Wheat Quality Council

Hard Spring Wheat Technical Committee

2008 Crop

February 17 – 19, 2009

Kansas City, MO

Wheat Quality Council

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Sponsored by the Wheat Quality Council
February 17-19, 2009
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Introduction

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

Eleven experimental lines of hard spring wheat were grown at up to five locations in 2008 and evaluated for kernel, milling, and bread baking quality against the check variety Glenn. To avoid any bias in the test procedures, code numbers were assigned to the experimental lines and maintained throughout the growing and harvesting of the plots and the milling and baking trials. Samples of wheat were milled at the USDA Hard Red Spring and Durum Wheat Quality Laboratory (WQL), Fargo, ND. Flour samples were shipped to independent laboratories and tested for bread baking quality.

From this report:

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

The results relate only to test samples that were volunteered for testing in the 2008 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.

I. USDA/ARS WQL Results/Evaluation

Quality Trait		Crookston	
		Glenn	00S0291-3
1	Wheat Protein (12%mb)	14.7	13.7
2	Flour Protein (12%mb)	14.0	13.0
3	Market Value (Score 1-6)	4.8	4.3
4	Market Value (Score 1-10)	10.0	8.2
5	Test Weight (lb/bu)	65.3	62.2
6	1000 Kernel Weight (g)	36.8	36.5
7	Kernel Size % Large	82	76
8	Kernel Size % Small	2	3
9	Wheat Moisture (%)	10.7	11.3
10	Wheat Ash (14%mb)	1.37	1.36
11	Wheat Falling Number (sec)	400	400
12	SKCS - Hardness Index	85.9	78.1
13	Vitreous Kernels (%)	96.6	80.7
	Flour Extraction (%)		
14	Tempered Wheat Basis (%)	70.7	73.5
15	Total Product Basis (%)	74.2	77.5
16	Flour /Bu Wheat (lbs)	48.4	47.8
17	Flour Color Brightness (L*)	90.9	90.5
18	Flour Color Yellowness (b*)	8.5	9.8
19	Flour Moisture (%)	13.3	13.0
20	Flour Ash (14%mb)	0.403	0.474
21	Flour Falling Number (Malted) (sec)	257	247
	Farinograph		
22	Water Absorption (500bu)	65.1	65.4
23	Water Absorption (14%mb)	64.3	64.9
24	Arrival Time (min)	3.2	3.8
25	Peak Time (min)	9.0	6.7
26	Dough Stability (min)	12.1	6.7
27	MTI (bu)	25.0	33.0
28	TTB (min)	14.8	10.9

II. Cooperator Results/Evaluation

29	Bake Absorption (Avg %)	63.6±2.4	63.4±2.6
30	Loaf Volume (% of Check)		96.0±8.1

Quality Trait	II. Cooperator Results/Evaluation	Crookston Glenn	Crookston 00S0291-3
31	**Mixing Requirement**	3.7±0.9	2.4±1.1
	5 Very Long		
	4 Long		
	3 Medium	———	
	2 Short		———
	1 Very Short		
32	**Dough Characteristics**	3.8±1.0	2.6±0.9
	5 Bucky-Tough		
	4 Strong-Elastic		
	3 Medium-Pliable	———	
	2 Mellow-Very Pliable		———
	1 Weak-Short or Sticky		
33	**Mixing Tolerance**		2.1±1.2
	5 Much More Tolerance Than Check		
	4 More Tolerance Than Check		
	3 Tolerance Equivalent To Check		
	2 Less Tolerance Than Check		———
	1 Much Less Tolerance Than Check		
34	**Internal Crumb Color**		2.7±0.5
	5 Much Brighter Than Check		
	4 Brighter Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		———
	1 Much Poorer Than Check		
35	**Internal Grain and Texture**		3.2±0.8
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		———
	2 Poorer Than Check		
	1 Much Poorer Than Check		
III. Cooperator Quality Assessment			
	Quality Trait 1-2: Protein		2.4±0.5
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		———
	1 Much Poorer Than Check		
	Quality Trait 3-21: Milling		3.1±1.1
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		———
	2 Poorer Than Check		
	1 Much Poorer Than Check		
	Quality Trait 22-35: Baking		2.4±0.9
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		———
	1 Much Poorer Than Check		
	Quality Trait 1-35: Overall Comparison		2.2±0.8
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		———
	1 Much Poorer Than Check		

