25.4	11.0	34.0	24.8
28	Mixing Tolerance Index (MTI) (BU)	12	17	9	25	5	11
29	Time To Breakdown (TTB) (min)	25.3	20.6	29.9	14.3	42.6	33.9
II. Cooperator Results							
30	Bake Absorption (Average %)	67.1	68.0	67.5	68.3	69.3	70.3
31	Loaf Volume (% of Check)		97.1		97.4		98.6

*Flour not malted.

SWQAC #6 – SY Rockford

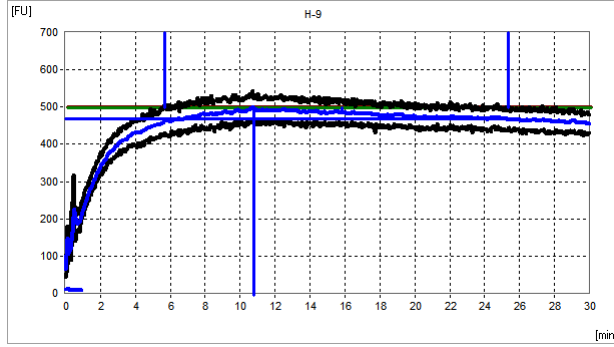
Quality Trait	Havre		Minot		Williston			
	Glenn H-9	H-6	Glenn M-9	M-6	Glenn W-9	W-6		
II. Cooperator Results								
32	Mixing Requirement 9 = Very Long 7 = Long 5 = Medium 3 = Short 1 = Very Short		6.1	4.8	6.2	5.0	7.5	6.4
33	Dough Characteristics 9 = Bucky – Tough 7 = Strong – Elastic 5 = Medium – Pliable 3 = Mellow – Very Pliable 1 = Weak – Short or Sticky		6.6	5.5	7.0	6.0	7.4	6.8
34	Mixing Tolerance 9 = Much More Tolerance Than Check 7 = More Tolerance Than Check 5 = Tolerance Equivalent To Check 3 = Less Tolerance Than Check 1 = Much Less Tolerance Than Check			4.5		3.6		4.2
35	Internal Crumb Color 9 = Much Brighter Than Check 7 = Brighter Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			4.8		5.4		5.2
36	Internal Grain and Texture 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			5.1		5.6		4.9
III. Cooperator Evaluation								
	Quality Traits 1-2: Protein 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			3.9		3.2		5.1
	Quality Traits 3-22: Milling 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			5.0		6.0		5.2
	Quality Traits 23-36: Baking 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			4.8		5.3		4.8
	Quality Traits 1-36: Overall Comparison 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			4.8		5.1		5.1

Cumulative Ash and Protein Curves

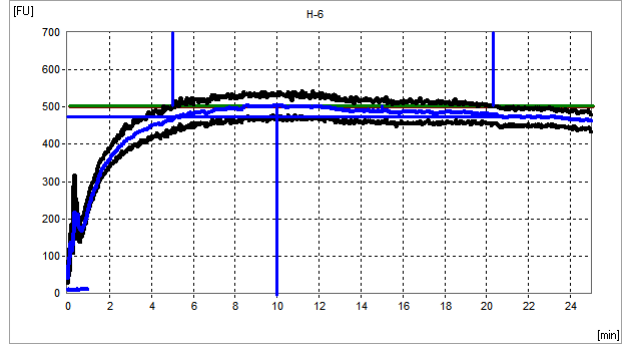


Farinograms

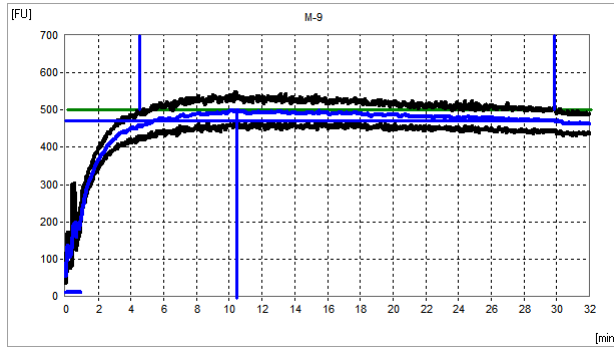
Glenn Check (Havre, H-9)



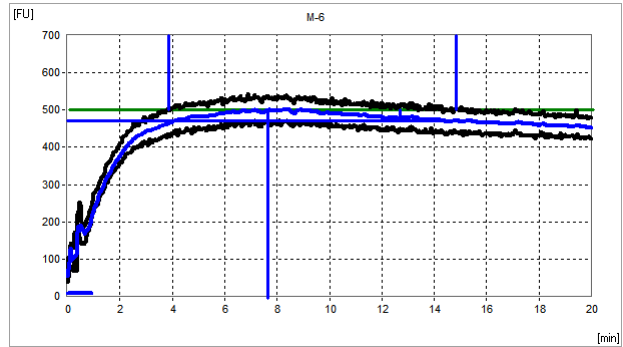
SY Rockford (Havre, H-6)



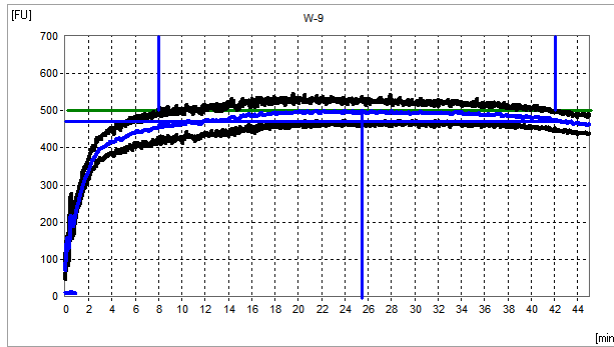
Glenn Check (Minot, M-9)



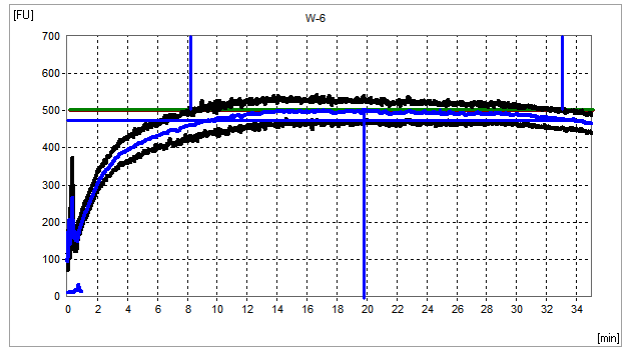
SY Rockford (Minot, M-6)



Glenn Check (Williston, W-9)

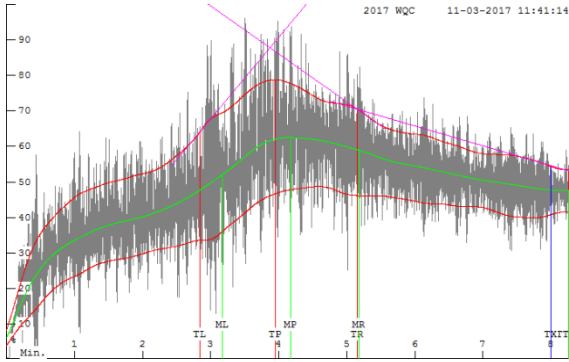


SY Rockford (Williston, W-6)

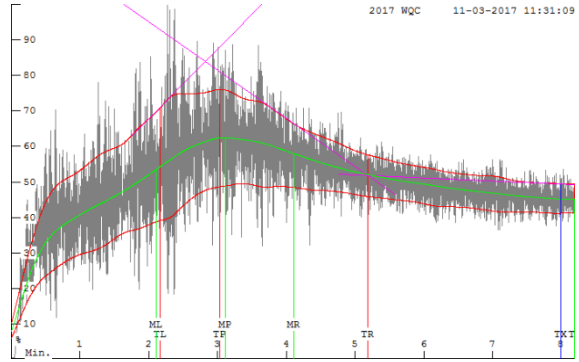


Mixograms

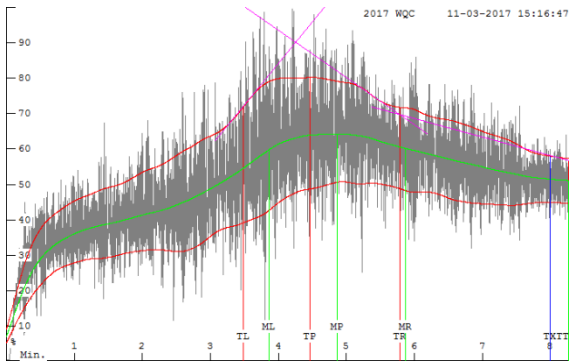
Glenn Check (Havre, H-9)



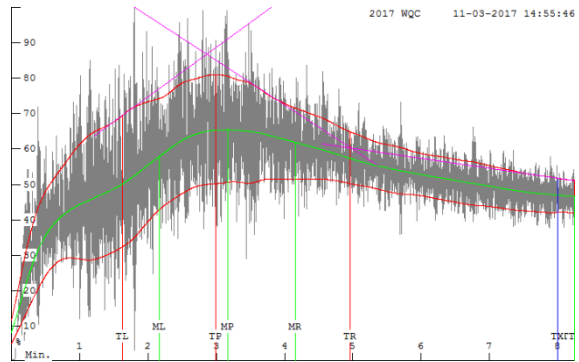
SY Rockford (Havre, H-6)



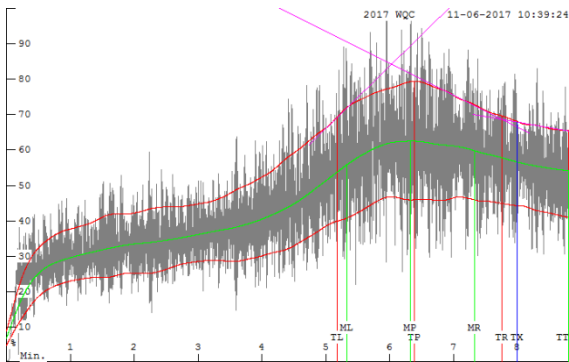
Glenn Check (Minot, M-9)



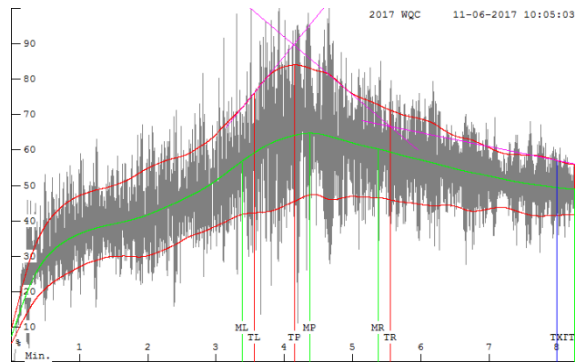
SY Rockford (Minot, M-6)



Glenn Check (Williston, W-9)

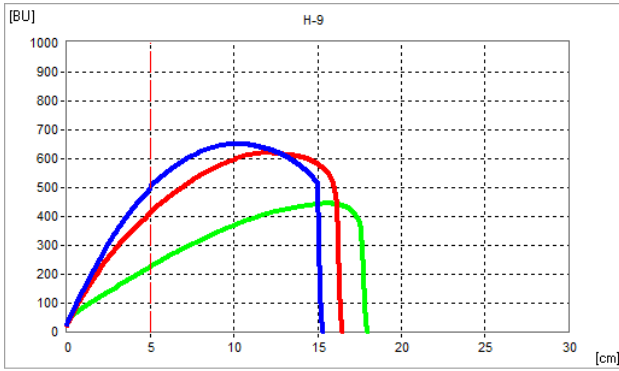


SY Rockford (Williston, W-6)

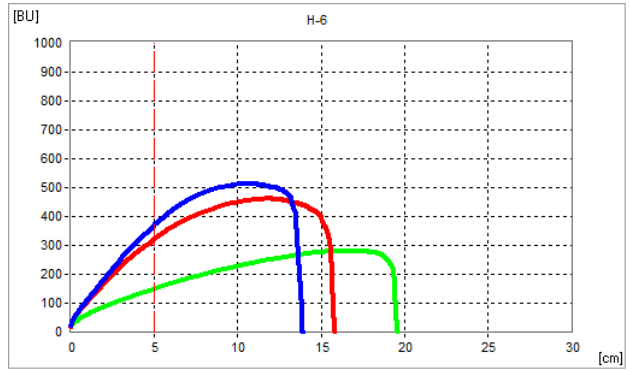


Extensograms

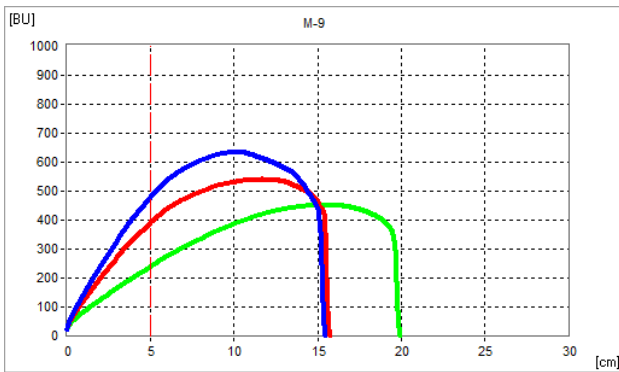
Glenn Check (Havre, H-9)



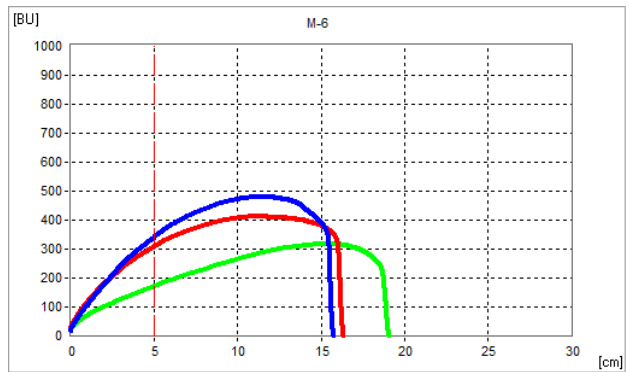
SY Rockford (Havre, H-6)



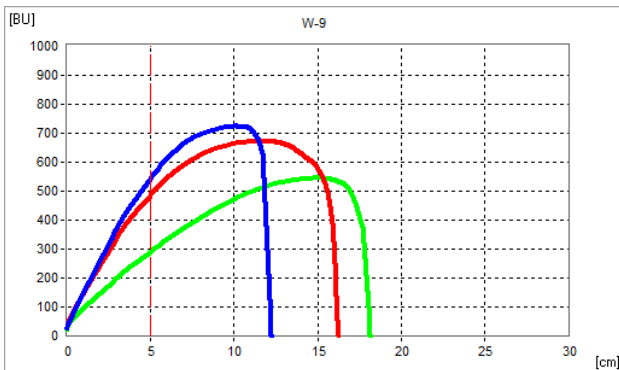
Glenn Check (Minot, M-9)



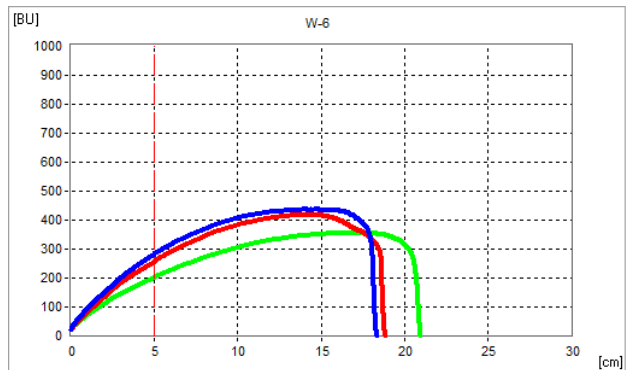
SY Rockford (Minot, M-6)



Glenn Check (Williston, W-9)



SY Rockford (Williston, W-6)



— 45 min; — 90 min; — 135 min

SWQAC #7 – WB9479

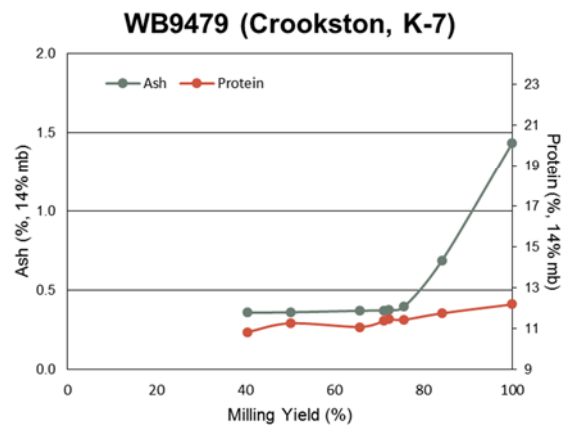
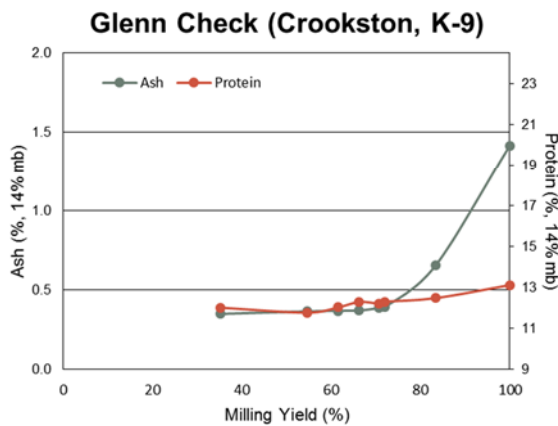
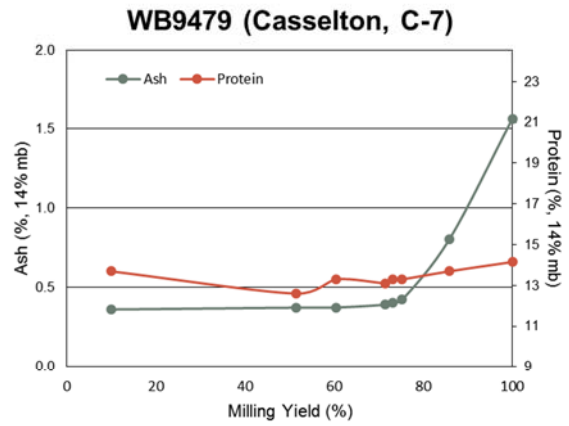
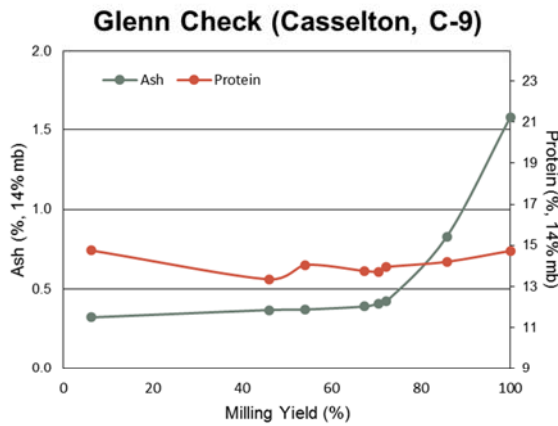
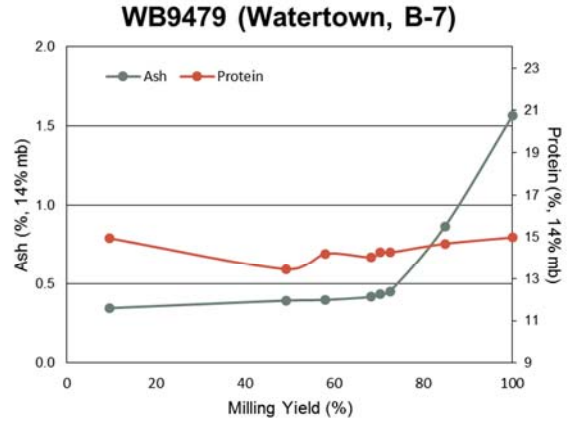
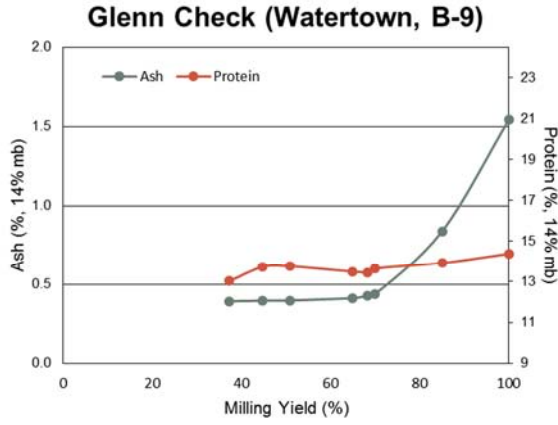
Quality Trait	Watertown		Casselton		Crookston		Minot		Williston		
	Glenn B-9	B-7	Glenn C-9	C-7	Glenn K-9	K-7	Glenn M-9	M-7	Glenn W-9	W-7	
I. USDA-ARS WQL Data											
1	Wheat Protein (% , 12% mb)	14.4	15.0	14.8	14.0	13.1	12.2	16.2	16.1	18.6	19.1
2	Flour Protein (% , 14% mb)	13.5	14.1	13.9	13.4	12.2	11.5	15.2	15.0	17.4	17.9
3	Market Value (Score 1-6)	4.3	3.1	4.2	3.6	4.4	4.4	4.9	4.2	4.0	3.7
4	Market Value (Score 1-10)	10.0	6.8	10.0	7.8	10.0	9.0	10.0	7.6	10.0	9.6
5	DON (ppm)	nd	nd	nd	nd	nd	0.89	nd	nd	nd	nd
6	Test Weight (lb/bu)	62.6	58.6	64.2	61.1	65.3	63.3	63.1	61.1	58.7	58.4
7	1000 Kernel Weight (g)	32.9	34.7	32.7	34.5	33.7	35.1	32.4	37.2	24.1	24.2
8	Kernel Size, % Large	61	79	66	77	70	80	62	81	6	14
9	Kernel Size, % Small	7	4	5	4	7	4	7	3	38	31
10	Wheat Moisture (%)	10.5	10.5	10.5	10.5	10.1	9.8	10.7	10.8	10.3	10.2
11	Wheat Ash (% , 14% mb)	1.42	1.46	1.55	1.46	1.36	1.39	1.48	1.40	1.45	1.44
12	Wheat Falling Number (sec)	365	232	344	312	404	426	372	255	404	376
13	SKCS Hardness Index	76.6	63.5	81.9	67.0	88.1	75.3	85.2	65.2	70.2	67.7
14	Vitreous Kernels (%)	28	15	91	47	88	68	78	20	96	89
Flour Extraction (%)											
15	Tempered Wheat Basis (%)	69.1	71.4	73.1	74.8	71.8	75.4	70.7	74.4	71.1	72.0
16	Total Product Basis (%)	70.0	72.5	72.2	75.3	71.9	75.7	71.2	74.2	71.0	71.4
17	Flour/Bu Wheat (lbs)	43.7	42.2	47.5	46.4	47.3	48.6	44.7	45.8	42.1	42.4
Flour Quality											
18	Flour Color Brightness (L*)	89.8	89.5	89.6	89.6	90.5	90.5	89.7	89.5	89.5	89.1
19	Flour Color Yellowness (b*)	7.8	7.7	8.2	8.7	8.5	9.2	8.3	8.3	8.7	9.4
20	Flour Moisture (%)	13.6	13.2	13.3	13.5	13.3	13.5	13.0	13.3	13.4	13.7
21	Flour Ash (% , 14% mb)	0.46	0.46	0.43	0.42	0.43	0.40	0.47	0.42	0.43	0.41
22	Flour Falling Number (Malted) (sec)	246	217*	259	252	249	253	250	245	249	255
Farinograph											
23	Water Absorption (% , 500 BU)	64.3	62.9	66.8	62.4	64.6	60.7	66.3	63.5	66.1	66.6
24	Water Absorption (% , 14% mb)	63.7	61.9	65.9	61.6	63.7	60.2	65.0	62.6	66.2	66.4
25	Arrival Time (min)	2.5	2.0	2.4	2.2	1.8	1.7	4.5	3.6	8.0	14.8
26	Peak Time (min)	4.7	4.5	6.3	6.7	5.0	2.7	10.5	10.3	25.5	28.7
27	Dough Stability (min)	9.4	7.5	8.7	11.2	9.7	9.7	25.4	24.1	34.0	31.8
28	Mixing Tolerance Index (MTI) (BU)	22	33	33	28	23	15	9	7	5	3
29	Time To Breakdown (TTB) (min)	11.1	8.9	11.0	11.8	11.0	10.5	29.9	26.4	42.6	48.0
II. Cooperator Results											
30	Bake Absorption (Average %)	65.8	65.3	67.6	64.4	65.7	62.4	67.5	66.4	69.3	69.7
31	Loaf Volume (% of Check)		100.0		99.0		96.7		95.4		97.3

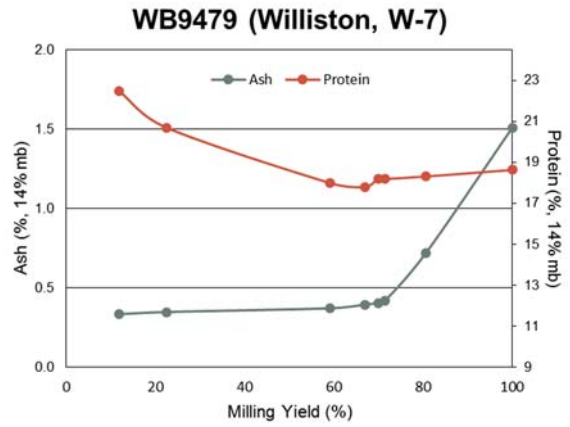
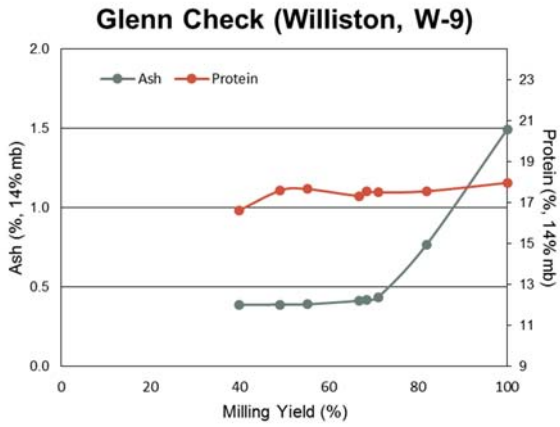
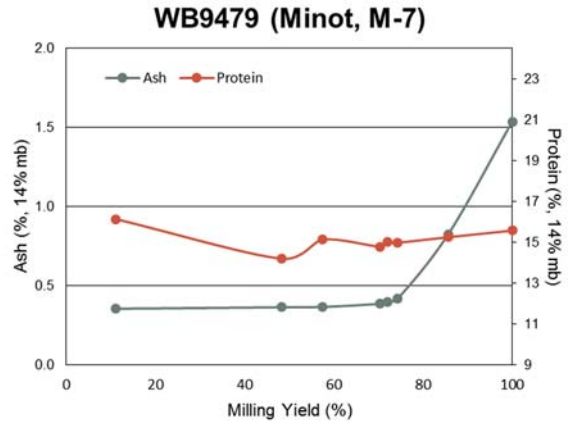
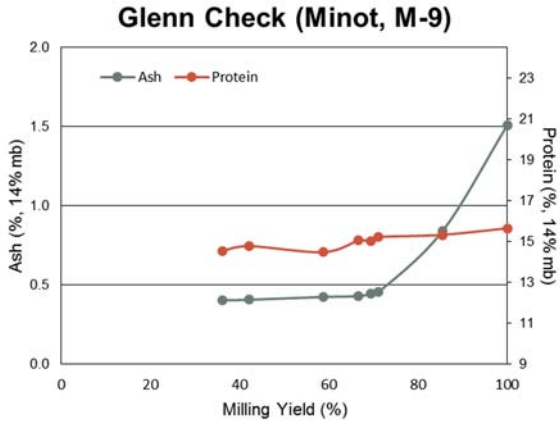
*Flour not malted.

