## Wheat Quality Council

## Hard Spring Wheat Technical Committee

# 2018 Crop



February 19-21, 2019

Kansas City, MO

Wheat Quality Council

Hard Spring Wheat Technical Committee

2018 Crop



Sponsored by the Wheat Quality Council February 19-21, 2019 Dave Green, Executive Vice President Wheat Quality Council P.O. Box 19539 Lenexa, KS 66285 Phone: 913-634-0248 E-mail: dave.green.wqc@gmail.com



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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 five locations in 2018 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 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 2018 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 2018 Wheat Quality Testing Program

	SWQC	
Source/Breeding Program	Code #	Identification
Syngenta	1	SY McCloud
BASF	2	PMWH25131094
North Dakota State University	3	Glenn (Check)
Montana State University	4	Lanning
Limagrain	5	LCS Rebel (Western Check)
BASF	6	PMWH25180325
University of Minnesota	7	Linkert (Eastern Check)
Limagrain	8	LCS Cannon
University of Minnesota	9	MN10201-4-A
South Dakota State University	10	SD4539

### **Source of Wheat**

## **Field Plot Locations and Procedures**

Coordinators: Steve Sebesta, Director, Joyana Baumann, Assistant Director, and Gonzalo Rojas-Cifuentes (decd.), 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.

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

## **Field Production Data**

			LOCATION		
Variable	Watertown	Casselton	Havre	Crookston	Minot
Planting Date	05/08/2018	05/05/2018	05/07/2018	05/11/2018	05/03/2018
Harvest Date	08/23/2018	8/11/2018	08/10/2018	08/13/2018	08/14/2018
Fertilizer (Ib/A)					
N	227	120	100	171	130
Р	54	25	20	7 ppm	37 ppm
К	229	*	10	136 ppm	390 ppm
Herbicide/rate/A					
Broadleaf	Wolverine 1.7 pt./A	Bronate 1 pt./A	Bromac 24 oz./A	Bromac 1.5 pt./A	Huskie 13 oz./A
Grass	*	Axial XL 16.4 oz./A	*	Axial XL 16 oz./A	Axial XL 16 oz./A
					Opensky 16 oz./A
					Gramoxone 32 oz./A
					Valor 2 oz./A
Fungicide	Tebustar 4 oz./A	Prosaro 6.5 oz./A	*	*	Quest 4 oz./A

\*No application.

	CLIMATOLOGICAL DATA					
Month	Watertown	Casselton	Havre	Crookston	Minot	
April	*	*	36.0 / 0.24	33.3 / 0.14	31.0 / 0.08	
May	62.3 / 1.99	61.8 / 1.46	58.9 / 1.10	61.3 / 1.72	61.0 / 0.65	
June	68.8 / 2.56	70.0 / 5.03	63.3 / 2.50	68.2 / 7.82	67.0 / 4.93	
July	69.7 / 2.15	69.6 / 3.08	69.5 / 0.18	68.8 / 1.47	69.0 / 1.44	
August	67.5 / 1.89	74.1 / 0.23	67.2 / 0.50	67.1 / 1.67	72.0 / 0.02	

\*Data not available.

		YIELD	DATA		
		Yield (bu/a	acre) / Test Weight / %	6 Moisture	
SWQC Code #	Watertown	Casselton	Havre	Crookston	Minot
1	60.3 / 60.1 / 13.0	70.8 / 61.0 / 13.4	**	59.0 / 60.0 / 12.3	43.2 / 63.9 / 11.3
2	*	75.6 / 62.0 / 12.4	*	53.0 / 58.0 / 11.2	42.3 / 62.5 / 11.4
3	56.9 / 59.2 / 13.2	63.9 / 61.0 / 13.0	38.6 / 62.3 / 9.4	47.0 / 59.0 / 12.3	54.4 / 65.3 / 11.7
4	*	*	48.4 / 57.9 / 9.2	*	*
5	*	*	43.8 / 61.4 / 9.6	*	55.6 / 64.0 / 11.6
6	*	81.8 / 62.0 / 11.6	*	55.0 / 56.0 / 12.5	72.5 / 62.6 / 11.2
7	58.7 / 58.6 / 13.0	64.0 / 61.0 / 12.0	*	56.0 / 59.0 / 11.8	*
8	74.0 / 60.1 / 13.0	77.4 / 61.0 / 12.1	49.0 / 62.1 / 8.6	53.0 / 61.0 / 12.5	65.2 / 64.2 / 11.2
9	65.2 / 59.0 / 13.0	60.8 / 61.5 / 11.4	*	61.0 / 58.0 / 13.3	*
10	62.5 / 59.5 / 13.0	68.9 / 60.5 / 11.4	*	55.0 / 59.0 / 12.5	*
Site Totals	6	8	4	8	6

\*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
At Planting	Delayed planting. Good conditions at planting.	Adequate moisture at planting; good stand establishment.	SWQC 1 (SY McCloud) – no data from the Havre site due to drill malfunction at time of seeding; was re-seeded, but not a good comparison to other entries. The spring wheat for the area was seeded later than typical due to prolonged snowcover and wet ground.	Started out with adequate moisture for emergence.	Adequate top soil moisture to get crop started. No subsoil moisture.
During Growth	Normal conditions.	Very dry in May but plenty of rain in June.	No issues.	Dry weather conditions.	Good growing conditions. Dry soil conditions going into reproductive stage. No pest issues observed.
At Flowering	Dry, low humidity. Warmer than average.	Wet conditions occasionally during flowering.	No issues.	Normal weather conditions.	Timely rainfall and good growing conditions. No pest issues observed.
During Maturation	ng Warm and dry. Nice dry down for harves		No issues. Water stressed from lack of precipitation.	Very dry weather.	Good growing conditions. No pest issues observed.
At Harvest	Normal conditions.	Very nice dry conditions for harvest.	Glenn was VERY TOUGH to thresh.	No lodging present at harvest.	Hot and dry weather conditions created ideal harvest conditions. No weather delays or pest issues.

### **Description of 2018 Hard Spring Wheat Lines**

#### SWQC #1 – SY McCloud

SY McCloud is a hard red spring wheat bred and developed by Syngenta Crop Protection, LLC and is primarily adapted for the Northern Plains of the USA. SY McCloud was selected from the cross 04S0196-1/SY Soren. It has medium-early heading, similar to SY Soren with high test weight. It is a standard semi-dwarf with height between SY Soren and Knudson. Straw strength is moderate to strong. It is resistant to stem rust and moderately resistant to leaf rust. It is moderately susceptible to FHB. Protein levels have been high, similar to SY Soren. Overall breadmaking characteristics are acceptable.

#### SWQC #2 - PMWH25131094

PMWH25131094 is a hybrid between traditional North American germplasms. The hybrid was created in 2015 and first yield trials were in 2016. The initial performance indicated this hybrid had commercial potential. In 2017, a larger seed lot of this hybrid was produced for wider scale testing such as in this trial. PMWH25131094 is an intermediate/tall height semi-dwarf with below average straw strength, above average protein, FHB and leaf disease resistance with good yield potential.

#### SWQC #4 – Lanning

Lanning hard red spring wheat was released by the Montana Agricultural Experiment Station due to its excellent yield potential in dryland areas of Montana and its superior end-use quality. Lanning was derived from the cross 'Glenn'/MT0747 by single seed descent beginning in the F<sub>2</sub> generation. A single plant in the F<sub>4</sub> generation was the source of experimental line MT1316, which subsequently was named Lanning. Lanning has grain yield equivalent to Vida, the most widely grown cultivar in Montana from 2010-2018. Lanning has higher grain protein and stronger gluten characteristics than Vida. Lanning is hollow-stemmed, suggesting that it will be susceptible to damage caused by the wheat stem sawfly (*Cephus cinctus* Nort.). Lanning should be of interest to producers of hard red spring on dryland acreage throughout the wheat-growing region of Montana.

#### SWQC #5 – 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.

#### SWQC #6 – PMWH25180325

PMWH25180325 is a hybrid between North American and South American germplasms. The hybrid was created in 2015 and first yield trials were in 2016. The initial performance suggested this hybrid had potential to be commercially viable. In 2017, a larger seed lot of this hybrid was

produced for wider scale testing such as in this trial. PMWH25180325 is an intermediate height semi-dwarf with average straw strength, protein, FHB and leaf disease resistance with very good yield potential.

#### SWQC #7 – Linkert

Linkert (MN97695-4/Ada sel) was released by the University of Minnesota in 2013 and has been the no. 1 variety in Minnesota since 2016, sown on >27% of the state's acreage from 2016-2018. Linkert is a mid-maturity hard red spring wheat with excellent straw strength, high grain protein content and good end-use quality characteristics. Linkert is moderately resistant to leaf rust, resistant to stripe rust, but moderately susceptible to Fusarium head blight and bacterial leaf streak. Linkert is resistant to preharvest sprouting.

#### SWQC #8 – LCS Cannon

LCS Cannon is a hard red spring wheat marketed by Limagrain Cereal Seeds. LCS Cannon was selected for its excellent straw strength, grain yield and consistent protein. Adapted from western North Dakota to the Red River Valley, LCS Cannon is an ideal fit for higher moisture and high management scenarios where lodging can be expected. LCS Cannon also has good resistance to stem rust, stripe rust and leaf rust and moderate resistance to fusarium head blight. In addition, LCS Cannon has desirable overall end-use quality. Registered and Certified seed of LCS Cannon is available for Spring 2019 planting. Plant Variety Protection will be applied for.

#### SWQC #9 - MN10201-4-A

MN10201-4-A (MN97695-BYDV/Sabin) contains a gene that provides good resistance to Barley Yellow Dwarf Virus (BYDV) and this line show relatively good yield performance in years with BYDV pressure. In years with little BYDV, its grain yield is average compared with current varieties. MN10201-4-A is a mid-maturity line with good straw strength, leaf rust resistance, and pre-harvest sprouting resistance, and moderate resistance to Fusarium head blight and bacterial leaf streak. Overall, end-use quality parameters of MN10201-4-A have been good despite its lower than average grain protein.

#### SWQC #10 – SD4539

SD4539 is an F<sub>4</sub> derived line developed from the population SD4189/SD4178. SD4178 was released as Prevail in 2013. SD4539 features a combination of grain yield potential, test weight, plant height and maturity that are all very similar to Forefront. Grain protein concentration and several other end-use quality measures are, however, significantly higher than those of Forefront.

## **Wheat Production Sites**

SWQAC			Production Sites						
Code #	Entry	Source	Watertown	Casselton	Havre	Crookston	Minot		
1	SY McCloud	Syngenta	Х	Х	Х*	Х	Х		
2	PMWH25131094	BASF		Х		Х	Х		
3	Glenn	NDSU	Х	Х	Х	Х	Х		
4	Lanning	MTSU			Х				
5	LCS Rebel	Limagrain			Х		Х		
6	PMWH25180325	BASF		Х		Х	Х		
7	Linkert	UMN	Х	Х		Х			
8	LCS Cannon	Limagrain	Х	Х	Х	Х	Х		
9	MN10201-4-A	UMN	Х	Х		Х			
10	SD4539	SDSU	Х	Х		Х			

\*Sample not received (see notes on page 7).

## **Grain Cleaning and Milling Procedures**

Wheat (approximately 3 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 (110 lbs) was tempered to 16.5% moisture content and conditioned for approximately 20-24 hours before milling. Milling was performed on the Miag Multomat. Feed rate was set at 180 lbs/hour. Break rollers were adjusted to the following releases through a U.S. 16 S.S. sieve: first break – 30%; second break – 53%; and third break, clean-up – 66%.

**Flour blending:** Sixteen mill streams were selected among 23 streams based on cumulative ash curves and blended to long patent flour. Cumulative ash content was calculated based on product basis milling yield (14% moisture basis).

Milling streams blended to long patent flour – 1<sup>st</sup> Break, 2<sup>nd</sup> Break I, Break Dust, Sizing I, 2<sup>nd</sup> Break II, 3<sup>rd</sup> Break, Sizing II, 5<sup>th</sup> Break, 4<sup>th</sup> Break, 1<sup>st</sup> Middlings, 2<sup>nd</sup> Middlings, 3<sup>rd</sup> Middlings, 4<sup>th</sup> Middlings, 6<sup>th</sup> Middlings, Tail Flour, and Tail Cyclone Flour.

## **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, AACCI Method 56-81);
- Single kernel characteristics (Perten Single Kernel Characterization System SKCS, AACCI Method 55-31):
  - 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 (Cereal Chem. 75:374, 1998; 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 patent 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 (cm<sup>2</sup>): 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;
- 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 2018 Hard Spring Wheat Lines**

## SWQC #1 – SY McCloud

		Wate	rtown	Cass	elton	Crool	ston	Mir	not
		Glenn		Glenn		Glenn		Glenn	
	Quality Trait	B-3	B-1	C-3	C-1	K-3	K-1	M-3	M-1
-	I. USDA-ARS WQL Data								
1	Wheat Protein (%, 12% mb)	16.5	16.1	14.4	13.7	15.9	15.5	15.7	15.5
2	Flour Protein (%, 14% mb)	15.4	14.7	13.5	12.4	15.2	14.2	14.8	14.4
3	Market Value (Score 1-6)	4.8	4.8	4.2	4.5	4.7	4.6	5.1	5.4
4	Market Value (Score 1-10)	10.0	9.6	10.0	9.4	10.0	9.6	10.0	9.2
5	DON (ppm)	0.22	0.34	0.10	0.26	0.42	0.49	nd	nd
6	Test Weight (lb/bu)	61.8	61.6	64.8	63.8	63.3	61.4	66.0	64.4
7	1000 Kernel Weight (g)	33.4	37.9	30.3	34.2	29.1	31.5	33.9	39.1
8	Kernel Size, % Large	66	81	52	71	52	54	67	74
9	Kernel Size, % Small	6	4	9	7	11	14	6	6
10	Wheat Moisture (%)	13.7	13.8	11.8	12.4	13.3	13.4	11.2	11.3
11	Wheat Ash (%, 14% mb)	1.59	1.58	1.83	1.64	1.56	1.62	1.41	1.44
12	Wheat Falling Number (sec)	378	364	412	413	386	433	390	404
13	SKCS Hardness Index	78.4	72.3	79.8	76.4	78.6	82.5	76.4	73.8
14	Vitreous Kernels (%)	72	59	89	67	87	87	96	89
	Flour Extraction (%)								
15	Tempered Wheat Basis (%)	68.2	67.2	68.1	66.5	68.7	67.8	68.2	67.7
16	Total Product Basis (%)	72.1	71.3	72.6	70.8	72.1	72.1	71.9	70.8
17	Flour/Bu Wheat (lbs)	41.8	41.1	44.9	43.2	43.4	41.4	46.0	44.3
	Flour Quality								
18	Flour Color Brightness (L*)	89.8	89.5	90.5	90.6	89.7	89.7	90.5	89.5
19	Flour Color Yellowness (b*)	9.0	10.9	9.5	11.4	9.6	11.9	9.4	11.0
20	Flour Moisture (%)	13.1	13.2	13.4	13.9	13.1	13.0	13.1	12.8
21	Flour Ash (%, 14% mb)	0.49	0.49	0.48	0.46	0.48	0.54	0.46	0.49
22	Flour Falling Number (Malted) (sec)	255	246	247	253	247	254	248	249
	<b>F</b> ourie o work h								
~~	Farinograph	07.0	C0 F	60 F	<b>CO 0</b>	64.0	C 4 F	<u> </u>	CO C
23	Water Absorption (%, 500 BU)	67.2	68.5	63.5	03.8	64.0	64.5	66.9	00.0
24	water Absorption (%, 14% mb)	00.2	67.6	62.8	63.4	63.0	63.2	65.7	67.1
25	Arrival Time (min)	3.6	4.3	3.1	2.8	4.2	4.2	4.6	4.8
20	Peak Time (min)	ð.5	7.3	7.5	0.5	9.3	1.1	8.0	7.8
21	Dougn Stability (min)	12.3	0.6	9.3	1.1	11.8	9.2	0.0	0.9
28	Mixing Tolerance Index (MTI) (BU)	27	26	31	36	24	27	25	37
29	Time To Breakdown (TTB) (min)	13.9	13.1	12.1	10.6	14.0	13.3	13.4	11.5
	II Cooperator Results								
30	Bake Absorption (Average %)	68.6	69 3	65.8	65 7	66 5	66.9	68.0	69 1
31	Loaf Volume (% of Check)	00.0	95.4	00.0	95.2	00.5	97.5	00.0	95.7
- 51			33.4		30.2		31.5		35.1

## SWQC #1 – SY McCloud

		Water	town	Casse	elton	Croo	kston	Min	ot
		Glenn		Glenn		Glenn		Glenn	
	Quality Trait	B-3	B-1	C-3	C-1	K-3	K-1	M-3	M-1
	II. Cooperator Results								
32	Mixing Requirement 9 = Very Long 7 = Long 5 = Medium 3 = Short 1 = Very Short	5.8	5.3	6.2	5.6	6.4	6.0	5.7	5.0
33	Dough Characteristics 9 = Bucky – Tough 7 = Strong – Elastic 5 = Medium – Pliable 3 = Mellow – Very Pliable 1 = Weak – Short or Sticky	7.1	6.5	6.8	5.9	7.1	6.5	6.8	5.9
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		4.3		4.9		4.4		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		4.3		3.6		3.8		3.9
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		4.8		5.1		5.5		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		4.1		3.8		4.1		4.8
	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		4.3		3.5		4.1		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		3.8		4.7		4.8		4.3
	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		4.0		4.2		4.3		4.5

## Farinograms



Glenn Check (Casselton, C-3)



Glenn Check (Crookston, K-3)



Glenn Check (Minot, M-3)





SY McCloud (Casselton, C-1)



SY McCloud (Crookston, K-1)



SY McCloud (Minot, M-1)



### **Mixograms**



#### **Extensograms**



19

## SWQC #2 – PMWH25131094

		Casse	elton	Crook	ston	Mir	not	_
		Glenn		Glenn		Glenn		
	Quality Trait	C-3	C-2	K-3	K-2	M-3	M-2	
	I. USDA-ARS WQL Data							
1	Wheat Protein (%, 12% mb)	14.4	12.8	15.9	15.6	15.7	14.3	
2	Flour Protein (%, 14% mb)	13.5	11.7	15.2	14.4	14.8	13.4	
-								
3	Market Value (Score 1-6)	4.2	4.1	4.7	3.9	5.1	4.9	
4	Market Value (Score 1-10)	10.0	7.8	10.0	8.2	10.0	8.0	
5	DON (ppm)	0.10	nd	0.42	0.13	nd	nd	
6	Test Weight (lb/bu)	64.8	63.0	63.3	59.4	66.0	63.4	
7	1000 Kernel Weight (g)	30.3	31.4	29.1	27.0	33.9	33.9	
8	Kernel Size, % Large	52	49	52	36	67	60	
9	Kernel Size, % Small	9	13	11	22	6	8	
10	Wheat Moisture (%)	11.8	11.9	13.3	12.8	11.2	11.1	
11	Wheat Ash (%, 14% mb)	1.83	1.67	1.56	1.68	1.41	1.47	
12	Wheat Falling Number (sec)	412	430	386	461	390	442	
13	SKCS Hardness Index	79.8	76.2	78.6	83.6	76.4	80.8	
14	Vitreous Kernels (%)	89	69	87	85	96	94	
	Flour Extraction (9/)							
15	FIGUR EXtraction (%)	68 1	67 7	68 7	67 /	68.2	68.8	
10	Total Product Basis (%)	72 6	71 2	72 4	70.6	71 0	71 0	
17	Flour/Bu Wheat (lbs)	12.0 AA 9	A3 5	12.1 13.1	<i>1</i> 0.0 <i>4</i> 0.1	46.0	11.5 AA 7	
17	riou/Du Wileat (153)	5	40.0	-5	40.1	40.0		
	Flour Quality							
18	Flour Color Brightness (L*)	90.5	90.7	89.7	90.0	90.5	90.0	
19	Flour Color Yellowness (b*)	9.5	10.5	9.6	10.4	9.4	10.0	
20	Flour Moisture (%)	13.4	13.7	13.1	12.8	13.1	13.2	
21	Flour Ash (%, 14% mb)	0.48	0.48	0.48	0.55	0.46	0.49	
22	Flour Falling Number (Malted) (sec)	247	256	247	253	248	255	
	Farinograph	00 F	<b>60 7</b>	04.0	00 A		00 <b>7</b>	
23	water Absorption (%, 500 BU)	63.5	60.7	64.0	63.4	66.9	63.7	
24	water Absorption (%, 14% mb)	62.8	60.2	63.0	62.2	65.7	62.8	
25	Arrival Time (min)	3.1	2.2	4.2	4.0	4.6	3.8	
26	Peak Time (min)	7.5	5.7	9.3	7.2	8.0	6.8	
27	Dough Stability (min)	9.3	7.6	11.8	8.6	8.8	7.5	
28	Mixing Tolerance Index (MTI) (BU)	31	39	24	30	25	34	
29	Time To Breakdown (TTB) (min)	12.1	9.8	14.6	12.5	13.4	11.1	
	II. Cooperator Results							
30	Bake Absorption (Average %)	65.8	63.6	66.5	66.0	68.0	65.7	
31	Loaf Volume (% of Check)		93.6		98.6		93.7	