I. USDA/ARS WQL Results/Evaluation

Quality Trait		Williston	
		Glenn	NDSW0449
1	Wheat Protein (12%mb)	16.9	17.4
2	Flour Protein (12%mb)	16.2	17.1
3	Market Value (Score 1-6)	4.4	3.9
4	Market Value (Score 1-10)	10.0	8.0
5	Test Weight (lb/bu)	61.7	57.8
6	1000 Kernel Weight (g)	24.8	22.3
7	Kernel Size % Large	5	3
8	Kernel Size % Small	18	31
9	Wheat Moisture (%)	9.4	9.5
10	Wheat Ash (14%mb)	1.14	1.36
11	Wheat Falling Number (sec)	400	400
12	SKCS - Hardness Index	69.5	62.7
13	Vitreous Kernels (%)	94.9	88.2
	Flour Extraction (%)		
14	Tempered Wheat Basis (%)	70.0	70.2
15	Total Product Basis (%)	73.6	74.5
16	Flour /Bu Wheat (lbs)	45.8	43.2
17	Flour Color Brightness (L*)	90.6	90.0
18	Flour Color Yellowness (b*)	9.7	10.6
19	Flour Moisture (%)	12.8	12.3
20	Flour Ash (14%mb)	0.405	0.418
21	Flour Falling Number (Malted) (sec)	249	238
	Farinograph		
22	Water Absorption (500bu)	64.5	65.7
23	Water Absorption (14%mb)	63.1	64.0
24	Arrival Time (min)	5.0	5.0
25	Peak Time (min)	12.9	7.5
26	Dough Stability (min)	15.0	9.7
27	MTI (bu)	14.0	21.0
28	TTB (min)	20.0	14.8

II. Cooperator Results/Evaluation

29	Bake Absorption (Avg %)	63.4±3.4	64.0±2.6
30	Loaf Volume (% of Check)		98.2±7.4

Quality Trait	II. Cooperator Results/Evaluation	Glenn	Williston NDSW0449
31	**Mixing Requirement**	4.2 ±0.8	3.4 ±1.3
	5 Very Long		
	4 Long	_____	
	3 Medium		_____
	2 Short		
	1 Very Short		
32	**Dough Characteristics**	4.2 ±0.8	4.0 ±0.7
	5 Bucky-Tough		
	4 Strong-Elastic	_____	_____
	3 Medium-Pliable		
	2 Mellow-Very Pliable		
	1 Weak-Short or Sticky		
33	**Mixing Tolerance**		2.9 ±1.3
	5 Much More Tolerance Than Check		
	4 More Tolerance Than Check		
	3 Tolerance Equivalent To Check		
	2 Less Tolerance Than Check		_____
	1 Much Less Tolerance Than Check		
34	**Internal Crumb Color**		2.7 ±1.0
	5 Much Brighter Than Check		
	4 Brighter Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		_____
	1 Much Poorer Than Check		
35	**Internal Grain and Texture**		2.7 ±1.2
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		_____
	1 Much Poorer Than Check		
III. Cooperator Quality Assessment			
	Quality Trait 1-2: Protein		3.2 ±1.1
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		_____
	2 Poorer Than Check		
	1 Much Poorer Than Check		
	Quality Trait 3-21: Milling		2.8 ±0.7
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		_____
	1 Much Poorer Than Check		
	Quality Trait 22-35: Baking		2.9 ±1.2
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		_____
	1 Much Poorer Than Check		
	Quality Trait 1-35: Overall Comparison		2.9 ±1.1
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		_____
	1 Much Poorer Than Check		