SWQAC #7 – WB9479

Quality Trait	Watertown		Casselton		Crookston		Minot		Williston			
	Glenn		Glenn		Glenn		Glenn		Glenn			
	B-9	B-7	C-9	C-7	K-9	K-7	M-9	M-7	W-9	W-7		
II. Cooperator Results												
32	Mixing Requirement 9 = Very Long 7 = Long 5 = Medium 3 = Short 1 = Very Short		6.8	6.7	5.5	6.2	6.6	6.8	6.2	6.9	7.5	7.8
33	Dough Characteristics 9 = Bucky – Tough 7 = Strong – Elastic 5 = Medium – Pliable 3 = Mellow – Very Pliable 1 = Weak – Short or Sticky		7.1	6.7	5.8	6.6	6.8	6.8	7.0	6.6	7.4	7.1
34	Mixing Tolerance 9 = Much More Tolerance Than Check 7 = More Tolerance Than Check 5 = Tolerance Equivalent To Check 3 = Less Tolerance Than Check 1 = Much Less Tolerance Than Check			5.0		6.2		5.3		4.9		4.6
35	Internal Crumb Color 9 = Much Brighter Than Check 7 = Brighter Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			5.5		5.3		5.0		5.3		5.2
36	Internal Grain and Texture 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			5.3		5.5		5.2		4.8		5.5
III. Cooperator Evaluation												
	Quality Traits 1-2: Protein 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			6.1		4.2		3.8		4.8		5.4
	Quality Traits 3-22: Milling 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			5.8		6.2		6.9		6.5		5.2
	Quality Traits 23-36: Baking 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			5.3		5.1		5.2		4.6		5.2
	Quality Traits 1-36: Overall Comparison 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			5.5		5.2		5.4		5.2		5.2

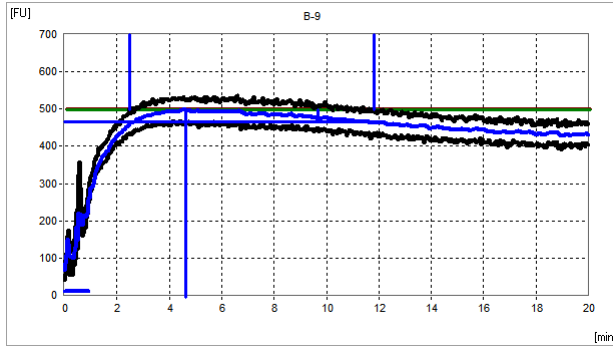
Cumulative Ash and Protein Curves



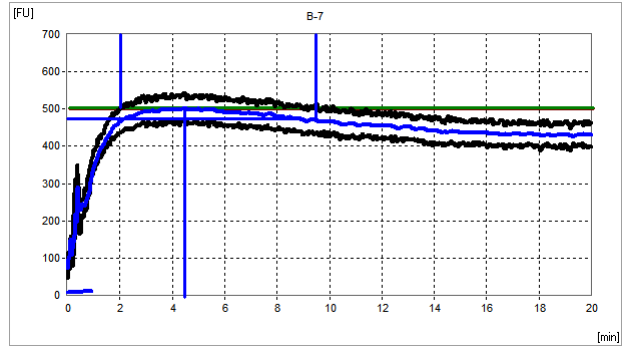


Farinograms

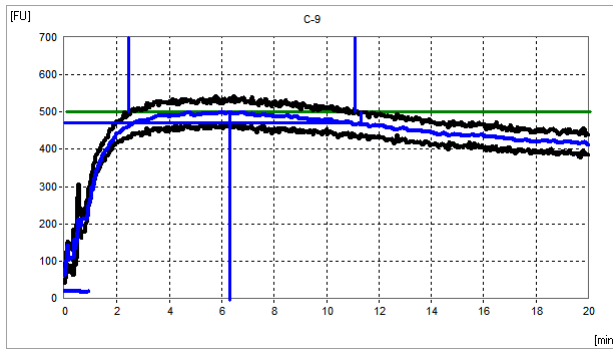
Glenn Check (Watertown, B-9)



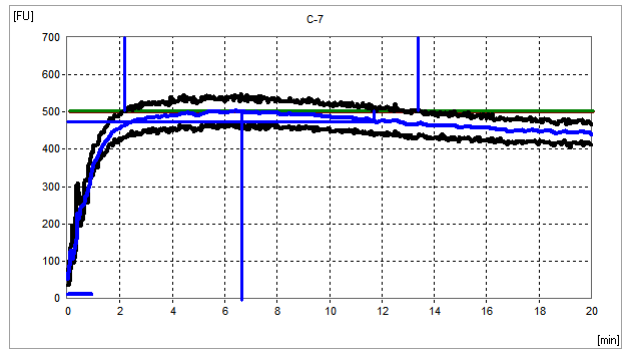
WB9479 (Watertown, B-7)



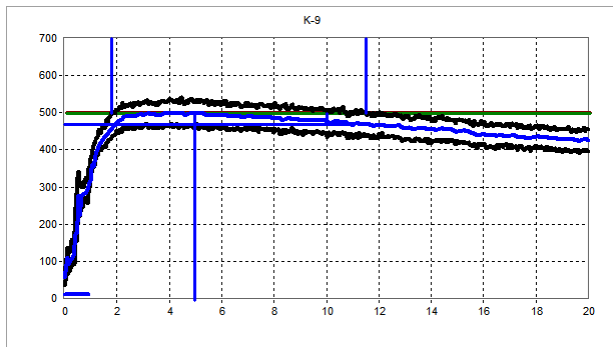
Glenn Check (Casselton, C-9)



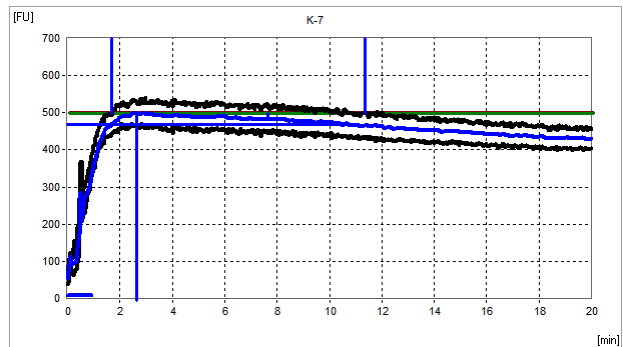
WB9479 (Casselton, C-7)



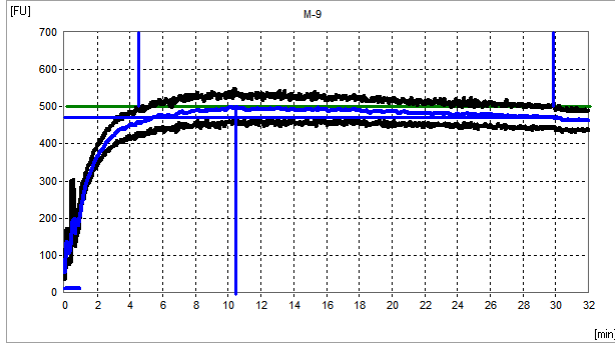
Glenn Check (Crookston, K-9)



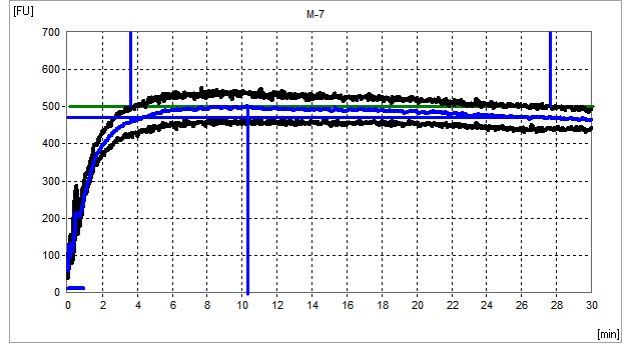
WB9479 (Crookston, K-7)



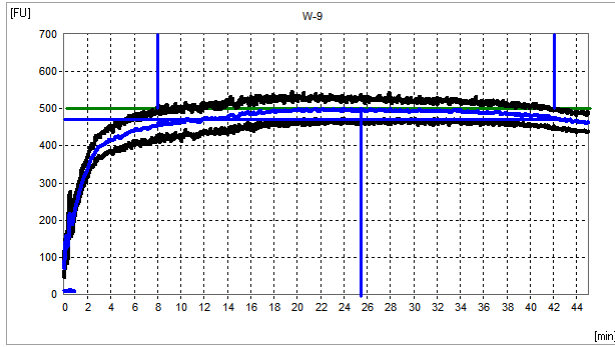
Glenn Check (Minot, M-9)



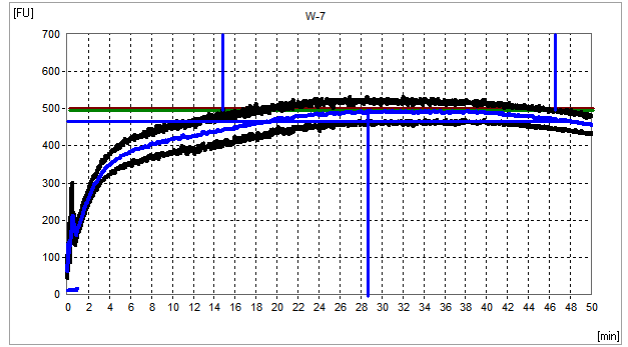
WB9479 (Minot, M-7)



Glenn Check (Williston, W-9)

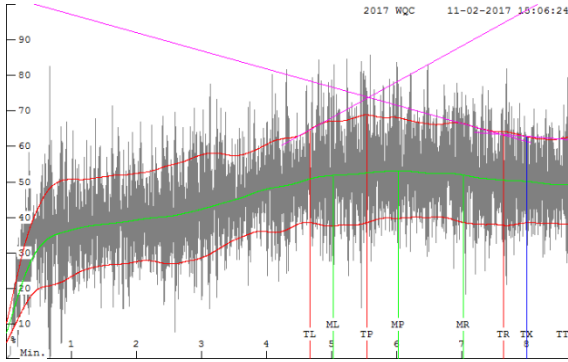


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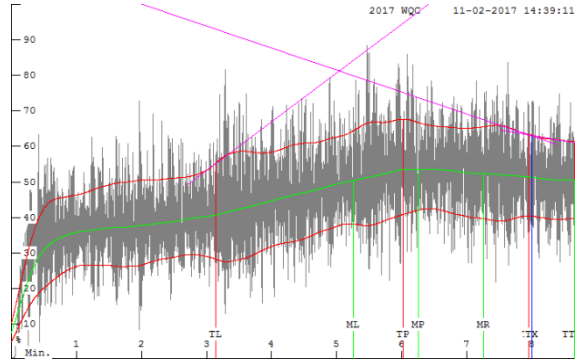


Mixograms

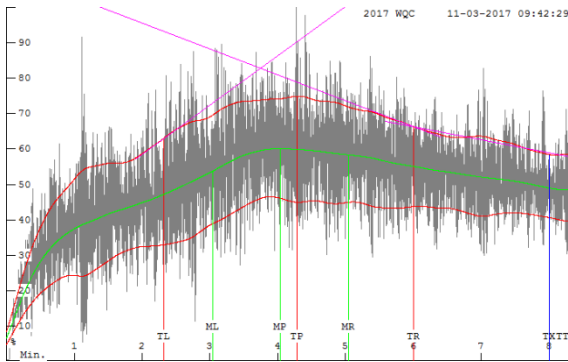
Glenn Check (Watertown, B-9)



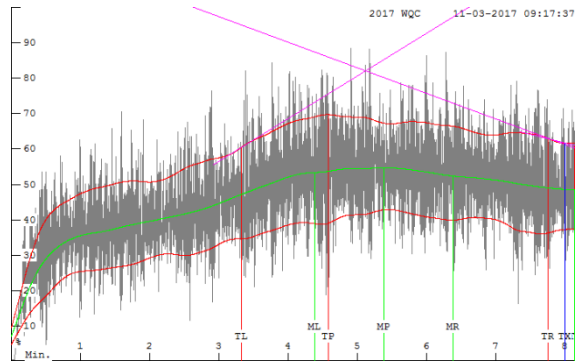
WB9479 (Watertown, B-7)



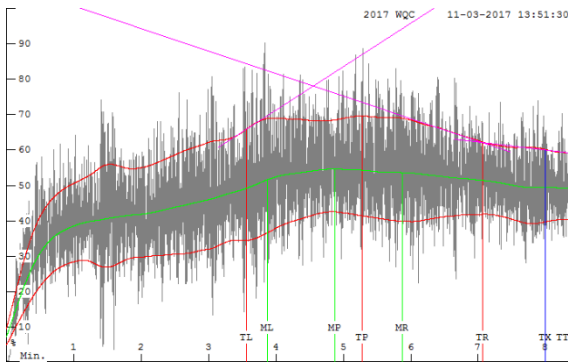
Glenn Check (Casselton, C-9)



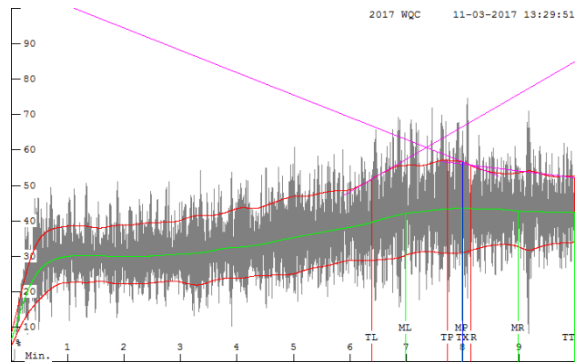
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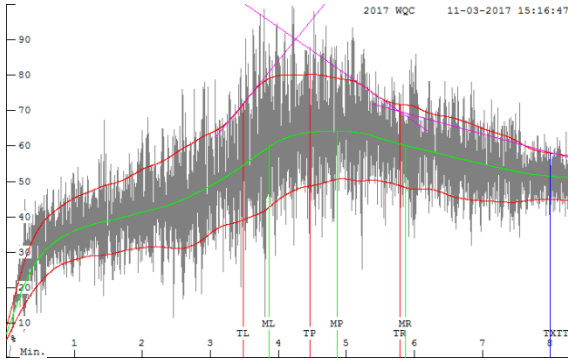
Glenn Check (Crookston, K-9)



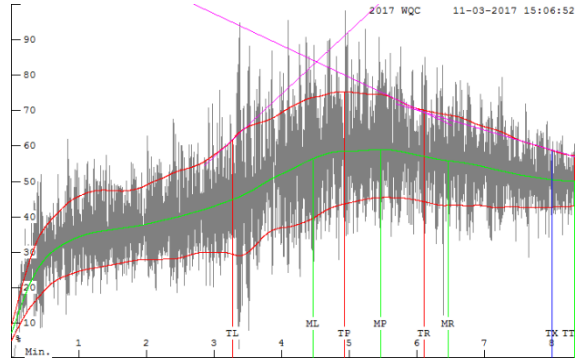
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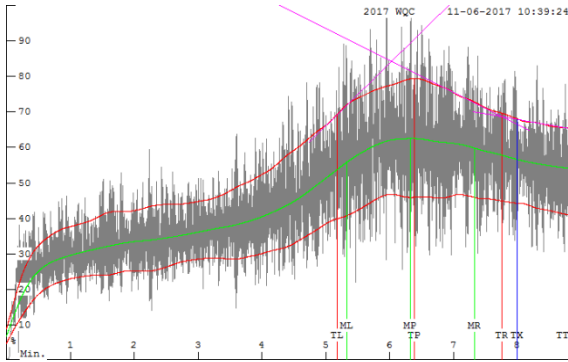
Glenn Check (Minot, M-9)



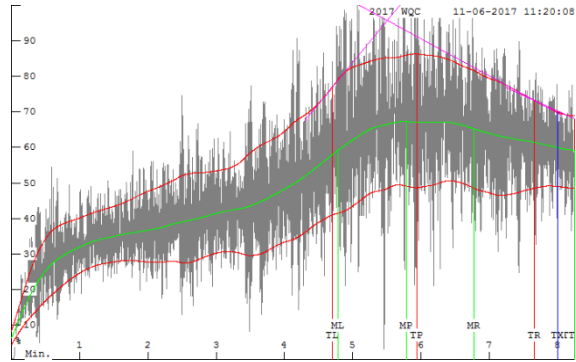
WB9479 (Minot, M-7)



Glenn Check (Williston, W-9)

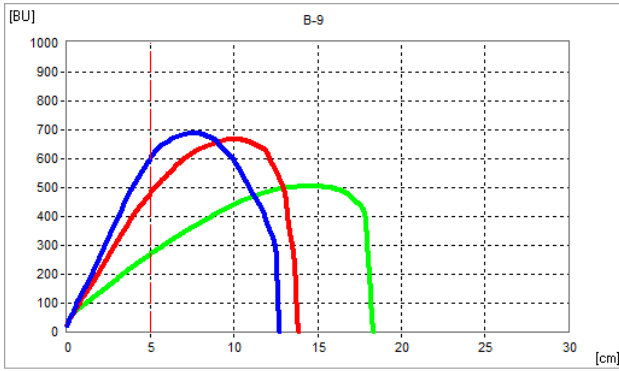


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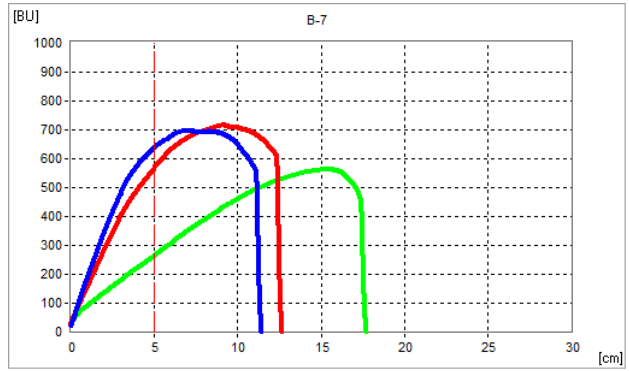


Extensograms

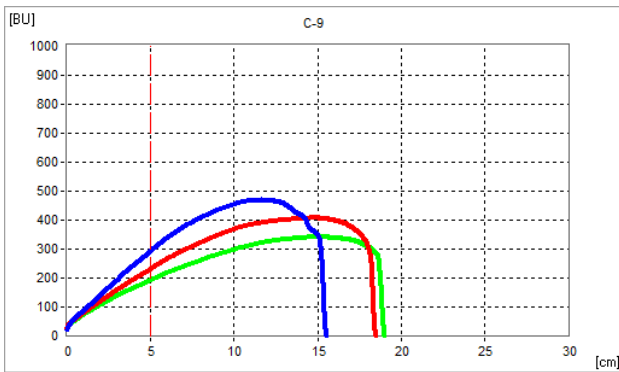
Glenn Check (Watertown, B-9)



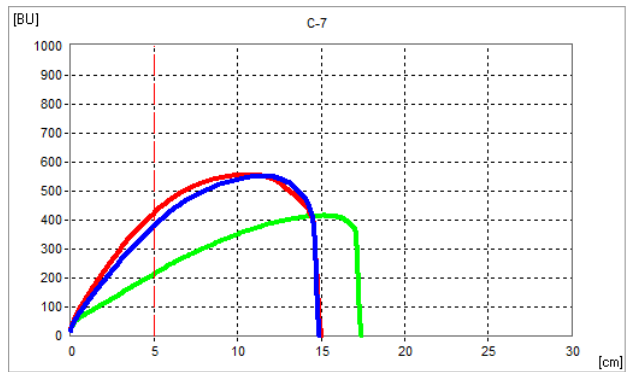
WB9479 (Watertown, B-7)



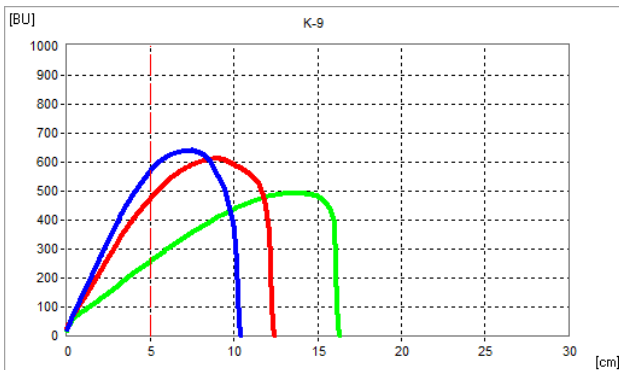
Glenn Check (Casselton, C-9)



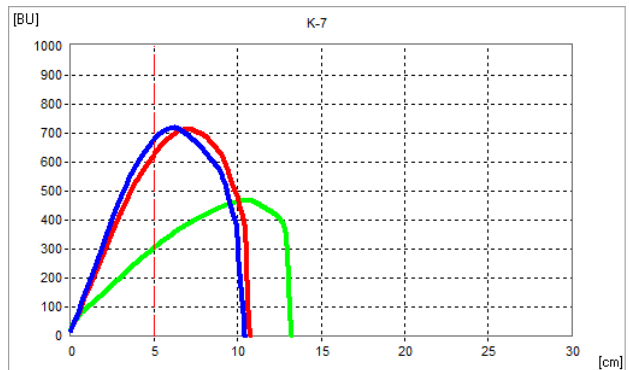
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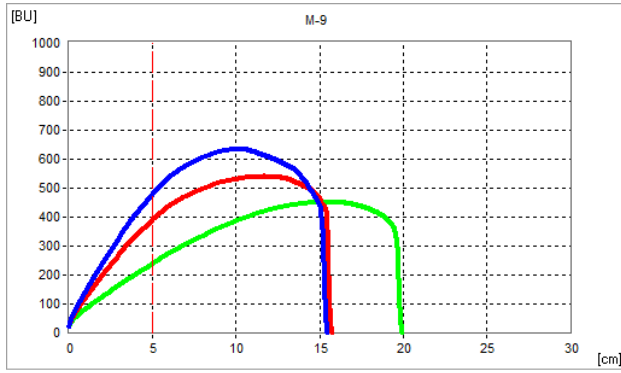


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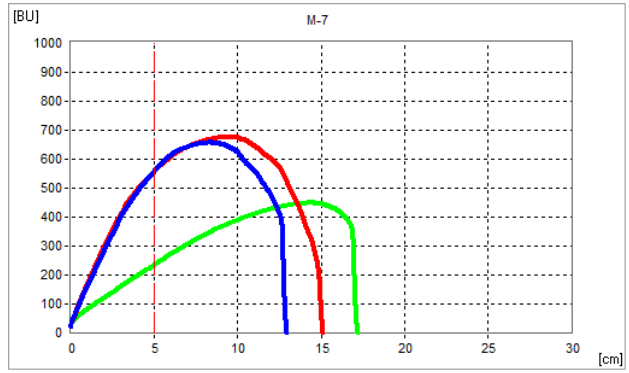


— 45 min; — 90 min; — 135 min

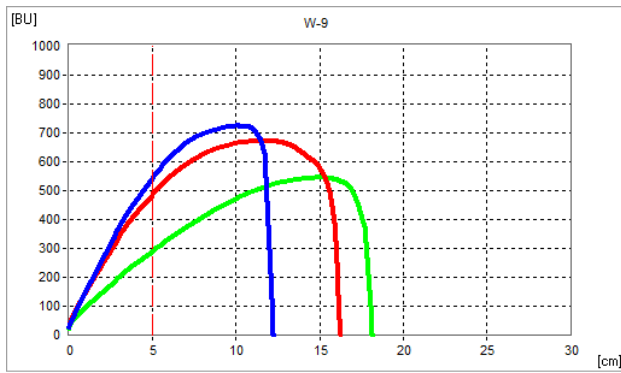
Glenn Check (Minot, M-9)



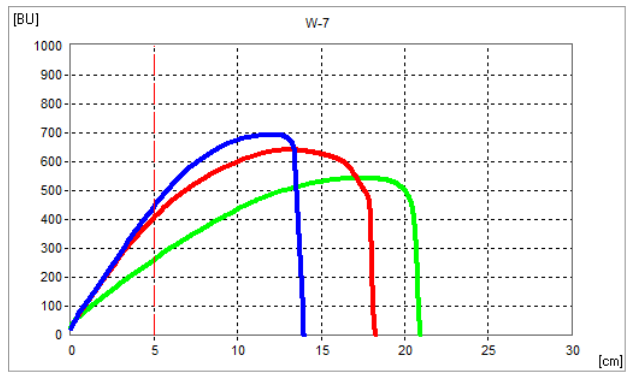
WB9479 (Minot, M-7)



Glenn Check (Williston, W-9)



WB9479 (Williston, W-7)



— 45 min; — 90 min; — 135 min

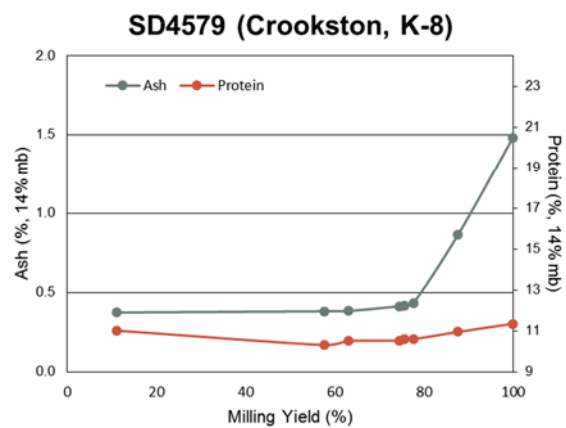
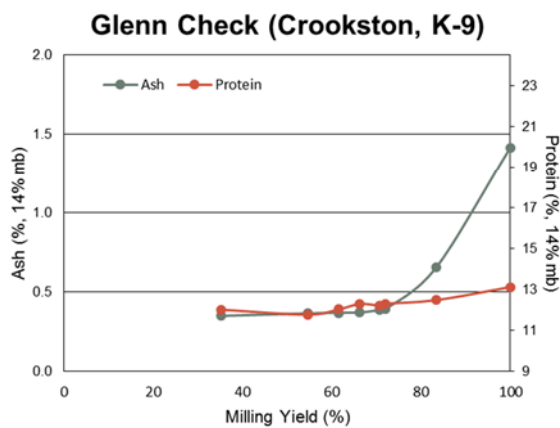
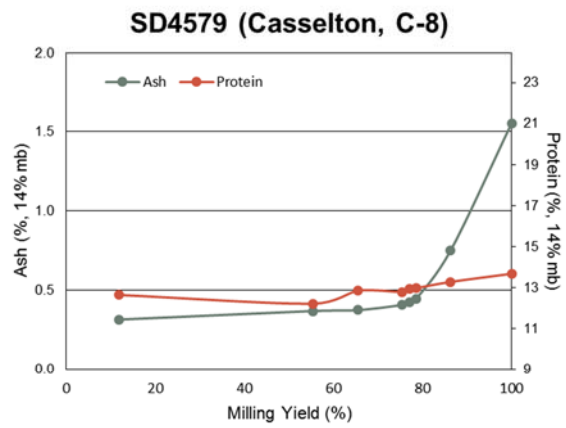
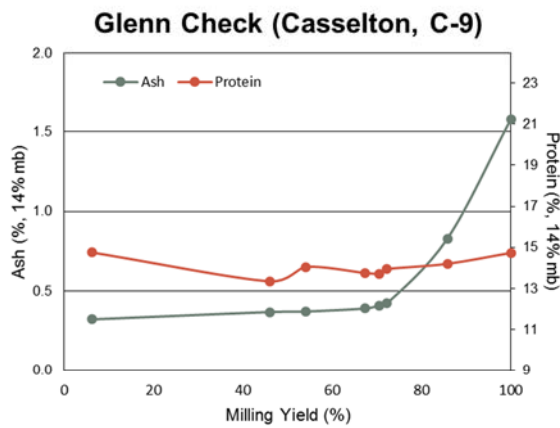
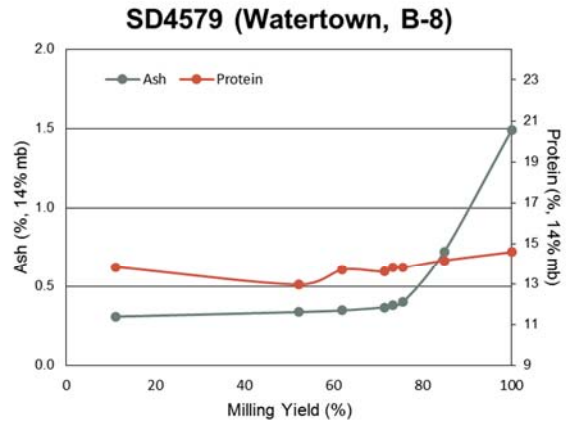
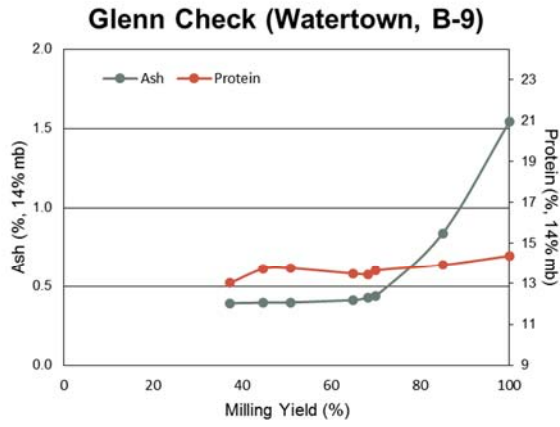
SWQAC #8 – SD4579