## SWQC #2 – PMWH25131094

		Casse	elton	Crook	ston	Min	ot
		Glenn		Glenn		Glenn	
	Quality Trait	C-3	C-2	K-3	K-2	M-3	M-2
32	II. Cooperator Results Mixing Requirement 9 = Very Long 7 = Long 5 = Medium 3 = Short 1 = Very Short	6.2	5.3	6.4	5.8	5.7	5.3
33	Dough Characteristics 9 = Bucky – Tough 7 = Strong – Elastic 5 = Medium – Pliable 3 = Mellow – Very Pliable 1 = Weak – Short or Sticky	6.8	5.0	7.1	6.3	6.8	6.2
34	<b>Mixing Tolerance</b> 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		3.8		4.3		4.3
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		4.3		5.0		4.8
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		4.8		5.0		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		3.3		4.1		3.0
	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		3.8		3.0		4.5
	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		3.8		4.8		4.1
	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		3.7		4.0		4.1

## Farinograms



Glenn Check (Casselton, C-3)

Glenn Check (Crookston, K-3)



Glenn Check (Minot, M-3)



PMWH25131094 (Casselton, C-2)



PMWH25131094 (Crookston, K-2)



PMWH25131094 (Minot, M-2)



#### **Mixograms**



Glenn Check (Crookston, K-3)



Glenn Check (Minot, M-3)

PMWH25131094 (Casselton, C-2)

PMWH25131094 (Crookston, K-2)





#### **Extensograms**



#### Glenn Check (Casselton, C-3)





#### Glenn Check (Minot, M-3)







PMWH25131094 (Crookston, K-2)



PMWH25131094 (Minot, M-2)

[cm]

## SWQC #4 – Lanning

		Hav	/re
		Glenn	
	Quality Trait	H-3	H-4
	I. USDA-ARS WQL Data		
1	Wheat Protein (%, 12% mb)	16.8	16.3
2	Flour Protein (%, 14% mb)	16.2	15.8
3	Market Value (Score 1-6)	5.0	4.3
4	Market Value (Score 1-10)	10.0	9.2
5	DON (ppm)	nd	nd
6	Test Weight (lb/bu)	62.9	59.9
7	1000 Kernel Weight (g)	26.5	28.1
8	Kernel Size, % Large	12	38
9	Kernel Size, % Small	21	13
10	Wheat Moisture (%)	9.5	9.3
11	Wheat Ash (%, 14% mb)	1.56	1.52
12	Wheat Falling Number (sec)	430	411
13	SKCS Hardness Index	80.2	76.9
14	Vitreous Kernels (%)	99	100
	Flour Extraction (%)		
15	Tempered Wheat Basis (%)	68.9	68.3
16	Total Product Basis (%)	72.0	72.8
17	Flour/Bu Wheat (lbs)	43.7	41.3
	Flour Quality		
18	Flour Color Brightness ( <i>L</i> *)	90.3	90.3
19	Flour Color Yellowness (b*)	9.9	10.0
20	Flour Moisture (%)	13.1	13.1
21	Flour Ash (%, 14% mb)	0.48	0.49
22	Flour Falling Number (Malted) (sec)	245	245
	Farinograph		
23	Water Absorption (%, 500 BU)	66.3	65.5
24	Water Absorption (%, 14% mb)	65.0	64.5
25	Arrival Lime (min)	5.4	5.2
26	Peak Time (min)	10.7	8.2
27	Dough Stability (min)	13.5	9.7
28	Mixing Tolerance Index (MTI) (BU)	24	27
29	Time To Breakdown (TFB) (min)	17.9	14.5
20	II. Cooperator Results	<b>CO O</b>	C7 7
30	Bake Absorption (Average %)	68.8	67.7
31	Loat volume (% of Check)		97.5

## SWQC #4 – Lanning

		Havre		
		Glenn		
	Quality Trait	H-3	H-4	
	II. Cooperator Results			
32	Mixing Requirement	6.4	5.3	
	9 = Very Long			
	7 = Long			
	5 = Medium 3 = Short			
	1 = Verv Short			
33	Dough Characteristics	7.2	6.9	
	9 = Bucky – Tough			
	7 = Strong – Elastic			
	5 = Medium – Pilable 3 = Mellow – Very Pliable			
	1 = Weak – Short or Sticky			
	· · · · · · · · · · · · · · · · · · ·			
34	Mixing Tolerance		4.3	
	9 = Much More Tolerance Than Check			
	/ = More Tolerance Than Check			
	3 = 1 ess Tolerance Equivalent To Check			
	1 = Much Less Tolerance Than Check			
35	Internal Crumb Color		4.3	
	9 = Much Brighter Than Check			
	7 = Brighter Than Check			
	5 = Equivalent To Check			
	1 = Much Poorer Than Check			
36	Internal Grain and Texture		4.8	
	9 = Much Better Than Check			
	7 = Better Than Check			
	3 = Poorer Than Check			
	1 = Much Poorer Than Check			
	III. Cooperator Evaluation			
	Quality Traits 1-2: Protein		4.4	
	9 = Much Better Than Check			
	5 = Equivalent To Check			
	3 = Poorer Than Check			
	1 = Much Poorer Than Check			
	Quality Traits 3-22: Milling		5.1	
	y = Much Better Than Check 7 = Retter Than Check			
	5 = Equivalent To Check			
	3 = Poorer Than Check			
	1 = Much Poorer Than Check			
	Quality Troits 02 20. Dation		4.0	
	Quality Iraits 23-36: Baking		4.2	
	y = Much Better Than Check 7 = Retter Than Check			
	5 = Equivalent To Check			
	3 = Poorer Than Check			
	1 = Much Poorer Than Check			
	Quality Traits 4.20. Quart 10 games -		4.2	
	Quality I raits 1-36: Uverall Comparison		4.3	
	♂ - Wuch beller Than Check 7 = Retter Than Check			
	5 = Equivalent To Check			
	3 = Poorer Than Check			
	1 = Much Poorer Than Check			

## Farinograms



Lanning (Havre, H-4) [FU] H-4 200-'n [min]

### **Mixograms**





## Extensograms



## SWQC #5 – LCS Rebel

		Havre		Minot	
		Glenn		Glenn	
	Quality Trait	H-3	H-5	M-3	M-5
	I. USDA-ARS WQL Data				
1	Wheat Protein (%, 12% mb)	16.8	17.2	15.7	14.9
2	Flour Protein (%, 14% mb)	16.2	16.4	14.8	14.0
3	Market Value (Score 1-6)	5.0	5.0	5.1	5.3
4	Market Value (Score 1-10)	10.0	10.0	10.0	9.0
5	DON (ppm)	nd	nd	nd	nd
6	Test Weight (lb/bu)	62.9	61.8	66.0	64.6
7	1000 Kernel Weight (g)	26.5	28.8	33.9	36.6
8	Kernel Size, % Large	12	25	67	76
9	Kernel Size, % Small	21	20	6	4
10	Wheat Moisture (%)	9.5	9.3	11.2	11.3
11	Wheat Ash (%, 14% mb)	1.56	1.45	1.41	1.44
12	Wheat Falling Number (sec)	430	476	390	424
13	SKCS Hardness Index	80.2	75.1	76.4	71.3
14	Vitreous Kernels (%)	99	100	96	96
	Flour Extraction (%)				
15	Tempered Wheat Basis (%)	68.9	70.0	68.2	70.2
16	Total Product Basis (%)	72.0	74.0	71.9	73.2
17	Flour/Bu Wheat (Ibs)	43.7	43.6	46.0	46.1
	Flour Quality				
18	Flour Color Brightness (L*)	90.3	90.3	90.5	90.6
19	Flour Color Yellowness (b*)	9.9	9.7	9.4	9.5
20	Flour Moisture (%)	13.1	13.1	13.1	12.9
21	Flour Ash (%, 14% mb)	0.48	0.45	0.46	0.41
22	Flour Falling Number (Malted) (sec)	245	243	248	249
	Farinograph				
23	Water Absorption (%, 500 BU)	66.3	67.7	66.9	65.2
24	Water Absorption (%, 14% mb)	65.0	66.5	65.7	63.8
25	Arrival Time (min)	5.4	5.7	4.6	3.9
26	Peak Time (min)	10.7	10.9	8.0	7.5
27	Dough Stability (min)	13.5	12.5	8.8	8.6
28	Mixing Tolerance Index (MTI) (BU)	24	25	25	32
29	Time To Breakdown (TTB) (min)	17.9	17.6	13.4	11.9
	II. Cooperator Results				
30	Bake Absorption (Average %)	68.8	69.5	68.0	67.3
31	Loaf Volume (% of Check)		100.0		98.6

## SWQC #5 – LCS Rebel

		Havre		Minot	
		Glenn		Glenn	
	Quality Trait	H-3	H-5	M-3	M-5
	II. Cooperator Results	• •			
32	Mixing Requirement	6.4	6.7	5.7	5.5
	9 = Very Long 7 = Long				
	5 = Medium				
	3 = Short				
	1 = Very Short				
33	Dough Characteristics	72	72	6.8	64
	9 = Bucky – Tough			0.0	0.4
	7 = Strong – Elastic				
	5 = Medium – Pliable				
	3 = Mellow – Very Pliable 1 = Weak – Short or Sticky				
34	Mixing Tolerance		5.3		4.8
	9 = Much More Tolerance Than Check				
	/ = More Tolerance Than Check				
	3 = Less Tolerance Equivalent To Check				
	1 = Much Less Tolerance Than Check				
35	Internal Crumb Color		5.7		5.3
	9 = Much Brighter Than Check 7 = Brighter Than Check				
	5 = Equivalent To Check				
	3 = Poorer Than Check				
	1 = Much Poorer Than Check				
36	Internal Grain and Texture		5.4		5.7
	9 = Much Better Than Check				
	7 = Better Than Check				
	5 = Equivalent To Check				
	1 = Much Poorer Than Check				
	III. Cooperator Evaluation				
	Quality Traits 1-2: Protein		5.2		3.9
	9 = Much Better Than Check 7 = Better Than Check				
	5 = Equivalent To Check				
	3 = Poorer Than Check				
	1 = Much Poorer Than Check				
	Quality Traits 3-22 <sup>,</sup> Milling		63		65
	9 = Much Better Than Check		0.5		0.5
	7 = Better Than Check				
	5 = Equivalent To Check				
	3 = Poorer Than Check 1 = Much Poorer Than Check				
	Quality Traits 23-36: Baking		6.0		4.8
	9 = Much Better Than Check				
	7 = Better Than Check				
	3 = Poorer Than Check				
	1 = Much Poorer Than Check				
					- 4
	Quality Traits 1-36: Overall Comparison		5.9		5.1
	$\frac{1}{7}$ = Better Than Check				
	5 = Equivalent To Check				
	3 = Poorer Than Check				
	1 = Much Poorer Than Check				

## Farinograms

[FU]

700



LCS Rebel (Havre, H-5)



Glenn Check (Minot, M-3)



LCS Rebel (Minot, M-5)



### **Mixograms**



Glenn Check (Minot, M-3)

LCS Rebel (Havre, H-5)



### **Extensograms**



#### [BU] H-5 900· 300-[cm]

LCS Rebel (Havre, H-5)

#### Glenn Check (Minot, M-3)

LCS Rebel (Minot, M-5)





## SWQC #6 – PMWH25180325

		Casselton 0		Crook	Crookston		not
		Glenn		Glenn		Glenn	
	Quality Trait	C-3	C-6	K-3	K-6	M-3	M-6
	I. USDA-ARS WQL Data						
1	Wheat Protein (%, 12% mb)	14.4	12.3	15.9	13.9	15.7	13.8
2	Flour Protein (%, 14% mb)	13.5	11.1	15.2	13.0	14.8	12.7
2	Market Value (Seers 4.6)	4.0	27	4 7	2.2	E 4	4.6
3 1	Market Value (Score 1-6)	4.2	J./ 7 9	4.7	5.Z 6.4	5.1 10.0	4.0
5	Market Value (Scole 1-10)	0.10	0.0	0.42	0.4	10.0 nd	0.02
5 6	DON (ppiii) Teet Weight (lb/bu)	0.10	0.00	0.42	0.07 50.4	11U	0.0Z
7	1000 Kornol Weight (ID/DU)	04.0	03.3	03.3	59.1 07.2	22.0	03.3
1	Kornel Size % Lorge	30.3	33.4	29.1	27.3	33.9	35.1
0	Kernel Size, % Large	52	00	52	30	6	00
9	Nerriel Size, % Sinal	9	40.4	42.2	424	44.2	0
10	Wheat Ach (%)	11.0	12.1	13.3	13.1	11.2	11.2
11	Wheat Ash (%, 14% mb)	1.83	1.70	1.50	1.73	1.41	1.42
12	Wheat Failing Number (Sec)	412	390	300	409	390	300
13	SKCS Hardness Index	/9.8	70.2	/8.6	//.9	/0.4	(4.5
14	vitreous Kerneis (%)	89	70	87	83	90	97
	Flour Extraction (%)						
15	Tempered Wheat Basis (%)	68.1	69.1	68.7	67.1	68.2	69.9
16	Total Product Basis (%)	72.6	72.7	72.1	71.6	71.9	73.3
17	Flour/Bu Wheat (lbs)	44.9	44.4	43.4	39.6	46.0	45.2
	Flour Quality						
18	Flour Color Brightness (/*)	90.5	90.9	89 7	89.8	90.5	90.5
19	Flour Color Vellowness (b*)	9.5	97	9.6	10.5	94	10.1
20	Flour Moisture (%)	13.4	13.3	13.1	13.0	13.1	12.8
21	Flour Ash (% 14% mb)	0.48	0.46	0.48	0 49	0.46	0.46
22	Flour Falling Number (Malted) (sec)	247	252	247	256	248	256
~~	Farinograph	C2 E	CO C	64.0	50 7	<b>CC 0</b>	C4 0
23	water Absorption (%, 500 BU)	63.5	60.6	64.0	59.7	66.9	61.9
24	water Absorption (%, 14% mb)	62.8	59.8	63.0	58.4	65.7	60.6
25	Arrival Time (min)	3.1	1.8	4.2	3.1	4.6	3.4
26	Peak Time (min)	7.5	5.5	9.3	6.7	8.0	6.3
27	Dougn Stability (min)	9.3	1.3	11.8	8.3	8.8	6.1
28	Wixing Tolerance Index (MTI) (BU)	31	40	24	32	25	48
29	Time To Breakdown (TTB) (min)	12.1	9.5	14.6	11.3	13.4	9.5
	II. Cooperator Results						
30	Bake Absorption (Average %)	65.8	63.1	66.5	63.2	68.0	64.2
31	Loaf Volume (% of Check)		91.1		96.0		90.5

## SWQC #6 – PMWH25180325

		Casselton		Crookston		Min	ot
		Glenn		Glenn		Glenn	
	Quality Trait	C-3	C-6	K-3	K-6	M-3	M-6
	II. Cooperator Results						
32	Mixing Requirement 9 = Very Long 7 = Long 5 = Medium 3 = Short 1 = Very Short	6.2	4.7	6.4	5.9	5.7	4.3
33	Dough Characteristics 9 = Bucky – Tough 7 = Strong – Elastic 5 = Medium – Pliable 3 = Mellow – Very Pliable 1 = Weak – Short or Sticky	6.8	5.0	7.1	5.6	6.8	4.8
34	<b>Mixing Tolerance</b> 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		3.6		3.6		2.8
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		4.8		4.7		4.4
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		4.9		5.4		5.3
	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		2.5		2.4		2.2
	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		5.1		3.8		5.4
	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		3.3		3.7		3.3
	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		3.5		3.3		2.9

## Farinograms



### Glenn Check (Casselton, C-3)

Glenn Check (Crookston, K-3)



Glenn Check (Minot, M-3)



PMWH25180325 (Casselton, C-6)



PMWH25180325 (Crookston, K-6)



PMWH25180325 (Minot, M-6)


#### **Mixograms**



Glenn Check (Crookston, K-3)



Glenn Check (Minot, M-3)

PMWH25180325 (Casselton, C-6)

PMWH25180325 (Crookston, K-6)



#### **Extensograms**

[BU]

1000

900 800

700

600

500

400

300

200 100

0

0



#### Glenn Check (Casselton, C-3)





Glenn Check (Minot, M-3)



5 10 15 20 25

30 [cm]

30

[cm]

PMWH25180325 (Casselton, C-6)

C-6



PMWH25180325 (Minot, M-6)

#### SWQC #7 – Linkert

		Water	town	Casselton		Croo	kston
		Glenn		Glenn		Glenn	
	Quality Trait	B-3	B-7	C-3	C-7	K-3	K-7
	I. USDA-ARS WQL Data						
1	Wheat Protein (%, 12% mb)	16.5	16.2	14.4	14.6	15.9	15.8
2	Flour Protein (%, 14% mb)	15.4	15.4	13.5	13.8	15.2	15.0
3	Market Value (Score 1-6)	4.8	5 1	4.2	4.6	47	4.6
Ă	Market Value (Score 1-0)	10.0	9.6	10.0	92	10.0	9.2
5	DON (npm)	0.22	0.81	0 10	1 14	0 42	1 78
6	Test Weight (Ib/bu)	61.8	60.3	64.8	62 1	63.3	60.6
7	1000 Kernel Weight (g)	33.4	36.8	30.3	33.8	29.1	31.5
8	Kernel Size, % Large	66	77	52	64	52	50
9	Kernel Size, % Small	6	5	9	6	11	12
10	Wheat Moisture (%)	13.7	13.5	11.8	11.3	13.3	12.7
11	Wheat Ash (%, 14% mb)	1.59	1.53	1.83	1.65	1.56	1.53
12	Wheat Falling Number (sec)	378	425	412	460	386	456
13	SKCS Hardness Index	78.4	74.5	79.8	71.3	78.6	79.5
14	Vitreous Kernels (%)	72	65	89	76	87	87
15	FIGUR Extraction (%)	60.0	60.2	60 1	60.6	60 7	60.2
15	Total Product Pasis (%)	00.Z	00.J 72.4	00.1 72.6	74.2	00.1 70.4	00.J 72.6
10	Flour/Bu Wheat (lbs)	12.1 41.8	40.9	72.0 44 9	14.Z 44.2	12.1 43.4	12.0 41.6
17	i ioui/Du Wileat (ibs)	41.0	40.5		77.2		41.0
	Flour Quality						
18	Flour Color Brightness (L*)	89.8	90.1	90.5	90.9	89.7	89.6
19	Flour Color Yellowness (b*)	9.0	8.7	9.5	8.5	9.6	9.0
20	Flour Moisture (%)	13.1	13.0	13.4	13.3	13.1	13.3
21	Flour Ash (%, 14% mb)	0.49	0.48	0.48	0.51	0.48	0.48
22	Flour Falling Number (Malted) (sec)	255	250	247	256	247	245
	Farinograph						
23	Water Absorption (%, 500 BU)	67.2	65.7	63.5	62.8	64.0	62.3
24	Water Absorption (%, 14% mb)	66.2	64.5	62.8	61.9	63.0	61.5
25	Arrival Time (min)	3.6	3.4	3.1	4.2	4.2	5.2
26	Peak Time (min)	8.5	10.2	7.5	8.3	9.3	10.4
27	Dough Stability (min)	12.3	18.8	9.3	12.2	11.8	18.5
28	Mixing Tolerance Index (MTI) (BU)	27	20	31	21	24	10
29	Time To Breakdown (TTB) (min)	13.9	<b>18.6</b>	12.1	16.5	14.6	22.0
	II. Cooperator Results						
30	Bake Absorption (Average %)	68.6	68.0	65.8	65.5	66.5	65.9
31	Loaf Volume (% of Check)		97.3		99.7		102.6