Quality Trait	Watertown		Casselton		Crookston		
	Glenn		Glenn		Glenn		
	B-9	B-8	C-9	C-8	K-9	K-8	
I. USDA-ARS WQL Data							
1	Wheat Protein (% , 12% mb)	14.4	14.5	14.8	13.7	13.1	11.4
2	Flour Protein (% , 14% mb)	13.5	13.6	13.9	12.8	12.2	10.7
3	Market Value (Score 1-6)	4.3	3.6	4.2	3.7	4.4	3.5
4	Market Value (Score 1-10)	10.0	8.4	10.0	7.2	10.0	6.6
5	DON (ppm)	nd	nd	nd	nd	nd	nd
6	Test Weight (lb/bu)	62.6	59.4	64.2	61.0	65.3	62.9
7	1000 Kernel Weight (g)	32.9	29.9	32.7	29.9	33.7	29.1
8	Kernel Size, % Large	61	29	66	29	70	29
9	Kernel Size, % Small	7	17	5	19	7	17
10	Wheat Moisture (%)	10.5	10.6	10.5	10.6	10.1	9.9
11	Wheat Ash (% , 14% mb)	1.42	1.39	1.55	1.43	1.36	1.44
12	Wheat Falling Number (sec)	365	376	344	370	404	403
13	SKCS Hardness Index	76.6	55.5	81.9	59.1	88.1	65.9
14	Vitreous Kernels (%)	28	20	91	27	88	44
Flour Extraction (%)							
15	Tempered Wheat Basis (%)	69.1	74.9	73.1	78.0	71.8	77.2
16	Total Product Basis (%)	70.0	75.6	72.2	78.5	71.9	77.7
17	Flour/Bu Wheat (lbs)	43.7	44.7	47.5	48.1	47.3	49.4
Flour Quality							
18	Flour Color Brightness (<i>L</i> *)	89.8	90.0	89.6	89.8	90.5	90.8
19	Flour Color Yellowness (<i>b</i> *)	7.8	7.0	8.2	8.1	8.5	8.0
20	Flour Moisture (%)	13.6	13.3	13.3	13.3	13.3	13.7
21	Flour Ash (% , 14% mb)	0.46	0.40	0.43	0.44	0.43	0.44
22	Flour Falling Number (Malted) (sec)	246	250	259	247	249	251
Farinograph							
23	Water Absorption (% , 500 BU)	64.3	61.6	66.8	61.3	64.6	58.5
24	Water Absorption (% , 14% mb)	63.7	60.7	65.9	60.3	63.7	57.8
25	Arrival Time (min)	2.5	3.5	2.4	3.0	1.8	1.9
26	Peak Time (min)	4.7	7.2	6.3	6.2	5.0	5.2
27	Dough Stability (min)	9.4	7.3	8.7	6.3	9.7	6.2
28	Mixing Tolerance Index (MTI) (BU)	22	44	33	42	23	45
29	Time To Breakdown (TTB) (min)	11.1	10.8	11.0	9.6	11.0	8.5
II. Cooperator Results							
30	Bake Absorption (Average %)	65.8	63.7	67.6	63.4	65.7	60.4
31	Loaf Volume (% of Check)		95.0		93.8		91.3

SWQAC #8 – SD4579

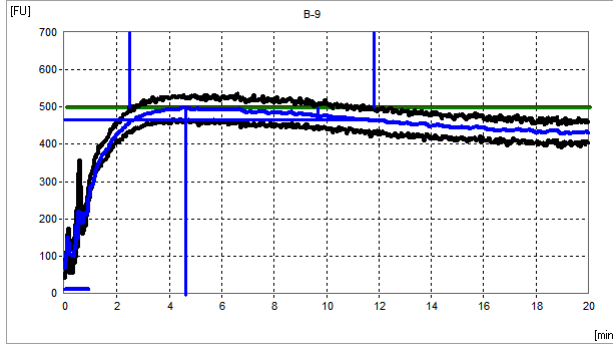
Quality Trait	Watertown		Casselton		Crookston			
	Glenn B-9	B-8	Glenn C-9	C-8	Glenn K-9	K-8		
II. Cooperator Results								
32	Mixing Requirement 9 = Very Long 7 = Long 5 = Medium 3 = Short 1 = Very Short		6.8	4.1	5.5	3.5	6.6	3.2
33	Dough Characteristics 9 = Bucky – Tough 7 = Strong – Elastic 5 = Medium – Pliable 3 = Mellow – Very Pliable 1 = Weak – Short or Sticky		7.1	4.3	5.8	3.4	6.8	3.9
34	Mixing Tolerance 9 = Much More Tolerance Than Check 7 = More Tolerance Than Check 5 = Tolerance Equivalent To Check 3 = Less Tolerance Than Check 1 = Much Less Tolerance Than Check			2.8		3.5		2.9
35	Internal Crumb Color 9 = Much Brighter Than Check 7 = Brighter Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			4.8		4.8		5.2
36	Internal Grain and Texture 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			4.7		4.6		5.2
III. Cooperator Evaluation								
	Quality Traits 1-2: Protein 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			5.1		3.4		2.3
	Quality Traits 3-22: Milling 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			6.9		6.7		7.2
	Quality Traits 23-36: Baking 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			3.9		3.5		3.5
	Quality Traits 1-36: Overall Comparison 9 = Much Better Than Check 7 = Better Than Check 5 = Equivalent To Check 3 = Poorer Than Check 1 = Much Poorer Than Check			4.4		3.7		3.5

Cumulative Ash and Protein Curves

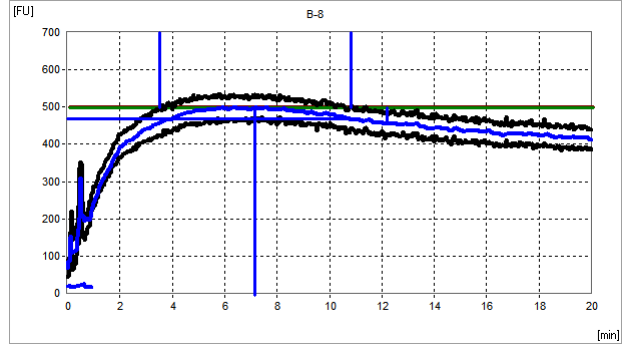


Farinograms

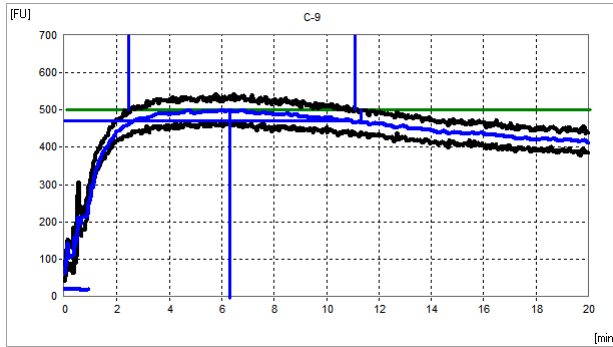
Glenn Check (Watertown, B-9)



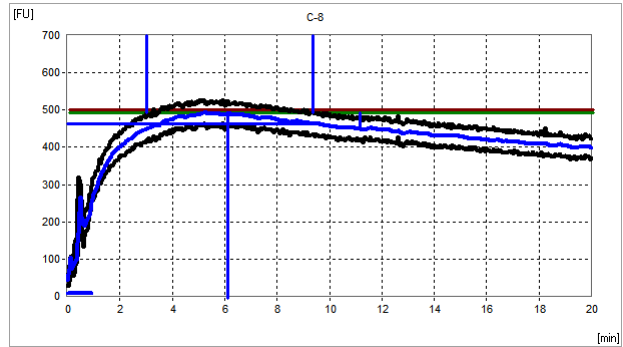
SD4579 (Watertown, B-8)



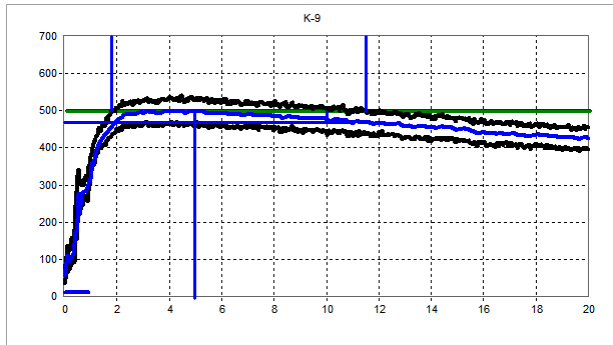
Glenn Check (Casselton, C-9)



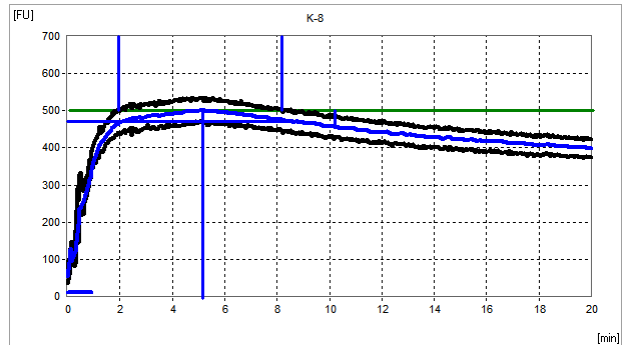
SD4579 (Casselton, C-8)



Glenn Check (Crookston, K-9)

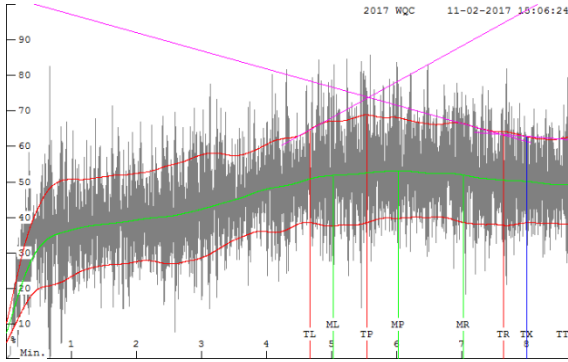


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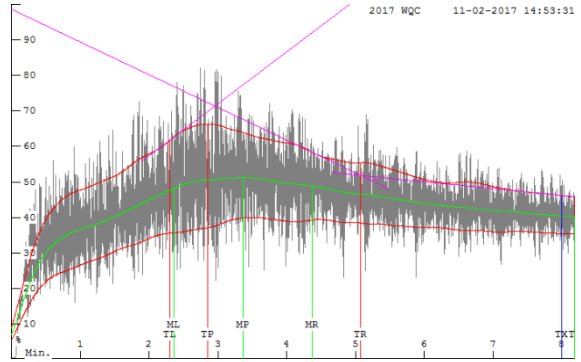


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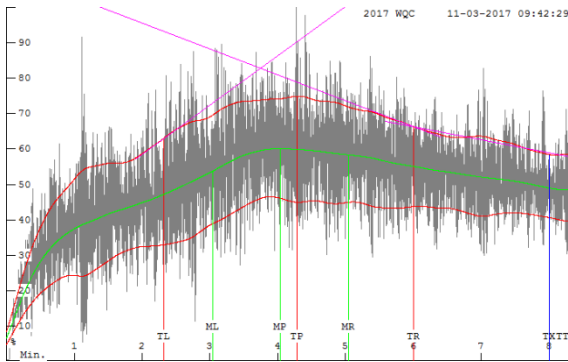
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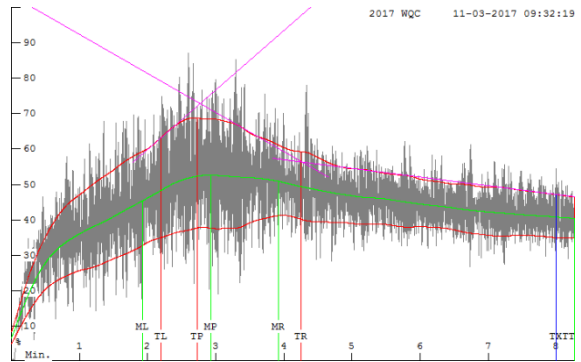
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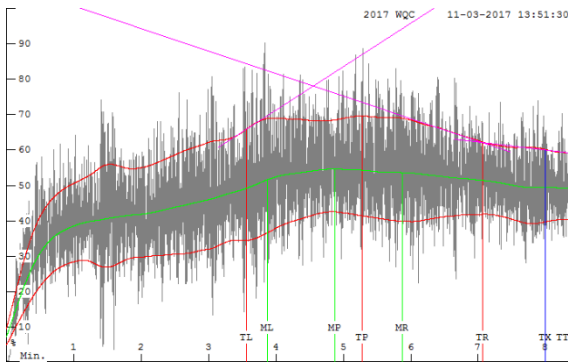
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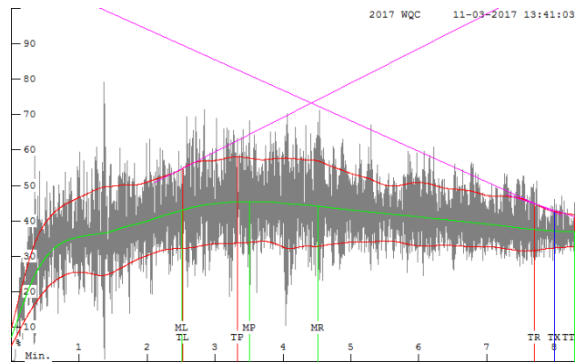
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Glenn Check (Crookston, K-9)

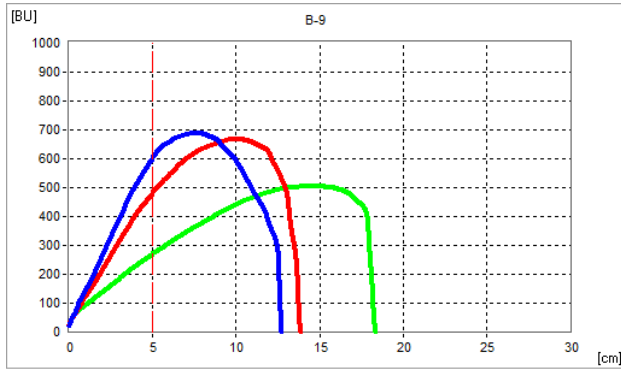


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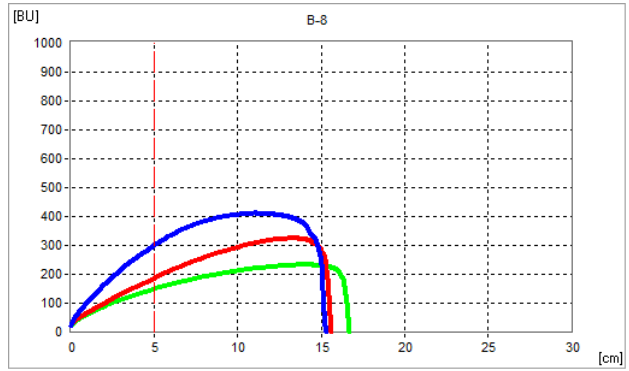


Extensograms

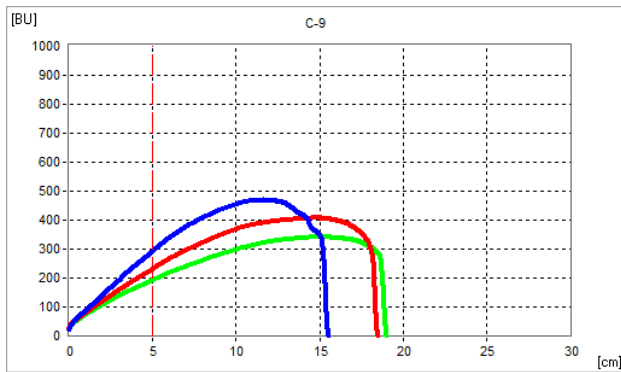
Glenn Check (Watertown, B-9)



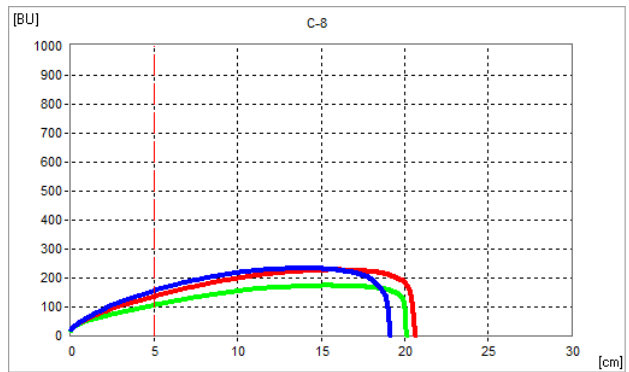
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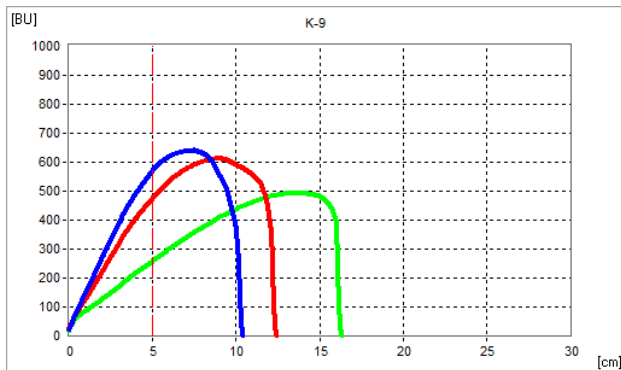
Glenn Check (Casselton, C-9)



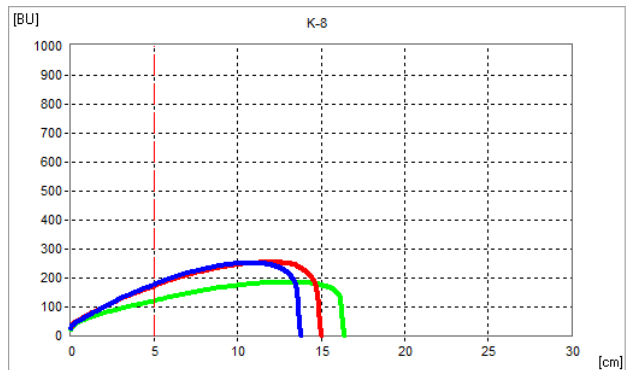
SD4579 (Casselton, C-8)



Glenn Check (Crookston, K-9)



SD4579 (Crookston, K-8)



— 45 min; — 90 min; — 135 min

SWQAC #10 – WB9590

Quality Trait	Watertown		Casselton		Havre		Crookston		Minot		Williston		
	Glenn B-9	B-10	Glenn C-9	C-10	Glenn H-9	H-10	Glenn K-9	K-10	Glenn M-9	M-10	Glenn W-9	W-10	
I. USDA-ARS WQL Data													
1	Wheat Protein (% , 12% mb)	14.4	15.0	14.8	14.4	16.2	17.0	13.1	12.5	16.2	16.0	18.6	18.7
2	Flour Protein (% , 14% mb)	13.5	14.1	13.9	13.5	15.5	16.3	12.2	11.8	15.2	15.5	17.4	18.1
3	Market Value (Score 1-6)	4.3	2.9	4.2	3.9	4.5	4.2	4.4	4.6	4.9	4.1	4.0	3.2
4	Market Value (Score 1-10)	10.0	6.8	10.0	8.4	10.0	9.0	10.0	8.6	10.0	8.0	10.0	8.8
5	DON (ppm)	nd	nd	nd	nd	nd	nd	nd	0.71	nd	nd	nd	nd
6	Test Weight (lb/bu)	62.6	58.2	64.2	61.8	61.8	59.1	65.3	63.0	63.1	60.3	58.7	56.8
7	1000 Kernel Weight (g)	32.9	34.2	32.7	36.9	24.5	27.0	33.7	36.6	32.4	37.0	24.1	24.9
8	Kernel Size, % Large	61	68	66	84	4	27	70	84	62	73	6	19
9	Kernel Size, % Small	7	7	5	3	26	15	7	4	7	5	38	25
10	Wheat Moisture (%)	10.5	10.6	10.5	10.4	8.9	8.8	10.1	10.7	10.7	9.9	10.3	10.4
11	Wheat Ash (% , 14% mb)	1.42	1.50	1.55	1.48	1.47	1.61	1.36	1.21	1.48	1.38	1.45	1.41
12	Wheat Falling Number (sec)	365	261	344	305	405	455	404	447	372	299	404	335
13	SKCS Hardness Index	76.6	62.9	81.9	71.8	70.8	65.5	88.1	72.8	85.2	69.8	70.2	67.1
14	Vitreous Kernels (%)	28	17	91	60	92	87	88	67	78	18	96	96
Flour Extraction (%)													
15	Tempered Wheat Basis (%)	69.1	69.3	73.1	74.5	70.6	69.1	71.8	74.1	70.7	72.6	71.1	69.8
16	Total Product Basis (%)	70.0	69.8	72.2	73.0	71.0	69.7	71.9	74.1	71.2	73.4	71.0	70.7
17	Flour/Bu Wheat (lbs)	43.7	40.7	47.5	46.4	44.3	41.4	47.3	47.5	44.7	44.4	42.1	40.1
Flour Quality													
18	Flour Color Brightness (L*)	89.8	89.6	89.6	89.5	90.0	89.6	90.5	90.1	89.7	89.4	89.5	89.2
19	Flour Color Yellowness (b*)	7.8	7.9	8.2	8.5	8.6	9.2	8.5	9.3	8.3	8.5	8.7	9.0
20	Flour Moisture (%)	13.6	13.5	13.3	13.4	13.8	13.7	13.3	13.4	13.0	13.1	13.4	13.6
21	Flour Ash (% , 14% mb)	0.46	0.45	0.43	0.45	0.45	0.44	0.43	0.38	0.47	0.46	0.43	0.42
22	Flour Falling Number (Malted) (sec)	246	286*	259	251	247	251	249	250	250	251	249	250
Farinograph													
23	Water Absorption (% , 500 BU)	64.3	63.4	66.8	65.1	64.5	65.5	64.6	60.9	66.3	65.1	66.1	66.6
24	Water Absorption (% , 14% mb)	63.7	62.7	65.9	64.2	64.3	65.1	63.7	60.1	65.0	64.1	66.2	66.5
25	Arrival Time (min)	2.5	2.8	2.4	3.4	5.7	5.6	1.8	2.1	4.5	4.8	8.0	7.7
26	Peak Time (min)	4.7	6.8	6.3	5.8	10.8	10.7	5.0	6.5	10.5	10.0	25.5	27.4
27	Dough Stability (min)	9.4	11.9	8.7	6.8	19.7	15.0	9.7	10.0	25.4	15.9	34.0	30.3
28	Mixing Tolerance Index (MTI) (BU)	22	23	33	34	12	19	23	24	9	19	5	6
29	Time To Breakdown (TTB) (min)	11.1	13.1	11.0	9.9	25.3	20.4	11.0	12.7	29.9	19.6	42.6	39.1

*Flour not malted.

SWQAC #10 – WB9590

Quality Trait	Watertown		Casselton		Havre		Crookston		Minot		Williston		
	Glenn B-9	B-10	Glenn C-9	C-10	Glenn H-9	H-10	Glenn K-9	K-10	Glenn M-9	M-10	Glenn W-9	W-10	
II. Cooperator Results													
30	Bake Absorption (Average %)	65.8	65.4	67.6	66.4	67.1	67.9	65.7	62.8	67.5	67.4	69.3	69.8
31	Loaf Volume (% of Check)		99.0		94.3		94.3		97.1		96.9		94.7
32	Mixing Requirement*	6.8	6.6	5.5	4.5	6.1	5.4	6.6	5.8	6.2	6.3	7.5	7.0
33	Dough Characteristics**	7.1	6.7	5.8	5.2	6.6	5.8	6.8	5.6	7.0	6.2	7.4	6.9
34	Mixing Tolerance†		5.9		4.3		4.5		4.9		4.0		4.6
35	Internal Crumb Color††		4.5		4.6		4.8		4.9		5.2		4.7
36	Internal Crumb Texture‡		4.9		4.8		4.8		5.4		4.9		4.6
III. Cooperator Evaluation‡													
	Quality Traits 1-2: Protein		5.9		4.5		5.9		4.1		5.0		5.4
	Quality Traits 3-22: Milling		4.8		5.6		4.1		7.1		6.0		4.8
	Quality Traits 23-36: Baking		4.8		4.2		4.8		5.0		4.4		4.2
	Quality Traits 1-36: Overall Comparison		4.9		4.3		4.6		5.4		5.2		4.6

*9 = Very long; 7 = Long; 5 = Medium; 3 = Short; 1 = Very short.

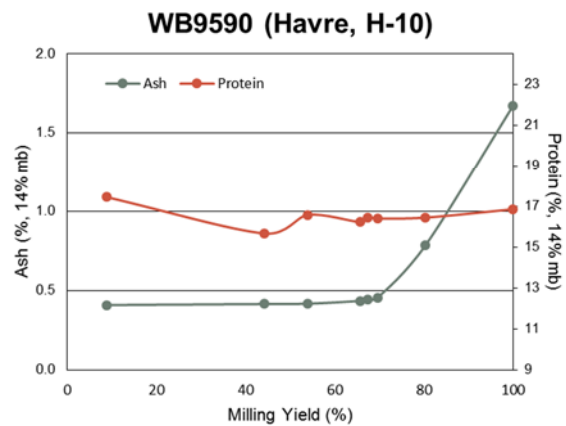
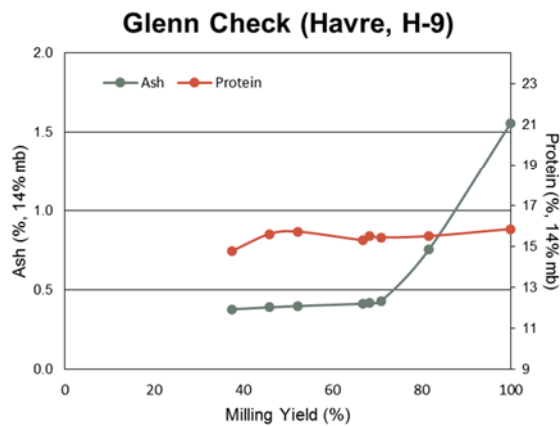
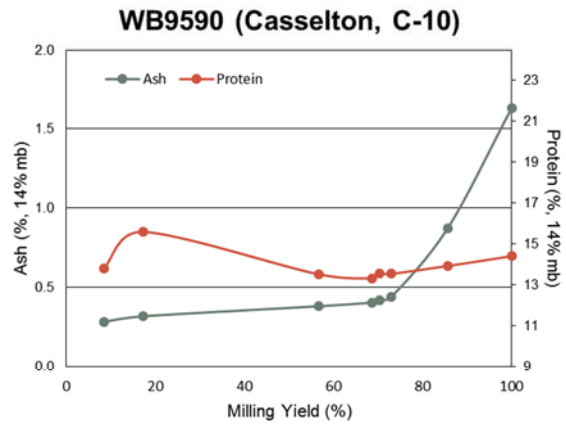
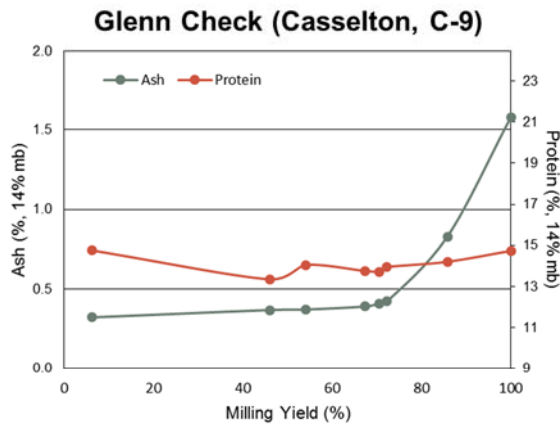
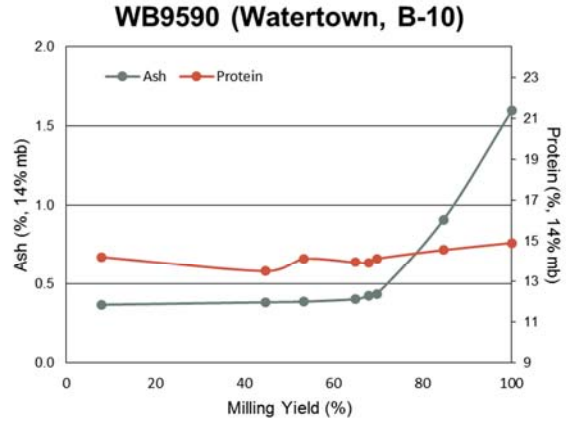
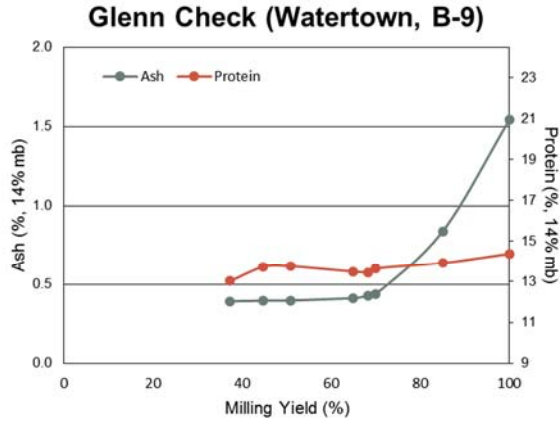
**9 = Bucky – Tough; 7 = Strong – Elastic; 5 = Medium – Pliable; 3 = Mellow – Very Pliable; 1 = Weak – Short or Sticky.

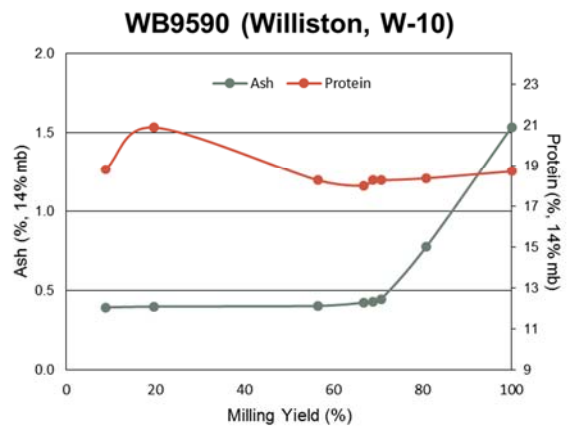
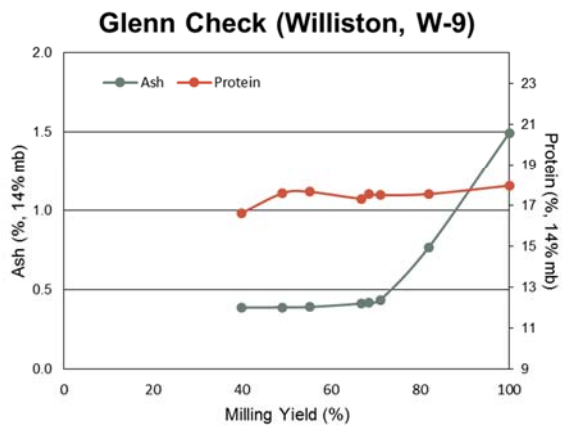
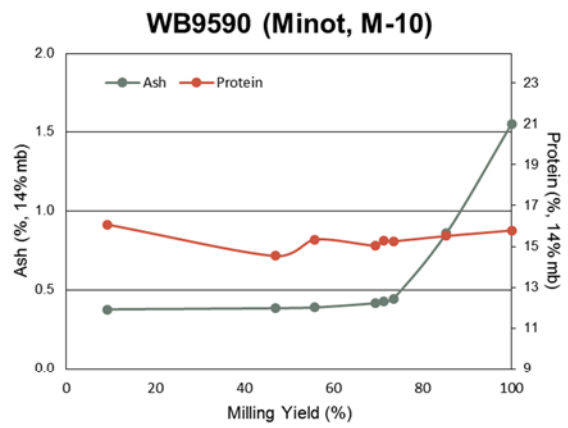
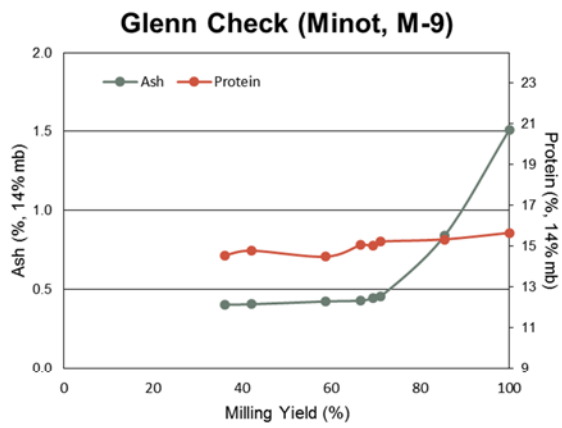
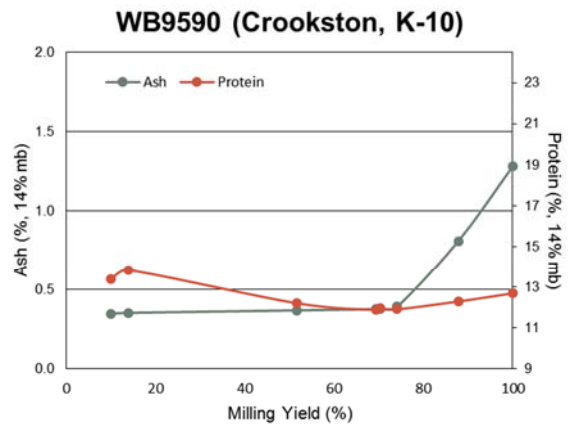
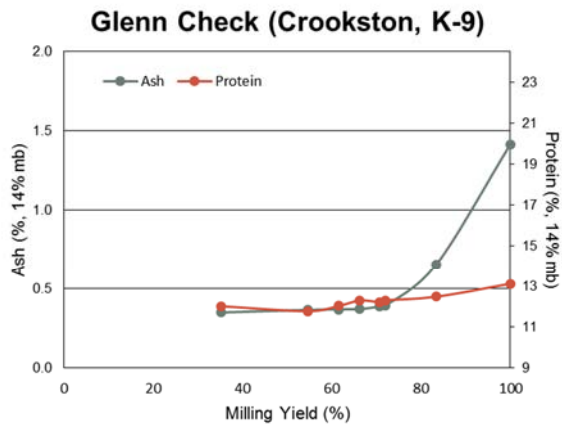
†9 = Much More Tolerance Than Check; 7 = More Tolerance Than Check; 5 = Tolerance Equivalent To Check; 3 = Less Tolerance Than Check; 1 = Much Less Tolerance Than Check.

††9 = Much Brighter Than Check; 7 = Brighter Than Check; 5 = Equivalent To Check; 3 = Poorer Than Check; 1 = Much Poorer Than Check.

‡9 = Much Better Than Check; 7 = Better Than Check; 5 = Equivalent To Check; 3 = Poorer Than Check; 1 = Much Poorer Than Check.

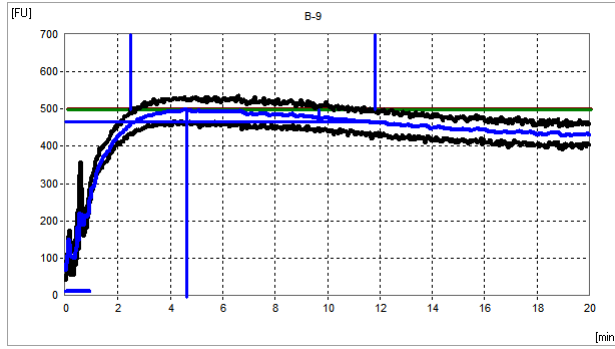
Cumulative Ash and Protein Curves



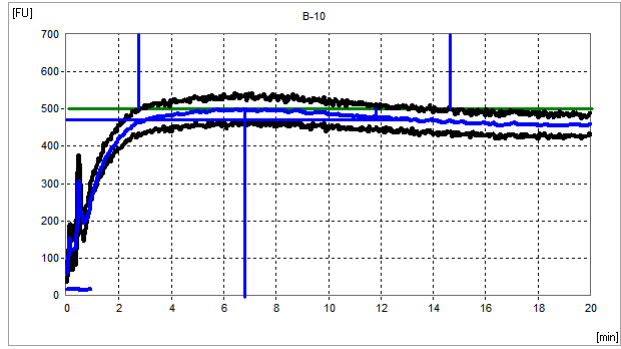


Farinograms

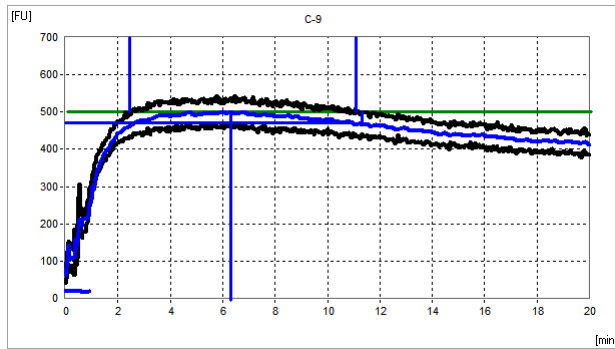
Glenn Check (Watertown, B-9)



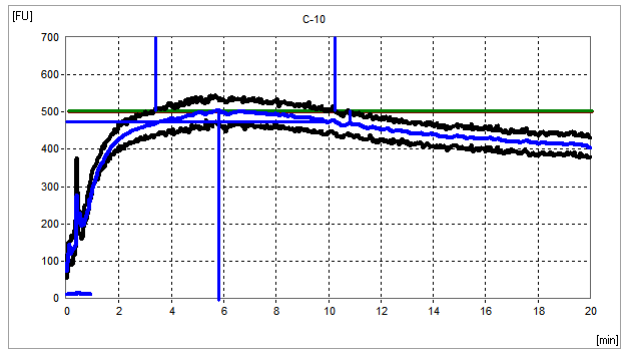
WB9590 (Watertown, B-10)



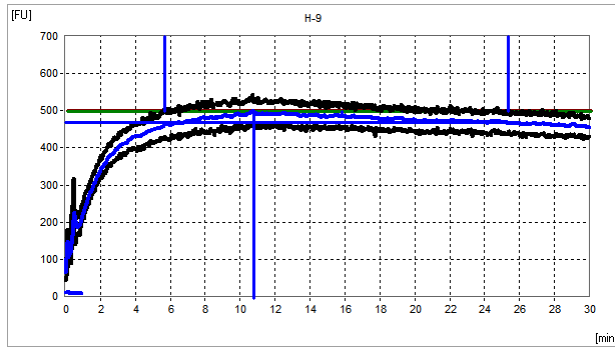
Glenn Check (Casselton, C-9)



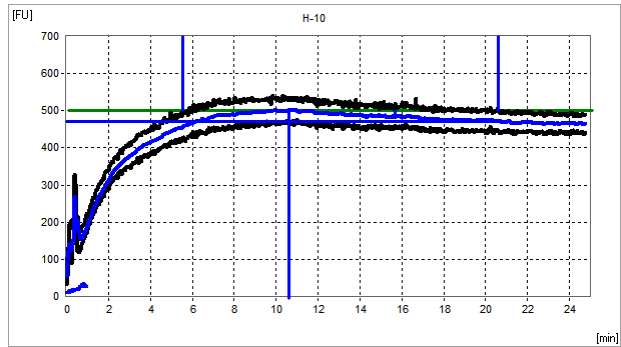
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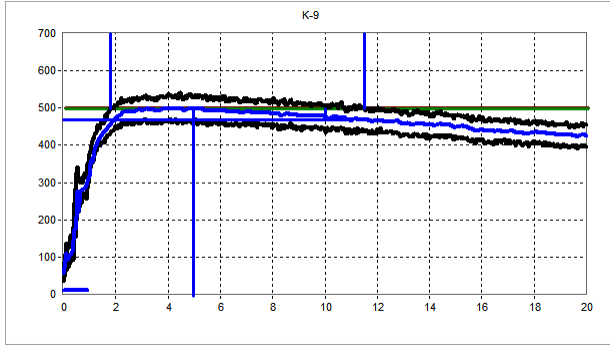
Glenn Check (Havre, H-9)



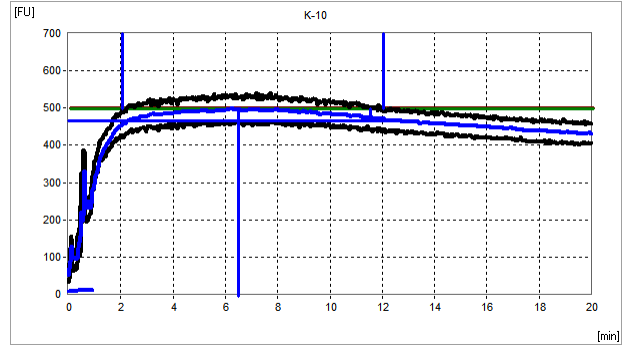
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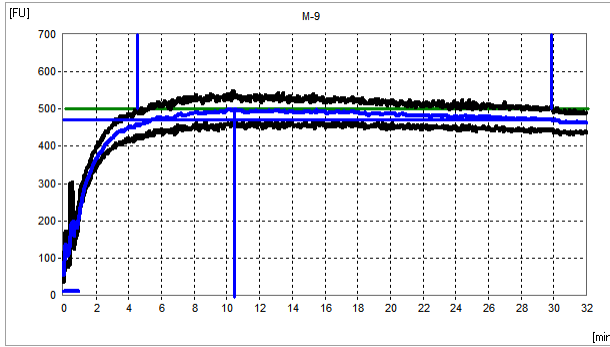
Glenn Check (Crookston, K-9)



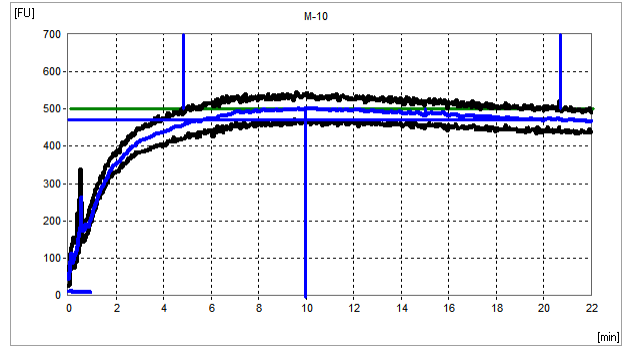
WB9590 (Crookston, K-10)



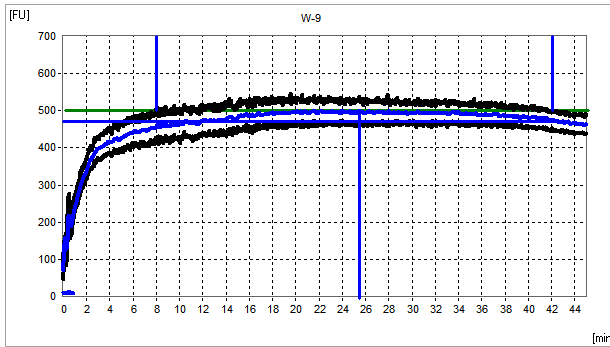
Glenn Check (Minot, M-9)



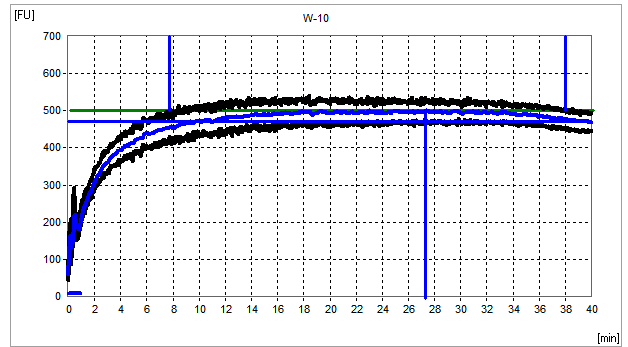
WB9590 (Minot, M-10)



Glenn Check (Williston, W-9)

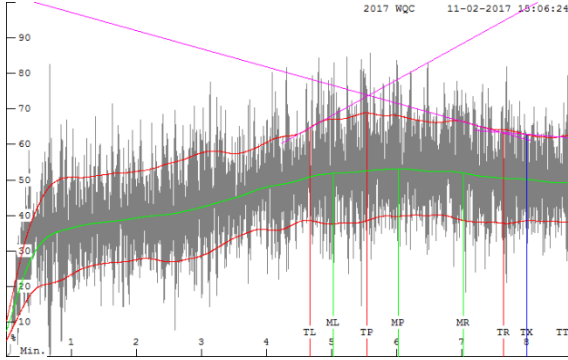


WB9590 (Williston, W-10)

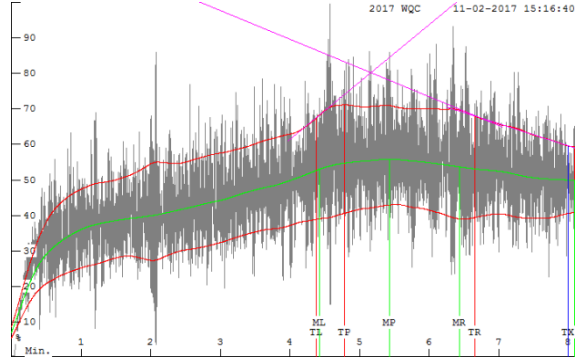


Mixograms

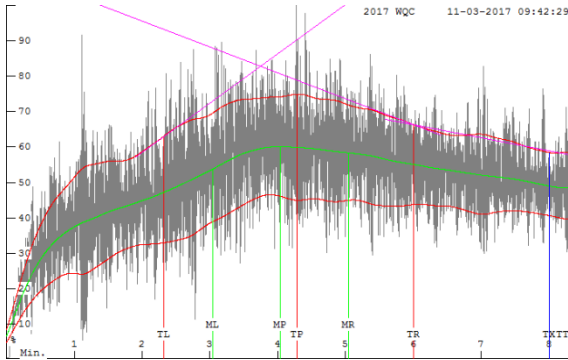
Glenn Check (Watertown, B-9)



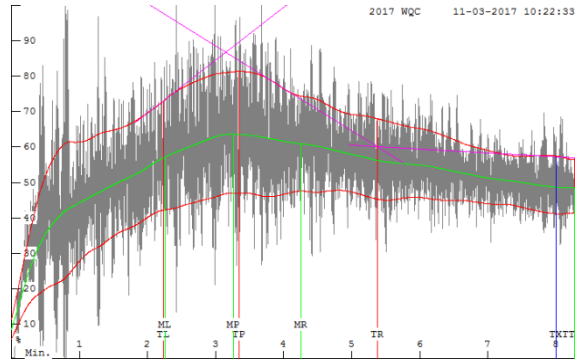
WB9590 (Watertown, B-10)



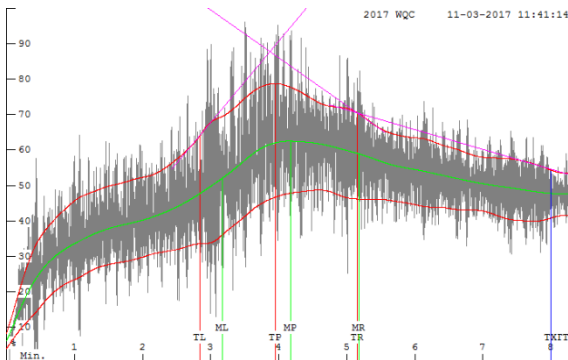
Glenn Check (Casselton, C-9)



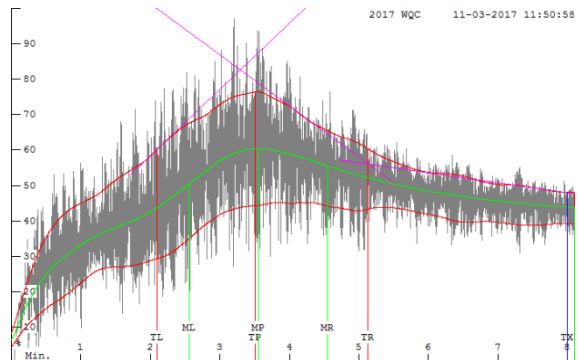
WB9590 (Casselton, C-10)



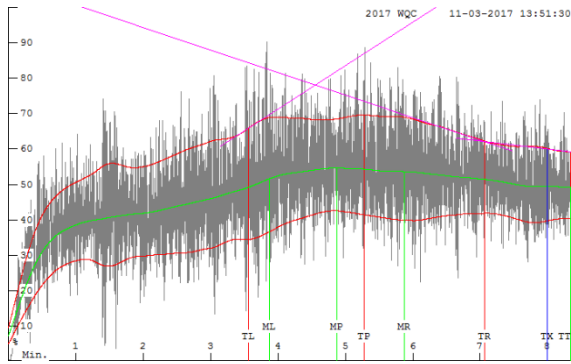
Glenn Check (Havre, H-9)



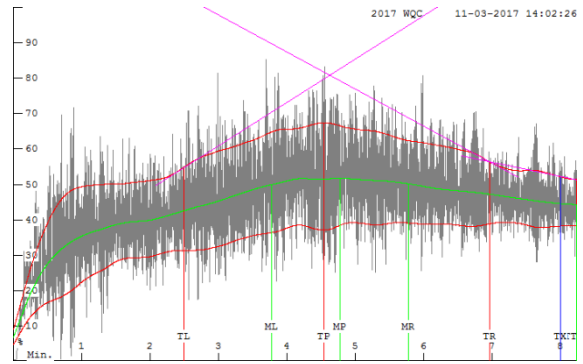
WB9590 (Havre, H-10)



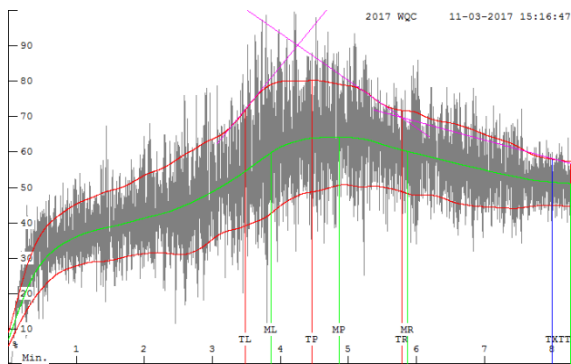
Glenn Check (Crookston, K-9)



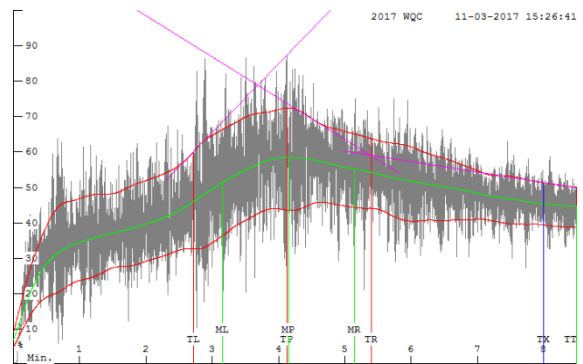
WB9590 (Crookston, K-10)



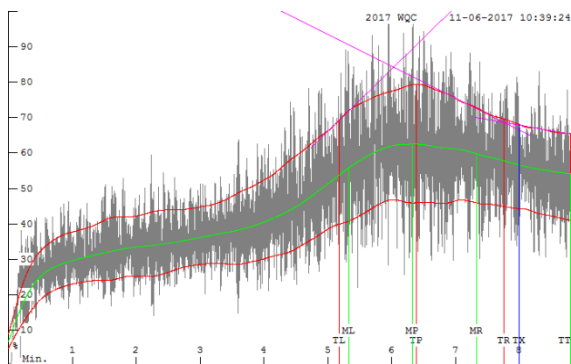
Glenn Check (Minot, M-9)



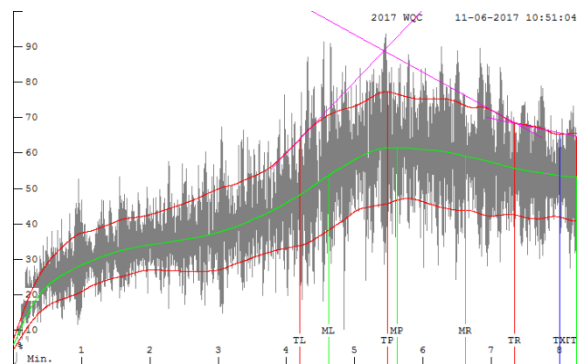
WB9590 (Minot, M-10)



Glenn Check (Williston, W-9)

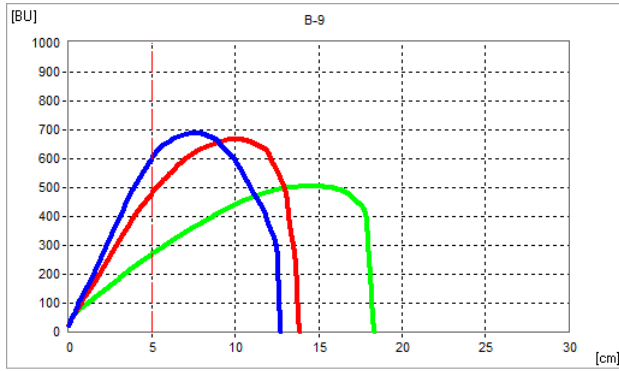


WB9590 (Williston, W-10)

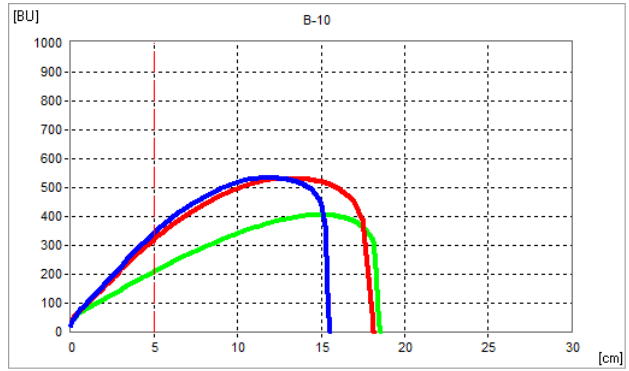


Extensograms

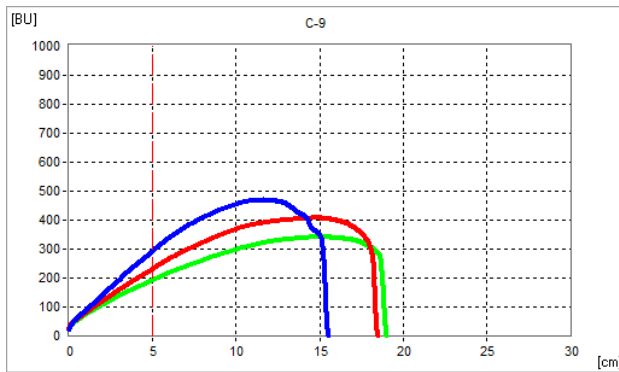
Glenn Check (Watertown, B-9)



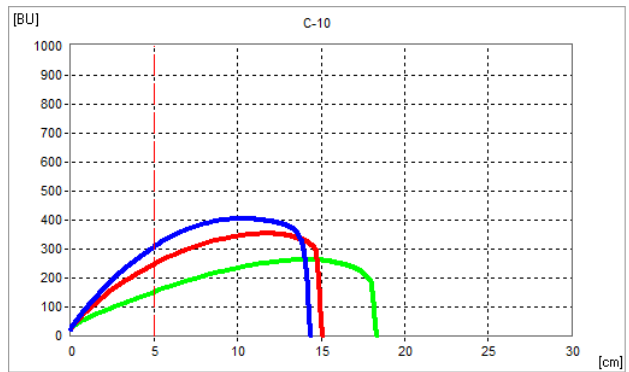
WB9590 (Watertown, B-10)



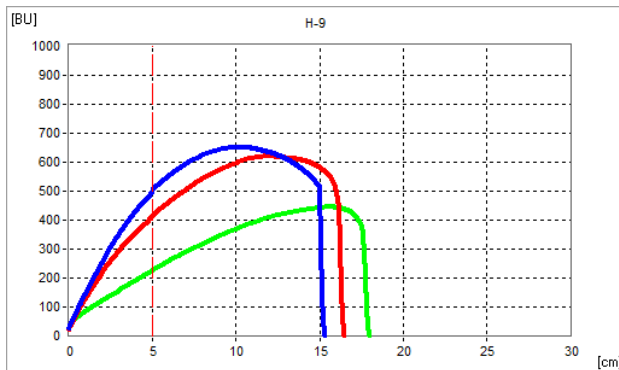
Glenn Check (Casselton, C-9)



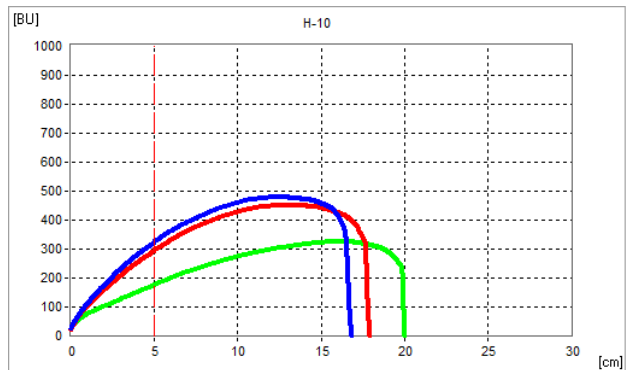
WB9590 (Casselton, C-10)



Glenn Check (Havre, H-9)