## SWQC #7 – Linkert

		Water	town	Casse	lton	Crook	ston
		Glenn		Glenn		Glenn	
	Quality Trait	B-3	B-7	C-3	C-7	K-3	K-7
	II. Cooperator Results						
32	Mixing Requirement 9 = Very Long 7 = Long 5 = Medium 3 = Short 1 = Very Short	5.8	6.3	6.2	6.7	6.4	7.0
33	Dough Characteristics 9 = Bucky – Tough 7 = Strong – Elastic 5 = Medium – Pliable 3 = Mellow – Very Pliable 1 = Weak – Short or Sticky	7.1	6.9	6.8	6.4	7.1	6.6
34	<b>Mixing Tolerance</b> 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		5.4		5.8		6.2
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		5.3		5.4		5.3
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		4.8		5.5		5.8
	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		4.9		5.4		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		4.8		5.3		4.9
	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		5.7		5.8
	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		5.6		5.6

## Farinograms



[FU] B-7 700 600 500 400 300 200-100 0 0 24 12 14 16 18 20 22 [min]

Linkert (Watertown, B-7)

Glenn Check (Casselton, C-3)



Glenn Check (Crookston, K-3)



Linkert (Casselton, C-7)



#### Linkert (Crookston, K-7) K-7



#### **Mixograms**



Glenn Check (Casselton, C-3)



Linkert (Watertown, B-7)

Linkert (Casselton, C-7)



#### **Extensograms**



## Linkert (Watertown, B-7) B-7



Glenn Check (Casselton, C-3)



Glenn Check (Crookston, K-3)





![](_page_42_Figure_9.jpeg)

![](_page_42_Figure_10.jpeg)

## SWQC #8 – LCS Cannon

Glenn   Glenn   Glenn   Glenn   Glenn   Glenn   Glenn   Glenn   K-3   K-4   M-3   M-3     1   Wheat Protein (%, 12% mb)   16.5   16.0   14.4   13.4   16.8   16.4   15.9   15.1   15.7   14.4   14.8   13.3     3   Market Value (Score 1-6)   4.8   4.8   4.2   4.1   5.0   5.3   4.7   4.1   5.1   14.1   14.8   13.3     4   Market Value (Score 1-6)   4.8   4.8   4.2   4.1   5.0   5.3   4.7   4.1   5.1   4.7     5   DON (pn)   0.22   0.22   0.10   0.23   nd   nd   0.42   2.9   10.0   10.0   10.0   10.0   10.0   10.0   13.0   13.2   2.5   2.2   2.9.1   13.2   14.1   12.0   6   6   7   5.0   5.1   13.1   12.8   11.2   11   10.0   10.0   10.0			Water	town	Cass	elton	На	vre	Crool	ston	Mir	not
Quality Trait   B-3   B-8   C-3   C-8   H-3   H-8   K-3   K-8   M-3   M-3     1   Wheat Protein (%, 12% mb)   16.5   16.0   14.4   13.4   16.8   16.4   15.9   15.1   15.7   14     2   Flour Protein (%, 14% mb)   16.4   15.1   13.5   12.5   16.2   15.6   15.2   14.1   14.8   13     3   Market Value (Score 1-6)   10.0   10.0   10.0   10.0   10.0   10.0   9.4   10.0   10.0   9.4   10.0   10.0   9.0   9.0   16.6   61.9   62.9   63.3   63.3   61.4   66.0   6   9   9   21   14   11   2.0   6.9   9   14   11   10.0			Glenn		Glenn		Glenn		Glenn		Glenn	
I. USDA-ARS WCL Data     1   Wheat Protein (%, 12% mb)   16.5   16.0   14.4   13.4   16.8   16.4   15.9   15.1   15.7   14.4     2   Flour Protein (%, 14% mb)   15.4   15.1   13.5   12.5   16.2   15.6   15.2   14.1   14.8   14.8     3   Market Value (Score 1-6)   4.8   4.8   4.2   4.1   5.0   5.3   4.7   4.1   5.1   4.4     4   Market Value (Score 1-6)   4.8   4.8   4.2   4.1   5.0   5.3   4.7   4.1   5.1   4.4     5   DO (pm)   0.2   0.25   0.10   0.23   nd   nd   0.4   8.4   3.2   2.5   2.9   2.2   1.2   2.6   5.3   6.1   6.6   6   9   9   1.4   11   2.0   6.6   7.6   5.5   9.1   13.3   12.8   11.2   11   11   11   Wheat Falling Number (Sec)   37.8		Quality Trait	B-3	B-8	C-3	C-8	H-3	H-8	K-3	K-8	M-3	M-8
1 Wheat Protein (%, 12% mb) 16.5 16.0 14.4 13.4 13.6 16.4 15.9 15.1 15.7 14.1 14.8 13.3   3 Market Value (Score 1-0) 10.0 10.0 10.0 10.0 9.4 10.0 10.0 9.0 10.0 10.0 9.0 10.0 10.0 9.0 10.0 10.0 9.0 10.0 10.0 9.0 10.0 10.0 9.0 10.0 10.0 9.0 10.0 10.0 9.0 10.0 10.0 9.0 10.0 10.0 9.0 10.0 10.0 10.0 9.0 10.0		I. USDA-ARS WQL Data										
2 Flour Protein (%, 14% mb) 15.4 15.1 13.5 12.5 16.2 15.6 15.2 14.1 14.8 13   3 Market Value (Score 1-6) 4.8 4.8 4.2 4.1 5.0 5.3 4.7 4.1 5.1 4.4   4 Market Value (Score 1-6) 10.0 10.0 9.4 10.0 <t< td=""><td>1</td><td>Wheat Protein (%, 12% mb)</td><td>16.5</td><td>16.0</td><td>14.4</td><td>13.4</td><td>16.8</td><td>16.4</td><td>15.9</td><td>15.1</td><td>15.7</td><td>14.7</td></t<>	1	Wheat Protein (%, 12% mb)	16.5	16.0	14.4	13.4	16.8	16.4	15.9	15.1	15.7	14.7
3   Market Value (Score 1-6) Market Value (Score 1-6)   4.8   4.2   4.1   5.0   5.3   4.7   4.1   5.1   4.4     4   Market Value (Score 1-6) DON (pm)   10.0   10.0   9.4   10.0	2	Flour Protein (%, 14% mb)	15.4	15.1	13.5	12.5	16.2	15.6	15.2	14.1	14.8	13.7
4 Market Value (\$core 1-10) 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 9.0 10.0 9.0 10.0 9.0 10.0 9.0 10.0 9.0 9.0 10.0 9.0 9.0 9.0 9.0 9.0 9.0 9.0 10.0 10.0 10.0 10.0 10.0 9.0 10.0 9.0 10.0 9.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 9.0 10.0	3	Market Value (Score 1-6)	4.8	4.8	4.2	4.1	5.0	5.3	4.7	4.1	5.1	4.7
5   DON (pp)   0.22   0.25   0.10   0.23   nd   nd   0.42   0.19   nd   nd     6   Test Weight (b/bu)   61.8   61.9   64.8   63.8   62.9   63.3   63.3   61.4   66.0   64     7   1000 Kernel Weight (g)   33.4   33.6   31.3   26.5   29.2   29.1   27.2   33.9   32.3     9   Kernel Size, % Small   6   6   9   9   21   14   11   20   6   9   9   21   14   11   20   6   9   9   21   14   11   20   6   9   9   21   14   11   20   6   9   9   21   14   11   20   6   9   9   21   14   11   20   6   33   35   33   33   33   12   26   33   83   93   39   39   39   39	4	Market Value (Score 1-10)	10.0	10.0	10.0	9.4	10.0	10.0	10.0	9.0	10.0	9.0
6 Test Weight (ib/bu) 61.8 64.8 63.3 62.9 63.3 61.4 66.0 64   7 1000 Kernel Weight (g) 33.4 35.2 30.3 31.3 26.5 29.2 29.1 27.2 33.9 32   8 Kernel Size, % Small 6 6 9 9 21 14 11 20 6 9   9 Kernel Size, % Small 6 6 9 9 21 14 11 20 6 9   10 Wheat Ash (%, 14% mb) 1.57 1.56 1.33 12.2 11.2 11   11 Wheat Ash (%, 14% mb) 1.59 1.43 1.83 1.57 1.56 1.56 1.41 1.3   12 Wheat Ash (%, 14% mb) 72 52 89 68 99 100 87 88 96 98   13 SKCS Hardness index 72.1 72.8 73.3 72.0 73.0 72.1 72.9 72.6 73.3 72.0 73.0 72.1 72.9 72.6 73.3	5	DON (ppm)	0.22	0.25	0.10	0.23	nd	nd	0.42	0.19	nd	nd
7 1000 Kernel Weight (g) 33.4 35.2 30.3 31.3 26.5 29.2 29.1 27.2 33.9 32   8 Kernel Size, % Large 66 76 52 59 12 26 52 37 67 55   9 Kernel Size, % Smail 6 6 9 9 21 14 11 20 6 9   10 Wheat Moisture (%) 13.7 13.6 11.8 11.5 9.5 9.1 13.3 12.8 11.2 11   11 Wheat Falling Number (sec) 378 358 412 394 430 508 386 395 390 38   13 SKCS Hardness Index 72. 52 89 68 99 100 87 88 96 99   14 Vitreous Kernels (%) 72.1 72.0 73.0 72.1 72.9 73.6 73.7 73.0 72.1 72.9 71.9 73.3 74.1 73.0 73.0 72.1 72.9 71.9 73.3 71.7 71	6	Test Weight (lb/bu)	61.8	61.9	64.8	63.8	62.9	63.3	63.3	61.4	66.0	64.6
8 Kernel Size, % Large 66 76 52 59 12 26 52 37 67 55   9 Kernel Size, % Small 6 6 9 9 21 14 11 20 6 9   10 Wheat Kahl (%, 14% mb) 1.59 1.43 1.83 1.57 1.56 1.39 1.55 1.41 1.3   11 Wheat Falling Number (sec) 378 358 412 394 430 508 386 395 390 38   13 SKCS Hardness Index 78.4 72.1 79.8 72.0 80.2 79.2 78.6 62.2 76.4 78.4 76.4 77.4 77.9 72.0 72.0 73.0 72.1 73.0 72.1 73.0 72.1 73.0 72.1 73.0 72.1 73.0 72.1 73.0 72.1 73.0 72.1 72.9 73.0 72.1 72.9 73.0 72.1 72.9 73.0 72.1 72.0 73.0 72.1 72.9 73.0 72.1 72.9 73	7	1000 Kernel Weight (g)	33.4	35.2	30.3	31.3	26.5	29.2	29.1	27.2	33.9	32.6
9 Kernel Size, % Smäll 6 6 9 9 21 14 11 20 6 9   10 Wheat Moisture (%) 13.7 13.6 11.8 11.5 9.5 9.1 13.3 12.8 11.2 11   11 Wheat Ash (%, 14% mb) 1.59 1.43 1.83 1.57 1.56 1.55 1.41 1.3   12 Wheat Falling Number (sec) 378 358 412 394 430 508 386 395 390 38   14 Vitroous Kernels (%) 72 52 89 68 99 100 87 88 96 94   15 Tempered Wheat Basis (%) 72.1 72.9 72.6 73.3 72.0 73.0 72.1 72.9 71.9 73.3   16 Total Product Basis (%) 72.1 72.9 72.6 73.3 72.0 73.0 72.1 72.9 71.9 73.3   16 Total Product Basis (%) 72.1 72.9 72.6 73.3 72.0 73.1 73.4 <	8	Kernel Size, % Large	66	76	52	59	12	26	52	37	67	59
10 Wheat Moisture (%) 13.7 13.6 11.8 11.5 9.5 9.1 13.3 12.8 11.2 11   11 Wheat Ash (%, 14% mb) 1.59 1.43 1.83 1.57 1.56 1.39 1.56 1.55 1.41 1.5   12 Wheat Falling Number (sec) 78 358 412 394 430 508 366 395 390 38   13 SKCS Hardness Index 78.4 72.1 79.8 72.0 80.2 79.2 78.6 82.4 76.4 78   14 Vitreous Kernels (%) 72 52 89 68 99 100 87 88 96 94   Flour Extraction (%)   15 Tempered Wheat Basis (%) 72.1 72.9 72.6 73.3 72.0 73.0 72.1 72.9 71.9 73.0   17 Flour Color Brightmess (L') 89.8 89.4 90.5 90.3 90.7 89.7 90.1 90.5 89.9 90.6 9.5 10.0 9.9 9.4 9.	9	Kernel Size, % Small	6	6	9	9	21	14	11	20	6	9
11 Wheat Ash (%, 14% mb) 1.59 1.43 1.83 1.57 1.56 1.39 1.56 1.55 1.41 1.3   12 Wheat Falling Number (sec) 378 358 412 394 430 508 386 395 390 38   13 SKCS Hardness Index 78.4 78.4 78.4 78.4 78.4 78.4 78.4 78.4 78.4 78.4 78.4 78.4 78.4 78.4 78.4 78.4 78.4 78.4 78.6 78.4 78.4 78.4 78.4 78.4 78.4 78.4 78.6 78.4 78.4 78.4 78.4 78.4 78.4 78.6 78.4 78.6 78.4 78.6 78.4 78.5 79.1 9	10	Wheat Moisture (%)	13.7	13.6	11.8	11.5	9.5	9.1	13.3	12.8	11.2	11.4
12 Wheat Falling Number (sec) 378 358 412 394 430 508 386 395 390 38   13 SKCS Hardness Index 78.4 72.1 79.8 72.0 80.2 79.2 78.6 82.4 76.4 78.8 96 99 100 87 88 96 99   Flour Extraction (%)   Flour Extraction (%)   16 Tempered Wheat Basis (%) 68.2 69.6 68.1 69.1 68.9 69.7 68.7 69.3 68.2 69   Flour Wheat Basis (%) 72.1 72.9 72.6 73.3 72.0 73.0 72.1 72.9 71.9 73   Flour Color Brightness (L*) 89.8 89.4 90.5 90.5 90.3 90.7 89.7 90.1 90.5 89   Flour Color Brightness (L*) 89.8 89.4 90.5 90.5 90.3 90.7 89.7 90.1 90.5 89   Flour Color Brightness (L*) 89.8 89.4 90.5 90.5	11	Wheat Ash (%, 14% mb)	1.59	1.43	1.83	1.57	1.56	1.39	1.56	1.55	1.41	1.35
13 SKCS Hardness Index Vitreous Kernels (%) 78.4 72.1 79.8 72.0 80.2 79.2 78.6 82.4 76.4 78   14 Vitreous Kernels (%) 72 52 89 68 99 100 87 88 96 99   Flour Extraction (%)   15 Tempered Wheat Basis (%) 72.1 72.0 73.3 72.0 73.0 72.1 72.9 73.0 72.1 72.9 73.0 72.0 73.0 72.1 72.9 73.0 72.0 73.0 72.1 72.9 73.0 72.0 73.0 72.1 72.9 73.0 72.1 72.9 73.0 72.1 72.9 73.0 72.0 73.0 72.1 72.9 73.0 72.0 73.0 72.1 72.9 73.0 72.1 72.9 73.0 72.0 73.0 72.1 72.9 73.0 72.1 72.9 73.0 72.1 72.9 73.1 73.7 72.0 73.0 72.1 73.9 74.3 73.1 73.1 73.1 73.1 73.1 73.1<	12	Wheat Falling Number (sec)	378	358	412	394	430	508	386	395	390	382
14 Vitreous Kernels (%) 72 52 89 68 99 100 87 88 96 94   Flour Extraction (%)   15 Tempered Wheat Basis (%) 68.2 69.6 68.1 69.1 68.9 69.7 68.7 69.3 68.2 69   16 Total Product Basis (%) 72.1 72.9 72.6 73.3 72.0 73.0 72.1 72.9 71.9 73   17 Flour/Bu Wheat (lbs) 41.8 43.0 44.9 45.0 43.7 44.3 43.4 42.8 46.0 45   Flour Color Brightness (L*)   18 Flour Color Yellowness (b*) 9.0 9.6 9.5 10.0 9.9 9.4 9.6 10.5 9.4 10   20 Flour Ash (%, 14% mb) 0.49 0.45 0.48 0.46 0.48 0.45 0.48 0.46 0.42 247 249 248 25   Flour Color Sightne (Mated) (sec) 255 259 247 258 245 240 247 249 <td>13</td> <td>SKCS Hardness Index</td> <td>78.4</td> <td>72.1</td> <td>79.8</td> <td>72.0</td> <td>80.2</td> <td>79.2</td> <td>78.6</td> <td>82.4</td> <td>76.4</td> <td>78.5</td>	13	SKCS Hardness Index	78.4	72.1	79.8	72.0	80.2	79.2	78.6	82.4	76.4	78.5
Flour Extraction (%)     15   Tempered Wheat Basis (%)   68.2   69.6   68.1   69.1   68.9   69.7   72.1   72.9   72.6   73.3   72.0   73.0   72.1   72.9   71.9   73     17   Flour/Bu Wheat (lbs)   41.8   43.0   44.9   45.0   43.7   44.3   43.4   42.8   46.0   45     Flour Color Brightness (L*)   89.8   89.4   90.5   90.5   90.3   90.7   89.7   90.1   90.5   89.7     19   Flour Color Brightness (L*)   89.8   89.4   90.5   90.5   90.3   90.7   89.7   90.1   90.5   89.7     20   Flour Moisture (%)   13.1   13.8   13.4   13.3   13.1   13.0   13.1   13.3   13.1   12.0   13.1   13.3   13.1   12.0   13.1   13.3   13.1   12.0     21   Flour Ash (%, 14% mb)   0.49   0.45   0.48   0.46   0.48	14	Vitreous Kernels (%)	72	52	89	68	99	100	87	88	96	94
15 Tempered Wheat Basis (%) 68.2 69.6 68.1 69.1 68.9 69.7 68.7 69.3 68.2 69   16 Total Product Basis (%) 72.1 72.9 72.6 73.3 72.0 73.0 72.1 72.9 71.9 73   17 Flour/Bu Wheat (lbs) 41.8 43.0 44.9 45.0 43.7 44.3 43.4 42.8 46.0 45   Flour Quality   18 Flour Color Brightness (L*) 9.0 9.6 9.5 10.0 9.9 9.4 9.6 10.5 9.4 10.5 10.7 13.1 13.3 13		Flour Extraction (%)										
16 Total Product Basis (%) 72.1 72.9 72.6 73.3 72.0 73.0 72.1 72.9 71.9 73   17 Flour/Bu Wheat (lbs) 41.8 43.0 44.9 45.0 43.7 44.3 43.4 42.8 46.0 45   Flour Quality   18 Flour Color Brightness (L*) 9.0 9.6 9.5 90.5 90.3 90.7 89.7 90.1 90.5 89   19 Flour Color Yellowness (b*) 9.0 9.6 9.5 10.0 9.9 9.4 9.6 10.5 9.4 10   20 Flour Ash (%, 14% mb) 0.49 0.45 0.48 0.46 0.48 0.46 0.48 0.46 0.48 0.46 0.48 0.48 0.46 0.48 0.45 0.48 0.45 0.48 0.57 63.9   22 Flour Falling Number (Matted) (sec) 255 259 247 258 245 240 247 249 248 25   23 Water Absorption (%, 500 BU) 67.2 64.7 63.5	15	Tempered Wheat Basis (%)	68.2	69.6	68.1	69.1	68.9	69.7	68.7	69.3	68.2	69.9
17 Flour/Bu Wheat (lbs) 41.8 43.0 44.9 45.0 43.7 44.3 43.4 42.8 46.0 45   Flour Quality   18 Flour Color Brightness (L*) 89.8 89.4 90.5 90.5 90.3 90.7 89.7 90.1 90.5 89   19 Flour Color Yellowness (b*) 9.0 9.6 9.5 10.0 9.9 9.4 9.6 10.5 9.4 10   20 Flour Moisture (%) 13.1 13.8 13.4 13.3 13.1 13.0 13.1 13.3 13.1 12.2   21 Flour Ash (%, 14% mb) 0.49 0.45 0.48 0.46 0.48 0.45 0.48 0.46 0.4   22 Flour Falling Number (Malted) (sec) 255 259 247 258 245 240 247 249 248 25   Fainograph   23 Water Absorption (%, 500 BU) 67.2 64.7 63.5 61.5 66.3 66.3 64.0 62.1 66.9 64.   <	16	Total Product Basis (%)	72.1	72.9	72.6	73.3	72.0	73.0	72.1	72.9	71.9	73.3
Flour Quality   18 Flour Color Brightness (L*) 89.8 89.4 90.5 90.5 90.3 90.7 89.7 90.1 90.5 89   19 Flour Color Yellowness (b*) 9.0 9.6 9.5 10.0 9.9 9.4 9.6 10.5 9.4 10   20 Flour Moisture (%) 13.1 13.8 13.4 13.3 13.1 13.0 13.1 13.3 13.1 12   21 Flour Ash (%, 14% mb) 0.49 0.45 0.48 0.46 0.48 0.45 0.48 0.46 0.48 0.48 0.	17	Flour/Bu Wheat (lbs)	41.8	43.0	44.9	45.0	43.7	44.3	43.4	42.8	46.0	45.9
18 Flour Color Brightness (L*) 89.8 89.4 90.5 90.5 90.3 90.7 89.7 90.1 90.5 89   19 Flour Color Yellowness (b*) 9.0 9.6 9.5 10.0 9.9 9.4 9.6 10.5 9.4 10.5 9.4 10   20 Flour Moisture (%) 13.1 13.8 13.4 13.3 13.1 13.0 13.1 13.3 13.1 12.3   21 Flour Ash (%, 14% mb) 0.49 0.45 0.48 0.46 0.48 0.45 0.48 0.46 0.48 0.45 0.48 0.46 0.48 0.45 0.48 0.46 0.42   22 Flour Falling Number (Malted) (sec) 255 259 247 258 240 247 249 248 25   Farinograph   23 Water Absorption (%, 500 BU) 67.2 64.7 63.5 61.5 66.3 64.0 62.1 66.9 64.   24 Water Absorption (%, 14% mb) 66.2 64.6 62.8 60.7 65.0 65.3		Flour Quality										
19 Flour Color Yellowness (b*) 9.0 9.6 9.5 10.0 9.9 9.4 9.6 10.5 9.4 10.5 9.6 10.5 10.5 9.4 10.5 10.5 9.6 10.5 10.5 10.5 10.5 10.5 10.	18	Flour Color Brightness (/*)	89.8	89 4	90.5	90.5	90.3	90 7	89 7	90 1	90.5	89.9
10 Flour Noistre (%) 13.1 13.8 13.4 13.3 13.1 13.1 13.3 13.1 13.1 13.1 13.1 13.1 13.1 13.1 13.1 13.1 13.1 13.1 13.1 13.1 13.1 13.1 13.1	19	Flour Color Yellowness (b*)	9.0	9.6	9.5	10.0	9.9	94	9.6	10.5	94	10.2
21 Flour Ash (%, 14% mb) 0.49 0.45 0.48 0.46 0.48 0.46 0.48 0.48 0.48 0.46 0.42   22 Flour Falling Number (Malted) (sec) 255 259 247 258 245 240 247 249 248 25   Farinograph   23 Water Absorption (%, 500 BU) 67.2 64.7 63.5 61.5 66.3 66.3 64.0 62.1 66.9 64.   24 Water Absorption (%, 500 BU) 66.2 64.6 62.8 60.7 65.0 65.3 63.0 61.3 65.7 63.   25 Arrival Time (min) 3.6 4.5 3.1 2.7 5.4 4.8 4.2 3.2 4.6 3.2   26 Peak Time (min) 8.5 7.9 7.5 6.3 10.7 8.5 9.3 6.7 8.0 7.2   27 Dough Stability (min) 12.3 8.9 9.3 8.0 13.5 13.3 11.8 10.0 8.8 8.2   28 Mixing Tolerance In	20	Flour Moisture (%)	13.1	13.8	13.4	13.3	13.1	13.0	13.1	13.3	13.1	12.9
22 Flour Falling Number (Malted) (sec) 255 259 247 258 245 240 247 249 248 255   Farinograph   23 Water Absorption (%, 500 BU) 67.2 64.7 63.5 61.5 66.3 66.3 64.0 62.1 66.9 64.4   24 Water Absorption (%, 14% mb) 66.2 64.6 62.8 60.7 65.0 65.3 63.0 61.3 65.7 63.2   25 Arrival Time (min) 3.6 4.5 3.1 2.7 5.4 4.8 4.2 3.2 4.6 3.2   26 Peak Time (min) 8.5 7.9 7.5 6.3 10.7 8.5 9.3 6.7 8.0 7.2   27 Dough Stability (min) 12.3 8.9 9.3 8.0 13.5 13.3 11.8 10.0 8.8 8.2   28 Mixing Tolerance Index (MTI) (BU) 27 27 31 37 24 12 24 21 25 32   29 Time To Breakdown (TTB) (min) <td< td=""><td>21</td><td>Flour Ash (%, 14% mb)</td><td>0.49</td><td>0.45</td><td>0.48</td><td>0.46</td><td>0.48</td><td>0.45</td><td>0.48</td><td>0.48</td><td>0.46</td><td>0.47</td></td<>	21	Flour Ash (%, 14% mb)	0.49	0.45	0.48	0.46	0.48	0.45	0.48	0.48	0.46	0.47
Farinograph   23 Water Absorption (%, 500 BU) 67.2 64.7 63.5 61.5 66.3 66.3 64.0 62.1 66.9 64   24 Water Absorption (%, 14% mb) 66.2 64.6 62.8 60.7 65.0 65.3 63.0 61.3 65.7 63.3   25 Arrival Time (min) 3.6 4.5 3.1 2.7 5.4 4.8 4.2 3.2 4.6 3.2   26 Peak Time (min) 8.5 7.9 7.5 6.3 10.7 8.5 9.3 6.7 8.0 7.2   27 Dough Stability (min) 12.3 8.9 9.3 8.0 13.5 13.3 11.8 10.0 8.8 8.7   28 Mixing Tolerance Index (MTI) (BU) 27 27 31 37 24 12 24 21 25 3''   29 Time To Breakdown (TTB) (min) 13.9 13.0 12.1 10.8 17.9 17.3 14.6 12.6 13.4 12   30 Bake Absorption (Average %)	22	Flour Falling Number (Malted) (sec)	255	259	247	258	245	240	247	249	248	252
23 Water Absorption (%, 500 BU) 67.2 64.7 63.5 61.5 66.3 64.0 62.1 66.9 64   24 Water Absorption (%, 14% mb) 66.2 64.6 62.8 60.7 65.0 65.3 63.0 61.3 65.7 63.3   25 Arrival Time (min) 3.6 4.5 3.1 2.7 5.4 4.8 4.2 3.2 4.6 3.4   26 Peak Time (min) 8.5 7.9 7.5 6.3 10.7 8.5 9.3 6.7 8.0 7.2   27 Dough Stability (min) 12.3 8.9 9.3 8.0 13.5 13.3 11.8 10.0 8.8 8.4   28 Mixing Tolerance Index (MTI) (BU) 27 27 31 37 24 12 24 21 25 3''   29 Time To Breakdown (TTB) (min) 13.9 13.0 12.1 10.8 17.9 17.3 14.6 12.6 13.4 12   30 Bake Absorption (Average %) 68.6 67.3 65.8 64.3 <t< td=""><td></td><td>Farinograph</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>		Farinograph										
24 Water Absorption (%, 14% mb) 66.2 64.6 62.8 60.7 65.0 65.3 63.0 61.3 65.7 63   25 Arrival Time (min) 3.6 4.5 3.1 2.7 5.4 4.8 4.2 3.2 4.6 3.0   26 Peak Time (min) 3.6 4.5 3.1 2.7 5.4 4.8 4.2 3.2 4.6 3.0   27 Dough Stability (min) 12.3 8.9 9.3 8.0 13.5 13.3 11.8 10.0 8.8 8.4   28 Mixing Tolerance Index (MTI) (BU) 27 27 31 37 24 12 24 21 25 3''   29 Time To Breakdown (TTB) (min) 13.9 13.0 12.1 10.8 17.9 17.3 14.6 12.6 13.4 12   II. Cooperator Results 30 Bake Absorption (Average %) 68.6 67.3 65.8 64.3 68.8 66.5 65.2 68.0 66.5	23	Water Absorption (% 500 BU)	67.2	64 7	63 5	61.5	66.3	66.3	64 0	62 1	66.9	64 5
25 Arrival Time (min) 3.6 4.5 3.1 2.7 5.4 4.8 4.2 3.2 4.6 3.   26 Peak Time (min) 8.5 7.9 7.5 6.3 10.7 8.5 9.3 6.7 8.0 7.   27 Dough Stability (min) 12.3 8.9 9.3 8.0 13.5 13.3 11.8 10.0 8.8 8.9   28 Mixing Tolerance Index (MTI) (BU) 27 27 31 37 24 12 24 21 25 3''   29 Time To Breakdown (TTB) (min) 13.9 13.0 12.1 10.8 17.9 17.3 14.6 12.6 13.4 12   II. Cooperator Results   30 Bake Absorption (Average %) 68.6 67.3 65.8 64.3 68.8 66.5 65.2 68.0 66.5	24	Water Absorption (% 14% mb)	66.2	64.6	62.8	60.7	65.0	65.3	63.0	61.3	65.7	63 1
26 Peak Time (min) 8.5 7.9 7.5 6.3 10.7 8.5 9.3 6.7 8.0 7.2   27 Dough Stability (min) 12.3 8.9 9.3 8.0 13.5 13.3 11.8 10.0 8.8 8.8   28 Mixing Tolerance Index (MTI) (BU) 27 27 31 37 24 12 24 21 25 3''   29 Time To Breakdown (TTB) (min) 13.9 13.0 12.1 10.8 17.9 17.3 14.6 12.6 13.4 12   II. Cooperator Results   30 Bake Absorption (Average %) 68.6 67.3 65.8 64.3 68.8 66.5 65.2 68.0 66.5	25	Arrival Time (min)	3.6	4.5	31	27	54	4.8	42	32	4.6	3.5
27 Dough Stability (min) 12.3 8.9 9.3 8.0 13.5 13.3 11.8 10.0 8.8 8.8   28 Mixing Tolerance Index (MTI) (BU) 27 27 23 31 37 24 12 24 21 25 3'   29 Time To Breakdown (TTB) (min) 13.9 13.0 12.1 10.8 17.9 17.3 14.6 12.6 13.4 12   II. Cooperator Results   30 Bake Absorption (Average %) 68.6 67.3 65.8 64.3 68.8 66.5 65.2 68.0 66.5	26	Peak Time (min)	8.5	7.9	7.5	6.3	10.7	8.5	9.3	6.7	8.0	7.2
28   Mixing Tolerance Index (MTI) (BU)   27   27   31   37   24   12   24   21   25   3*     29   Time To Breakdown (TTB) (min)   13.9   13.0   12.1   10.8   17.9   17.3   14.6   12.6   13.4   12     II.   Cooperator Results   30   Bake Absorption (Average %)   68.6   67.3   65.8   64.3   68.8   68.8   66.5   65.2   68.0   66.5	27	Dough Stability (min)	12.3	8.9	9.3	8.0	13.5	13.3	11.8	10.0	8.8	8.4
29 Time To Breakdown (TTB) (min) 13.9 13.0 12.1 10.8 17.9 17.3 14.6 12.6 13.4 12   II. Cooperator Results   30 Bake Absorption (Average %) 68.6 67.3 65.8 64.3 68.8 66.5 65.2 68.0 66.5	28	Mixing Tolerance Index (MTI) (BU)	27	27	31	37	24	12	24	21	25	31
II. Cooperator Results     30   Bake Absorption (Average %)   68.6   67.3   65.8   64.3   68.8   66.5   65.2   68.0   66.5	29	Time To Breakdown (TTB) (min)	13.9	13.0	12.1	10.8	17.9	17.3	14.6	12.6	13.4	12.1
30 Bake Absorption (Average %) 68.6 67.3 65.8 64.3 68.8 68.8 66.5 65.2 68.0 66.		II Cooperator Results										
	30	Bake Absorption (Average %)	68 6	67.3	65.8	64.3	68.8	68.8	66 5	65.2	68.0	66.5
31 Loaf Volume (% of Check) 93.8 95.5 99.4 99.1 96	31	Loaf Volume (% of Check)	00.0	93.8	00.0	95.5	00.0	99.4	00.0	99.1	00.0	96.2