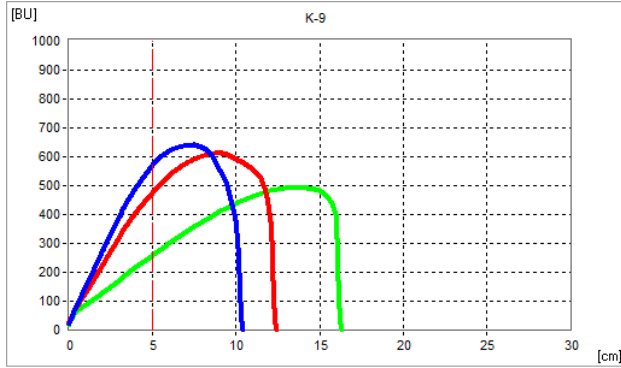


WB9590 (Havre, H-10)

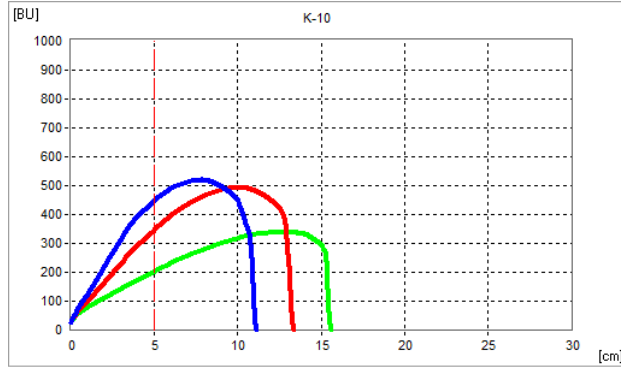


— 45 min; — 90 min; — 135 min

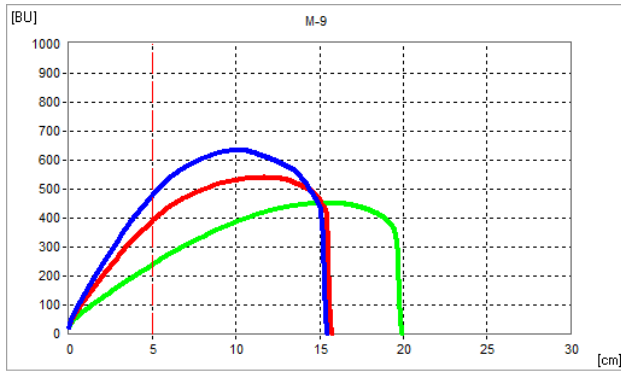
Glenn Check (Crookston, K-9)



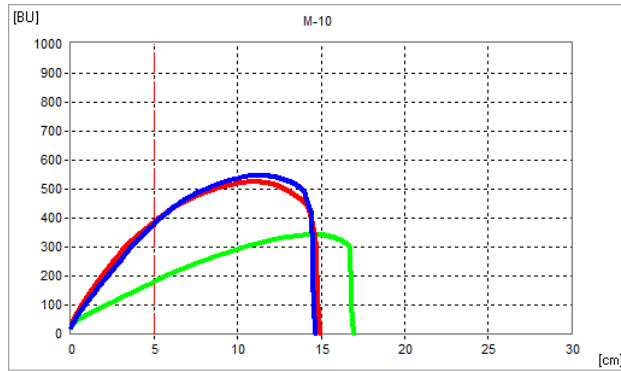
WB9590 (Crookston, K-10)



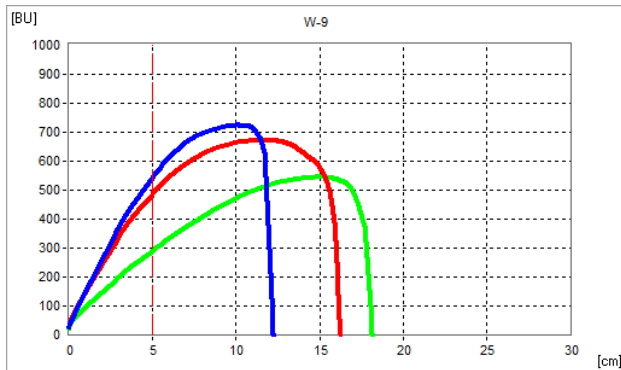
Glenn Check (Minot, M-9)



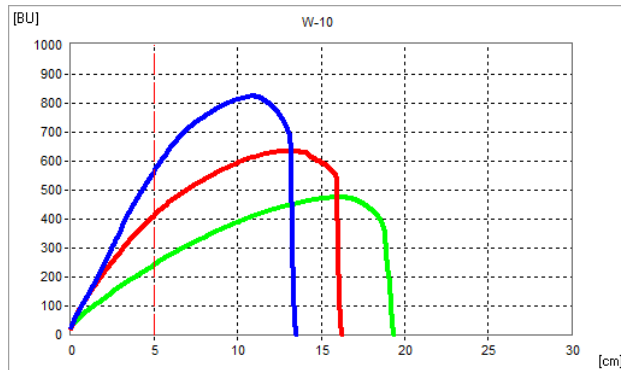
WB9590 (Minot, M-10)



Glenn Check (Williston, W-9)



WB9590 (Williston, W-10)



— 45 min; — 90 min; — 135 min

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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 Glenn Check was evaluated along with the experimental lines for each growing locations. Method #2 was developed on a scale of 0 to 10 where the experimental lines were evaluated against the Glenn Check for each growing locations.

Wheat Marketing Score – Method #1

Wheat Marketing Score or Export Marketing Score						
	Score	Test Weight (lb/bu)	1000 KWT (g)	Falling Number (sec)	Wheat Protein (% , 12% mb)	Wheat Ash (% , 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	3 g up, 4 g 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

Component Score	Wheat Protein (% 12% mb)	Test Weight (lb/bu)	Falling Number (sec)	1000 Kernel Weight (g)	Wheat Ash (% 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	--
Weight of each factor	0.3	0.2	0.2	0.2	0.1

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

Wheat Kernel Characteristics by Location

Location	ID	Entry	Wheat Protein (%, 12% mb)	Wheat Marketing Score		DON (ppm)	Test Weight (lbs/bu)	1000 Kernel Weight (g)	Kernel Size		Wheat Moisture (%)	Wheat Ash (%, 14% mb)	Falling Number (sec)	SKCS Hardness Index	Vitreous Kernels (%)
				1-6	1-10				Large (%)	Small (%)					
Watertown	B-2	SD4465	13.9	2.9	8.0	nd	58.3	32.1	60	8	10.7	1.53	335	71.2	19
	B-4	LCS Rebel	14.3	3.1	8.0	nd	59.9	34.6	72	7	10.8	1.45	275	65.1	33
	B-7	WB9479	15.0	3.1	6.8	nd	58.6	34.7	79	4	10.5	1.46	232	63.5	15
	B-8	SD4579	14.5	3.6	8.4	nd	59.4	29.9	29	17	10.6	1.39	376	55.5	20
	B-9	Glenn	14.4	4.3	10.0	nd	62.6	32.9	61	7	10.5	1.42	365	76.6	28
B-10	WB9590	15.0	2.9	6.8	nd	58.2	34.2	68	7	10.6	1.50	261	62.9	17	
Casselton	C-2	SD4465	14.1	4.0	8.6	nd	61.4	33.3	65	6	10.7	1.50	373	74.6	45
	C-4	LCS Rebel	13.9	4.3	9.4	nd	63.3	34.0	68	5	10.6	1.38	357	73.7	56
	C-5	MN13288-1	14.6	4.0	8.4	nd	60.4	30.6	46	14	10.1	1.49	401	78.7	42
	C-7	WB9479	14.0	3.6	7.8	nd	61.1	34.5	77	4	10.5	1.46	312	67.0	47
	C-8	SD4579	13.7	3.7	7.2	nd	61.0	29.9	29	19	10.6	1.43	370	59.1	27
C-9	Glenn	14.8	4.2	10.0	nd	64.2	32.7	66	5	10.5	1.55	344	81.9	91	
C-10	WB9590	14.4	3.9	8.4	nd	61.8	36.9	84	3	10.4	1.48	305	71.8	60	
Havre	H-1	WB9719	15.9	4.5	10.0	nd	61.1	25.0	26	21	9.1	1.39	418	70.5	96
	H-3	WB9616CLP	17.2	3.7	8.4	nd	58.0	21.0	4	33	9.2	1.57	448	71.6	96
	H-4	LCS Rebel	16.2	4.4	9.6	nd	60.0	25.2	11	26	8.9	1.37	434	69.2	97
	H-5	MN13288-1	16.6	4.1	8.8	nd	58.0	27.8	8	30	8.9	1.50	513	66.5	88
	H-6	SY Rockford	15.7	3.9	8.4	nd	57.7	26.8	11	28	8.7	1.38	428	65.6	87
H-9	Glenn	16.2	4.5	10.0	nd	61.8	24.5	4	26	8.9	1.47	405	70.8	92	
H-10	WB9590	17.0	4.2	9.0	nd	59.1	27.0	27	15	8.8	1.61	455	65.5	87	
Crookston	K-2	SD4465	12.6	4.0	8.8	nd	62.2	31.8	47	12	9.6	1.41	413	83.9	62
	K-4	LCS Rebel	12.4	4.5	9.4	nd	64.5	36.8	75	5	10.2	1.27	404	77.6	71
	K-5	MN13288-1	12.0	4.0	7.6	nd	62.0	32.8	62	8	9.5	1.42	424	82.2	64
	K-7	WB9479	12.2	4.4	9.0	0.89	63.3	35.1	80	4	9.8	1.39	426	75.3	68
	K-8	SD4579	11.4	3.5	6.6	nd	62.9	29.1	29	17	9.9	1.44	403	65.9	44
K-9	Glenn	13.1	4.4	10.0	nd	65.3	33.7	70	7	10.1	1.36	404	88.1	88	
K-10	WB9590	12.5	4.6	8.6	0.71	63.0	36.6	84	4	10.7	1.21	447	72.8	67	
Minot	M-1	WB9719	15.8	4.8	10.0	nd	62.2	35.3	80	4	10.2	1.42	363	71.2	69
	M-4	LCS Rebel	15.0	3.8	7.2	nd	61.3	35.2	67	6	9.9	1.34	277	71.0	62
	M-6	SY Rockford	14.9	4.3	8.0	nd	60.2	35.1	66	6	10.3	1.45	384	67.2	22
	M-7	WB9479	16.1	4.2	7.6	nd	61.1	37.2	81	3	10.8	1.40	255	65.2	20
	M-9	Glenn	16.2	4.9	10.0	nd	63.1	32.4	62	7	10.7	1.48	372	85.2	78
M-10	WB9590	16.0	4.1	8.0	nd	60.3	37.0	73	5	9.9	1.38	299	69.8	18	
Williston	W-1	WB9719	18.3	4.1	10.0	nd	59.4	25.0	24	22	11.0	1.43	389	70.1	82
	W-3	WB9616CLP	20.3	3.4	8.8	nd	58.6	26.2	14	22	10.7	1.49	327	66.2	90
	W-4	LCS Rebel	19.6	2.9	8.4	nd	57.3	24.0	12	34	10.7	1.42	306	69.4	98
	W-6	SY Rockford	19.0	3.3	8.8	nd	57.1	27.4	15	27	10.4	1.38	335	69.0	98
	W-7	WB9479	19.1	3.7	9.6	nd	58.4	24.2	14	31	10.2	1.44	376	67.7	89
W-9	Glenn	18.6	4.0	10.0	nd	58.7	24.1	6	38	10.3	1.45	404	70.2	96	
W-10	WB9590	18.7	3.2	8.8	nd	56.8	24.9	19	25	10.4	1.41	335	67.1	96	

Flour Characteristics by Location

Location	ID	Entry	Flour Extraction			Flour Color				Flour Moisture (%)	Flour Protein (% (%, 14% mb))	Flour Ash (% (%, 14% mb))	Flour FN Malted (sec)
			TWB* (%)	TPB* (%)	Flour/bu Wheat (lbs)	L*	b*	L	b				
Watertown	B-2	SD4465	72.2	72.8	42.2	89.4	8.6	86.6	8.2	13.1	12.8	0.49	260
	B-4	LCS Rebel	73.2	73.9	43.8	89.6	7.6	86.9	7.3	12.8	13.2	0.45	269**
	B-7	WB9479	71.4	72.5	42.2	89.5	7.7	86.7	7.4	13.2	14.1	0.45	217**
	B-8	SD4579	74.9	75.6	44.7	90.0	7.0	87.4	6.8	13.3	13.6	0.40	250
	B-9	Glenn	69.1	70.0	43.7	89.8	7.8	87.2	7.5	13.6	13.5	0.46	246
	B-10	WB9590	69.3	69.8	40.7	89.6	7.9	86.8	7.6	13.5	14.1	0.45	286**
Casselton	C-2	SD4465	73.5	73.6	45.5	89.7	9.2	87.0	8.8	13.0	13.0	0.48	254
	C-4	LCS Rebel	75.1	75.9	45.0	89.9	8.6	87.2	8.2	13.0	12.9	0.41	252
	C-5	MN13288-1	73.4	74.2	45.1	89.6	8.8	86.9	8.4	13.3	13.4	0.50	250
	C-7	WB9479	74.8	75.3	46.4	89.6	8.7	86.9	8.3	13.5	13.4	0.42	252
	C-8	SD4579	78.0	78.5	48.1	89.8	8.1	87.1	7.8	13.3	12.8	0.44	247
	C-9	Glenn	73.1	72.2	47.5	89.6	8.2	86.8	7.9	13.3	13.9	0.43	259
	C-10	WB9590	74.5	73.0	46.4	89.5	8.5	86.8	8.2	13.4	13.5	0.45	251
Havre	H-1	WB9719	70.8	70.2	43.3	89.6	9.0	86.8	8.6	12.5	15.1	0.43	247
	H-3	WB9616CLP	69.7	69.6	40.8	90.3	7.7	87.7	7.4	13.2	16.4	0.42	254
	H-4	LCS Rebel	72.9	73.1	44.2	90.1	8.6	87.5	8.3	13.4	15.2	0.39	245
	H-5	MN13288-1	69.8	70.2	41.2	90.1	8.4	87.4	8.1	14.0	16.2	0.43	250
	H-6	SY Rockford	70.1	70.3	41.1	90.2	8.9	87.6	8.5	13.9	14.7	0.41	249
	H-9	Glenn	70.6	71.0	44.3	90.0	8.6	87.3	8.3	13.8	15.5	0.45	247
	H-10	WB9590	69.1	69.7	41.4	89.6	9.2	86.9	8.7	13.7	16.3	0.44	251
Crookston	K-2	SD4465	72.7	73.1	46.2	90.5	10.0	87.9	9.5	13.8	11.5	0.42	249
	K-4	LCS Rebel	76.3	76.4	49.5	90.6	8.9	88.1	8.6	13.4	11.3	0.39	256
	K-5	MN13288-1	74.5	74.5	47.0	90.5	8.7	88.0	8.4	13.4	11.1	0.46	251
	K-7	WB9479	75.4	75.7	48.6	90.5	9.2	88.0	8.8	13.5	11.5	0.40	253
	K-8	SD4579	77.2	77.7	49.4	90.8	8.0	88.4	7.7	13.7	10.7	0.44	251
	K-9	Glenn	71.8	71.9	47.3	90.5	8.5	88.0	8.2	13.3	12.2	0.43	249
	K-10	WB9590	74.1	74.1	47.5	90.1	9.3	87.5	8.9	13.4	11.8	0.38	250
Minot	M-1	WB9719	67.6	68.0	43.1	89.6	8.0	86.8	7.6	13.7	15.0	0.38	249
	M-4	LCS Rebel	73.5	74.1	46.1	90.3	8.0	87.7	7.7	13.5	14.0	0.40	250
	M-6	SY Rockford	73.7	73.5	45.3	90.3	8.4	87.7	8.1	13.2	13.5	0.40	245
	M-7	WB9479	74.4	74.2	45.8	89.5	8.3	86.7	7.9	13.3	15.0	0.42	245
	M-9	Glenn	70.7	71.2	44.7	89.7	8.3	87.0	7.9	13.0	15.2	0.47	250
	M-10	WB9590	72.6	73.4	44.4	89.4	8.5	86.7	8.1	13.1	15.5	0.46	251
Williston	W-1	WB9719	69.3	69.6	41.4	89.7	8.8	87.0	8.4	13.7	17.4	0.42	249
	W-3	WB9616CLP	68.1	68.2	40.3	90.2	7.1	87.5	6.9	13.6	18.6	0.42	253
	W-4	LCS Rebel	71.5	71.7	41.3	89.7	8.7	87.0	8.3	13.6	18.3	0.42	250
	W-6	SY Rockford	70.7	70.8	41.0	89.7	8.7	87.0	8.3	13.9	17.3	0.47	250
	W-7	WB9479	72.0	71.4	42.4	89.1	9.4	86.3	9.0	13.7	17.9	0.41	255
	W-9	Glenn	71.1	71.0	42.1	89.5	8.7	86.7	8.3	13.4	17.4	0.43	249
	W-10	WB9590	69.8	70.7	40.1	89.2	9.0	86.4	8.6	13.6	18.1	0.42	250

*TWB = Tempered wheat basis; TPB = Total product basis.

**Flour not malted.

Flour Protein Characteristics by Location

Location	ID	Entry	TPP/TMP [†]	HMW Glutenin Subunits		
				GLU-A1	GLU-B1	GLU-D1
Watertown	B-2	SD4465	0.927	2*	5+10	7+9
	B-4	LCS Rebel	0.884	2*	5+10	7+9
	B-7	WB9479	0.837	2*	5+10	7 ^{oe} +8 [‡]
	B-8	SD4579	0.769	2*	5+10	7+9
	B-9	Glenn	0.820	2*	5+10	7+9
	B-10	WB9590	0.830	2*	5+10	7+9
Casselton	C-2	SD4465	0.996	2*	5+10	7+9
	C-4	LCS Rebel	0.973	2*	5+10	7+9
	C-5	MN13288-1	0.930	1	5+10	7+8
	C-7	WB9479	0.939	2*	5+10	7 ^{oe} +8
	C-8	SD4579	0.833	2*	5+10	7+9
	C-9	Glenn	0.822	2*	5+10	7+9
Havre	C-10	WB9590	0.859	2*	5+10	7+9
	H-1	WB9719	0.839	2*	5+10	7+9
	H-3	WB9616CLP	0.817	2*, 1	5+10	17+18
	H-4	LCS Rebel	0.864	2*	5+10	7+9
	H-5	MN13288-1	0.829	1	5+10	7+8
	H-6	SY Rockford	0.709	2*	5+10	7+8
H-9	Glenn	0.795	2*	5+10	7+9	
Crookston	H-10	WB9590	0.821	2*	5+10	7+9
	K-2	SD4465	1.079	2*	5+10	7+9
	K-4	LCS Rebel	0.992	2*	5+10	7+9
	K-5	MN13288-1	0.934	1	5+10	7+8
	K-7	WB9479	0.925	2*	5+10	7 ^{oe} +8
	K-8	SD4579	0.838	2*	5+10	7+9
K-9	Glenn	0.902	2*	5+10	7+9	
Minot	K-10	WB9590	0.885	2*	5+10	7+9
	M-1	WB9719	0.834	2*	5+10	7+9
	M-4	LCS Rebel	0.930	2*	5+10	7+9
	M-6	SY Rockford	0.714	2*	5+10	7+8
	M-7	WB9479	0.828	2*	5+10	7 ^{oe} +8
	M-9	Glenn	0.793	2*	5+10	7+9
Williston	M-10	WB9590	0.757	2*	5+10	7+9
	W-1	WB9719	0.787	2*	5+10	7+9
	W-3	WB9616CLP	0.797	2*, 1	5+10	17+18
	W-4	LCS Rebel	0.847	2*	5+10	7+9
	W-6	SY Rockford	0.703	2*	5+10	7+8
	W-7	WB9479	0.812	2*	5+10	7 ^{oe} +8
W-9	Glenn	0.776	2*	5+10	7+9	
	W-10	WB9590	0.769	2*	5+10	7+9

[†]TPP/TMP = Total polymeric protein / total monomeric protein.

[‡]7^{oe} = Over-expression of HMW glutenin subunit 7. Will need confirmation by PCR analysis.

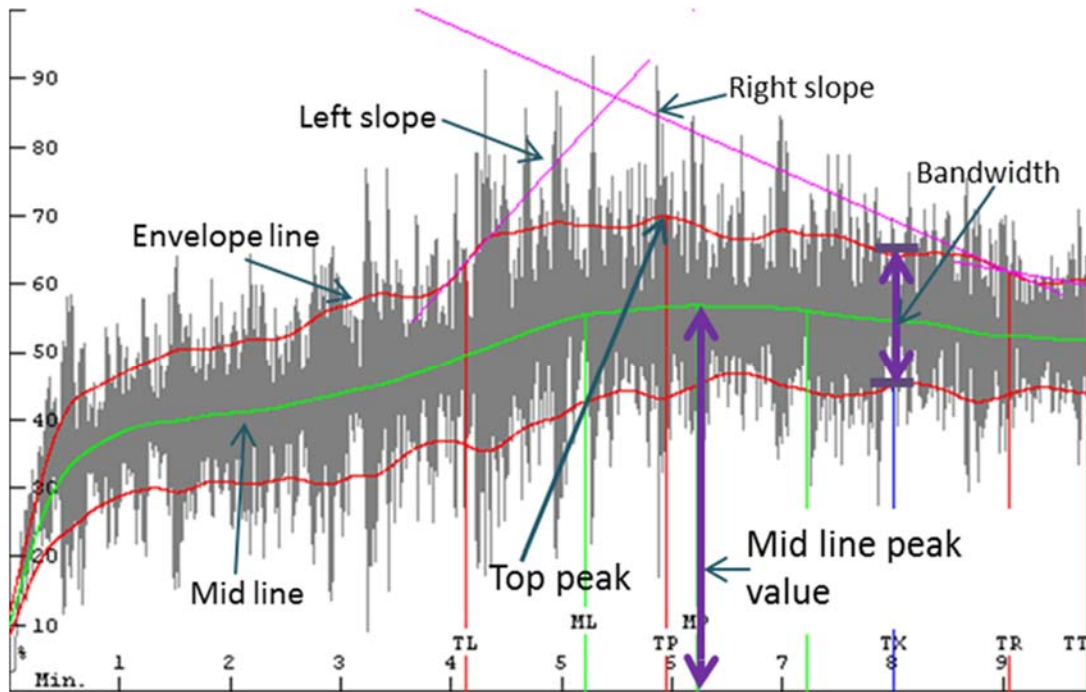
Farinograph Characteristics by Location

Location	ID	Entry	Water Abs. (%, 500 BU)	Water Abs. (%, 14% mb)	Arrival Time (min)	Peak Time (min)	Dough Stability (min)	MTI (BU)	TTB (min)
Watertown	B-2	SD4465	63.3	62.1	2.4	6.2	8.5	34	10.6
	B-4	LCS Rebel	65.0	63.4	2.4	5.2	8.1	27	10.6
	B-7	WB9479	62.9	61.9	2.0	4.5	7.5	33	8.9
	B-8	SD4579	61.6	60.7	3.5	7.2	7.3	44	10.8
	B-9	Glenn	64.3	63.7	2.5	4.7	9.4	22	11.1
	B-10	WB9590	63.4	62.7	2.8	6.8	11.9	23	13.1
Casselton	C-2	SD4465	64.5	63.1	3.5	6.5	6.2	51	9.3
	C-4	LCS Rebel	64.9	63.4	2.7	7.0	8.3	38	10.6
	C-5	MN13288-1	61.6	60.6	2.4	6.7	9.7	29	11.8
	C-7	WB9479	62.4	61.6	2.2	6.7	11.2	28	11.8
	C-8	SD4579	61.3	60.3	3.0	6.2	6.3	42	9.6
	C-9	Glenn	66.8	65.9	2.4	6.3	8.7	33	11.0
C-10	WB9590	65.1	64.2	3.4	5.8	6.8	34	9.9	
Havre	H-1	WB9719	67.0	66.1	4.8	11.4	12.3	33	15.5
	H-3	WB9616CLP	63.9	63.1	3.7	10.5	30.3	11	34.9
	H-4	LCS Rebel	65.6	65.0	5.8	13.2	14.4	27	18.6
	H-5	MN13288-1	62.1	62.3	3.6	9.2	35.9	6	41.0
	H-6	SY Rockford	66.2	66.3	5.0	10.0	15.3	17	20.6
	H-9	Glenn	64.5	64.3	5.7	10.8	19.7	12	25.3
H-10	WB9590	65.5	65.1	5.6	10.7	15.0	19	20.4	
Crookston	K-2	SD4465	62.2	61.8	2.9	5.7	6.6	37	9.6
	K-4	LCS Rebel	63.4	62.7	2.2	6.8	9.0	30	11.2
	K-5	MN13288-1	59.7	58.9	1.6	3.4	8.2	17	9.5
	K-7	WB9479	60.7	60.2	1.7	2.7	9.7	15	10.5
	K-8	SD4579	58.5	57.8	1.9	5.2	6.2	45	8.5
	K-9	Glenn	64.6	63.7	1.8	5.0	9.7	23	11.0
K-10	WB9590	60.9	60.1	2.1	6.5	10.0	24	12.7	
Minot	M-1	WB9719	67.3	66.5	5.4	9.4	10.3	22	16.5
	M-4	LCS Rebel	64.7	63.8	4.2	10.4	15.4	19	18.5
	M-6	SY Rockford	67.1	66.1	3.9	7.7	11.0	25	14.3
	M-7	WB9479	63.5	62.6	3.6	10.3	24.1	7	26.4
	M-9	Glenn	66.3	65.0	4.5	10.5	25.4	9	29.9
	M-10	WB9590	65.1	64.1	4.8	10.0	15.9	19	19.6
Williston	W-1	WB9719	67.7	67.9	16.0	32.4	30.0	6	48.0
	W-3	WB9616CLP	66.1	65.3	10.6	31.5	29.9	5	42.1
	W-4	LCS Rebel	67.4	66.5	9.8	32.3	41.8	8	51.9
	W-6	SY Rockford	68.2	68.2	8.2	19.9	24.8	11	33.9
	W-7	WB9479	66.6	66.4	14.8	28.7	31.8	3	48.0
	W-9	Glenn	66.1	66.2	8.0	25.5	34.0	5	42.6
W-10	WB9590	66.6	66.5	7.7	27.4	30.3	6	39.1	

Mixograph Characteristics by Location

Location	ID	Entry	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	B-2	SD4465	4.8	70.7	28.9	4.9	55.8	28.4	210.8
	B-4	LCS Rebel	5.0	73.1	30.4	4.9	57.4	29.8	213.5
	B-7	WB9479	6.0	67.6	26.8	6.3	53.6	24.6	257.8
	B-8	SD4579	2.9	66.2	29.1	3.4	51.2	24.1	134.8
	B-9	Glenn	5.6	68.8	30.3	6.0	53.1	28.3	254.9
B-10	WB9590	4.8	71.1	30.5	5.4	55.8	28.0	230.6	
Casselton	C-2	SD4465	2.7	73.5	32.2	3.4	58.0	28.5	146.3
	C-4	LCS Rebel	4.0	73.2	33.5	3.9	55.1	33.1	163.9
	C-5	MN13288-1	4.9	64.0	26.1	5.1	50.2	25.3	190.5
	C-7	WB9479	4.6	69.7	30.8	5.4	54.6	24.4	228.3
	C-8	SD4579	2.7	68.7	31.0	2.9	52.6	30.9	113.0
	C-9	Glenn	4.3	74.9	30.0	4.0	60.1	28.1	176.1
C-10	WB9590	3.4	81.3	34.4	3.3	63.6	34.3	156.9	
Havre	H-1	WB9719	3.4	74.1	33.0	3.8	58.4	26.6	155.5
	H-3	WB9616CLP	4.6	69.1	29.3	5.0	54.1	27.0	193.9
	H-4	LCS Rebel	4.0	79.7	33.4	4.3	63.2	31.1	179.1
	H-5	MN13288-1	4.8	67.6	26.4	5.1	55.1	22.1	194.8
	H-6	SY Rockford	3.0	76.0	27.4	3.1	62.5	27.0	140.8
	H-9	Glenn	4.0	78.8	32.2	4.2	62.5	29.9	172.9
H-10	WB9590	3.5	76.4	32.2	3.6	60.4	32.1	143.5	
Crookston	K-2	SD4465	3.6	73.9	31.7	3.8	57.1	31.9	158.5
	K-4	LCS Rebel	3.8	73.8	32.3	4.1	56.8	29.6	180.2
	K-5	MN13288-1	4.9	57.0	26.0	5.4	43.6	21.6	190.6
	K-7	WB9479	7.7	57.1	26.3	8.0	43.5	25.7	267.8
	K-8	SD4579	3.3	58.0	24.2	3.5	45.5	23.8	129.9
	K-9	Glenn	5.3	69.6	28.2	4.9	54.6	25.9	208.4
K-10	WB9590	4.6	67.4	30.4	4.8	51.7	28.1	194.4	
Minot	M-1	WB9719	3.1	77.6	31.8	3.4	62.7	29.4	147.8
	M-4	LCS Rebel	4.0	79.4	35.2	4.5	61.9	31.8	196.5
	M-6	SY Rockford	3.0	81.0	30.8	3.2	65.4	30.0	153.6
	M-7	WB9479	4.9	75.3	31.8	5.5	59.1	29.1	232.7
	M-9	Glenn	4.5	80.2	31.5	4.9	64.2	28.5	219.4
M-10	WB9590	4.1	72.4	28.9	4.2	58.5	28.9	170.0	
Williston	W-1	WB9719	6.5	77.2	34.9	6.5	59.9	34.1	254.1
	W-3	WB9616CLP	6.5	75.5	33.3	6.8	59.6	28.9	240.6
	W-4	LCS Rebel	6.9	83.5	40.1	7.4	64.1	35.1	303.7
	W-6	SY Rockford	4.2	84.0	38.5	4.4	64.8	35.7	194.3
	W-7	WB9479	5.9	86.3	37.7	5.8	67.3	36.9	247.0
	W-9	Glenn	6.4	79.4	33.4	6.3	62.5	33.4	250.1
W-10	WB9590	5.5	77.3	31.6	5.6	61.5	30.0	218.8	

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 midline is shown, including envelope and midline % of full value. These values are traditionally the most meaningful. A midline peak time around 3-5 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 midline from time 0 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 midline 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 Manufacturing Company)

Extensograph Characteristics by Location

45 Minutes Resting								
Location	ID	Entry	Energy (cm ²)	Resistance (BU)	Extensibility (mm)	Maximum (BU)	Ratio Number	Ratio Number (max)
Watertown	B-2	SD4465	76	203	169	364	1.2	2.2
	B-4	LCS Rebel	84	211	172	404	1.2	2.4
	B-7	WB9479	117	266	177	563	1.5	3.2
	B-8	SD4579	51	151	167	233	0.9	1.4
	B-9	Glenn	115	271	184	505	1.5	2.8
	B-10	WB9590	93	211	186	406	1.1	2.2
Casselton	C-2	SD4465	55	143	186	211	0.8	1.1
	C-4	LCS Rebel	68	149	195	274	0.8	1.4
	C-5	MN13288-1	93	238	176	420	1.4	2.4
	C-7	WB9479	88	216	174	415	1.2	2.4
	C-8	SD4579	48	108	202	175	0.5	0.9
	C-9	Glenn	84	195	190	341	1.0	1.8
Havre	C-10	WB9590	62	154	184	265	0.8	1.4
	H-1	WB9719	68	196	162	345	1.2	2.1
	H-3	WB9616CLP	105	205	207	395	1.0	1.9
	H-4	LCS Rebel	106	183	216	394	0.9	1.8
	H-5	MN13288-1	96	268	164	467	1.6	2.8
	H-6	SY Rockford	70	151	196	282	0.8	1.4
	H-9	Glenn	97	228	180	444	1.3	2.5
H-10	WB9590	84	179	200	325	0.9	1.6	
Crookston	K-2	SD4465	53	167	159	257	1.1	1.6
	K-4	LCS Rebel	80	178	188	343	1.0	1.8
	K-5	MN13288-1	89	290	152	473	1.9	3.1
	K-7	WB9479	75	306	132	467	2.3	3.5
	K-8	SD4579	41	123	164	187	0.8	1.1
	K-9	Glenn	96	259	164	493	1.6	3.0
Minot	K-10	WB9590	66	204	157	339	1.3	2.2
	M-1	WB9719	52	130	186	208	0.7	1.1
	M-4	LCS Rebel	93	246	173	434	1.4	2.5
	M-6	SY Rockford	76	174	191	318	0.9	1.7
	M-7	WB9479	94	236	172	450	1.4	2.6
	M-9	Glenn	115	240	199	452	1.2	2.3
Williston	M-10	WB9590	71	182	170	343	1.1	2.0
	W-1	WB9719	110	195	216	407	0.9	1.9
	W-3	WB9616CLP	101	191	210	387	0.9	1.9
	W-4	LCS Rebel	160	282	216	603	1.3	2.8
	W-6	SY Rockford	99	205	210	357	1.0	1.7
	W-7	WB9479	143	262	210	542	1.3	2.6
	W-9	Glenn	122	291	183	544	1.6	3.0
W-10	WB9590	113	243	194	475	1.3	2.5	

90 Minutes Resting								
Location	ID	Entry	Energy (cm ²)	Resistance (BU)	Extensibility (mm)	Maximum (BU)	Ratio Number	Ratio Number (max)
Watertown	B-2	SD4465	99	360	146	536	2.5	3.7
	B-4	LCS Rebel	100	329	152	530	2.2	3.5
	B-7	WB9479	118	570	127	715	4.5	5.7
	B-8	SD4579	62	187	157	324	1.2	2.1
	B-9	Glenn	114	483	139	667	3.5	4.8
	B-10	WB9590	124	322	183	531	1.8	2.9
Casselton	C-2	SD4465	69	223	160	324	1.4	2.0
	C-4	LCS Rebel	89	229	180	378	1.3	2.1
	C-5	MN13288-1	110	345	159	532	2.2	3.3
	C-7	WB9479	111	426	150	556	2.8	3.7
	C-8	SD4579	64	137	207	229	0.7	1.1
	C-9	Glenn	97	233	185	407	1.3	2.2
Havre	C-10	WB9590	70	250	151	353	1.7	2.3
	H-1	WB9719	104	357	159	492	2.2	3.1
	H-3	WB9616CLP	123	328	177	540	1.9	3.1
	H-4	LCS Rebel	116	288	181	500	1.6	2.8
	H-5	MN13288-1	124	510	140	691	3.6	4.9
	H-6	SY Rockford	97	322	159	461	2.0	2.9
	H-9	Glenn	134	415	165	620	2.5	3.8
H-10	WB9590	108	296	179	451	1.7	2.5	
Crookston	K-2	SD4465	68	307	134	371	2.3	2.8
	K-4	LCS Rebel	94	362	146	502	2.5	3.4
	K-5	MN13288-1	84	505	110	599	4.6	5.4
	K-7	WB9479	94	628	108	713	5.8	6.6
	K-8	SD4579	50	174	150	255	1.2	1.7
	K-9	Glenn	95	476	125	611	3.8	4.9
Minot	K-10	WB9590	82	348	134	493	2.6	3.7
	M-1	WB9719	75	201	183	303	1.1	1.7
	M-4	LCS Rebel	116	340	169	526	2.0	3.1
	M-6	SY Rockford	94	311	164	411	1.9	2.5
	M-7	WB9479	133	558	151	676	3.7	4.5
	M-9	Glenn	114	391	158	540	2.5	3.4
Williston	M-10	WB9590	104	388	149	524	2.6	3.5
	W-1	WB9719	135	327	189	565	1.7	3.0
	W-3	WB9616CLP	105	251	184	458	1.4	2.5
	W-4	LCS Rebel	151	417	171	703	2.4	4.1
	W-6	SY Rockford	103	258	189	419	1.4	2.2
	W-7	WB9479	153	408	183	641	2.2	3.5
	W-9	Glenn	146	486	163	671	3.0	4.1
W-10	WB9590	133	414	163	633	2.5	3.9	

135 Minutes Resting								
Location	ID	Entry	Energy (cm ²)	Resistance (BU)	Extensibility (mm)	Maximum (BU)	Ratio Number	Ratio Number (max)
Watertown	B-2	SD4465	103	426	139	571	3.1	4.1
	B-4	LCS Rebel	97	378	140	545	2.7	3.9
	B-7	WB9479	108	638	115	697	5.6	6.1
	B-8	SD4579	84	301	154	411	2.0	2.7
	B-9	Glenn	109	604	127	688	4.7	5.4
	B-10	WB9590	106	344	156	533	2.2	3.4
Casselton	C-2	SD4465	62	216	148	322	1.5	2.2
	C-4	LCS Rebel	89	222	183	375	1.2	2.1
	C-5	MN13288-1	90	439	127	546	3.5	4.3
	C-7	WB9479	105	382	149	551	2.6	3.7
	C-8	SD4579	61	158	191	234	0.8	1.2
	C-9	Glenn	91	294	156	469	1.9	3.0
Havre	C-10	WB9590	78	310	144	405	2.2	2.8
	H-1	WB9719	108	419	152	539	2.8	3.5
	H-3	WB9616CLP	119	345	170	540	2.0	3.2
	H-4	LCS Rebel	120	390	160	578	2.4	3.6
	H-5	MN13288-1	115	626	120	744	5.2	6.2
	H-6	SY Rockford	92	370	140	514	2.6	3.7
	H-9	Glenn	135	503	154	651	3.3	4.2
H-10	WB9590	108	325	169	480	1.9	2.8	
Crookston	K-2	SD4465	67	362	119	421	3.1	3.5
	K-4	LCS Rebel	88	356	138	501	2.6	3.6
	K-5	MN13288-1	86	575	108	642	5.3	5.9
	K-7	WB9479	91	678	106	718	6.4	6.8
	K-8	SD4579	45	180	138	252	1.3	1.8
	K-9	Glenn	82	571	105	640	5.5	6.1
Minot	K-10	WB9590	73	448	112	519	4.0	4.6
	M-1	WB9719	72	226	164	328	1.4	2.0
	M-4	LCS Rebel	103	415	142	559	2.9	3.9
	M-6	SY Rockford	100	343	158	480	2.2	3.0
	M-7	WB9479	111	560	130	656	4.3	5.1
	M-9	Glenn	130	480	155	634	3.1	4.1
Williston	M-10	WB9590	103	381	147	546	2.6	3.7
	W-1	WB9719	109	401	146	585	2.8	4.0
	W-3	WB9616CLP	114	308	175	511	1.8	2.9
	W-4	LCS Rebel	173	529	168	791	3.2	4.7
	W-6	SY Rockford	107	284	184	436	1.6	2.4
	W-7	WB9479	118	448	141	692	3.2	4.9
	W-9	Glenn	111	543	124	722	4.4	5.8
W-10	WB9590	137	567	135	823	4.2	6.1	

Ash/Protein Content in Mill Streams

Watertown (Group B)

SD4465 (B-2)

Mill Stream	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Yield	Ash	Protein	Yield	Ash	Protein
Straight Grade:						
1 BK	6.7	0.39	12.0	6.7	0.39	12.0
1 R	40.4	0.44	12.5	47.2	0.43	12.4
2 BK	8.2	0.50	15.5	55.3	0.44	12.9
2 R	13.2	0.57	12.6	68.5	0.47	12.8
3 BK	1.7	1.06	19.3	70.2	0.48	13.0
3 R	2.6	1.06	13.5	72.8	0.50	13.0
Bran & Shorts:						
Shorts	11.6	3.30	16.7	84.4	0.88	13.5
Bran	15.6	5.43	15.9	100.0	1.60	13.9
Straight Grade		0.49	12.8			
Wheat		1.53	13.6			

LCS Rebel (B-4)

Mill Stream	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Yield	Ash	Protein	Yield	Ash	Protein
Straight Grade:						
1 BK	8.3	0.37	12.4	8.3	0.37	12.4
1 R	41.1	0.41	12.9	49.3	0.41	12.8
2 BK	8.6	0.44	16.5	57.9	0.41	13.4
2 R	11.8	0.53	12.9	69.7	0.43	13.3
3 BK	1.8	0.90	19.8	71.5	0.44	13.4
3 R	2.4	1.14	14.3	73.9	0.46	13.5
Bran & Shorts:						
Shorts	12.2	3.45	17.1	86.0	0.89	14.0
Bran	14.0	5.69	16.7	100.0	1.56	14.4
Straight Grade		0.45	13.2			
Wheat		1.45	13.9			

WB9479 (B-7)

Mill Stream	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Yield	Ash	Protein	Yield	Ash	Protein
Straight Grade:						
1 BK	9.6	0.35	15.0	9.6	0.35	15.0
1 R	39.7	0.41	13.1	49.2	0.40	13.5
2 BK	8.7	0.43	18.5	57.9	0.40	14.2
2 R	10.4	0.52	13.0	68.3	0.42	14.0
3 BK	1.9	1.00	22.7	70.3	0.43	14.3
3 R	2.3	1.06	14.1	72.5	0.45	14.3
Bran & Shorts:						
Shorts	12.3	3.31	17.2	84.9	0.87	14.7
Bran	15.1	5.47	16.7	100.0	1.57	15.0
Straight Grade		0.45	14.1			
Wheat		1.46	14.7			

SD4579 (B-8)

Mill Stream	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Yield	Ash	Protein	Yield	Ash	Protein
Straight Grade:						
1 BK	11.0	0.31	13.8	11.0	0.31	13.8
1 R	41.3	0.34	12.7	52.3	0.34	13.0
2 BK	9.6	0.40	17.7	61.8	0.35	13.7
2 R	9.6	0.49	13.0	71.4	0.37	13.6
3 BK	1.9	0.85	21.4	73.3	0.38	13.8
3 R	2.3	1.04	14.1	75.6	0.40	13.8
Bran & Shorts:						
Shorts	9.3	3.37	17.0	84.9	0.72	14.2
Bran	15.1	5.79	16.9	100.0	1.49	14.6
Straight Grade		0.40	13.6			
Wheat		1.39	14.2			

Glenn Check (B-9)

Mill Stream	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Yield	Ash	Protein	Yield	Ash	Protein
Straight Grade:						
1 R	37.3	0.39	13.0	37.3	0.39	13.0
2 BK	7.5	0.41	17.3	44.7	0.39	13.7
1 BK	6.1	0.41	14.0	50.8	0.40	13.8
2 R	14.2	0.47	12.6	65.0	0.41	13.5
3 R	3.3	0.71	12.7	68.3	0.43	13.5
3 BK	1.7	0.86	21.3	70.0	0.44	13.7
Bran & Shorts:						
Shorts	15.0	2.71	15.3	85.1	0.84	13.9
Bran	14.9	5.54	17.0	100.0	1.54	14.4
Straight Grade		0.46	13.5			
Wheat		1.42	14.1			

WB9590 (B-10)

Mill Stream	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Yield	Ash	Protein	Yield	Ash	Protein
Straight Grade:						
1 BK	7.9	0.37	14.2	7.9	0.37	14.2
1 R	36.9	0.39	13.4	44.8	0.38	13.5
2 BK	8.4	0.41	17.4	53.2	0.39	14.1
2 R	11.7	0.48	13.1	64.9	0.40	14.0
3 R	2.9	0.88	13.6	67.9	0.42	13.9
3 BK	1.9	0.88	21.6	69.8	0.44	14.1
Bran & Shorts:						
Shorts	14.9	3.12	16.6	84.7	0.91	14.6
Bran	15.3	5.40	16.9	100.0	1.60	14.9
Straight Grade		0.45	14.1			
Wheat		1.50	14.6			

Casselton (Group C)

SD4465 (C-2)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	7.4	0.39	12.1	7.4	0.39	12.1
1 R	39.5	0.42	12.4	47.0	0.41	12.3
2 BK	8.5	0.46	15.8	55.5	0.42	12.9
2 R	13.7	0.49	12.3	69.2	0.43	12.8
3 R	2.6	1.02	13.2	71.8	0.46	12.8
3 BK	1.7	1.08	19.9	73.6	0.47	12.9
Bran & Shorts:						
Shorts	11.3	3.13	16.3	84.8	0.82	13.4
Bran	15.2	5.94	16.8	100.0	1.60	13.9
Straight Grade		0.48		13.0		
Wheat		1.50		13.8		

LCS Rebel (C-4)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	8.2	0.35	12.7	8.2	0.35	12.7
1 R	41.0	0.38	12.2	49.2	0.37	12.3
2 BK	8.8	0.42	16.0	58.0	0.38	12.9
2 R	13.8	0.49	12.0	71.9	0.40	12.7
3 BK	1.7	0.94	20.1	73.5	0.41	12.9
3 R	2.3	0.95	13.0	75.9	0.43	12.9
Bran & Shorts:						
Shorts	10.4	3.21	16.1	86.3	0.77	13.3
Bran	13.7	6.15	17.2	100.0	1.50	13.8
Straight Grade		0.41		12.9		
Wheat		1.38		13.5		

MN13288-1 (C-5)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	5.9	0.42	12.8	5.9	0.42	12.8
1 R	42.4	0.45	12.9	48.3	0.45	12.9
2 BK	8.8	0.48	15.7	57.1	0.46	13.4
2 R	13.0	0.62	13.2	70.1	0.49	13.3
3 BK	1.9	0.99	19.7	72.0	0.50	13.5
3 R	2.2	1.15	14.1	74.2	0.52	13.5
Bran & Shorts:						
Shorts	11.6	3.57	16.7	85.7	0.93	14.0
Bran	14.3	5.62	17.7	100.0	1.60	14.5
Straight Grade		0.50		13.4		
Wheat		1.49		14.3		

WB9479 (C-7)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	9.9	0.36	13.7	9.9	0.36	13.7
1 R	41.5	0.38	12.3	51.5	0.37	12.6
2 BK	9.0	0.38	17.3	60.4	0.37	13.3
2 R	11.0	0.49	12.1	71.4	0.39	13.1
3 BK	1.7	0.97	21.5	73.1	0.41	13.3
3 R	2.2	1.04	13.2	75.3	0.42	13.3
Bran & Shorts:						
Shorts	10.6	3.51	16.5	85.9	0.81	13.7
Bran	14.1	6.18	16.9	100.0	1.56	14.2
Straight Grade		0.42		13.4		
Wheat		1.46		13.7		

SD4579 (C-8)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	11.8	0.31	12.6	11.8	0.31	12.6
1 R	43.6	0.38	12.1	55.5	0.37	12.2
2 BK	10.0	0.41	16.4	65.4	0.37	12.8
2 R	10.0	0.62	12.4	75.4	0.41	12.8
3 BK	1.7	1.21	20.2	77.1	0.42	12.9
3 R	1.4	1.48	14.0	78.5	0.44	13.0
Bran & Shorts:						
Shorts	7.8	3.83	16.3	86.3	0.75	13.3
Bran	13.7	6.60	16.2	100.0	1.55	13.7
Straight Grade		0.44		12.8		
Wheat		1.43		13.4		

Glenn Check (C-9)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	6.2	0.32	14.8	6.2	0.32	14.8
1 R	39.8	0.38	13.1	46.0	0.37	13.3
2 BK	8.1	0.39	18.0	54.1	0.37	14.1
2 R	13.2	0.47	12.5	67.3	0.39	13.8
3 R	3.1	0.79	13.0	70.4	0.41	13.7
3 BK	1.8	0.94	22.8	72.2	0.42	13.9
Bran & Shorts:						
Shorts	13.5	3.00	15.6	85.8	0.83	14.2
Bran	14.2	6.11	17.9	100.0	1.58	14.7
Straight Grade		0.43		13.9		
Wheat		1.55		14.5		

WB9590 (C-10)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	8.4	0.28	13.8	8.4	0.28	13.8
2 BK	8.8	0.35	17.3	17.2	0.32	15.6
1 R	39.5	0.41	12.6	56.7	0.38	13.5
2 R	12.0	0.51	12.4	68.6	0.41	13.3
3 BK	1.8	0.96	22.0	70.4	0.42	13.5
3 R	2.6	1.05	13.5	73.0	0.44	13.5
Bran & Shorts:						
Shorts	12.6	3.36	16.1	85.6	0.87	13.9
Bran	14.4	6.14	17.3	100.0	1.63	14.4
Straight Grade						
Wheat		0.41	12.9			
		1.38	13.5			

Havre (Group H)

WB9719 (H-1)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 R	35.7	0.36	14.5	35.7	0.36	14.5
2 BK	8.0	0.40	20.1	43.8	0.37	15.5
1 BK	8.0	0.44	18.3	51.8	0.38	15.9
2 R	14.0	0.45	13.3	65.8	0.39	15.4
3 BK	1.2	0.60	23.5	67.0	0.40	15.5
3 R	3.2	0.75	13.5	70.2	0.41	15.4
Bran & Shorts:						
Shorts	15.3	3.25	16.3	85.5	0.92	15.6
Bran	14.5	4.74	17.9	100.0	1.47	15.9
Straight Grade						
Wheat		0.43	15.1			
		1.39	15.6			

WB9616CLP (H-3)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	4.3	0.38	16.4	4.3	0.38	16.4
1 R	37.2	0.38	15.3	41.5	0.38	15.4
2 BK	12.3	0.40	19.6	53.8	0.38	16.4
2 R	11.7	0.57	15.4	65.5	0.42	16.2
3 BK	1.7	0.61	23.1	67.2	0.42	16.4
3 R	2.3	0.97	15.9	69.6	0.44	16.4
Bran & Shorts:						
Shorts	12.7	3.36	18.4	82.3	0.89	16.7
Bran	17.7	4.97	19.1	100.0	1.61	17.1
Straight Grade						
Wheat		0.42	16.4			
		1.57	16.8			

LCS Rebel (H-4)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 R	42.2	0.35	14.5	42.2	0.35	14.5
2 BK	8.9	0.37	19.3	51.1	0.35	15.4
1 BK	6.5	0.40	16.4	57.6	0.36	15.5
2 R	11.8	0.43	13.8	69.5	0.37	15.2
3 BK	1.6	0.62	22.6	71.0	0.38	15.4
3 R	2.1	0.77	14.2	73.1	0.39	15.3
Bran & Shorts:						
Shorts	9.4	2.95	16.6	82.5	0.68	15.5
Bran	17.5	5.11	18.4	100.0	1.45	16.0
Straight Grade						
Wheat		0.39	15.2			
		1.37	15.8			

MN13288-1 (H-5)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
2 BK	9.1	0.40	18.9	9.1	0.40	18.9
1 R	37.1	0.40	15.7	46.2	0.40	16.3
1 BK	5.8	0.42	16.3	52.0	0.40	16.3
2 R	14.4	0.52	15.2	66.3	0.43	16.1
3 BK	1.7	0.63	22.8	68.0	0.43	16.2
3 R	2.2	0.76	15.4	70.2	0.44	16.2
Bran & Shorts:						
Shorts	10.7	3.16	16.9	80.9	0.80	16.3
Bran	19.1	5.03	17.9	100.0	1.61	16.6
Straight Grade						
Wheat		0.43	16.2			
		1.50	16.3			

SY Rockford (H-6)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 R	35.6	0.36	13.7	35.6	0.36	13.7
2 BK	9.9	0.36	18.9	45.5	0.36	14.9
1 BK	6.8	0.39	16.1	52.4	0.36	15.0
2 R	13.5	0.46	13.1	65.9	0.38	14.6
3 BK	2.1	0.57	23.0	67.9	0.39	14.9
3 R	2.4	0.76	13.8	70.3	0.40	14.8
Bran & Shorts:						
Shorts	9.8	2.74	16.2	80.1	0.69	15.0
Bran	19.9	4.77	17.8	100.0	1.50	15.6
Straight Grade		0.41	14.7			
Wheat		1.38	15.3			

Glenn Check (H-9)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 R	37.5	0.38	14.8	37.5	0.38	14.8
2 BK	8.4	0.45	19.3	45.9	0.39	15.6
1 BK	6.5	0.46	16.6	52.4	0.40	15.7
2 R	14.5	0.47	13.9	66.9	0.42	15.3
3 BK	1.5	0.69	23.4	68.5	0.42	15.5
3 R	2.6	0.75	14.0	71.0	0.43	15.5
Bran & Shorts:						
Shorts	10.7	2.91	16.0	81.7	0.76	15.5
Bran	18.3	5.13	17.4	100.0	1.56	15.9
Straight Grade		0.45	15.5			
Wheat		1.47	15.8			

WB9590 (H-10)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	8.9	0.41	17.4	8.9	0.41	17.4
1 R	35.4	0.42	15.2	44.3	0.41	15.7
2 BK	9.6	0.43	20.8	53.9	0.42	16.6
2 R	11.8	0.51	14.6	65.8	0.43	16.2
3 BK	1.7	0.68	25.1	67.5	0.44	16.4
3 R	2.2	0.90	15.0	69.7	0.46	16.4
Bran & Shorts:						
Shorts	10.7	2.94	16.7	80.4	0.79	16.4
Bran	19.6	5.29	18.5	100.0	1.67	16.8
Straight Grade		0.44	16.3			
Wheat		1.61	16.6			

Crookston (Group K)

SD4465 (K-2)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 R	41.5	0.36	11.3	41.5	0.36	11.3
2 R	15.6	0.41	11.0	57.1	0.37	11.2
1 BK	6.8	0.42	11.4	63.9	0.38	11.2
2 BK	5.7	0.44	13.4	69.5	0.38	11.4
3 BK	1.0	0.70	15.7	70.5	0.39	11.4
3 R	2.6	0.76	11.3	73.1	0.40	11.4
Bran & Shorts:						
Shorts	8.7	2.58	14.4	81.8	0.63	11.8
Bran	18.2	5.00	14.7	100.0	1.43	12.3
Straight Grade		0.42	11.5			
Wheat		1.41	12.3			

LCS Rebel (K-4)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 R	41.7	0.33	10.7	41.7	0.33	10.7
1 BK	9.1	0.38	12.7	50.8	0.34	11.1
2 R	16.5	0.38	10.6	67.3	0.35	11.0
2 BK	4.9	0.38	14.4	72.2	0.35	11.2
3 BK	0.9	0.56	16.3	73.0	0.35	11.3
3 R	3.3	0.64	10.9	76.4	0.37	11.2
Bran & Shorts:						
Shorts	9.3	3.11	14.2	85.7	0.67	11.6
Bran	14.3	5.14	15.1	100.0	1.31	12.1
Straight Grade		0.39	11.3			
Wheat		1.27	12.1			

MN13288-1 (K-5)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	6.2	0.39	11.1	6.2	0.39	11.1
2 BK	5.6	0.42	12.5	11.8	0.41	11.7
1 R	41.2	0.42	10.8	53.0	0.42	11.0
2 R	17.0	0.52	11.2	70.0	0.44	11.0
3 BK	1.1	0.68	14.8	71.1	0.45	11.1
3 R	3.3	0.94	11.6	74.5	0.47	11.1
Bran & Shorts:						
Shorts	9.1	3.26	14.0	83.6	0.77	11.4
Bran	16.4	5.09	14.5	100.0	1.48	11.9
Straight Grade		0.46		11.1		
Wheat		1.42		11.7		

WB9479 (K-7)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 R	40.5	0.36	10.8	40.5	0.36	10.8
1 BK	9.6	0.37	13.0	50.1	0.36	11.3
2 R	15.7	0.40	10.5	65.8	0.37	11.1
2 BK	5.4	0.40	15.0	71.2	0.37	11.4
3 BK	1.0	0.66	17.4	72.2	0.38	11.5
3 R	3.5	0.78	11.0	75.7	0.40	11.4
Bran & Shorts:						
Shorts	8.6	3.29	14.5	84.3	0.69	11.8
Bran	15.7	5.41	14.5	100.0	1.43	12.2
Straight Grade		0.40		11.5		
Wheat		1.39		12.0		

SD4579 (K-8)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	11.1	0.37	11.0	11.1	0.37	11.0
1 R	46.6	0.38	10.1	57.6	0.38	10.3
2 BK	5.5	0.40	12.6	63.1	0.38	10.5
2 R	11.4	0.58	10.6	74.5	0.41	10.5
3 BK	1.2	0.65	14.7	75.7	0.42	10.6
3 R	2.0	1.07	10.9	77.7	0.43	10.6
Bran & Shorts:						
Shorts	10.0	4.22	13.7	87.7	0.86	11.0
Bran	12.3	5.87	14.2	100.0	1.48	11.4
Straight Grade		0.44		10.7		
Wheat		1.44		11.2		

Glenn Check (K-9)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 R	35.1	0.35	12.0	35.1	0.35	12.0
2 R	19.5	0.40	11.3	54.7	0.37	11.8
1 BK	6.9	0.40	14.1	61.5	0.37	12.0
2 BK	4.8	0.40	15.8	66.3	0.37	12.3
3 R	4.5	0.62	11.0	70.7	0.39	12.2
3 BK	1.2	0.64	17.8	71.9	0.39	12.3
Bran & Shorts:						
Shorts	11.4	2.31	13.6	83.4	0.66	12.5
Bran	16.6	5.22	16.3	100.0	1.42	13.1
Straight Grade		0.43		12.2		
Wheat		1.36		12.8		

WB9590 (K-10)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	10.0	0.35	13.4	10.0	0.35	13.4
2 BK	3.9	0.36	15.0	13.9	0.35	13.8
1 R	37.7	0.37	11.6	51.6	0.37	12.2
2 R	17.7	0.40	10.9	69.4	0.37	11.9
3 BK	1.0	0.59	17.1	70.3	0.38	11.9
3 R	3.7	0.61	11.1	74.1	0.39	11.9
Bran & Shorts:						
Shorts	13.8	3.07	14.3	87.8	0.81	12.3
Bran	12.2	4.67	15.6	100.0	1.28	12.7
Straight Grade		0.38		11.8		
Wheat		1.21		12.2		