## SWQC #8 – LCS Cannon

		Watert	own	Casse	lton	Hav	re	Crook	ston	Min	ot
	Quality Trait	Glenn B-3	<b>B</b> _8	Glenn	C-8	Glenn	н_8	Glenn	K-8	Glenn M-3	M_8
	II. Cooperator Results	D-3	D-0	0-5	0-0	11-5	11-0	N-5	N-0	IVI-5	IVI-O
32	Mixing Requirement 9 = Very Long 7 = Long 5 = Medium 3 = Short 1 = Very Short	5.8	4.8	6.2	4.7	6.4	6.3	6.4	5.6	5.7	5.1
33	Dough Characteristics 9 = Bucky – Tough 7 = Strong – Elastic 5 = Medium – Pliable 3 = Mellow – Very Pliable 1 = Weak – Short or Sticky	7.1	5.7	6.8	5.6	7.2	7.2	7.1	6.3	6.8	5.4
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		3.8		3.8		5.3		4.6		4.0
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		4.9		5.0		6.0		4.8		4.7
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		5.1		5.8		4.9		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		4.1		4.0		4.3		3.8		3.6
	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		6.0		5.3		6.3		5.2		5.3
	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		3.9		4.4		6.0		4.6		4.4
	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		4.0		4.3		5.9		4.4		4.5

## Farinograms

![](_page_45_Figure_1.jpeg)

#### Glenn Check (Watertown, B-3) [FU]

B-8 700 600 500 400 300 200 100 0 12 14 18 20 [min]

LCS Cannon (Watertown, B-8)

Glenn Check (Casselton, C-3)

![](_page_45_Figure_5.jpeg)

Glenn Check (Havre, H-3)

![](_page_45_Figure_7.jpeg)

LCS Cannon (Casselton, C-8)

![](_page_45_Figure_9.jpeg)

![](_page_45_Figure_10.jpeg)

LCS Cannon (Havre, H-8)

![](_page_46_Figure_0.jpeg)

#### Glenn Check (Crookston, K-3)

Glenn Check (Minot, M-3)

![](_page_46_Figure_3.jpeg)

LCS Cannon (Crookston, K-8)

![](_page_46_Figure_5.jpeg)

LCS Cannon (Minot, M-8)

![](_page_46_Figure_7.jpeg)

#### **Mixograms**

![](_page_47_Figure_1.jpeg)

Glenn Check (Casselton, C-3)

![](_page_47_Figure_3.jpeg)

Glenn Check (Havre, H-3)

LCS Cannon (Watertown, B-8)

LCS Cannon (Casselton, C-8)

![](_page_47_Figure_7.jpeg)

![](_page_48_Figure_0.jpeg)

![](_page_48_Figure_1.jpeg)

![](_page_48_Figure_2.jpeg)

![](_page_48_Figure_3.jpeg)

#### **Extensograms**

![](_page_49_Figure_1.jpeg)

Glenn Check (Casselton, C-3)

C-3

[BU]

#### [BU] B-8 [cm]

#### LCS Cannon (Watertown, B-8)

![](_page_49_Figure_4.jpeg)

![](_page_49_Figure_5.jpeg)

![](_page_49_Figure_6.jpeg)

[cm]

![](_page_49_Figure_7.jpeg)

![](_page_50_Figure_0.jpeg)

#### SWQC #9 – MN10201-4-A

		Water	town	Cass	elton	Croo	kston
		Glenn		Glenn		Glenn	
	Quality Trait	B-3	B-9	C-3	C-9	K-3	K-9
	I. USDA-ARS WQL Data						
1	Wheat Protein (%, 12% mb)	16.5	16.4	14.4	12.4	15.9	14.5
2	Flour Protein (%, 14% mb)	15.4	15.4	13.5	11.6	15.2	13.7
3	Market Value (Score 1-6)	4.8	4.9	4.2	3.8	4.7	3.8
4	Market Value (Score 1-10)	10.0	10.0	10.0	7.4	10.0	8.0
5	DON (ppm)	0.22	0.31	0.10	0.41	0.42	1.32
6	Test Weight (Ib/bu)	61.8	60.9	64.8	62.1	63.3	60.8
7	1000 Kernel Weight (g)	33.4	33.7	30.3	31.7	29.1	28.7
8	Kernel Size, % Large	66	69	52	53	52	47
9	Kernel Size, % Small	6	7	9	12	11	15
10	Wheat Moisture (%)	13.7	13.6	11.8	11.6	13.3	13.1
11	Wheat Ash (%, 14% mb)	1.59	1.50	1.83	1.55	1.56	1.66
12	Wheat Falling Number (sec)	378	411	412	415	386	407
13	SKCS Hardness Index	78.4	69.2	79.8	74.2	78.6	73.5
14	Vitreous Kernels (%)	72	81	89	82	87	84
	Flour Extraction (%)						
15	Tempered Wheat Basis (%)	68.2	69.4	68.1	69.5	68.7	69.8
16	Total Product Basis (%)	72.1	72.8	72.6	73.1	72.1	73.9
17	Flour/Bu Wheat (lbs)	41.8	42.1	44.9	44.0	43.4	42.5
	Flour Quelity						
40	Flour Quality	00.0	00.4	00 E	00.4	90 7	00.0
18	Flour Color Brightness (L*)	89.8	89.1	90.5	90.4	89.7	89.Z
19	Flour Color fellowness $(D^{*})$	9.0	11.5	9.5	11.4	9.0	12.0
20	FIGUR MOISTURE ( $\%$ )	0.40	13.0	13.4	13.3	13.1	0.45
21	Flour ASII (70, 1470 IIID)	0.49	250	0.40	0.44	0.40	0.45
22	Flour Failing Number (Mailed) (Sec)	200	200	241	201	24/	209
	Earinograph						
23	Water Absorption (% 500 BU)	67.2	62 7	63.5	58.8	64 0	59 1
24	Water Absorption (%, 14% mb)	66.2	62 1	62.8	58.1	63.0	58.3
25	Arrival Time (min)	3.6	4.0	3.1	2.1	4.2	3.6
26	Peak Time (min)	8.5	8.3	7.5	7.0	9.3	8.5
27	Dough Stability (min)	12.3	11.6	9.3	9.3	11.8	11.0
28	Mixing Tolerance Index (MTI) (BU)	27	19	31	33	24	25
29	Time To Breakdown (TTB) (min)	13.9	14.8	12.1	11.6	14.6	13.7
	II. Cooperator Results						
30	Bake Absorption (Average %)	68.6	65.9	65.8	61.9	66.5	62.9
31	Loaf Volume (% of Check)		93.5		95.8		100.0