Minot (Group M)

WB9719 (M-1)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	7.5	0.34	16.2	7.5	0.34	16.2
1 R	32.6	0.36	13.7	40.0	0.36	14.2
2 BK	8.5	0.37	19.4	48.5	0.36	15.1
2 R	14.4	0.42	13.1	62.9	0.37	14.6
3 R	3.0	0.69	13.8	66.0	0.39	14.6
3 BK	2.0	0.69	23.6	68.0	0.40	14.9
Bran & Shorts:						
Shorts	12.8	2.45	16.2	80.8	0.72	15.1
Bran	19.2	4.86	18.6	100.0	1.51	15.8
Straight Grade		0.38	15.0			
Wheat		1.42	15.4			

LCS Rebel (M-4)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 R	40.0	0.34	13.4	40.0	0.34	13.4
1 BK	7.6	0.35	14.5	47.6	0.35	13.6
2 BK	8.0	0.37	17.8	55.6	0.35	14.2
2 R	14.3	0.43	13.0	69.9	0.37	13.9
3 BK	1.5	0.71	21.6	71.4	0.37	14.1
3 R	2.7	0.77	13.7	74.1	0.39	14.1
Bran & Shorts:						
Shorts	9.7	3.03	16.9	83.9	0.70	14.4
Bran	16.1	5.44	18.4	100.0	1.46	15.1
Straight Grade		0.40	14.0			
Wheat		1.34	14.6			

SY Rockford (M-6)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	8.7	0.35	14.1	8.7	0.35	14.1
1 R	39.8	0.37	12.5	48.5	0.36	12.8
2 BK	9.3	0.39	17.9	57.8	0.37	13.6
2 R	11.6	0.46	12.3	69.4	0.38	13.4
3 BK	1.9	0.72	21.5	71.3	0.39	13.6
3 R	2.2	0.82	13.2	73.5	0.40	13.6
Bran & Shorts:						
Shorts	8.1	3.03	16.7	81.6	0.67	13.9
Bran	18.4	5.25	17.2	100.0	1.51	14.5
Straight Grade		0.40	13.5			
Wheat		1.45	14.5			

WB9479 (M-7)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	11.1	0.35	16.1	11.1	0.35	16.1
1 R	37.1	0.37	13.6	48.3	0.36	14.2
2 BK	9.2	0.38	20.0	57.5	0.37	15.1
2 R	12.8	0.48	13.2	70.3	0.39	14.8
3 BK	1.7	0.93	24.2	72.0	0.40	15.0
3 R	2.2	0.99	14.2	74.2	0.42	15.0
Bran & Shorts:						
Shorts	11.4	3.49	17.0	85.6	0.83	15.2
Bran	14.4	5.78	17.5	100.0	1.54	15.6
Straight Grade		0.42	15.0			
Wheat		1.40	15.8			

Glenn Check (M-9)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 R	36.0	0.40	14.5	36.0	0.40	14.5
1 BK	6.0	0.43	16.2	42.1	0.41	14.8
2 R	16.6	0.47	13.7	58.7	0.42	14.5
2 BK	8.0	0.47	19.2	66.7	0.43	15.0
3 R	2.8	0.80	14.2	69.4	0.45	15.0
3 BK	1.7	0.92	23.7	71.2	0.46	15.2
Bran & Shorts:						
Shorts	14.3	2.75	15.9	85.5	0.84	15.3
Bran	14.5	5.44	17.6	100.0	1.51	15.7
Straight Grade		0.47	15.2			
Wheat		1.48	15.9			

WB9590 (M-10)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	9.3	0.38	16.1	9.3	0.38	16.1
1 R	37.7	0.39	14.2	46.9	0.38	14.5
2 BK	8.8	0.41	19.6	55.7	0.39	15.3
2 R	13.6	0.52	13.8	69.3	0.42	15.0
3 BK	1.9	0.88	23.8	71.2	0.43	15.3
3 R	2.2	0.97	14.7	73.4	0.44	15.3
Bran & Shorts:						
Shorts	11.9	3.41	17.1	85.4	0.86	15.5
Bran	14.6	5.58	17.4	100.0	1.55	15.8
Straight Grade		0.46	15.5			
Wheat		1.38	15.7			

Williston (Group W)

WB9719 (W-1)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 R	36.2	0.35	16.1	36.2	0.35	16.1
1 BK	7.2	0.37	19.2	43.4	0.36	16.6
2 BK	10.5	0.37	22.7	53.9	0.36	17.8
2 R	11.6	0.49	15.5	65.5	0.38	17.4
3 BK	2.0	0.59	27.3	67.5	0.39	17.7
3 R	2.1	0.84	16.0	69.6	0.40	17.7
Bran & Shorts:						
Shorts	10.7	2.94	18.6	80.3	0.74	17.8
Bran	19.7	4.68	20.6	100.0	1.51	18.3
Straight Grade		0.42		17.4		
Wheat		1.43		17.9		

WB9616CLP (W-3)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
2 BK	9.6	0.32	23.7	9.6	0.32	23.7
1 BK	8.1	0.34	18.7	17.6	0.33	21.4
1 R	35.6	0.36	17.5	53.2	0.35	18.8
2 R	10.1	0.51	17.5	63.3	0.37	18.6
3 BK	2.4	0.53	28.2	65.7	0.38	18.9
3 R	2.5	0.80	17.8	68.2	0.40	18.9
Bran & Shorts:						
Shorts	10.0	2.75	20.2	78.2	0.70	19.1
Bran	21.8	4.78	22.5	100.0	1.59	19.8
Straight Grade		0.42		18.6		
Wheat		1.49		19.9		

LCS Rebel (W-4)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 BK	7.0	0.35	18.4	7.0	0.35	18.4
1 R	41.0	0.39	17.2	48.0	0.38	17.4
2 BK	10.3	0.40	22.5	58.3	0.39	18.3
2 R	9.4	0.57	16.7	67.7	0.41	18.1
3 BK	1.9	0.61	27.0	69.6	0.42	18.3
3 R	2.1	1.04	17.4	71.7	0.44	18.3
Bran & Shorts:						
Shorts	10.7	3.12	19.5	82.4	0.78	18.4
Bran	17.6	4.86	21.5	100.0	1.50	19.0
Straight Grade		0.42		18.3		
Wheat		1.42		19.2		

SY Rockport (W-6)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
2 BK	10.3	0.41	22.3	10.3	0.41	22.3
1 BK	7.8	0.42	18.5	18.1	0.41	20.6
1 R	36.2	0.43	16.2	54.3	0.42	17.7
2 R	12.3	0.59	15.7	66.6	0.45	17.3
3 BK	2.1	0.64	28.1	68.6	0.46	17.6
3 R	2.2	1.03	16.7	70.8	0.48	17.6
Bran & Shorts:						
Shorts	10.1	2.98	18.8	80.9	0.79	17.7
Bran	19.1	4.79	20.9	100.0	1.55	18.4
Straight Grade		0.47		17.3		
Wheat		1.38		18.5		

WB9479 (W-7)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
2 BK	11.9	0.33	22.5	11.9	0.33	22.5
1 BK	10.5	0.36	18.7	22.4	0.35	20.7
1 R	36.8	0.38	16.3	59.2	0.37	18.0
2 R	7.8	0.57	16.4	67.0	0.39	17.8
3 BK	2.9	0.63	27.7	69.9	0.40	18.2
3 R	1.5	1.05	17.2	71.4	0.42	18.2
Bran & Shorts:						
Shorts	9.2	3.06	19.3	80.7	0.72	18.3
Bran	19.3	4.79	19.9	100.0	1.51	18.6
Straight Grade		0.41		17.9		
Wheat		1.44		18.7		

Glenn Check (W-9)

Mill	Stream (%, 14% mb)			Cumulative (%, 14% mb)		
	Stream	Yield	Ash	Protein	Yield	Ash
Straight Grade:						
1 R	39.8	0.39	16.6	39.8	0.39	16.6
2 BK	9.3	0.40	21.8	49.1	0.39	17.6
1 BK	6.0	0.41	18.2	55.1	0.39	17.7
2 R	11.8	0.52	15.8	66.9	0.41	17.3
3 BK	1.7	0.68	26.2	68.5	0.42	17.6
3 R	2.5	0.88	16.3	71.0	0.44	17.5
Bran & Shorts:						
Shorts	10.9	2.93	17.9	81.9	0.77	17.6
Bran	18.1	4.78	19.8	100.0	1.50	18.0
Straight Grade		0.43		17.4		
Wheat		1.45		18.2		

WB9590 (W-10)

Mill	Stream			Cumulative		
	(% , 14% mb)			(% , 14% mb)		
Stream	Yield	Ash	Protein	Yield	Ash	Protein
Straight Grade:						
1 BK	8.8	0.39	18.8	8.8	0.39	18.8
2 BK	10.8	0.40	22.6	19.6	0.40	20.9
1 R	36.8	0.41	16.9	56.4	0.40	18.3
2 R	10.4	0.54	16.5	66.8	0.42	18.0
3 BK	2.0	0.68	27.8	68.8	0.43	18.3
3 R	1.9	1.02	17.3	70.7	0.45	18.3
Bran & Shorts:						
Shorts	10.1	3.08	19.1	80.8	0.78	18.4
Bran	19.2	4.74	20.2	100.0	1.54	18.7
Straight Grade		0.42	18.1			
Wheat		1.41	18.3			

Cooperators' Bake Data

Glenn Checks

WATERTOWN (B-9)				
Cooperator	Bake Absorption (%)	Loaf Volume (cc)	Mixing Requirement	Dough Characteristics
A	68.0	1170	7	9
B	68.7	933	8	8
C	65.9	1055	5	6
D	59.0	2925	9	9
E	66.5	2125	5	5
F	68.0	1055	7	5
G	62.0	2750	5	5
H	70.2	945	7	7
I	63.0	2956	9	8
J	68.8	892	7	7
K	65.7	2775	9	7
L	64.9	1035	6	8
M	64.3	2948	5	8
Avg.	65.8		6.8	7.1
S.D.	3.1		1.6	1.4

CASSELTON (C-9)				
Cooperator	Bake Absorption (%)	Loaf Volume (cc)	Mixing Requirement	Dough Characteristics
A	70.0	1070	5	7
B	71.4	920	6	7
C	67.7	1038	4	6
D	60.0	2800	4	4
E	69.0	2350	5	5
F	68.0	940	5	5
G	64.0	2700	5	5
H	71.9	970	7	3
I	64.0	2839	9	8
J	71.1	901	4	6
K	67.9	3000	7	7
L	67.6	1040	6	6
M	66.8	2835	5	7
Avg.	67.6		5.5	5.8
S.D.	3.4		1.5	1.4

HAVRE (H-9)				
Cooperator	Bake Absorption (%)	Loaf Volume (cc)	Mixing Requirement	Dough Characteristics
A	71.0	1025	5	7
B	73.0	1040	6	8
C	65.3	986	4	6
D	61.0	2925	9	9
E	66.5	2525	7	5
F	71.0	1120	5	5
G	62.0	2950	5	5
H	70.5	1080	7	7
I	63.0	2927	9	9
J	69.2	908	3	5
K	66.3	2775	9	9
L	69.0	1100	5	6
M	64.5	3093	5	5
Avg.	67.1		6.1	6.6
S.D.	3.8		2.0	1.7

CROOKSTON (K-9)				
Cooperator	Bake Absorption (%)	Loaf Volume (cc)	Mixing Requirement	Dough Characteristics
A	67.0	1040	5	9
B	70.4	908	7	8
C	66.7	1008	5	6
D	58.0	2925	9	9
E	66.5	2075	5	4
F	66.0	910	7	5
G	63.0	2600	5	5
H	68.9	825	7	7
I	63.0	2956	9	8
J	68.5	823	7	6
K	65.7	2600	9	9
L	65.4	1030	6	6
M	64.6	2990	5	6
Avg.	65.7		6.6	6.8
S.D.	3.1		1.6	1.7

MINOT (M-9)				
Cooperator	Bake Absorption (%)	Loaf Volume (cc)	Mixing Requirement	Dough Characteristics
A	72.0	1240	7	7
B	63.0	1063	6	9
C	67.3	1069	4	6
D	61.0	3000	9	9
E	68.5	1975	6	5
F	71.0	1115	5	5
G	65.0	2450	5	5
H	72.2	1070	7	9
I	63.0	2956	9	9
J	69.8	1020	3	8
K	67.0	2875	9	7
L	71.4	1140	6	6
M	66.3	2916	5	6
Avg.	67.5		6.2	7.0
S.D.	3.7		1.9	1.6

WILLISTON (W-9)				
Cooperator	Bake Absorption (%)	Loaf Volume (cc)	Mixing Requirement	Dough Characteristics
A	74.0	1210	7	7
B	74.5	1125	9	8
C	67.1	1040	5	6
D	64.0	2825	9	9
E	68.0	2450	8	8
F	75.0	1215	9	5
G	65.0	3050	5	5
H	73.6	1190	9	9
I	64.0	2809	9	9
J	71.0	1002	7	7
K	68.2	2900	9	9
L	69.9	1260	6	8
M	66.1	3078	5	6
Avg.	69.3		7.5	7.4
S.D.	4.0		1.7	1.5

WB9719

HAVRE (H-1)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	70.0	890	86.8	1	5	3	3	5	5	5	3	3
B	69.5	970	93.3	4	8	4	5	4	4	5	4	4
C	67.9	833	84.5	3	6	6	3	4	5	5	3	4
D	61.0	2925	100.0	9	9	5	5	5	5	5	5	5
E	69.0	2425	96.0	7	5	5	7	5	6	5	7	7
F	71.0	945	84.4	5	3	3	5	5	5	5	3	3
G	65.0	2800	94.9	3	3	3	5	5	4	5	5	5
H	70.3	990	91.7	7	5	3	5	7	5	5	7	5
I	64.0	2986	102.0	9	9	6	5	5	4	5	6	6
J	71.2	844	93.0	1	6	3	5	5	5	6	3	5
K	68.1	2825	101.8	9	9	5	3	5	5	7	5	5
L	71.5	1070	97.3	4	5	3	5	5	5	5	4	4
M	67.0	3118	100.8	5	5	5	5	7	5	5	6	5
Avg.	68.1		94.3	5.2	6.0	4.2	4.7	5.2	4.8	5.2	4.7	4.7
S.D.	3.1		6.2	2.9	2.1	1.2	1.1	0.9	0.6	0.6	1.5	1.1

MINOT (M-1)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	70.0	1165	94.0	3	7	1	5	5	5	3	5	3
B	72.9	1035	97.4	4	7	4	5	5	4	5	5	5
C	68.2	1020	95.4	3	6	3	5	3	4	5	4	4
D	61.0	2825	94.2	9	9	5	5	5	5	5	5	5
E	69.5	2350	119.0	6	5	5	6	6	5	5	8	7
F	70.0	1045	93.7	3	3	1	5	5	3	3	3	1
G	65.0	2500	102.0	2	3	3	6	6	5	3	6	5
H	69.0	985	92.1	5	5	3	5	7	5	3	7	5
I	64.0	2809	95.0	9	8	5	4	4	5	3	4	4
J	71.8	919	90.1	3	3	4	5	5	5	5	2	4
K	68.5	2875	100.0	7	5	5	5	3	5	3	5	5
L	71.8	1050	92.1	4	6	2	5	5	4	4	4	4
M	67.3	2828	97.0	5	5	5	5	5	5	5	5	5
Avg.	68.4		97.1	4.8	5.5	3.5	5.1	4.9	4.6	4.0	4.8	4.4
S.D.	3.4		7.4	2.3	1.9	1.5	0.5	1.1	0.7	1.0	1.6	1.4

WILLISTON (W-1)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	74.0	1130	93.4	7	7	3	5	7	5	3	5	5
B	74.9	1098	97.6	9	9	5	5	6	5	5	6	5
C	68.5	943	90.7	5	6	5	5	5	5	4	5	5
D	63.0	2725	96.5	9	9	5	5	5	5	5	5	5
E	69.5	2350	95.9	8	8	5	5	7	5	5	6	6
F	75.0	1060	87.2	9	3	1	5	5	5	3	3	3
G	66.0	2500	82.0	5	5	5	4	4	5	4	4	4
H	72.5	1120	94.1	9	9	7	5	5	5	5	5	5
I	64.0	2927	104.2	9	9	5	5	5	5	3	6	4
J	72.8	952	95.0	8	5	5	5	5	5	6	4	5
K	69.9	2725	94.0	9	9	5	5	5	5	5	3	3
L	72.3	1185	94.0	6	7	4	5	5	5	4	5	5
M	67.7	3191	103.7	5	4	5	6	4	5	4	6	5
Avg.	70.0		94.5	7.5	6.9	4.6	5.0	5.2	5.0	4.3	4.8	4.6
S.D.	4.0		5.9	1.7	2.1	1.4	0.4	0.9	0.0	0.9	1.1	0.9

SD4465

WATERTOWN (B-2)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	67.0	1030	88.0	5	9	3	5	9	3	7	7	7
B	70.2	965	103.4	7	8	5	5	6	5	6	5	5
C	65.0	878	83.2	5	6	4	7	7	4	4	4	5
D	59.0	2900	99.1	9	9	5	5	5	5	5	5	5
E	65.5	2000	94.1	5	4	5	6	6	6	4	4	4
F	67.0	910	86.3	5	7	7	5	3	3	7	3	3
G	61.0	2600	94.5	4	4	4	5	5	4	7	5	5
H	67.6	930	98.4	7	7	7	5	7	5	7	7	7
I	62.0	2986	101.0	9	9	6	5	5	3	7	5	6
J	67.2	896	100.4	8	6	4	5	5	4	5	5	5
K	64.1	2925	105.4	7	5	3	5	5	3	7	5	5
L	64.3	1030	99.5	5	6	4	5	5	4	7	5	4
M	63.3	2794	94.8	7	7	8	4	5	4	7	7	6
Avg.	64.9		96.0	6.4	6.7	5.0	5.2	5.6	4.1	6.2	5.2	5.2
S.D.	3.1		6.7	1.7	1.8	1.6	0.7	1.4	1.0	1.2	1.2	1.1

CASSELTON (C-2)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	66.5	915	85.5	3	5	3	5	5	3	5	5	5
B	68.0	985	107.1	4	7	4	5	5	4	5	5	5
C	65.4	860	82.9	3	5	4	5	6	4	4	5	4
D	59.0	3000	107.1	4	4	5	5	5	5	5	5	5
E	66.5	2350	100.0	5	4	4	7	6	7	4	4	4
F	67.0	920	97.9	5	5	3	3	5	3	7	5	5
G	62.0	2600	96.3	4	4	4	4	4	3	5	4	4
H	67.6	915	94.3	5	5	3	5	9	3	7	9	7
I	62.0	2897	102.0	9	7	5	5	4	3	4	4	4
J	68.3	849	94.2	3	5	4	6	6	4	2	4	3
K	65.1	2900	96.7	7	5	3	5	3	1	7	5	7
L	65.6	965	92.8	4	4	3	3	5	3	5	3	2
M	64.5	2780	98.1	5	6	4	5	5	4	5	5	4
Avg.	65.2		96.5	4.7	5.1	3.8	4.8	5.2	3.6	5.0	4.8	4.5
S.D.	2.7		7.1	1.7	1.0	0.7	1.1	1.4	1.4	1.4	1.4	1.4

CROOKSTON (K-2)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	63.5	970	93.3	5	3	5	3	5	3	5	5	5
B	67.0	880	96.9	4	7	5	5	6	5	6	5	5
C	63.9	840	83.3	4	6	3	5	6	4	4	4	4
D	57.0	2825	96.6	5	5	3	5	6	5	5	4	4
E	64.0	2300	110.8	5	3	5	5	6	5	4	4	4
F	64.0	845	92.9	3	7	3	5	3	3	5	5	3
G	60.0	2450	94.2	2	2	2	3	3	4	6	3	3
H	66.9	870	105.5	5	5	3	5	7	3	7	9	7
I	61.0	2897	98.0	8	5	3	5	5	4	6	4	5
J	66.7	816	99.1	3	5	4	5	7	4	1	4	3
K	63.6	2750	105.8	7	7	5	5	7	3	7	7	7
L	62.6	935	90.8	4	4	3	3	5	4	5	3	3
M	62.2	2786	93.2	5	6	5	6	4	4	7	4	4
Avg.	63.3		97.0	4.6	5.0	3.8	4.6	5.4	3.9	5.2	4.7	4.4
S.D.	2.8		7.2	1.6	1.6	1.1	1.0	1.4	0.8	1.6	1.7	1.4

WB9616CLP

HAVRE (H-3)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	70.0	970	94.6	5	7	9	5	3	7	3	5	5
B	71.8	1135	109.1	6	9	5	6	3	5	5	5	5
C	64.6	888	90.1	4	6	5	5	3	7	5	4	5
D	62.0	3000	102.6	9	9	5	5	5	6	5	5	5
E	66.0	2925	115.8	8	7	7	5	5	3	3	3	3
F	73.0	1035	92.4	9	3	1	5	7	7	5	5	5
G	62.0	2700	91.5	9	6	7	5	5	7	4	5	5
H	71.0	1120	103.7	7	9	5	5	5	7	3	5	5
I	62.0	3045	104.0	9	9	5	5	5	7	5	6	5
J	68.1	958	105.5	5	6	5	5	3	6	1	6	4
K	65.1	2900	104.5	9	9	5	5	5	9	5	5	3
L	68.8	1190	108.2	4	6	7	6	6	7	4	7	7
M	63.9	3467	112.1	9	7	9	6	5	7	4	7	6
Avg.	66.8		102.6	7.2	7.2	5.8	5.2	4.6	6.5	4.0	5.2	4.8
S.D.	3.9		8.2	2.1	1.8	2.1	0.4	1.3	1.4	1.2	1.1	1.1

WILLISTON (W-3)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	75.5	950	78.5	7	7	1	5	1	7	1	1	1
B	78.7	1173	104.3	9	9	5	6	6	5	4	6	5
C	66.6	863	83.0	4	6	4	5	2	3	5	3	3
D	65.0	2725	96.5	9	9	5	5	5	5	5	5	5
E	68.0	2500	102.0	9	9	6	7	7	3	4	4	3
F	77.0	970	79.8	9	5	5	5	5	7	3	1	3
G	65.0	2500	82.0	5	5	5	3	3	5	4	3	4
H	73.5	1165	97.9	7	9	5	5	7	7	3	5	5
I	63.0	2809	100.0	9	9	5	5	5	8	2	5	3
J	70.3	1035	103.3	6	5	5	6	5	6	6	5	6
K	67.3	2575	88.8	9	7	5	7	7	9	3	3	3
L	71.7	1260	100.0	5	6	4	8	6	7	3	6	6
M	66.1	3078	100.0	5	5	5	6	5	6	4	5	6
Avg.	69.8		93.5	7.2	7.0	4.6	5.6	4.9	6.0	3.6	4.0	4.1
S.D.	5.1		9.6	2.0	1.8	1.2	1.3	1.9	1.8	1.3	1.7	1.6

LCS Rebel

WATERTOWN (B-4)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	68.0	975	83.3	5	5	3	5	7	5	7	5	5
B	70.8	988	105.9	7	8	5	5	6	5	6	6	6
C	67.4	983	93.2	5	6	4	4	6	5	5	5	5
D	59.0	2925	100.0	9	9	5	5	5	5	5	5	5
E	67.0	1975	92.9	5	5	5	5	4	5	3	4	4
F	67.0	970	91.9	5	7	9	5	3	5	7	5	7
G	63.0	2800	101.8	4	4	4	6	6	5	7	6	6
H	69.9	965	102.1	7	7	7	5	5	5	7	5	5
I	63.0	2927	99.0	9	8	5	5	5	4	8	5	5
J	68.5	909	101.9	6	7	5	5	5	5	7	5	6
K	65.4	2800	100.9	9	7	5	5	3	5	7	5	5
L	66.2	1060	102.4	5	7	4	3	5	5	7	4	4
M	65.0	2847	96.6	6	7	6	5	5	5	7	4	6
Avg.	66.2		97.8	6.3	6.7	5.2	4.8	5.0	4.9	6.4	4.9	5.3
S.D.	3.2		6.1	1.8	1.4	1.5	0.7	1.2	0.3	1.3	0.6	0.9

CASSELTON (C-4)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	67.0	975	91.1	5	9	3	5	5	3	7	5	5
B	70.5	983	106.8	5	7	5	5	6	5	6	7	6
C	67.5	1023	98.6	4	5	5	5	5	4	5	5	5
D	59.0	3000	107.1	6	6	7	5	5	5	5	6	6
E	67.0	2250	95.7	5	5	5	5	5	7	5	5	5
F	67.0	935	99.5	3	5	5	3	5	3	7	5	5
G	63.0	2650	98.1	5	5	5	5	5	3	8	5	5
H	68.7	910	93.8	7	5	3	5	5	3	7	5	5
I	62.0	2927	103.1	9	9	6	5	5	3	7	5	4
J	68.3	896	99.4	3	7	5	5	5	4	5	5	5
K	65.4	2825	94.2	9	7	7	5	5	1	9	7	9
L	66.0	950	91.3	5	6	5	5	3	3	6	4	3
M	64.9	2840	100.2	5	6	5	5	4	3	7	5	5
Avg.	65.9		98.4	5.5	6.3	5.1	4.8	4.8	3.6	6.5	5.3	5.2
S.D.	3.1		5.2	1.9	1.4	1.2	0.6	0.7	1.4	1.3	0.9	1.4

HAVRE (H-4)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	71.0	1190	116.1	5	7	9	7	5	5	7	7	7
B	73.5	980	94.2	7	8	4	5	5	5	6	5	5
C	67.1	978	99.2	4	6	7	5	4	5	5	5	5
D	61.0	3050	104.3	9	9	5	5	5	5	5	5	5
E	67.5	2300	91.1	7	5	5	5	5	5	5	6	6
F	70.0	1050	93.8	7	5	9	5	7	3	7	5	5
G	63.0	2500	84.7	3	3	3	4	4	5	7	4	4
H	71.3	1040	96.3	7	7	3	5	5	5	7	5	5
I	63.0	3045	104.0	9	9	5	5	5	4	7	6	7
J	70.0	908	100.0	4	6	3	5	3	5	8	4	6
K	67.0	2725	98.2	9	9	5	7	9	5	7	9	9
L	69.4	1065	96.8	5	8	4	5	5	5	6	4	4
M	65.6	3116	100.7	5	6	5	6	6	5	6	7	6
Avg.	67.6		98.4	6.2	6.8	5.2	5.3	5.2	4.8	6.4	5.5	5.7
S.D.	3.7		7.5	2.0	1.8	2.0	0.9	1.5	0.6	1.0	1.5	1.4

CROOKSTON (K-4)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	64.0	1000	96.2	5	3	5	3	5	3	9	5	5
B	69.0	885	97.5	5	8	5	5	6	4	8	5	6
C	65.5	968	96.0	5	6	5	4	4	4	6	5	5
D	57.0	2925	100.0	9	9	5	5	4	5	5	5	5
E	65.5	2075	100.0	5	5	5	5	5	5	5	5	5
F	64.0	920	101.1	3	7	7	5	5	3	9	5	7
G	61.0	2750	105.8	4	4	4	6	7	4	9	7	7
H	68.2	830	100.6	7	5	3	5	9	3	7	3	5
I	62.0	2956	100.0	9	8	5	5	4	3	9	5	4
J	67.5	829	100.7	3	7	5	5	7	4	9	5	6
K	64.7	2700	103.8	7	7	5	5	7	1	9	5	7
L	64.1	995	96.6	4	6	4	5	5	4	7	4	4
M	63.4	2750	92.0	5	6	5	5	5	4	9	5	5
Avg.	64.3		99.3	5.5	6.2	4.8	4.8	5.6	3.6	7.8	4.9	5.5
S.D.	3.2		3.6	2.0	1.7	0.9	0.7	1.5	1.0	1.6	0.9	1.1

MINOT (M-4)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	70.0	1255	101.2	5	7	3	5	5	3	7	5	5
B	72.6	1018	95.8	7	7	4	5	5	5	7	5	6
C	66.3	1128	105.5	5	6	4	5	6	3	5	6	5
D	60.0	2975	99.2	9	9	5	5	5	5	5	5	5
E	66.5	2275	115.2	7	6	6	6	6	6	6	7	6
F	69.0	1060	95.1	5	7	5	5	5	3	7	3	3
G	63.0	2550	104.1	4	4	4	6	6	3	7	6	6
H	70.0	1000	93.5	7	9	5	5	7	3	7	7	7
I	62.0	2956	100.0	9	9	5	5	5	3	7	5	6
J	68.9	953	93.4	4	7	4	6	6	4	3	5	4
K	65.8	2750	95.7	9	7	5	7	5	1	7	5	7
L	70.4	1050	92.1	7	6	3	4	4	3	6	3	3
M	64.7	3065	105.1	5	6	6	7	7	4	7	4	6
Avg.	66.9		99.7	6.4	6.9	4.5	5.5	5.5	3.5	6.2	5.1	5.3
S.D.	3.7		6.5	1.9	1.4	1.0	0.9	0.9	1.3	1.2	1.3	1.3