## SWQC #9 - MN10201-4-A

		Water	town	Casse	lton	Crook	ston
		Glenn		Glenn		Glenn	
	Quality Trait	B-3	B-9	C-3	C-9	K-3	K-9
	II. Cooperator Results						
32	Mixing Requirement 9 = Very Long 7 = Long 5 = Medium 3 = Short 1 = Very Short	5.8	5.3	6.2	4.8	6.4	6.0
33	Dough Characteristics 9 = Bucky – Tough 7 = Strong – Elastic 5 = Medium – Pliable 3 = Mellow – Very Pliable 1 = Weak – Short or Sticky	7.1	5.5	6.8	5.3	7.1	5.8
34	<b>Mixing Tolerance</b> 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		4.1		3.8		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		3.5		4.0		3.7
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		4.9		5.3		5.1
	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		4.6		2.8		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		6.2		5.3		5.9
	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		3.6		3.8		4.3
	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		4.2		3.8		4.4

#### **Farinograms**

![](_page_53_Figure_1.jpeg)

## Glenn Check (Watertown, B-3)

Glenn Check (Casselton, C-3)

![](_page_53_Figure_4.jpeg)

Glenn Check (Crookston, K-3)

![](_page_53_Figure_6.jpeg)

MN10201-4-A (Watertown, B-9)

![](_page_53_Figure_8.jpeg)

MN10201-4-A (Casselton, C-9)

![](_page_53_Figure_10.jpeg)

MN10201-4-A (Crookston, K-9)

![](_page_53_Figure_12.jpeg)

#### **Mixograms**

![](_page_54_Figure_1.jpeg)

Glenn Check (Casselton, C-3)

![](_page_54_Figure_3.jpeg)

![](_page_54_Figure_4.jpeg)

HINT TO ZO T -4-AC (VValler TOWT, D-9)

![](_page_54_Figure_6.jpeg)

![](_page_54_Figure_7.jpeg)

MN10201-4-A (Watertown, B-9)

#### **Extensograms**

![](_page_55_Figure_1.jpeg)

#### Glenn Check (Casselton, C-3)

![](_page_55_Figure_3.jpeg)

Glenn Check (Crookston, K-3)

![](_page_55_Figure_5.jpeg)

MN10201-4-A (Watertown, B-9)

![](_page_55_Figure_7.jpeg)

MN10201-4-A (Casselton, C-9)

![](_page_55_Figure_9.jpeg)

MN10201-4-A (Crookston, K-9)

![](_page_55_Figure_11.jpeg)

![](_page_55_Figure_12.jpeg)

#### SWQC #10 - SD4539

		Water	town	Cass	elton	Crook	ston
		Glenn		Glenn		Glenn	
	Quality Trait	B-3	B-10	C-3	C-10	K-3	K-10
	I. USDA-ARS WQL Data						
1	Wheat Protein (%, 12% mb)	16.5	15.9	14.4	13.1	15.9	14.9
2	Flour Protein (%, 14% mb)	15.4	14.8	13.5	12.1	15.2	14.0
3	Market Value (Score 1-6)	4.8	5.1	4.2	3.8	4.7	3.9
4	Market Value (Score 1-10)	10.0	9.4	10.0	8.0	10.0	8.4
5	DON (ppm)	0.22	0.11	0.10	0.38	0.42	1.32
6	Test Weight (lb/bu)	61.8	61.2	64.8	62.1	63.3	60.4
7	1000 Kernel Weight (g)	33.4	34.6	30.3	30.5	29.1	27.5
8	Kernel Size, % Large	66	68	52	49	52	35
9	Kernel Size, % Small	6	8	9	12	11	22
10	Wheat Moisture (%)	13.7	13.7	11.8	11.7	13.3	13.0
11	Wheat Ash (%, 14% mb)	1.59	1.46	1.83	1.75	1.56	1.71
12	Wheat Falling Number (sec)	378	454	412	446	386	466
13	SKCS Hardness Index	78.4	71.8	79.8	70.4	78.6	78.2
14	Vitreous Kernels (%)	72	64	89	67	87	87
	Flour Extraction (%)						
15	Tempered Wheat Basis (%)	68.2	67.0	68.1	70.2	68.7	66.9*
16	Total Product Basis (%)	72.1	70.6	72.6	74.5	72.1	73.1*
17	Flour/Bu Wheat (lbs)	41.8	40.8	44.9	44.4	43.4	40.8*
	Flour Quality						
18	Flour Color Brightness (L*)	89.8	89.7	90.5	90.8	89.7	89.5
19	Flour Color Yellowness (b*)	9.0	9.3	9.5	9.8	9.6	9.6
20	Flour Moisture (%)	13.1	13.5	13.4	13.3	13.1	12.9
21	Flour Ash (%, 14% mb)	0.49	0.41	0.48	0.45	0.48	0.46
22	Flour Falling Number (Malted) (sec)	255	254	247	250	247	244
	E seine suren b						
22	Farinograph	67.0	<b>CE C</b>	C0 E	CO 0	C4 0	<b>CO O</b>
23	Water Absorption (%, 500 BU)	67.2	05.0	03.5	60.Z	64.0	62.2
24	water Absorption (%, 14% mb)	2 6	65.0	02.0	59.3	63.0	00.9
25	Arrival Time (min)	3.0 0 E	4.3	3.1 7 E	2.2	4.2	১.1 স হ
20	Peak Time (min)	0.0 40.0	9.4	1.5	0.4	9.3	1.3
21	Dough Stability (Min) Mixing Toloranco Index (MTI) (PU)	27	24	9.5	9.2	24	10
20 20	Time To Breakdown (TTP) (min)	12 0	24 15 9	12.1	33	24	14.2
23	Time To Breakdown (TTB) (mm)	13.9	13.0	12.1	11.1	14.0	14.2
	II. Cooperator Results						
30	Bake Absorption (Average %)	68.6	67.4	65.8	63.1	66.5	65.2
31	Loaf Volume (% of Check)		94.7		96.3		101.8

\*There was a mill malfunction and the sample had to be discarded. Remaining sample (66 lbs) was then milled but the yields decreased some due to the small sample size (minimum of 90 lbs is needed to achieve optimum yields).

## SWQC #10 – SD4539

		Water	town	Casse	elton	Crook	ston
	Quality Trait	Glenn B-3	B-10	Glenn C-3	C-10	Glenn K-3	K-10
32	II. Cooperator Results Mixing Requirement 9 = Very Long 7 = Long 5 = Medium 3 = Short 1 = Very Short	5.8	5.7	6.2	5.6	6.4	6.0
33	Dough Characteristics 9 = Bucky – Tough 7 = Strong – Elastic 5 = Medium – Pliable 3 = Mellow – Very Pliable 1 = Weak – Short or Sticky	7.1	6.3	6.8	5.8	7.1	6.2
34	<b>Mixing Tolerance</b> 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		4.8		4.8		4.4
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		5.1		5.4		5.3
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		4.8		5.8		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		4.0		3.8		3.7
	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		4.4		6.0		4.4
	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		4.3		4.8		5.3
	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		4.3		5.0		4.4

## Farinograms

![](_page_58_Figure_1.jpeg)

Glenn Check (Watertown, B-3)

Glenn Check (Casselton, C-3)

![](_page_58_Figure_4.jpeg)

Glenn Check (Crookston, K-3)

![](_page_58_Figure_6.jpeg)

SD4539 (Watertown, B-10)

![](_page_58_Figure_8.jpeg)

SD4539 (Casselton, C-10)

![](_page_58_Figure_10.jpeg)

SD4539 (Crookston, K-10)

![](_page_58_Figure_12.jpeg)

#### **Mixograms**

![](_page_59_Figure_1.jpeg)

Glenn Check (Casselton, C-3)

![](_page_59_Figure_3.jpeg)

![](_page_59_Figure_4.jpeg)

SD4539 (Watertown, B-10)

![](_page_59_Figure_6.jpeg)

SD4539 (Casselton, C-10)

![](_page_59_Figure_8.jpeg)

![](_page_59_Figure_9.jpeg)

#### **Extensograms**

![](_page_60_Figure_1.jpeg)

#### SD4539 (Watertown, B-10)

![](_page_60_Figure_3.jpeg)

SD4539 (Casselton, C-10)

C-10

[cm]

#### Glenn Check (Casselton, C-3)

![](_page_60_Figure_5.jpeg)

Glenn Check (Crookston, K-3)

![](_page_60_Figure_7.jpeg)

[BU]

400-

100-

![](_page_60_Figure_8.jpeg)

## Appendix

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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 Mai	keting Sc	ore or Export l	Marketin	g Score	
	Score	Test Weight (Ib/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 (+/-) fro	m Target Value	1	3 g up, 4 g down	25	1.0	0.10

#### Wheat Marketing Score – Method #1

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 (Ib/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	$-1 \le \text{Diff} \le 2$	Diff ≥ -25	$-2 \le \text{Diff} \le 4$	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	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)

#### Miag Mill Streams

		Mill			
Mill Stream	Abbreviation	Stream #		Product	
1 <sup>st</sup> Break	1 Bk	1			
2 <sup>nd</sup> Break I	2 Bk I	2			
Break Dust	Bk Dust	3			
Sizing I	Sz I	4			
2 <sup>nd</sup> Break II	2 Bk II	5			
3 <sup>rd</sup> Break	3 Bk	6			
Sizing II	Sz II	7			
5 <sup>th</sup> Break	5 Bk	8	Long		
4 <sup>th</sup> Break	4 Bk	9	Flour	Straight	
1 <sup>st</sup> Middlings	1 M	10	1 IOUI	Grade	
2 <sup>nd</sup> Middlings	2 M	11		Flour	Whole
3 <sup>rd</sup> Middlings	3 M	12			Wheat
4 <sup>th</sup> Middlings	4 M	13			Flour
6 <sup>th</sup> Middlings	6 M	15			
Tail Flour	Tail	16			
Tail Cyclone Flour*	TC	22			
5 <sup>th</sup> Middlings	5 M	14	Clear		
Low Grade	LG	17	Flour		
Low Quality	LQ	18	Tiour		
Tail Shorts	Tail Sh	19		1	
Head Shorts	Head Sh	20	Short & Bran		
Bran	Bran	21			
Tail Cyclone Shorts*	TC Sh	23			

\*Tail Cyclone fraction was separated into flour and short by rebolting.

#### Calculation of flour extraction:

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

#### **Miag Multomat Mill Flow Chart**

(Hard Red Spring & Durum Wheat Quality Laboratory, Cereal Crops Research Unit, USDA-ARS-RRVARC, Fargo, ND)

![](_page_65_Figure_2.jpeg)

Sieve Opening Size - µm

## Wheat Kernel Characteristics by Location

			Wheat					1000							
			Wheat Marketing			Test	Kernel	Kernel Size		Wheat	Wheat	Falling	SKCS	Vitreous	
			Protein	Sc	ore	DON	Weight	Weight	Large	Small	Moisture	Ash	Number	Hardness	Kernels
Location	ID	Entry	<u>(%, 12% mb)</u>	1-6	1-10	(ppm)	(lbs/bu)	<u>(g)</u>	(%)	(%)	(%)	<u>(%, 14% mb)</u>	(sec)	Index	(%)
	B-1	SY McCloud	16.1	4.8	9.6	0.34	61.6	37.9	81	4	13.8	1.58	364	72.3	59
	B-3	Glenn	16.5	4.8	10.0	0.22	61.8	33.4	66	6	13.7	1.59	378	78.4	72
Watertown	B-7	Linkert	16.2	5.1	9.6	0.81	60.3	36.8	77	5	13.5	1.53	425	74.5	65
	B-8	LCS Cannon	16.0	4.8	10.0	0.25	61.9	35.2	76	6	13.6	1.43	358	72.1	52
	B-9	MN10201-4-A	16.4	4.9	10.0	0.31	60.9	33.7	69	7	13.6	1.50	411	69.2	81
	B-10	SD4539	15.9	5.1	9.4	0.11	61.2	34.6	68	8	13.7	1.46	454	71.8	64
	C-1	SY McCloud	13.7	4.5	9.4	0.26	63.8	34.2	71	7	12.4	1.64	413	76.4	67
	C-2	PMWH25131094	12.8	4.1	7.8	nd	63.0	31.4	49	13	11.9	1.67	430	76.2	69
	C-3	Glenn	14.4	4.2	10.0	0.10	64.8	30.3	52	9	11.8	1.83	412	79.8	89
Casselton	C-6	PMWH25180325	12.3	3.7	7.8	0.06	63.3	33.4	65	9	12.1	1.76	396	70.2	70
	C-7	Linkert	14.6	4.6	9.2	1.14	62.1	33.8	64	6	11.3	1.65	460	71.3	76
	C-8	LCS Cannon	13.4	4.1	9.4	0.23	63.8	31.3	59	9	11.5	1.57	394	72.0	68
	C-9	MN10201-4-A	12.4	3.8	7.4	0.41	62.1	31.7	53	12	11.6	1.55	415	74.2	82
	C-10	SD4539	13.1	3.8	8.0	0.38	62.1	30.5	49	12	11.7	1.75	446	70.4	67
	H-3	Glenn	16.8	5.0	10.0	nd	62.9	26.5	12	21	9.5	1.56	430	80.2	99
Havro	H-4	Lanning	16.3	4.3	9.2	nd	59.9	28.1	38	13	9.3	1.52	411	76.9	100
navio	H-5	LCS Rebel	17.2	5.0	10.0	nd	61.8	28.8	25	20	9.3	1.45	476	75.1	100
	H-8	LCS Cannon	16.4	5.3	10.0	nd	63.3	29.2	26	14	9.1	1.39	508	79.2	100
	K-1	SY McCloud	15.5	4.6	9.6	0.49	61.4	31.5	54	14	13.4	1.62	433	82.5	87
	K-2	PMWH25131094	15.6	3.9	8.2	0.13	59.4	27.0	36	22	12.8	1.68	461	83.6	85
	K-3	Glenn	15.9	4.7	10.0	0.42	63.3	29.1	52	11	13.3	1.56	386	78.6	87
Crookston	K-6	PMWH25180325	13.9	3.2	6.4	0.67	59.1	27.3	36	24	13.1	1.73	409	77.9	83
CIOCKSION	K-7	Linkert	15.8	4.6	9.2	1.78	60.6	31.5	50	12	12.7	1.53	456	79.5	87
	K-8	LCS Cannon	15.1	4.1	9.0	0.19	61.4	27.2	37	20	12.8	1.55	395	82.4	88
	K-9	MN10201-4-A	14.5	3.8	8.0	1.32	60.8	28.7	47	15	13.1	1.66	407	73.5	84
	K-10	SD4539	14.9	3.9	8.4	1.32	60.4	27.5	35	22	13.0	1.71	466	78.2	87
	M-1	SY McCloud	15.5	5.4	9.2	nd	64.4	39.1	74	6	11.3	1.44	404	73.8	89
	M-2	PMWH25131094	14.3	4.9	8.0	nd	63.4	33.9	60	8	11.1	1.47	442	80.8	94
Minot	M-3	Glenn	15.7	5.1	10.0	nd	66.0	33.9	67	6	11.2	1.41	390	76.4	96
WITTOL	M-5	LCS Rebel	14.9	5.3	9.0	nd	64.6	36.6	76	4	11.3	1.44	424	71.3	96
	M-6	PMWH25180325	13.8	4.6	7.4	0.02	63.5	35.1	65	8	11.2	1.42	388	74.5	97
	M-8	LCS Cannon	14.7	4.7	9.0	nd	64.6	32.6	59	9	11.4	1.35	382	78.5	94

#### **Flour Characteristics** by Location

				Flour Ext	ur Extraction					Flour	Flour		
			TWB*	TPB*	Flour/bu	Flour Color				Moisture	Protein	Flour Ash	Flour FN
Location	ID	Entry	(%)	(%)	Wheat (lbs)	L*	<b>b</b> *	L	b	(%)	(%, 14% mb)	(%, 14% mb)	Malted (sec)
Watertown	B-1	SY McCloud	67.2	71.3	41.1	89.5	10.9	86.7	10.2	13.2	14.7	0.49	246
	B-3	Glenn	68.2	72.1	41.8	89.8	9.0	87.1	8.6	13.1	15.4	0.49	255
	B-7	Linkert	68.3	72.1	40.9	90.1	8.7	87.4	8.3	13.0	15.4	0.48	250
watertown	B-8	LCS Cannon	69.6	72.9	43.0	89.4	9.6	86.7	9.1	13.8	15.1	0.45	259
	B-9	MN10201-4-A	69.4	72.8	42.1	89.1	11.5	86.2	10.8	13.6	15.4	0.42	250
	B-10	SD4539	67.0	70.6	40.8	89.7	9.3	87.0	8.9	13.5	14.8	0.41	254
	C-1	SY McCloud	66.5	70.8	43.2	90.6	11.4	88.1	10.8	13.9	12.4	0.46	253
	C-2	PMWH25131094	67.7	71.3	43.5	90.7	10.5	88.3	10.0	13.7	11.7	0.48	256
	C-3	Glenn	68.1	72.6	44.9	90.5	9.5	87.9	9.0	13.4	13.5	0.48	247
Consolton	C-6	PMWH25180325	69.1	72.7	44.4	90.9	9.7	88.5	9.3	13.3	11.1	0.46	252
Cassenon	C-7	Linkert	69.6	74.2	44.2	90.9	8.5	88.5	8.2	13.3	13.8	0.51	256
	C-8	LCS Cannon	69.1	73.3	45.0	90.5	10.0	88.0	9.6	13.3	12.5	0.46	258
	C-9	MN10201-4-A	69.5	73.1	44.0	90.4	11.4	87.8	10.8	13.3	11.6	0.44	257
	C-10	SD4539	70.2	74.5	44.4	90.8	9.8	88.3	9.3	13.3	12.1	0.45	250
	H-3	Glenn	68.9	72.0	43.7	90.3	9.9	87.7	9.5	13.1	16.2	0.48	245
Havro	H-4	Lanning	68.3	72.8	41.3	90.3	10.0	87.8	9.5	13.1	15.8	0.49	245
пачте	H-5	LCS Rebel	70.0	74.0	43.6	90.3	9.7	87.8	9.2	13.1	16.4	0.45	243
	H-8	LCS Cannon	69.7	73.0	44.3	90.7	9.4	88.2	9.0	13.0	15.6	0.45	240
	K-1	SY McCloud	67.8	72.1	41.4	89.7	11.9	87.0	11.1	13.0	14.2	0.54	254
	K-2	PMWH25131094	67.4	70.6	40.1	90.0	10.4	87.4	9.9	12.8	14.4	0.55	253
	K-3	Glenn	68.7	72.1	43.4	89.7	9.6	87.0	9.1	13.1	15.2	0.48	247
Creeksten	K-6	PMWH25180325	67.1	71.6	39.6	89.8	10.5	87.2	9.9	13.0	13.0	0.49	256
Crookston	K-7	Linkert	68.3	72.6	41.6	89.6	9.0	86.9	8.5	13.3	15.0	0.48	245
	K-8	LCS Cannon	69.3	72.9	42.8	90.1	10.5	87.5	10.0	13.3	14.1	0.48	249
	K-9	MN10201-4-A	69.8	73.9	42.5	89.2	12.0	86.3	11.3	13.4	13.7	0.45	259
	K-10	SD4539	66.9 <sup>†</sup>	73.1 <sup>†</sup>	40.8 <sup>†</sup>	89.5	9.6	86.7	9.1	12.9	14.0	0.46	244
	M-1	SY McCloud	67.7	70.8	44.3	89.5	11.0	86.7	10.4	12.8	14.4	0.49	249
	M-2	PMWH25131094	68.8	71.9	44.7	90.0	10.0	87.3	9.5	13.2	13.4	0.49	255
Minot	M-3	Glenn	<b>68.2</b>	71.9	46.0	90.5	9.4	88.0	9.0	13.1	14.8	0.46	248
WIIIOU	M-5	LCS Rebel	70.2	73.2	46.1	90.6	9.5	88.1	9.0	12.9	14.0	0.41	249
	M-6	PMWH25180325	69.9	73.3	45.2	90.5	10.1	88.0	9.6	12.8	12.7	0.46	256
	M-8	LCS Cannon	69.9	73.3	45.9	89.9	10.2	87.3	9.7	12.9	13.7	0.47	252

\*TWB = Tempered wheat basis; TPB = Total product basis. † There was a mill malfunction and the sample had to be discarded. Remaining sample (66 lbs) was then milled but the yields decreased some due to the small sample size (minimum of 90 lbs is needed to achieve optimum yields).

#### Flour Protein Characteristics by Location

				HMW Glutenin Subunits					
Location	ID	Entry	TPP/TMP*	GLU-A1	GLU-B1	GLU-D1			
	B-1	SY McCloud	0.88	2*	7+9	5+10			
	B-3	Glenn	0.88	2*	7+9	5+10			
Watartown	B-7	Linkert	0.99	1	7oe+8	5+10			
watertown	B-8	LCS Cannon	0.79	2*	7+9	5+10			
	B-9	MN10201-4-A	0.88	2*	7+8	5+10			
	B-10	SD4539	0.93	2*	7oe+8	5+10			
	C-1	SY McCloud	0.93	2*	7+9	5+10			
	C-2	PMWH25131094	1.01	2*	7+9	5+10			
	C-3	Glenn	0.97	2*	7+9	5+10			
Cassaltan	C-6	PMWH25180325	1.00	2*	7+9	5+10			
Cassellon	C-7	Linkert	0.99	1	7oe+8	5+10			
	C-8	LCS Cannon	0.88	2*	7+9	5+10			
	C-9	MN10201-4-A	0.98	2*	7+8	5+10			
	C-10	SD4539	0.97	2*	7oe+8	5+10			
	H-3	Glenn	0.87	2*	7+9	5+10			
Hours	H-4	Lanning	0.86	2*	7+9	5+10			
паче	H-5	LCS Rebel	0.93	2*	7+9	5+10			
	H-8	LCS Cannon	0.84	2*	7+9	5+10			
	K-1	SY McCloud	0.86	2*	7+9	5+10			
	K-2	PMWH25131094	0.92	2*	7+9	5+10			
	K-3	Glenn	0.85	2*	7+9	5+10			
Crookston	K-6	PMWH25180325	0.93	2*	7+9	5+10			
CIOURSIUII	K-7	Linkert	0.99	1	7oe+8	5+10			
	K-8	LCS Cannon	0.80	2*	7+9	5+10			
	K-9	MN10201-4-A	0.95	2*	7+8	5+10			
	K-10	SD4539	0.94	2*	7oe+8	5+10			
	M-1	SY McCloud	0.88	2*	7+9	5+10			
	M-2	PMWH25131094	0.99	2*	7+9	5+10			
Minot	M-3	Glenn	0.98	2*	7+9	5+10			
WITTOL	M-5	LCS Rebel	0.96	2*	7+9	5+10			
	M-6	PMWH25180325	1.00	2*	7+9	5+10			
	M-8	LCS Cannon	0.87	2*	7+9	5+10			

TPP/TMP = Total polymeric protein / total monomeric protein.

# Farinograph Characteristics by Location

					Arrival	Peak	Dough		
Location	ID	Entr	Water Abs.	Water Abs.	Time	Time	Stability	MTI	TTB
Location		Entry SV McCloud	(%, 500 BU)	(%, 14% mb)	(min) 4.2	(min) 7.2	(min)	(BU)	(min) 12.1
	D-1 D 2	Glopp	00.0 67.0	07.0	4.3	7.3 9 E	0.0	20	13.1
	D-3	Gierri	07.Z	00.2 64 E	3.0	0.0 10.0	12.3	21	10.0
Watertown			64.7	04.5	3.4	7.0	10.0	20	10.0
	D-0		62.7	62.1	4.5	1.9	0.9	10	14.0
	B-10	SD4539	65.6	65.0	4.0	0.3 Q 1	11.0	24	14.0
	C-1	SV McCloud	63.8	63.4	2.8	6.5	77	36	10.6
	C-2	PMWH25231094	60.7	60.2	2.0	5.7	7.6	39	9.8
	C-3	Glenn	63.5	62.8	31	7.5	9.3	31	12 1
	C-6	PMWH25180325	60.6	59.8	1.8	5.5	7.3	40	9.5
Casselton	C-7	Linkert	62.8	61.9	4.2	8.3	12.2	21	16.5
	C-8	LCS Cannon	61.5	60.7	2.7	6.3	8.0	37	10.8
	C-9	MN10201-4-A	58.8	58.1	2.1	7.0	9.3	33	11.6
	C-10	SD4539	60.2	59.3	2.2	6.4	9.2	33	11.1
	H-3	Glenn	66.3	65.0	5.4	10.7	13.5	24	17.9
Hayma	H-4	Lanning	65.5	64.5	5.2	8.2	9.7	27	14.5
navre	H-5	LCS Rebel	67.7	66.5	5.7	10.9	12.5	25	17.6
	H-8	LCS Cannon	66.3	65.3	4.8	8.5	13.3	12	17.3
	K-1	SY McCloud	64.5	63.2	4.2	7.7	9.2	27	13.3
	K-2	PMWH25131094	63.4	62.2	4.0	7.2	8.6	30	12.5
	K-3	Glenn	64.0	63.0	4.2	9.3	11.8	24	14.6
Crookston	K-6	PMWH25180325	59.7	58.4	3.1	6.7	8.3	32	11.3
Crockston	K-7	Linkert	62.3	61.5	5.2	10.4	18.5	10	22.0
	K-8	LCS Cannon	62.1	61.3	3.2	6.7	10.0	21	12.6
	K-9	MN10201-4-A	59.1	58.3	3.6	8.5	11.0	25	13.7
	K-10	SD4539	62.2	60.9	3.7	7.3	11.3	18	14.2
	M-1	SY McCloud	68.6	67.1	4.8	7.8	6.9	37	11.5
	M-2	PMWH25131094	63.7	62.8	3.8	6.8	7.5	34	11.1
Minot	M-3	Glenn	66.9	65.7	4.6	8.0	8.8	25	13.4
	M-5	LCS Rebel	65.2	63.8	3.9	7.5	8.6	32	11.9
	M-6	PMWH25180325	61.9	60.6	3.4	6.3	6.1	48	9.5
	M-8	LCS Cannon	64.5	63.1	3.5	7.2	8.4	31	12.1

## Mixograph Characteristics by Location

			Envelope Peak	Envelope Peak	Envelope Peak	Midline Peak	Midline Peak	Midline Peak	Midline Peak
			Time	Value	Width	Time	Value	Width	Integral
Location	ID	Entry	(min)	(%)	(%)	(min)	(%)	(%)	<u>(% TQ*min)</u>
	B-1	SY McCloud	3.4	83.1	37.4	3.6	63.7	35.3	157.2
	B-3	Glenn	3.9	80.1	35.0	4.2	62.2	31.4	188.4
Watertown	B-7	Linkert	3.8	78.6	35.4	4.2	62.3	28.3	1/4.6
	B-8	LCS Cannon	2.9	79.5	31.8	3.1	63.6	28.0	135.9
	B-9	MN10201-4-A	3.6	73.9	31.2	3.8	57.5	30.5	145.9
	B-10	SD4539	3.5	81.7	34.9	3.4	64.9	34.0	151.2
	C-1		3.4	75.0	33.8	3.6	57.5	32.0	154.9
	0-2	PIMWH25131094	3.5	67.8	31.0	3.7	51.7	29.2	150.6
	<b>U-3</b>	Glenn DMM/UDE100205	4.1	1 <b>2.9</b> 67.5	31.5	4.0	50.0	30.0	100.3
Casselton		PIVIVITZ3160323	3.4 4 1	07.5	34.7	3.9	50.3	30.0	105.0
	C-7		4.1	73.9	22.0	4.0	56.6	20.9	190.0
	C-0	MN10201-4-A	3.2	64.4	33.9 27.4	3.0 4 3	50.0	20.4	140.7
	C-10	SD/530	3.8	71 7	27.4	4.3	54.9	20.0	170.1
	H-3	Glenn	3.6	76.8	31 1	4.0	62.0	27.3	166.8
	H-4	Lanning	3.2	73.9	31.3	3.5	58.8	28.4	137.7
Havre	H-5	LCS Rebel	4.0	82.7	37.8	4.3	64.2	31.0	181.9
	H-8	I CS Cannon	3.9	76.2	29.8	4.0	60.8	28.9	168.9
	K-1	SY McCloud	3.8	79.7	34.1	3.9	62.9	33.7	162.7
	K-2	PMWH25131094	3.4	77.2	34.3	3.6	60.2	31.0	153.0
	K-3	Glenn	4.2	77.4	34.4	4.5	60.5	28.7	183.5
One elvetere	K-6	PMWH25180325	3.9	69.0	28.7	4.1	54.9	26.4	152.2
Crookston	K-7	Linkert	4.5	83.5	38.2	4.7	64.2	37.3	192.5
	K-8	LCS Cannon	3.5	74.9	31.9	3.8	60.0	28.6	154.0
	K-9	MN10201-4-A	4.0	71.6	29.2	4.1	56.3	28.4	156.3
	K-10	SD4539	3.7	80.1	34.5	3.9	63.2	31.5	165.9
	M-1	SY McCloud	2.8	81.1	30.3	2.9	65.6	29.8	133.3
	M-2	PMWH25131094	3.0	75.5	32.7	3.3	59.3	30.2	135.0
Minot	M-3	Glenn	3.1	81.7	37.5	3.4	63.6	31.4	146.2
in in iter	M-5	LCS Rebel	3.0	77.6	33.3	3.2	60.4	31.0	134.8
	M-6	PMWH25180325	2.8	71.7	32.9	3.1	55.4	28.2	118.5
	M-8	LCS Cannon	2.7	79.8	38.4	3.1	61.1	33.1	132.6

#### Interpreting Mixogram Results

![](_page_71_Figure_1.jpeg)

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 (cm²)	Resistance (BU)	Extensibility (mm)	Maximum (BU)	Ratio Number	Ratio Number (max)				
	B-1	SY McCloud	64	174	176	280	1.0	1.6				
Watertown	B-3	Glenn	89	191	196	361	1.0	1.8				
	B-7	Linkert	111	214	216	395	1.0	1.8				
	B-8		81	179	206	293	0.9	1.4				
	D-9 B 10	SD4530	01	103	203	313	0.0	1.0				
	C-1	SY McCloud	87	194	196	345	1.0	1.0				
	C-2	PMWH25131094	71	201	173	313	1.2	1.8				
	C-3	Glenn	81	231	166	391	1.4	2.4				
Consolton	C-6	PMWH25180325	71	188	177	301	1.1	1.7				
Cassellon	C-7	Linkert	100	206	196	426	1.1	2.2				
	C-8	LCS Cannon	90	206	193	362	1.1	1.9				
	C-9	MN10201-4-A	88	209	186	369	1.1	2.0				
	C-10	SD4539	87	229	179	364	1.3	2.0				
	H-3	Glenn	1 <b>24</b> 01	<b>214</b> 175	218	458 310	1.0	<b>2.1</b>				
Havre	H_5		115	203	210	400	0.0	1.5				
	H-8	LCS Cannon	128	294	192	525	1.5	2.7				
	K-1	SY McCloud	89	212	188	374	1.1	2.0				
	K-2	PMWH25131094	91	200	197	358	1.0	1.8				
	K-3	Glenn	109	225	198	441	1.1	2.2				
Crookston	K-6	PMWH25180325	92	206	189	393	1.1	2.1				
Orookston	K-7	Linkert	123	241	202	500	1.2	2.5				
	K-8	LCS Cannon	95	210	191	395	1.1	2.1				
	K-9	MN10201-4-A	110	215	211	409	1.0	1.9				
	K-10 M 1	SD4539	120	214	216	447	1.0	2.1				
	M-2	PMW/H25131094	02	181	205	323	0.9	1.5				
	M-3	Glenn	92	176	208	347	0.8	1.7				
Minot	M-5	LCS Rebel	86	168	213	311	0.8	1.5				
	M-6	PMWH25180325	67	179	176	285	1.0	1.6				
	M-8	LCS Cannon	79	162	203	297	0.8	1.5				

	90 Minutes Resting										
Location	ID	Entry	Energy (cm²)	Resistance (BU)	Extensibility (mm)	Maximum (BU)	Ratio Number	Ratio Number (max)			
Watertown	B-1	SY McCloud	88	230	179	375	1.3	2.1			
	<b>B-3</b>	Glenn	<b>112</b>	262	<b>186</b>	<b>486</b>	<b>1.4</b>	<b>2.6</b>			
	B-7	Linkert	120	265	198	471	1.3	2.4			
	B-8	LCS Cannon	83	205	186	344	1.1	1.8			
	B-9	MN10201-4-A	105	266	193	406	1.4	2.1			
	B-10	SD4539	96	241	181	409	1.3	2.3			
Casselton	C-1	SY McCloud	89	200	192	363	1.0	1.9			
	C-2	PMWH25131094	74	217	161	368	1.3	2.3			
	C-3	Glenn	<b>114</b>	<b>358</b>	<b>164</b>	<b>534</b>	<b>2.2</b>	<b>3.3</b>			
	C-6	PMWH25180325	80	263	157	391	1.7	2.5			
	C-7	Linkert	124	320	178	553	1.8	3.1			
	C-8	LCS Cannon	91	244	173	416	1.4	2.4			
	C-9	MN10201-4-A	79	257	155	407	1.7	2.6			
	C-10	SD4539	109	272	175	515	1.6	2.9			
Havre	<b>H-3</b>	Glenn	<b>140</b>	<b>338</b>	<b>188</b>	<b>582</b>	<b>1.8</b>	<b>3.1</b>			
	H-4	Lanning	108	220	211	396	1.0	1.9			
	H-5	LCS Rebel	135	294	200	519	1.5	2.6			
	H-8	LCS Cannon	158	347	197	627	1.8	3.2			
Crookston	K-1 K-2 K-6 K-7 K-8 K-9 K-10	SY McCloud PMWH25131094 Glenn PMWH25180325 Linkert LCS Cannon MN10201-4-A SD4539	101 101 <b>133</b> 106 151 102 119 133	244 253 <b>269</b> 318 394 274 306 286	186 180 <b>198</b> 164 181 172 178 198	424 448 543 511 645 474 528 536	1.3 1.4 1.9 2.2 1.6 1.7 1.4	2.3 2.5 <b>2.7</b> 3.1 3.6 2.8 3.0 2.7			
Minot	M-1	SY McCloud	106	259	188	430	1.4	2.3			
	M-2	PMWH25131094	89	246	174	395	1.4	2.3			
	<b>M-3</b>	Glenn	<b>112</b>	<b>229</b>	<b>206</b>	<b>425</b>	<b>1.1</b>	<b>2.1</b>			
	M-5	LCS Rebel	103	263	177	467	1.5	2.6			
	M-6	PMWH25180325	76	223	164	368	1.4	2.2			
	M-8	LCS Cannon	98	262	174	444	1.5	2.5			

			135	Minutes Re	sting			
			_					Ratio
Location	חו	Entry	Energy	Resistance	Extensibility	Maximum	Ratio Numbor	Number (max)
Location	B-1	SY McCloud	83	241	166	391	1 4	2.3
	B-3	Glenn	105	239	193	420	1.2	2.2
	B-7	Linkert	122	292	189	503	1.5	2.7
watertown	B-8	LCS Cannon	88	179	202	339	0.9	1.7
	B-9	MN10201-4-A	95	221	193	376	1.1	1.9
	B-10	SD4539	94	273	164	463	1.7	2.8
	C-1	SY McCloud	93	284	169	412	1.7	2.4
	C-2	PMWH25131094	83	270	158	407	1.7	2.6
	C-3	Glenn	102	302	161	515	1.9	3.2
Casselton	C-6	PMWH25180325	76	248	152	406	1.6	2.7
Cassenton	C-7	Linkert	117	287	176	557	1.6	3.2
	C-8	LCS Cannon	90	303	152	467	2.0	3.1
	C-9	MN10201-4-A	97	373	151	488	2.5	3.2
	C-10	SD4539	116	327	172	526	1.9	3.1
Havre	H-3	Glenn	134	355	174	618	2.0	3.6
Havre	H-4	Lanning	105	267	180	459	1.5	2.6
	H-5	LCS Rebel	144	350	184	607	1.9	3.3
	H-8	LCS Cannon	144	396	1/2	654	2.3	3.8
	K-1	SY McCloud	114	294	179	501	1.6	2.8
	K-2	PIVIVHZ5131094	122	291	180	510	1.0	2.8
	N-J K G		143	290	190	303	1.5	3.0
Crookston	K-0	Linkort	101	290	174	494	1.7	3.0
	K-8		144	285	164	505	2.2	3.0
	K-0	MN10201_4_Δ	100	200	169	518	1.7	3.1
	K-10	SD4539	135	289	193	563	1.5	2.9
	M-1	SY McCloud	96	227	190	393	12	21
	M-2	PMWH25131094	91	229	178	400	1.3	2.2
•••	M-3	Glenn	123	295	201	447	1.5	2.2
Minot	M-5	LCS Rebel	105	221	196	432	1.1	2.2
	M-6	PMWH25180325	85	226	174	382	1.3	2.2
	M-8	LCS Cannon	125	280	196	497	1.4	2.5

## Ash Content in Mill Streams

## **Glenn Check - Casselton**



	<u>Stre</u> (%, 14	<u>eam</u> % mb)	<u>Cumu</u> (%, 14	lative % mb)
Mill Stream	Yield	Ash	Yield	Ash
Patent:				
2 M	19.1	0.24	19.1	0.24
Sz I	3.5	0.29	22.6	0.24
1 M	4.8	0.32	27.5	0.26
Sz II	2.9	0.35	30.4	0.27
3 M	15.2	0.35	45.6	0.29
4 M	8.6	0.62	54.1	0.35
Bk Dust	2.3	0.62	56.5	0.36
4 Bk	4.9	0.70	61.4	0.38
1 Bk	1.6	0.71	63.0	0.39
6 M	3.0	0.79	66.1	0.41
3 Bk	1.5	0.80	67.6	0.42
2 Bk II	1.1	0.81	68.7	0.43
2 Bk I	0.5	0.89	69.2	0.43
TC	0.5	1.03	69.7	0.43
Tail	1.3	1.36	71.0	0.45
5 Bk	1.6	1.43	72.6	0.47
Clear Flour:				
LG	1.2	1.66	73.8	0.49
LQ	0.3	1.66	74.1	0.50
5 M	1.5	1.81	75.7	0.52
Bran & Shorts:				
TC Sh	0.1	2.98	75.8	0.53
Tail Sh	2.1	3.62	77.9	0.61
Head Sh	17.8	5.78	95.7	1.57
Bran	4.3	7.42	100.0	1.83
Patent (Rebolted)		0.48		
Wheat		1.83		

## **Cooperators' Bake Data**

#### **Glenn Checks**

	WA	TERTOWN	(B-3)	
Cooperator	Bake Absorption (%)	Loaf Volume (cc)	Mixing Requirement	Dough Characteristics
Α	71.0	1115	5	5
В	72.2	1090	5	8
С	68.4	1070	5	7
D	61.0	2775	9	9
E	64.0	2600	5	5
F	71.9	1140	6	7
G	64.0	2868	9	9
Н	72.5	1135	5	7
I	68.2	2700	7	7
J	71.2	904	4	7
K	67.2	2361	5	7
L	71.9	1185	5	7
Avg.	68.6		5.8	7.1
S.D.	3.9		1.6	1.2