WILLISTON (W-4)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	76.5	1245	102.9	9	9	5	7	5	7	5	5	5
B	76.7	1018	90.5	9	9	5	4	4	5	5	4	5
C	68.8	1103	106.1	6	6	6	5	3	4	5	5	5
D	65.0	2925	103.5	9	9	5	5	5	5	5	5	5
E	69.5	2175	88.8	9	9	7	5	6	4	4	5	4
F	76.0	1160	95.5	9	3	3	5	5	7	5	5	5
G	65.0	2200	72.1	6	6	5	3	3	5	5	3	4
H	75.8	1010	84.9	9	9	7	5	5	7	5	5	7
I	64.0	2986	106.3	9	9	5	5	5	7	5	6	5
J	71.3	1078	107.6	9	6	5	5	5	6	4	6	5
K	68.5	2650	91.4	9	9	5	5	5	9	7	3	3
L	72.0	1265	100.4	7	8	7	5	3	7	5	5	6
M	67.4	3103	100.8	5	6	5	6	5	6	5	6	5
Avg.	70.5		96.2	8.1	7.5	5.4	5.0	4.5	6.1	5.0	4.8	4.9
S.D.	4.6		10.3	1.5	1.9	1.1	0.9	1.0	1.4	0.7	1.0	1.0

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CASSELTON (C-5)													
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)									
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall	
A	67.0	1075	100.5	5	7	7	5	7	5	5	7	7	7
B	71.4	965	104.9	6	8	5	5	5	5	5	6	5	5
C	63.4	918	88.4	5	6	6	5	7	5	3	5	4	4
D	59.0	3000	107.1	9	9	9	5	5	5	5	7	7	7
E	63.5	2350	100.0	5	7	6	6	6	5	3	3	3	3
F	68.0	940	100.0	7	3	1	3	5	5	7	5	5	5
G	60.0	2700	100.0	6	6	6	6	6	4	5	6	6	6
H	69.3	935	96.4	7	9	3	5	7	5	7	7	7	7
I	60.0	3015	106.2	9	9	6	5	5	4	4	4	4	4
J	65.5	899	99.8	5	6	5	5	3	5	1	5	4	4
K	62.6	2850	95.0	9	7	5	9	7	3	7	7	7	7
L	62.4	995	95.7	5	6	6	5	5	5	5	5	5	5
M	61.6	2962	104.5	7	7	7	6	6	5	6	4	6	6
Avg.	64.1		99.9	6.5	6.9	5.5	5.4	5.7	4.7	4.8	5.5	5.4	5.4
S.D.	3.8		5.2	1.6	1.7	1.9	1.3	1.2	0.6	1.8	1.3	1.4	1.4

HAVRE (H-5)													
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)									
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall	
A	69.0	1150	112.2	5	9	7	9	5	7	5	7	7	7
B	73.2	978	94.0	6	9	5	5	5	5	5	5	5	5
C	63.4	983	99.7	4	6	4	5	5	6	4	5	5	5
D	62.0	3000	102.6	9	9	5	5	5	6	5	5	5	5
E	64.0	2500	99.0	7	6	6	7	5	3	4	3	3	3
F	72.0	1100	98.2	9	3	3	5	7	5	5	5	5	5
G	60.0	2950	100.0	9	7	8	5	5	6	4	5	5	5
H	70.7	1030	95.4	7	7	5	5	5	7	5	5	5	5
I	62.0	3015	103.0	9	9	5	5	5	7	5	4	6	6
J	67.5	949	104.5	3	6	6	6	4	5	5	6	5	5
K	64.3	3000	108.1	9	9	5	5	9	7	3	7	7	7
L	67.4	1045	95.0	5	7	8	3	3	6	4	3	4	4
M	62.1	3193	103.2	5	6	6	5	5	6	4	6	5	5
Avg.	66.0		101.2	6.7	7.2	5.6	5.4	5.2	5.8	4.5	5.1	5.2	5.2
S.D.	4.3		5.2	2.2	1.8	1.4	1.4	1.4	1.1	0.7	1.3	1.1	1.1

CROOKSTON (K-5)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	62.0	950	91.3	5	9	9	5	7	3	7	7	7
B	65.5	818	90.1	6	8	5	5	6	5	6	5	5
C	61.9	870	86.3	6	6	4	5	4	3	4	4	4
D	57.0	3000	102.6	9	9	5	5	4	5	5	5	5
E	61.5	2200	106.0	4	5	4	6	5	5	4	4	4
F	64.0	895	98.4	7	1	3	5	3	3	7	5	5
G	58.0	2450	94.2	3	3	3	3	4	3	8	4	4
H	64.8	795	96.4	7	5	3	5	5	3	7	3	5
I	58.0	2986	101.0	9	8	5	5	4	3	8	3	4
J	63.9	820	99.6	4	7	5	5	6	3	4	5	4
K	60.9	2500	96.2	9	9	5	7	7	1	7	5	7
L	60.4	980	95.1	5	6	4	5	5	2	6	5	3
M	59.7	2826	94.5	5	7	6	5	4	3	8	3	4
Avg.	61.4		96.3	6.1	6.4	4.7	5.1	4.9	3.2	6.2	4.5	4.7
S.D.	2.7		5.3	2.0	2.4	1.6	0.9	1.3	1.2	1.5	1.1	1.2

SY Rockford

HAVRE (H-6)													
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)									
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall	
A	70.5	1030	100.5	5	5	7	3	3	5	5	5	5	5
B	73.1	958	92.1	4	7	5	5	5	4	6	4	4	4
C	67.2	913	92.6	3	6	5	3	3	4	4	4	4	4
D	61.0	2875	98.3	5	5	3	5	5	5	5	4	4	4
E	68.0	2350	93.1	7	5	5	5	5	6	3	6	5	5
F	70.0	990	88.4	3	5	5	5	5	3	5	3	3	3
G	63.0	3000	101.7	4	4	4	6	6	3	5	6	6	6
H	69.6	975	90.3	5	5	3	5	7	3	5	5	5	5
I	64.0	2986	102.0	9	8	6	5	5	3	6	6	5	5
J	71.1	877	96.6	1	5	4	5	4	5	4	2	4	4
K	68.3	2900	104.5	7	7	3	5	7	1	7	7	7	7
L	71.6	1040	94.5	4	4	4	3	4	4	5	4	4	4
M	66.2	3333	107.8	5	5	5	7	7	5	5	6	6	6
Avg.	68.0		97.1	4.8	5.5	4.5	4.8	5.1	3.9	5.0	4.8	4.8	4.8
S.D.	3.6		5.9	2.0	1.2	1.2	1.2	1.4	1.3	1.0	1.4	1.1	1.1

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MINOT (M-6)													
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)									
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall	
A	70.0	1075	86.7	3	5	1	7	7	1	7	5	5	5
B	72.3	1010	95.0	5	7	4	5	4	5	7	5	6	6
C	67.8	1053	98.5	3	6	3	5	5	3	5	5	4	4
D	60.0	2925	97.5	9	9	5	5	5	5	5	5	5	5
E	69.0	2300	116.5	5	5	4	7	7	6	5	8	7	7
F	68.0	1055	94.6	3	7	3	5	5	1	7	3	3	3
G	65.0	2500	102.0	3	3	3	6	6	3	7	6	6	6
H	71.8	985	92.1	7	5	3	5	9	3	7	9	7	7
I	64.0	2956	100.0	9	8	5	5	4	3	7	5	6	6
J	71.1	884	86.7	2	6	4	6	5	4	3	3	3	3
K	68.1	2925	101.7	7	7	5	5	5	1	5	7	7	7
L	73.1	1020	89.5	4	5	2	3	4	3	6	3	2	2
M	67.1	3056	104.8	5	5	5	6	7	4	7	5	5	5
Avg.	68.3		97.4	5.0	6.0	3.6	5.4	5.6	3.2	6.0	5.3	5.1	5.1
S.D.	3.7		8.2	2.3	1.6	1.3	1.0	1.5	1.6	1.3	1.8	1.7	1.7

WILLISTON (W-6)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	74.5	1140	94.2	7	7	3	5	1	5	5	3	5
B	75.1	1088	96.7	6	8	5	5	6	5	5	6	5
C	68.9	1020	98.1	4	6	4	3	3	4	5	3	3
D	64.0	2975	105.3	9	9	5	5	5	5	5	5	5
E	70.0	2300	93.9	8	7	4	7	6	4	5	6	5
F	74.0	1120	92.2	7	5	5	5	5	5	5	5	5
G	66.0	3000	98.4	4	4	5	6	6	5	5	6	6
H	71.7	1180	99.2	7	9	3	5	7	5	5	5	5
I	65.0	2956	105.2	9	9	5	5	5	6	5	7	6
J	73.1	1031	102.9	3	6	4	5	5	5	7	3	5
K	70.2	2850	98.3	9	7	3	5	5	5	5	5	5
L	73.6	1245	98.8	5	6	3	6	4	6	5	4	5
M	68.2	3021	98.1	5	5	5	5	6	6	5	5	6
Avg.	70.3		98.6	6.4	6.8	4.2	5.2	4.9	5.1	5.2	4.8	5.1
S.D.	3.7		4.0	2.1	1.6	0.9	0.9	1.6	0.6	0.6	1.3	0.8

WB9479

WATERTOWN (B-7)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	68.5	1125	96.2	7	7	5	7	7	7	7	7	7
B	72.3	958	102.7	7	8	5	5	5	5	5	5	5
C	64.2	1025	97.2	5	6	4	4	5	6	5	5	5
D	60.0	2925	100.0	9	9	5	5	5	5	5	5	5
E	65.0	2250	105.9	5	5	5	8	5	4	3	4	4
F	69.0	995	94.3	9	5	5	5	3	7	7	5	7
G	61.0	2800	101.8	3	3	3	6	6	6	7	6	6
H	69.9	965	102.1	9	7	7	5	7	7	7	7	7
I	61.0	2839	96.0	9	9	6	5	5	7	7	4	3
J	67.1	925	103.7	5	7	4	5	5	6	4	5	5
K	63.9	2775	100.0	9	7	5	7	5	7	7	5	5
L	63.8	1040	100.5	5	6	3	5	6	6	6	6	6
M	62.9	2927	99.3	5	8	8	5	5	6	6	5	7
Avg.	65.3		100.0	6.7	6.7	5.0	5.5	5.3	6.1	5.8	5.3	5.5
S.D.	3.8		3.4	2.1	1.7	1.4	1.1	1.0	1.0	1.3	0.9	1.3

CASSELTON (C-7)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	67.0	1045	97.7	5	7	7	5	9	3	7	7	7
B	70.6	893	97.1	7	8	5	5	6	5	6	5	5
C	63.8	938	90.4	4	6	7	5	4	4	4	5	4
D	59.0	3000	107.1	9	9	9	5	5	5	5	7	7
E	64.5	2400	102.1	5	4	7	7	6	7	5	3	4
F	67.0	965	102.7	7	3	3	5	5	5	7	5	7
G	60.0	2700	100.0	7	7	7	5	5	4	7	5	5
H	68.5	905	93.3	7	7	5	5	9	3	7	7	7
I	61.0	3015	106.2	9	9	6	5	5	4	7	4	4
J	66.4	868	96.3	3	6	5	5	3	4	3	3	3
K	63.6	3000	100.0	7	7	5	7	5	3	9	5	5
L	63.1	1015	97.6	5	6	7	5	5	3	6	6	4
M	62.4	2736	96.5	5	7	7	5	5	5	7	4	5
Avg.	64.4		99.0	6.2	6.6	6.2	5.3	5.5	4.2	6.2	5.1	5.2
S.D.	3.4		4.8	1.8	1.7	1.5	0.8	1.7	1.2	1.6	1.4	1.4

CROOKSTON (K-7)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	64.0	960	92.3	7	9	9	5	7	3	7	7	7
B	66.1	798	87.9	8	8	5	5	5	5	7	4	5
C	62.4	925	91.8	5	6	5	4	5	4	4	5	4
D	57.0	2875	98.3	8	8	5	5	4	5	5	5	5
E	62.5	2150	103.6	5	5	5	5	4	5	5	6	6
F	64.0	880	96.7	9	3	5	5	5	3	9	5	7
G	60.0	2450	94.2	5	5	5	3	4	4	9	4	4
H	66.1	790	95.8	7	7	3	5	7	3	7	7	7
I	60.0	2927	99.0	9	9	6	5	5	3	8	4	3
J	65.4	812	98.7	6	7	5	5	6	4	8	5	6
K	62.2	2825	108.7	9	9	5	7	5	3	7	7	7
L	61.4	985	95.6	6	6	5	6	5	3	6	5	4
M	60.7	2845	95.2	5	7	6	5	5	4	8	3	5
Avg.	62.4		96.7	6.8	6.8	5.3	5.0	5.2	3.8	6.9	5.2	5.4
S.D.	2.7		5.3	1.6	1.8	1.3	0.9	1.0	0.8	1.6	1.3	1.4

MINOT (M-7)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	71.0	1195	96.4	7	7	3	7	7	5	7	7	7
B	71.4	983	92.5	8	8	5	5	4	5	6	4	5
C	64.6	1008	94.3	5	6	5	5	4	5	6	5	5
D	61.0	2800	93.3	9	9	5	5	5	5	5	5	5
E	65.5	2325	117.7	7	5	5	5	5	5	5	4	5
F	70.0	1055	94.6	9	3	5	5	5	3	7	3	3
G	62.0	2100	85.7	5	5	5	6	6	5	8	6	7
H	71.1	915	85.5	7	7	5	5	5	5	7	5	7
I	62.0	2986	101.0	9	9	5	5	5	5	8	5	6
J	67.5	932	91.4	5	7	5	6	5	5	2	5	4
K	64.6	2625	91.3	9	9	7	5	3	5	9	3	3
L	69.4	1020	89.5	5	6	4	5	3	5	6	3	4
M	63.5	3112	106.7	5	5	5	5	6	5	8	5	6
Avg.	66.4		95.4	6.9	6.6	4.9	5.3	4.8	4.8	6.5	4.6	5.2
S.D.	3.8		8.8	1.8	1.9	0.9	0.6	1.1	0.6	1.8	1.2	1.4

WILLISTON (W-7)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	75.5	1190	98.3	9	7	5	5	5	5	5	5	5
B	75.9	1050	93.3	9	8	5	5	5	5	5	4	5
C	67.5	980	94.2	5	6	5	5	4	4	5	5	5
D	65.0	3000	106.2	9	9	5	5	5	5	5	5	5
E	68.5	2400	98.0	9	8	5	6	7	4	5	6	5
F	76.0	1055	86.8	9	3	1	5	5	5	5	3	3
G	65.0	2900	95.1	5	5	5	6	6	5	6	6	6
H	72.6	1145	96.2	9	9	5	5	7	7	5	7	7
I	64.0	2986	106.3	9	9	5	5	5	6	6	6	6
J	71.2	972	97.0	9	7	5	5	5	5	6	5	5
K	68.4	2850	98.3	9	9	5	5	5	7	5	5	5
L	70.1	1220	96.8	5	7	4	6	6	6	5	6	6
M	66.6	3017	98.0	5	5	5	5	7	6	5	5	5
Avg.	69.7		97.3	7.8	7.1	4.6	5.2	5.5	5.4	5.2	5.2	5.2
S.D.	4.3		5.0	1.9	1.9	1.1	0.4	1.0	1.0	0.4	1.0	0.9

SD4579

WATERTOWN (B-8)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	66.5	950	81.2	3	5	1	5	5	5	9	3	3
B	68.4	1000	107.2	5	7	4	6	5	4	7	5	5
C	62.6	835	79.1	3	5	3	5	3	5	6	3	3
D	60.0	2625	89.7	3	3	2	3	4	5	3	3	3
E	63.5	2400	112.9	5	4	5	5	7	5	4	4	4
F	68.0	880	83.4	3	1	1	5	3	5	9	3	5
G	60.0	2550	92.7	3	3	3	4	4	5	8	4	4
H	66.9	940	99.5	5	7	3	5	7	7	7	7	7
I	60.0	2809	95.0	7	4	2	5	3	5	9	3	3
J	65.5	905	101.5	2	4	3	6	6	5	4	3	4
K	62.7	2750	99.1	5	5	3	3	3	5	9	3	3
L	62.4	1000	96.6	4	4	3	6	5	5	7	5	6
M	61.6	2863	97.1	5	4	4	5	6	5	8	5	7
Avg.	63.7		95.0	4.1	4.3	2.8	4.8	4.7	5.1	6.9	3.9	4.4
S.D.	3.0		9.9	1.4	1.6	1.1	1.0	1.5	0.6	2.1	1.3	1.5

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CASSELTON (C-8)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	65.5	875	81.8	3	1	3	3	3	3	9	3	3
B	67.4	953	103.6	3	7	4	5	6	4	8	6	6
C	62.8	788	75.9	3	5	4	3	2	4	6	3	3
D	59.0	2600	92.9	2	2	2	5	5	3	3	2	2
E	63.5	2500	106.4	5	4	5	8	9	7	3	2	3
F	66.0	840	89.4	3	1	1	5	3	3	9	1	3
G	60.0	2700	100.0	4	4	5	4	4	3	9	4	4
H	68.4	910	93.8	5	3	3	5	5	3	7	7	7
I	60.0	2750	96.9	2	3	2	4	3	3	8	1	1
J	65.5	829	92.0	2	3	5	6	5	3	1	2	2
K	62.3	2800	93.3	5	3	3	3	3	1	9	3	3
L	62.1	1050	101.0	3	4	3	6	8	3	7	7	6
M	61.3	2632	92.8	5	4	5	5	4	4	8	4	5
Avg.	63.4		93.8	3.5	3.4	3.5	4.8	4.6	3.4	6.7	3.5	3.7
S.D.	3.0		8.4	1.2	1.6	1.3	1.4	2.1	1.3	2.7	2.1	1.8

CROOKSTON (K-8)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	60.5	825	79.3	3	3	5	3	3	1	9	3	3
B	63.9	873	96.1	4	7	4	5	6	4	8	4	5
C	61.2	755	74.9	3	5	3	4	3	2	6	3	3
D	57.0	2675	91.5	3	3	2	5	5	4	5	2	2
E	60.5	2300	110.8	4	5	5	7	7	5	5	4	4
F	63.0	760	83.5	3	1	1	5	3	1	9	1	3
G	58.0	2350	90.4	2	2	1	6	6	2	9	6	6
H	63.2	770	93.3	5	5	3	5	7	3	9	9	7
I	58.0	2780	94.0	1	5	1	5	3	2	8	1	1
J	62.7	739	89.8	2	4	3	6	7	2	1	4	2
K	59.8	2725	104.8	3	3	3	5	7	1	9	3	3
L	59.0	920	89.3	4	4	3	6	6	1	7	4	3
M	58.5	2652	88.7	5	4	4	6	4	2	9	2	4
Avg.	60.4		91.3	3.2	3.9	2.9	5.2	5.2	2.3	7.2	3.5	3.5
S.D.	2.3		9.5	1.2	1.6	1.4	1.0	1.7	1.3	2.4	2.1	1.7

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WATERTOWN (B-10)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	69.0	1065	91.0	7	7	5	5	9	7	5	7	7
B	69.6	968	103.8	7	8	5	4	5	5	5	5	5
C	64.3	970	91.9	5	6	7	5	4	6	5	5	5
D	60.0	3100	106.0	9	9	5	5	5	5	5	5	5
E	65.5	2250	105.9	5	4	6	5	4	4	3	4	4
F	69.0	955	90.5	7	3	7	5	5	5	5	3	3
G	61.0	2550	92.7	7	7	7	4	4	6	5	4	4
H	69.5	955	101.1	7	5	7	5	7	7	5	7	7
I	62.0	2897	98.0	9	8	5	5	5	7	5	4	5
J	67.9	869	97.4	3	7	5	5	5	6	2	2	3
K	64.7	3000	108.1	9	9	5	3	3	7	7	5	5
L	64.1	1050	101.4	4	7	6	3	3	6	5	4	5
M	63.4	2927	99.3	7	7	7	5	5	6	5	7	6
Avg.	65.4		99.0	6.6	6.7	5.9	4.5	4.9	5.9	4.8	4.8	4.9
S.D.	3.3		6.1	1.9	1.8	1.0	0.8	1.6	1.0	1.2	1.5	1.3

CASSELTON (C-10)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	68.0	885	82.7	3	9	3	3	3	5	5	5	5
B	70.5	928	100.9	5	7	5	5	5	5	5	5	5
C	66.1	923	88.9	4	5	4	5	3	5	4	4	4
D	59.0	2725	97.3	4	4	5	5	5	5	5	5	5
E	67.0	2300	97.9	5	4	4	5	5	6	5	4	4
F	68.0	860	91.5	5	3	5	3	3	5	5	1	3
G	63.0	2700	100.0	4	4	4	5	5	4	8	5	5
H	71.9	970	100.0	5	5	5	5	7	3	7	7	7
I	63.0	2780	97.9	9	7	5	5	4	4	6	4	4
J	69.0	809	89.8	1	5	5	5	5	5	5	2	4
K	66.2	2725	90.8	5	5	3	3	3	3	7	1	1
L	65.9	990	95.2	4	4	3	5	8	4	6	6	4
M	65.1	2652	93.5	5	5	5	6	6	5	5	5	5
Avg.	66.4		94.3	4.5	5.2	4.3	4.6	4.8	4.5	5.6	4.2	4.3
S.D.	3.4		5.4	1.8	1.6	0.9	1.0	1.6	0.9	1.1	1.8	1.4

HAVRE (H-10)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	71.0	1010	98.5	5	3	5	3	5	7	3	3	3
B	73.9	1010	97.1	4	7	5	5	4	4	5	4	4
C	66.2	900	91.3	3	5	5	5	3	6	4	4	5
D	62.0	3000	102.6	9	9	5	5	5	6	5	5	5
E	67.5	2475	98.0	7	5	5	5	5	3	4	6	5
F	72.0	995	88.8	5	3	3	5	5	5	5	3	3
G	63.0	2200	74.6	4	4	4	4	4	6	3	4	4
H	70.4	970	89.8	5	5	3	5	5	7	3	5	5
I	63.0	2956	101.0	9	9	5	5	5	7	4	6	5
J	70.2	876	96.5	1	5	4	5	5	6	6	3	5
K	67.1	2700	97.3	9	9	5	5	7	7	3	7	5
L	71.0	1020	92.7	4	6	4	5	5	6	4	5	5
M	65.5	3013	97.4	5	5	5	6	4	7	4	7	6
Avg.	67.9		94.3	5.4	5.8	4.5	4.8	4.8	5.9	4.1	4.8	4.6
S.D.	3.8		7.2	2.5	2.1	0.8	0.7	0.9	1.3	1.0	1.4	0.9

CROOKSTON (K-10)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	64.0	950	91.3	5	7	7	3	5	5	7	7	7
B	66.5	880	96.9	5	7	5	5	6	5	8	5	6
C	63.0	888	88.1	4	5	5	5	4	4	5	4	4
D	58.0	2800	95.7	5	5	4	5	5	5	5	4	4
E	63.0	2150	103.6	5	5	5	5	4	5	5	5	5
F	65.0	895	98.4	7	3	3	5	5	3	7	5	5
G	60.0	2600	100.0	5	5	5	5	5	4	8	5	5
H	67.0	785	95.2	7	5	3	5	9	3	7	7	7
I	60.0	2927	99.0	9	9	6	5	4	4	9	4	4
J	65.0	788	95.7	4	5	5	5	6	4	9	4	6
K	62.1	2700	103.8	9	7	5	5	5	3	9	5	7
L	61.6	1015	98.5	4	4	5	5	7	4	6	6	5
M	60.9	2868	95.9	6	6	6	6	5	4	7	4	5
Avg.	62.8		97.1	5.8	5.6	4.9	4.9	5.4	4.1	7.1	5.0	5.4
S.D.	2.7		4.3	1.7	1.6	1.1	0.6	1.4	0.8	1.5	1.1	1.1

MINOT (M-10)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	71.5	1090	87.9	5	5	3	5	3	5	7	3	5
B	72.2	1000	94.1	7	7	4	6	6	5	5	4	5
C	66.1	993	92.9	4	6	4	5	5	5	5	4	5
D	61.0	2725	90.8	9	9	5	5	5	5	5	5	5
E	67.0	2375	120.3	6	5	5	5	8	5	5	7	7
F	71.0	1040	93.3	5	3	1	5	3	5	7	3	5
G	63.0	2450	100.0	4	4	4	4	4	5	6	4	4
H	69.9	995	93.0	7	9	5	5	5	5	7	5	7
I	62.0	2986	101.0	9	9	5	5	5	5	6	5	5
J	69.2	888	87.1	7	5	4	6	6	5	3	4	4
K	66.1	2775	96.5	9	7	3	7	5	5	9	5	5
L	72.1	1040	91.2	5	6	3	4	3	5	6	4	4
M	65.1	3252	111.5	5	6	6	6	6	5	7	4	7
Avg.	67.4		96.9	6.3	6.2	4.0	5.2	4.9	5.0	6.0	4.4	5.2
S.D.	3.9		9.5	1.8	1.9	1.3	0.8	1.4	0.0	1.5	1.0	1.1

WILLISTON (W-10)												
Cooperator	Bake Absorption (%)	Loaf Volume		Quality Score Compared to Check (Glenn)								
		(cc)	(% of Check)	Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	75.0	1000	82.6	7	5	3	3	1	7	5	3	3
B	75.7	1028	91.4	8	8	5	5	5	5	5	4	5
C	67.1	925	88.9	4	6	5	4	4	4	5	4	4
D	65.0	3000	106.2	9	9	5	5	5	5	5	5	5
E	68.5	2450	100.0	9	8	5	4	6	5	4	5	5
F	76.0	1075	88.5	9	3	3	3	5	5	5	3	3
G	65.0	3050	100.0	5	5	5	5	5	5	4	5	6
H	72.4	1095	92.0	7	9	5	5	3	7	5	3	5
I	64.0	2897	103.1	9	9	5	5	5	5	4	6	5
J	71.3	946	94.4	5	7	5	5	5	5	6	4	5
K	68.5	2675	92.2	9	9	5	7	5	7	5	3	3
L	72.2	1200	95.2	5	6	4	5	5	5	4	5	5
M	66.6	2971	96.5	5	6	5	5	6	5	5	5	6
Avg.	69.8		94.7	7.0	6.9	4.6	4.7	4.6	5.4	4.8	4.2	4.6
S.D.	4.2		6.5	2.0	1.9	0.8	1.0	1.3	1.0	0.6	1.0	1.0

Hard Red Spring Wheat Breeding Quality Target Values

	Quality Parameter	Target Value*
Wheat	Test Weight (lb/bu, Grading Factor)	60
	Protein (% , 12% mb)	14.5
	Ash (% , 14% mb)	< 1.65
	Vitreousness (% dark, hard & vitreous, DHV)	80
	1000 Kernel Weight (g)	> 31
	Falling Number (sec)	400
	Wheat Hardness (SKCS)	80
	Wheat Hardness (NIR)	70
Milling	Flour Extraction:	
	Buhler Lab Mill (% , 0.48% ash)	70
	Quadrumat Senior (% , 0.48% ash)	70
	Protein Loss (%)	< 1.0
Flour	Ash (% , 14% mb)	0.48
	Color (<i>L*</i> value)	90
	Wet Gluten (% , 14% mb, 13.5% protein)	36
Farinograph (50 g bowl)	Absorption (%)	64
	Peak Time (min)	6-8
	Stability (min)	15-17
Mixograph	Peak time (min)	5
Bread Baking[‡]	Loaf Volume (cc)	1050
	Grain & Texture (1 = poor, 10 = excellent) [†]	8.5

*HRS Wheat Breeding Quality Targets were developed by a committee of HRS wheat breeders and quality personnel. Contact Senay Simsek, North Dakota State University, Department of Plant Sciences, for more information.

[†]Subjective ratings and classifications are from North Dakota State University, Hard Red Spring Wheat Quality Laboratory.

[‡]Bread quality based on 100 g pup loaf, straight dough method (North Dakota State University, Hard Red Spring Wheat Quality Laboratory).

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 and they 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 being released as a named variety.
5. These targets will be reviewed periodically and updated as needed.
6. Utilization of these breeding targets by all HRS wheat breeders is essential to provide better uniformity and consistency and meeting the needs of our domestic and export markets.