	CAS	SSSELTON	(C-3)	
Cooperator	Bake Absorption (%)	Loaf Volume (cc)	Mixing Requirement	Dough Characteristics
Α	67.0	1070	5	5
В	72.0	998	6	7
С	65.2	970	5	8
D	58.0	2950	9	7
E	60.0	2350	5	5
F	70.0	1030	7	8
G	62.0	2986	9	9
н	69.0	1150	5	6
I	64.8	2725	7	7
J	68.0	838	4	6
ĸ	63.5	2229	5	6
L	70.1	1095	7	7
Avg.	65.8		6.2	6.8
S.D.	4.3		1.6	1.2

		HAVRE (H-3	3)	
Cooperator	Bake Absorption (%)	Loaf Volume (cc)	Mixing Requirement	Dough Characteristics
Α	72.0	1045	5	5
В	77.7	1078	7	8
С	66.6	1010	5	7
D	62.0	3075	9	9
E	64.0	2700	6	7
F	70.0	1120	5	7
G	64.0	2956	9	9
Н	73.0	1125	5	7
I	67.0	2600	9	9
J	70.2	868	5	6
ĸ	66.3	2240	5	3
L	72.6	1160	7	9
Avg.	68.8		6.4	7.2
S.D.	4.6		1.7	1.9

	CB	OOKSTON	(K 2)	
	UK		(R-3)	
		Loai		
	Bake	Volume	Mixing	Dough
Cooperator	Absorption (%)	(cc)	Requirement	Characteristics
Α	70.0	1060	5	5
В	71.7	1048	6	8
С	64.5	963	5	7
D	60.0	2900	9	9
E	62.0	2400	5	5
F	66.7	1115	5	9
G	63.0	2897	9	9
н	72.0	960	5	7
I	65.0	2650	9	9
J	68.2	824	5	7
ĸ	64.0	2496	5	5
L	70.8	1095	9	5
Avg.	66.5		6.4	7.1
S.D.	4.0		1.9	1.7

		MINOT (M-3	3)	
Cooperator	Bake Absorption (%)	Volume (cc)	Mixing Requirement	Dough Characteristics
Α	70.0	1185	5	5
В	72.7	1085	4	8
С	67.4	1075	4	7
D	59.0	2900	9	9
E	63.0	2400	6	6
F	70.6	1065	5	6
G	64.0	3015	9	9
н	72.5	1125	5	7
I	67.7	2825	7	7
J	70.7	844	4	7
К	66.9	2278	5	5
L	71.7	1050	5	5
Avg.	68.0		5.7	6.8
S.D.	4.2		1.8	1.4

### SY McCloud

WATERTOWN (B-1)												
		Lo	oaf Volume				Quality	y Score Co	mpared to	Check (Gle	enn)	
	Bake						Internal	Internal				
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &				
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
Α	71.0	1015	91.0	5	5	5	5	3	5	3	1	3
В	72.3	1050	96.3	4	8	5	5	6	5	5	5	5
С	68.8	1030	96.3	4	7	4	5	5	4	5	4	5
D	61.0	2725	98.2	9	9	5	5	5	5	5	5	5
E	65.0	2400	92.3	5	4	5	4	6	3	3	5	4
F	74.2	1130	99.1	5	5	3	3	1	4	4	2	2
G	65.0	2839	99.0	9	9	5	4	5	4	5	5	4
н	72.0	1005	88.5	4	5	4	3	5	4	4	4	4
I	69.6	2675	99.1	5	7	5	5	7	3	3	5	5
J	72.7	809	89.5	4	7	5	4	6	5	6	2	4
K	68.5	2373	100.5	5	5	3	4	5	4	4	5	4
L	71.9	1120	94.5	5	7	3	5	3	3	5	3	3
Avg.	69.3		95.4	5.3	6.5	4.3	4.3	4.8	4.1	4.3	3.8	4.0
S.D.	3.9		4.1	1.8	1.7	0.9	0.8	1.7	0.8	1.0	1.5	1.0

	CASSELTON (C-1)											
		Lo	oaf Volume				Quality	y Score Coi	npared to (	Check (Gle	nn)	
	Bake						Internal	Internal				
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &				
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
Α	65.0	955	89.3	5	5	5	1	1	3	1	1	1
В	72.1	970	97.2	5	7	5	3	5	4	4	5	4
С	65.8	950	97.9	5	6	4	3	5	4	6	5	5
D	60.0	2975	100.8	9	7	5	5	5	7	5	5	5
E	61.0	2200	93.6	5	5	5	4	4	3	3	4	4
F	68.9	1065	103.4	4	5	4	4	5	4	3	5	5
G	63.0	3015	101.0	8	8	5	4	4	4	4	6	5
Н	65.5	985	85.7	5	4	4	1	5	3	4	4	4
I	65.4	2600	95.4	7	7	7	5	7	3	3	7	5
J	68.6	766	91.4	4	6	5	4	6	3	3	3	3
K	63.8	2126	95.4	5	6	5	4	5	4	3	4	4
L	68.7	995	90.9	5	5	5	5	9	3	3	7	5
Avg.	65.7		95.2	5.6	5.9	4.9	3.6	5.1	3.8	3.5	4.7	4.2
S.D.	3.5		5.3	1.6	1.2	0.8	1.4	1.9	1.1	1.2	1.7	1.2

					CROOKSTON (	K-1)						
		Lo	oaf Volume			Quality Score Compared to Check (Glenn)						
Cooperator	Bake Absorption (%)	(cc)	(% of Check)	- Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Millina	Baking	Overall
Α	69.0	995	93.9	5	5	5	3	3	5	5	3	3
В	75.0	983	93.8	5	8	5	4	5	4	5	6	5
С	65.5	943	97.9	5	7	4	3	7	4	5	5	5
D	61.0	2875	99.1	9	9	5	5	5	5	5	5	5
E	62.0	2400	100.0	5	4	4	2	4	5	3	4	4
F	68.3	1075	96.4	5	5	4	4	7	4	4	4	4
G	63.0	2927	101.0	9	9	4	6	6	4	4	5	4
н	70.0	935	97.4	5	5	4	3	3	3	3	4	4
I	65.2	2550	96.2	7	7	5	5	5	3	3	5	3
J	68.3	788	95.6	5	6	5	6	7	5	5	4	5
ĸ	64.5	2562	102.6	5	8	5	4	5	4	4	6	4
L	70.6	1055	96.3	7	5	3	1	9	3	3	7	5
Avg.	66.9		97.5	6.0	6.5	4.4	3.8	5.5	4.1	4.1	4.8	4.3
S.D.	4.1		2.7	1.6	1.7	0.7	1.5	1.8	0.8	0.9	1.1	0.8

					MINOT (M-1)	)								
		Lo	oaf Volume			Quality Score Compared to Check (Glenn)								
	Bake						Internal	Internal						
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &						
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall		
Α	69.0	1050	88.6	3	5	1	3	3	5	3	3	1		
В	75.8	1075	99.1	4	8	4	3	6	5	5	5	5		
С	69.0	1008	93.8	4	6	5	3	5	5	5	4	5		
D	61.0	2925	100.9	7	7	4	5	5	7	5	5	5		
E	64.0	2300	95.8	5	5	5	4	6	5	5	4	5		
F	73.6	1115	104.7	4	4	3	4	3	5	4	4	5		
G	65.0	2839	94.2	9	9	6	5	4	4	4	4	4		
н	72.0	930	82.7	3	5	4	2	5	4	3	4	4		
I	69.1	2850	100.9	7	7	5	5	5	5	3	5	5		
J	72.0	744	88.2	4	7	4	4	6	5	7	3	5		
ĸ	68.6	2262	99.3	5	3	3	4	5	5	4	4	5		
L	70.5	1060	101.0	5	5	1	5	9	3	3	7	5		
Avg.	69.1		95.7	5.0	5.9	3.8	3.9	5.2	4.8	4.3	4.3	4.5		
S.D.	4.2		6.5	1.8	1.7	1.5	1.0	1.6	0.9	1.2	1.1	1.2		

#### PMWH25131094

					CASSELTON (	C-2)						l .
		Lo	oaf Volume				Quality	y Score Co	mpared to	Check (Gle	enn)	
	Bake						Internal	Internal				1
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &				
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
Α	67.0	980	91.6	5	5	1	5	3	5	1	3	1
В	68.9	903	90.5	6	6	6	4	5	3	5	4	4
С	62.8	900	92.8	5	6	4	4	5	3	5	4	4
D	58.0	2950	100.0	7	5	4	5	5	7	5	5	5
E	59.0	2500	106.4	5	5	5	5	4	4	5	4	5
F	66.9	925	89.8	7	4	4	3	4	3	4	3	3
G	60.0	2927	98.0	2	4	1	4	3	3	5	2	3
н	65.0	980	85.2	5	5	4	3	5	1	4	5	4
I	62.2	2600	95.4	7	7	5	5	7	3	3	5	5
J	65.2	782	93.3	5	6	4	4	6	3	2	2	2
K	60.7	2128	95.5	5	2	3	5	5	3	4	4	5
L	67.5	925	84.5	5	5	5	5	5	1	3	5	3
Avg.	63.6		93.6	5.3	5.0	3.8	4.3	4.8	3.3	3.8	3.8	3.7
S.D.	3.7		6.1	1.4	1.3	1.5	0.8	1.1	1.6	1.3	1.1	1.3

					CROOKSTON (	K-2)						
		Lo	oaf Volume				Quality	y Score Coi	npared to	Check (Gle	nn)	
	Bake						Internal	Internal				
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &				
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
Α	69.0	1030	97.2	5	5	3	5	3	5	3	5	3
В	73.8	1053	100.5	5	8	5	5	5	4	4	5	5
С	65.0	990	102.8	4	7	4	5	3	4	5	4	4
D	60.0	2875	99.1	9	9	5	5	5	5	5	5	5
E	61.0	2600	108.3	5	3	4	6	5	5	3	5	4
F	68.3	1095	98.2	5	5	3	5	5	4	4	5	4
G	62.0	2927	101.0	9	9	4	6	6	4	3	5	4
Н	69.5	935	97.4	5	3	4	5	3	3	1	4	3
I	64.2	2525	95.3	9	9	5	5	5	3	3	5	5
J	67.4	786	95.4	4	7	4	6	7	5	1	3	4
K	63.4	2301	92.2	5	5	5	4	4	4	3	4	4
L	68.7	1045	95.4	5	5	5	3	9	3	1	7	3
Avg.	66.0		98.6	5.8	6.3	4.3	5.0	5.0	4.1	3.0	4.8	4.0
S.D.	4.1		4.2	1.9	2.2	0.8	0.9	1.8	0.8	1.4	1.0	0.7

					MINOT (M-2	)						
		Lo	oaf Volume				Quality	y Score Coi	mpared to	Check (Gle	nn)	
Cooperator	Bake Absorption		(% of Chock)	Mixing	Dough	Mixing	Internal Crumb	Internal Grain &	Protoin	Milling	Pakina	Overall
	67.0	1040	87.8	5	5	3	5	3	1	5	Baking	3
B	73.8	1005	92.6	4	8	4	5	6	4	5	5	5
Ē	64.2	900	83.7	4	7	5	5	3	3	5	3	3
D	60.0	2900	100.0	5	6	4	5	5	6	5	5	5
E	60.0	2400	100.0	5	4	4	4	7	4	5	4	5
F	68.3	1010	94.8	4	4	4	4	5	3	5	4	4
G	62.0	2986	99.0	9	9	5	5	5	3	5	4	4
н	68.5	990	88.0	5	5	4	5	7	1	3	5	4
I	64.8	2575	91.2	7	7	7	5	7	3	5	3	5
J	67.6	761	90.2	4	7	4	5	7	4	1	3	3
K	63.7	2258	99.1	5	7	5	5	5	3	5	5	5
L	68.9	1025	97.6	7	5	3	5	5	1	5	5	3
Avg.	65.7		93.7	5.3	6.2	4.3	4.8	5.4	3.0	4.5	4.1	4.1
S.D.	4.1		5.6	1.6	1.6	1.1	0.4	1.4	1.5	1.2	0.9	0.9

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					HAVRE (H-4	)						
		Lo	oaf Volume				Qualit	y Score Co	mpared to	Check (Gle	nn)	
	Bake						Internal	Internal				
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &				
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
Α	71.0	1010	96.7	3	5	1	3	3	5	7	3	3
В	74.7	1050	97.4	5	8	5	4	7	5	5	6	6
С	65.5	950	94.1	4	7	3	5	6	5	5	4	5
D	62.0	2875	93.5	9	9	9	5	5	5	5	5	5
E	63.0	2500	92.6	5	5	5	4	4	5	5	4	4
F	69.2	1130	100.9	3	6	3	4	3	4	4	4	4
G	64.0	2986	101.0	9	9	5	5	5	4	6	4	5
н	72.0	980	87.1	3	3	3	3	3	5	5	3	4
I	66.5	2750	105.8	9	9	5	5	5	3	3	3	3
J	69.7	840	96.8	4	7	5	5	5	5	6	3	5
ĸ	65.5	2313	103.3	5	6	5	5	6	4	5	6	5
L	69.8	1165	100.4	5	9	3	3	5	3	5	5	3
Avg.	67.7		97.5	5.3	6.9	4.3	4.3	4.8	4.4	5.1	4.2	4.3
S.D.	3.9		5.2	2.3	2.0	2.0	0.9	1.3	0.8	1.0	1.1	1.0

/					HAVRE (H-5	)						
/		L¢	oaf Volume				Qualit	y Score Co	mpared to	Check (Gle	enn)	
	Bake						Internal	Internal				
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &				
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
Α	72.0	1105	105.7	7	5	5	5	5	5	9	9	9
В	77.2	1035	96.0	7	8	5	6	6	5	6	5	6
С	68.0	1020	101.0	4	7	5	6	5	5	4	5	5
D	62.0	2875	93.5	9	9	9	5	5	5	5	5	5
E	64.0	2600	96.3	5	4	4	6	7	5	6	7	6
F	71.4	1160	103.6	6	7	4	6	5	6	6	6	6
G	64.0	2956	100.0	9	9	5	5	5	5	7	5	5
н	75.0	1125	100.0	6	5	6	7	5	5	7	6	7
I	68.5	2625	101.0	9	9	5	5	3	5	7	5	5
J	71.8	864	99.5	6	7	5	5	5	5	8	6	6
к	67.7	2333	104.2	5	7	5	5	5	6	6	6	6
L	72.7	1145	98.7	7	9	5	7	9	5	5	7	5
Avg.	69.5		100.0	6.7	7.2	5.3	5.7	5.4	5.2	6.3	6.0	5.9
S.D.	4.7		3.6	1.7	1.7	1.3	0.8	1.4	0.4	1.4	1.2	1.2

					MINOT (M-5	)						
		Lc	oaf Volume				Quality	y Score Co	npared to	Check (Gle	enn)	
	Bake						Internal	Internal				
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &				
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
Α	68.0	1150	97.0	5	5	5	5	5	3	7	5	5
В	76.9	1088	100.3	6	8	4	6	7	5	5	6	5
С	66.4	1003	93.3	4	7	5	5	5	4	6	5	5
D	60.0	2950	101.7	9	9	5	5	5	5	5	5	5
E	61.0	2500	104.2	5	3	3	5	6	5	7	5	6
F	69.1	1035	97.2	4	6	5	5	6	4	5	5	4
G	63.0	3015	100.0	9	9	5	5	5	4	7	5	6
Н	71.5	1090	96.9	3	5	4	5	7	3	7	5	5
I	65.8	2700	95.6	7	7	7	5	7	3	9	5	5
J	68.9	821	97.3	4	7	4	5	6	4	7	4	5
K	65.2	2260	99.2	5	6	5	7	6	4	6	5	5
L	71.4	1060	101.0	5	5	5	5	3	3	7	3	5
Avg.	67.3		98.6	5.5	6.4	4.8	5.3	5.7	3.9	6.5	4.8	5.1
S.D.	4.8		3.0	1.9	1.8	1.0	0.6	1.2	0.8	1.2	0.7	0.5

#### PMWH25180325

					CASSELTON (	C-6)						l .
		Lo	oaf Volume				Quality	y Score Co	mpared to	Check (Gle	enn)	
	Bake						Internal	Internal				1
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &				
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
Α	63.0	900	84.1	5	5	3	5	1	3	5	1	1
В	69.4	893	89.5	5	6	6	4	5	5	5	4	5
С	64.2	883	91.0	5	6	4	5	4	2	5	4	3
D	57.0	2900	98.3	5	5	3	5	5	4	5	3	3
E	59.0	2450	104.3	5	5	5	5	6	4	5	5	5
F	67.1	910	88.3	5	4	4	7	7	2	6	5	5
G	59.0	2956	99.0	2	4	1	4	3	3	6	2	3
Н	64.0	930	80.9	5	5	3	3	5	1	6	4	4
I	61.8	2525	92.7	5	7	3	5	7	1	5	3	3
J	65.0	782	93.3	4	5	4	4	6	2	2	1	2
K	60.6	2090	93.8	5	3	4	5	5	2	6	3	5
L	67.0	850	77.6	5	5	3	5	5	1	5	5	3
Avg.	63.1		91.1	4.7	5.0	3.6	4.8	4.9	2.5	5.1	3.3	3.5
S.D.	3.8		7.7	0.9	1.0	1.2	1.0	1.7	1.3	1.1	1.4	1.3

					CROOKSTON (	K-6)						
		Lo	oaf Volume				Quality	y Score Coi	npared to (	Check (Gle	enn)	1
	Bake						Internal	Internal				
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &				
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
Α	67.0	960	90.6	7	5	3	5	3	3	5	1	3
В	71.5	983	93.8	8	7	5	4	5	3	5	5	5
С	62.5	920	95.5	5	6	3	5	4	2	4	4	4
D	59.0	2800	96.6	4	4	3	5	5	4	5	3	3
E	58.0	2250	93.8	5	3	3	3	4	4	4	3	3
F	64.4	1050	94.2	6	5	3	4	5	2	4	3	3
G	58.0	2956	102.0	9	9	4	6	6	3	4	3	3
н	67.0	1000	104.2	5	5	4	5	7	1	3	5	4
I	60.4	2450	92.5	5	7	5	5	5	1	3	3	3
J	63.2	795	96.5	5	6	4	6	7	2	2	2	2
ĸ	59.7	2493	99.9	5	5	5	5	5	3	3	5	4
L	67.7	1020	93.2	7	5	1	3	9	1	3	7	3
Avg.	63.2		96.0	5.9	5.6	3.6	4.7	5.4	2.4	3.8	3.7	3.3
S.D.	4.4		4.1	1.5	1.6	1.2	1.0	1.6	1.1	1.0	1.6	0.8

					MINOT (M-6	)						
		Lo	oaf Volume				Quality	y Score Co	mpared to	Check (Gle	nn)	
0	Bake Absorption	()	(0) - <b>5</b> Oh I-)	Mixing	Dough	Mixing	Internal Crumb	Internal Grain &	Destain		Dekina	0
Cooperator	(%)	(00)		Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
Α	66.0	980	82.7	3	5	1	5	3	1	1	1	1
В	71.3	940	86.6	4	6	3	4	5	4	5	5	5
С	63.9	925	86.0	4	6	4	4	4	2	5	3	3
D	59.0	2550	87.9	3	3	3	5	5	3	5	3	3
E	59.0	2350	97.9	5	3	3	5	6	4	6	4	3
F	66.8	990	93.0	4	4	3	4	6	2	5	4	3
G	60.0	2780	92.2	6	6	3	4	3	2	6	3	3
н	68.0	1010	89.8	5	3	2	3	7	1	5	4	3
I	62.6	2625	92.9	3	5	3	5	5	1	7	1	1
J	65.4	742	87.9	4	4	3	5	6	3	3	1	2
ĸ	61.9	2248	98.7	5	8	5	6	6	2	6	5	5
L	66.6	950	90.5	5	5	1	3	7	1	5	5	3
Avg.	64.2		90.5	4.3	4.8	2.8	4.4	5.3	2.2	5.4	3.3	2.9
S.D.	3.8		4.7	1.0	1.5	1.1	0.9	1.4	1.1	1.1	1.5	1.2

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WATERTOWN (B-7)												
		L¢	baf Volume				Qualit	y Score Co	mpared to	Check (Gle	enn)	
	Bake						Internal	Internal				
/	Absorption			Mixing	Dough	Mixing	Crumb	Grain &				
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
A	70.0	1135	101.8	5	5	3	5	5	5	5	5	5
В	75.0	1083	99.4	6	8	4	6	6	5	5	5	5
С	66.6	1083	101.2	5	7	6	5	5	5	5	5	5
D	61.0	3075	110.8	9	9	5	5	5	5	5	5	5
E	63.0	2000	76.9	5	5	6	5	3	5	4	3	3
F	70.5	1100	96.5	5	6	8	5	3	4	5	3	3
G	64.0	2897	101.0	9	9	5	5	5	6	7	5	6
н	72.5	1055	93.0	5	5	5	7	5	5	4	6	5
I	66.5	2550	94.4	9	7	7	5	5	5	5	5	5
J	69.3	862	95.4	5	6	6	5	6	5	5	6	5
к	65.7	2233	94.6	5	7	5	5	5	4	5	4	5
L	71.7	1210	102.1	7	9	5	5	5	5	3	5	5
Avg.	68.0		97.3	6.3	6.9	5.4	5.3	4.8	4.9	4.8	4.8	4.8
S.D.	4.2		8.1	1.8	1.6	1.3	0.6	0.9	0.5	0.9	1.0	0.9

	CASSELTON (C-7)													
		Lo	oaf Volume				Quality	y Score Co	npared to	Check (Gle	enn)			
	Bake						Internal	Internal						
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &						
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall		
Α	68.0	1130	105.6	7	5	5	5	3	7	7	7	7		
В	72.4	1063	106.5	7	7	5	6	7	4	6	6	6		
С	64.0	995	102.6	5	7	7	6	5	5	4	5	5		
D	60.0	3200	108.5	9	7	5	5	4	7	5	5	5		
E	59.0	2500	106.4	5	4	5	7	7	5	4	7	7		
F	68.4	1040	101.0	7	8	6	6	6	5	6	6	6		
G	61.0	2927	98.0	9	9	6	5	5	6	5	6	6		
Н	70.0	1110	96.5	6	7	7	5	3	6	5	5	5		
I	63.9	2675	98.2	9	9	7	5	7	5	5	5	5		
J	67.0	784	93.6	4	5	6	5	6	5	5	5	5		
κ	62.8	2123	95.2	5	4	4	5	4	5	7	4	5		
L	70.0	920	84.0	7	5	7	5	9	5	5	7	5		
Avg.	65.5		99.7	6.7	6.4	5.8	5.4	5.5	5.4	5.3	5.7	5.6		
S.D.	4.4		7.0	1.7	1.8	1.0	0.7	1.8	0.9	1.0	1.0	0.8		

					CROOKSTON (	K-7)						
		Lo	oaf Volume				Quality	y Score Co	mpared to	Check (Gle	enn)	
Cooperator	Bake Absorption (%)	(cc)	(% of Check)	- Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
Α	70.0	1135	107.1	7	5	5	5	5	5	7	7	7
В	73.9	1123	107.2	7	8	4	6	8	5	5	7	6
С	63.7	960	99.7	5	6	7	5	5	5	5	5	5
D	61.0	3100	106.9	9	9	5	5	5	5	5	5	5
E	61.0	2200	91.7	5	3	3	4	6	5	4	5	5
F	66.8	1090	97.8	6	6	9	5	7	5	5	6	6
G	61.0	3015	104.1	9	9	6	6	6	5	4	6	6
н	71.0	1175	122.4	7	7	9	8	5	5	5	7	6
I	63.5	2475	93.4	9	9	7	5	3	5	5	3	5
J	66.5	786	95.4	6	6	7	6	7	5	5	7	6
ĸ	62.3	2483	99.5	5	4	5	5	4	5	4	5	5
L	70.0	1160	105.9	9	7	7	3	9	5	5	7	5
Avg.	65.9		102.6	7.0	6.6	6.2	5.3	5.8	5.0	4.9	5.8	5.6
S.D.	4.5		8.3	1.7	2.0	1.9	1.2	1.7	0.0	0.8	1.3	0.7

### LCS Cannon

	WATERTOWN (B-8)												
		Lo	oaf Volume				Quality	y Score Co	mpared to	Check (Gle	enn)		
	Bake						Internal	Internal					
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &					
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall	
Α	71.0	995	89.2	3	5	1	5	3	3	7	1	1	
В	72.0	1060	97.2	4	7	5	7	6	5	5	5	5	
С	65.8	853	79.7	4	5	4	5	4	4	6	3	3	
D	61.0	2750	99.1	7	7	5	5	5	5	5	5	5	
E	62.0	2800	107.7	5	3	5	5	4	5	4	4	4	
F	68.9	1105	96.9	4	6	3	5	6	4	6	5	4	
G	64.0	2927	102.1	8	8	4	4	4	4	8	6	5	
Н	71.0	950	83.7	4	5	4	3	4	5	7	4	5	
I	66.6	2575	95.4	5	7	5	5	5	3	7	5	5	
J	69.7	770	85.2	3	7	5	5	7	4	6	1	3	
K	64.7	2218	93.9	5	3	3	5	5	4	6	5	5	
L	70.6	1130	95.4	5	5	1	5	3	3	5	3	3	
Avg.	67.3		93.8	4.8	5.7	3.8	4.9	4.7	4.1	6.0	3.9	4.0	
S.D.	3.8		8.0	1.5	1.6	1.5	0.9	1.2	0.8	1.1	1.6	1.3	

	CASSELTON (C-8)												
		Lo	oaf Volume				Quality	y Score Cor	npared to (	Check (Gle	nn)		
	Bake						Internal	Internal					
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &					
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall	
Α	66.0	960	89.7	3	5	3	5	3	5	5	3	3	
В	71.9	938	94.0	4	6	5	5	5	3	5	5	5	
С	63.7	850	87.6	4	6	4	5	3	4	5	3	3	
D	59.0	3150	106.8	5	5	3	5	5	7	5	4	3	
E	59.0	2450	104.3	5	5	5	5	4	4	6	5	5	
F	67.0	1040	101.0	3	6	4	7	7	3	6	6	6	
G	60.0	2897	97.0	9	9	5	4	3	5	6	4	5	
Н	66.5	905	78.7	4	3	3	3	3	3	5	3	3	
I	62.7	2775	101.8	5	7	3	5	7	3	5	5	5	
J	65.5	792	94.5	4	5	4	5	6	4	4	3	4	
K	61.5	2161	96.9	5	5	3	6	6	4	6	5	5	
L	69.1	1030	94.1	5	5	3	5	9	3	5	7	5	
Avg.	64.3		95.5	4.7	5.6	3.8	5.0	5.1	4.0	5.3	4.4	4.3	
S.D.	4.1		7.8	1.6	1.4	0.9	1.0	2.0	1.2	0.6	1.3	1.1	

					HAVRE (H-8	6)						
		Lo	oaf Volume	_			Quality	y Score Co	mpared to	Check (Gle	enn)	
Cooperator	Bake Absorption (%)	(cc)	(% of Check)	- Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Millina	Baking	Overall
Α	71.0	1080	103.3	7	5	3	5	5	5	7	7	7
В	78.0	1073	99.5	6	8	4	7	8	5	5	7	7
С	66.3	950	94.1	4	7	5	7	6	4	5	4	5
D	62.0	2975	96.7	9	9	9	5	5	5	5	5	5
E	64.0	2700	100.0	5	4	5	5	4	5	6	5	5
F	70.1	1090	97.3	5	7	5	6	6	4	6	5	5
G	64.0	3015	102.0	9	9	5	5	5	4	6	6	6
н	74.0	1155	102.7	5	7	9	7	5	4	7	7	7
I	67.3	2675	102.9	9	9	5	5	5	3	7	5	5
J	70.3	912	105.1	5	7	6	7	6	5	8	8	7
ĸ	66.3	2356	105.2	5	9	3	6	5	4	6	6	5
L	72.6	970	83.6	7	5	5	7	9	3	7	7	7
Avg.	68.8		99.4	6.3	7.2	5.3	6.0	5.8	4.3	6.3	6.0	5.9
S.D.	4.7		6.0	1.8	1.7	1.9	1.0	1.4	0.8	1.0	1.2	1.0

	CROOKSTON (K-8)													
		Lo	oaf Volume				Quality	y Score Co	npared to	Check (Gle	enn)			
	Bake Absorption			Mixing	Dough	Mixing	Internal Crumb	Internal Grain &						
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall		
Α	68.0	1015	95.8	5	5	3	5	3	3	7	3	3		
В	72.9	1025	97.8	5	8	5	5	6	4	5	5	5		
С	63.4	893	92.7	4	6	5	5	3	4	5	4	4		
D	60.0	3050	105.2	8	7	5	5	5	5	5	5	5		
E	60.0	2250	93.8	5	4	4	4	4	4	6	4	4		
F	65.6	1060	95.1	5	5	4	5	4	4	5	4	4		
G	61.0	3015	104.1	9	9	5	6	5	4	5	5	5		
н	69.5	1040	108.3	5	5	4	5	5	3	5	5	5		
1	63.3	2600	98.1	7	7	5	5	5	3	5	5	5		
J	66.5	820	99.5	4	7	5	5	6	4	3	4	4		
К	62.1	2458	98.5	5	7	5	5	4	4	6	4	4		
L	70.0	1100	100.5	5	5	5	3	9	3	5	7	5		
Avg.	65.2		99.1	5.6	6.3	4.6	4.8	4.9	3.8	5.2	4.6	4.4		
S.D.	4.3		4.8	1.6	1.5	0.7	0.7	1.6	0.6	0.9	1.0	0.7		

					MINOT (M-8	)						
		Lo	oaf Volume				Quality	y Score Co	mpared to	Check (Gle	nn)	
Connector	Bake Absorption	(22)	(9/ of Chook)	Mixing	Dough	Mixing	Internal Crumb	Internal Grain &	Drotoin	Milling	Daking	Overall
	(%)	025		Requirement	Characteristics	1 Olerance	Color	rexture	Protein	7	Бакінд	Overall
Å	00.0	900 110E	00.1	5	0	I E	5	3	5	7	I C	5
В	74.9	1105	101.8	4	8	5	5	1	5	5	0	6
С	66.0	945	87.9	4	7	5	4	4	3	5	4	4
D	60.0	2775	95.7	5	6	4	5	5	5	5	4	4
E	61.0	2450	102.1	5	3	3	4	8	4	7	6	7
F	68.4	1090	102.3	4	4	5	5	7	3	5	6	6
G	63.0	3045	101.0	8	7	4	5	4	3	5	5	4
н	71.0	1010	89.8	3	5	4	3	7	3	5	4	4
I	65.1	2700	95.6	7	7	5	5	7	3	7	5	5
J	67.8	819	97.0	4	5	4	5	6	4	1	4	3
К	64.5	2241	98.4	7	3	3	5	5	4	6	5	5
L	68.5	1045	99.5	5	5	5	5	3	3	5	3	3
Avg.	66.5		96.2	5.1	5.4	4.0	4.7	5.5	3.6	5.3	4.4	4.5
S.D.	4.2		6.2	1.5	1.6	1.2	0.7	1.7	0.8	1.6	1.4	1.3

#### MN10201-4-A

	WATERTOWN (B-9)												
		Lo	oaf Volume				Quality	y Score Co	mpared to	Check (Gle	enn)		
	Bake						Internal	Internal					
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &					
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall	
Α	70.0	1015	91.0	5	5	1	3	3	3	7	1	1	
В	71.7	1088	99.8	4	7	4	4	5	5	5	5	5	
С	63.6	900	84.1	4	6	5	4	7	5	6	4	5	
D	61.0	2750	99.1	9	7	5	3	5	5	5	5	5	
E	60.0	2150	82.7	5	2	4	3	4	5	6	3	4	
F	69.0	1050	92.1	4	5	4	4	5	5	6	3	4	
G	62.0	2868	100.0	7	6	4	4	4	4	8	4	4	
н	70.0	1070	94.3	5	4	5	1	4	5	9	3	4	
I	64.1	2600	96.3	7	5	5	3	7	5	7	5	5	
J	67.3	845	93.5	4	7	6	4	7	5	6	3	5	
K	62.7	2295	97.2	5	7	5	4	5	5	6	4	5	
L	69.4	1090	92.0	5	5	1	5	3	3	3	3	3	
Avg.	65.9		93.5	5.3	5.5	4.1	3.5	4.9	4.6	6.2	3.6	4.2	
S.D.	4.1		5.6	1.6	1.5	1.6	1.0	1.4	0.8	1.5	1.2	1.2	

	CASSELTON (C-9)												
		Lo	oaf Volume				Quality	y Score Coi	npared to	Check (Gle	enn)		
	Bake						Internal	Internal					
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &					
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall	
Α	64.0	950	88.8	5	5	3	5	3	3	5	1	3	
В	68.9	925	92.7	6	7	5	5	5	4	5	5	5	
С	61.3	900	92.8	4	6	5	3	7	3	5	4	4	
D	58.0	3075	104.2	5	5	3	5	5	5	5	4	3	
E	58.0	2500	106.4	5	5	5	4	4	4	5	3	4	
F	64.3	1065	103.4	4	6	5	7	7	2	6	6	4	
G	58.0	2897	97.0	4	5	2	3	3	3	6	3	4	
н	64.5	995	86.5	5	5	5	1	5	1	6	5	5	
I	60.1	2575	94.5	5	5	3	5	7	1	5	3	3	
J	63.0	778	92.8	4	5	5	4	6	3	3	2	3	
K	58.8	2217	99.5	5	5	4	5	5	3	7	5	5	
L	64.1	1000	91.3	5	5	1	1	7	1	5	5	3	
Avg.	61.9		95.8	4.8	5.3	3.8	4.0	5.3	2.8	5.3	3.8	3.8	
S.D.	3.4		6.3	0.6	0.7	1.4	1.8	1.5	1.3	1.0	1.5	0.8	

					CROOKSTON (	K-9)						
		Lo	oaf Volume	_			Quality	y Score Co	mpared to	Check (Gle	enn)	
Cooperator	Bake Absorption (%)	(cc)	(% of Check)	- Mixing Requirement	Dough Characteristics	Mixing	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
Α	68.0	1050	99.1	7	5	1	3	3	3	9	5	5
В	69.5	980	93.5	7	7	5	4	5	4	5	5	5
С	60.8	883	91.7	5	6	5	4	5	3	5	4	4
D	60.0	2975	102.6	4	5	4	4	5	5	5	4	3
E	58.0	2550	106.3	5	3	4	4	6	4	4	3	4
F	63.5	1100	98.7	5	6	4	2	6	3	5	3	3
G	58.0	3015	104.1	9	9	5	5	4	3	6	4	4
н	67.0	1100	114.6	5	5	4	3	5	3	7	5	6
I	60.3	2625	99.1	7	7	5	5	3	3	7	5	5
J	63.4	792	96.1	4	7	5	4	7	3	5	3	4
K	59.1	2450	98.2	5	5	5	5	5	3	6	4	5
L	67.0	1060	96.8	9	5	3	1	7	1	7	7	5
Avg.	62.9		100.0	6.0	5.8	4.2	3.7	5.1	3.2	5.9	4.3	4.4
S.D.	4.1		6.2	1.8	1.5	1.2	1.2	1.3	0.9	1.4	1.2	0.9

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WATERTOWN (B-10)												
1		L¢	baf Volume			Quality Score Compared to Check (Glenn)						
	Bake						Internal	Internal				
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &				
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
A	70.0	1050	94.2	5	5	5	5	3	5	3	3	3
В	71.6	1050	96.3	5	7	5	5	4	5	4	5	5
С	67.0	970	90.7	4	6	4	5	5	3	6	4	4
D	61.0	2925	105.4	9	9	5	5	7	5	5	5	5
E	62.0	1950	75.0	5	5	6	5	4	4	4	5	5
F	70.0	1055	92.5	5	5	4	5	4	4	3	3	3
G	64.0	2927	102.1	9	9	5	5	5	5	6	6	6
н	71.0	1065	93.8	5	5	5	5	5	4	6	5	5
I	67.0	2625	97.2	7	7	5	5	7	3	5	5	5
J	69.9	847	93.7	4	7	5	5	6	4	4	3	4
K	65.6	2299	97.4	5	5	5	6	5	3	4	4	4
L	70.2	1160	97.9	5	5	3	5	3	3	3	3	3
Avg.	67.4		94.7	5.7	6.3	4.8	5.1	4.8	4.0	4.4	4.3	4.3
S.D.	3.6		7.4	1.7	1.5	0.8	0.3	1.3	0.9	1.2	1.1	1.0

CASSELTON (C-10)												
		Lo	oaf Volume	Quality Score Compared to Check (Glenn)								
	Bake						Internal	Internal				
	Absorption			Mixing	Dough	Mixing	Crumb	Grain &				
Cooperator	(%)	(cc)	(% of Check)	Requirement	Characteristics	Tolerance	Color	Texture	Protein	Milling	Baking	Overall
Α	65.0	985	92.1	5	5	3	7	5	3	9	3	5
В	70.4	923	92.5	6	7	5	6	6	4	6	5	6
С	62.4	933	96.2	5	6	5	7	6	4	5	5	5
D	58.0	3150	106.8	5	5	4	5	5	7	5	5	4
E	58.0	2500	106.4	5	4	5	5	6	5	6	6	6
F	65.7	1010	98.1	4	4	5	3	3	3	6	3	3
G	59.0	2927	98.0	9	9	5	4	4	4	6	4	5
Н	65.0	980	85.2	5	5	5	3	5	3	7	5	6
I	61.3	2575	94.5	7	7	5	5	7	3	7	3	5
J	64.5	788	94.0	4	6	5	6	7	4	3	4	4
K	60.2	2267	101.7	5	6	5	5	6	3	7	6	6
L	68.0	985	90.0	7	5	5	9	9	3	5	9	5
Avg.	63.1		96.3	5.6	5.8	4.8	5.4	5.8	3.8	6.0	4.8	5.0
S.D.	4.0		6.4	1.4	1.4	0.6	1.7	1.5	1.2	1.5	1.7	1.0

					CROOKSTON (	<b>(-10)</b>						
		Lo	oaf Volume		Quality Score Compared to Check (Glenn)							
Cooperator	Bake Absorption (%)	(cc)	(% of Check)	- Mixing Requirement	Dough Characteristics	Mixing Tolerance	Internal Crumb Color	Internal Grain & Texture	Protein	Milling	Baking	Overall
A	68.0	1090	102.8	5	5	3	5	5	5	7	5	5
В	72.4	1043	99.5	7	8	5	6	4	4	5	5	5
С	64.0	1025	106.4	5	6	5	5	7	3	5	5	5
D	60.0	3050	105.2	7	7	5	5	5	5	5	5	4
E	60.0	2450	102.1	5	3	4	6	7	4	4	6	5
F	67.0	1040	93.3	5	5	4	4	4	3	3	4	3
G	60.0	3015	104.1	9	9	5	6	5	4	5	4	4
Н	70.5	1055	109.9	5	5	5	7	5	3	3	6	5
I	62.9	2650	100.0	7	7	3	5	3	3	5	5	3
J	65.8	836	101.5	5	7	6	7	7	4	3	7	5
K	62.2	2447	98.0	5	7	5	5	5	3	3	4	4
L	69.6	1085	99.1	7	5	3	3	9	3	5	7	5
Avg.	65.2		101.8	6.0	6.2	4.4	5.3	5.5	3.7	4.4	5.3	4.4
S.D.	4.3		4.3	1.3	1.6	1.0	1.2	1.7	0.8	1.2	1.1	0.8

## Hard Red Spring Wheat Breeding Quality Target Values

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

<sup>†</sup>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. <u>Breeding target values are a tool.</u> 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.