I. USDA/ARS WQL Results/Evaluation

Quality Trait		Brookings		Casselton		Crookston	
		Glenn	SD3851	Glenn	SD3851	Glenn	SD3851
1	Wheat Protein (12%mb)	13.3	11.3	14.3	13.8	14.7	13.5
2	Flour Protein (12%mb)	12.4	10.9	13.4	12.9	14.0	13.0
3	Market Value (Score 1-6)	4.1	3.6	4.3	4.2	4.8	4.4
4	Market Value (Score 1-10)	10.0	7.8	10.0	9.0	10.0	8.4
5	Test Weight (lb/bu)	65.4	63.8	65.2	63.9	65.3	64.1
6	1000 Kernel Weight (g)	33.2	37.2	35.6	34.2	36.8	36.5
7	Kernel Size % Large	77	70	80	72	82	68
8	Kernel Size % Small	5	4	2	4	2	5
9	Wheat Moisture (%)	10.6	10.7	12.1	10.6	10.7	10.5
10	Wheat Ash (14%mb)	1.67	1.60	1.72	1.48	1.37	1.21
11	Wheat Falling Number (sec)	400	388	400	400	400	387
12	SKCS - Hardness Index	87.5	81.9	88.5	80.4	85.9	85.9
13	Vitreous Kernels (%)	87.0	46.9	95.6	73.2	96.6	79.3
	Flour Extraction (%)						
14	Tempered Wheat Basis (%)	68.3	71.8	67.6	72.0	70.7	72.3
15	Total Product Basis (%)	71.7	75.3	70.6	75.8	74.2	75.7
16	Flour /Bu Wheat (lbs)	46.8	47.9	46.2	48.2	48.4	48.5
17	Flour Color Brightness (L*)	90.8	90.9	90.7	90.4	90.9	90.4
18	Flour Color Yellowness (b*)	8.9	10.5	8.7	10.0	8.5	10.1
19	Flour Moisture (%)	12.4	13.0	12.6	12.2	13.3	12.3
20	Flour Ash (14%mb)	0.473	0.493	0.418	0.496	0.403	0.458
21	Flour Falling Number (Malted) (sec)	249	250	249	245	257	252
	Farinograph						
22	Water Absorption (500bu)	65.4	62.1	67.0	65.6	65.1	63.3
23	Water Absorption (14%mb)	63.9	61.2	66.0	64.4	64.3	62.3
24	Arrival Time (min)	1.9	1.3	3.0	3.3	3.2	2.0
25	Peak Time (min)	3.3	1.8	5.8	6.7	9.0	6.7
26	Dough Stability (min)	7.2	5.4	7.6	6.2	12.1	10.1
27	MTI (bu)	24.0	34.0	37.0	51.0	25.0	23.0
28	TTB (min)	8.8	6.2	10.7	9.5	14.8	12.1

II. Cooperator Results/Evaluation

29	Bake Absorption (Avg %)	63.1±2.3	61.0±2.5	64.4±2.6	62.9±2.4	63.6±2.4	61.5±1.9
30	Loaf Volume (% of Check)		95.6±8.2		99.4±7.5		94.7±5.3

Quality Trait	II. Cooperator Results/Evaluation	Brookings Glenn	Brookings SD3851	Casselton Glenn	Casselton SD3851	Crookston Glenn	Crookston SD3851
31	Mixing Requirement	3.7±1.0	3.6±1.2	3.3±0.9	3.2±0.8	3.7±0.9	3.3±0.9
	5 Very Long						
	4 Long						
	3 Medium						
	2 Short						
	1 Very Short						
32	Dough Characteristics	3.8±1.1	3.4±1.1	3.9±0.9	3.0±1.2	3.8±1.0	3.2±1.0
	5 Bucky-Tough						
	4 Strong-Elastic						
	3 Medium-Pliable						
	2 Mellow-Very Pliable						
	1 Weak-Short or Sticky						
33	Mixing Tolerance		2.6±0.5		2.6±0.5		2.8±0.7
	5 Much More Tolerance Than Check						
	4 More Tolerance Than Check						
	3 Tolerance Equivalent To Check						
	2 Less Tolerance Than Check						
	1 Much Less Tolerance Than Check						
34	Internal Crumb Color		2.8±0.7		2.8±0.7		2.8±2.8
	5 Much Brighter Than Check						
	4 Brighter Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
35	Internal Grain and Texture		3.6±0.9		3.1±0.8		3.4±1.0
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
III. Cooperator Quality Assessment							
	Quality Trait 1-2: Protein		1.9±0.9		2.3±0.5		2.2±0.4
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
	Quality Trait 3-21: Milling		3.6±0.9		3.6±1.1		3.1±0.8
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
	Quality Trait 22-35: Baking		2.7±1.3		2.9±0.8		2.8±0.8
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
	Quality Trait 1-35: Overall Comparison		2.4±1.0		2.9±0.8		2.6±0.7
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						

I. USDA/ARS WQL Results/Evaluation

Quality Trait		Brookings		Casselton		Williston	
		Glenn	ND806	Glenn	ND806	Glenn	ND806
1	Wheat Protein (12%mb)	13.3	12.4	14.3	12.2	16.9	17.3
2	Flour Protein (12%mb)	12.4	11.3	13.4	11.1	16.2	16.5
3	Market Value (Score 1-6)	4.1	3.6	4.3	3.7	4.4	3.9
4	Market Value (Score 1-10)	10.0	8.2	10.0	5.6	10.0	8.4
5	Test Weight (lb/bu)	65.4	62.2	65.2	62.6	61.7	58.1
6	1000 Kernel Weight (g)	33.2	33.6	35.6	28.0	24.8	22.5
7	Kernel Size % Large	77	72	80	22	5	9
8	Kernel Size % Small	5	4	2	13	18	19
9	Wheat Moisture (%)	10.6	10.6	12.1	10.6	9.4	9.5
10	Wheat Ash (14%mb)	1.67	1.65	1.72	1.42	1.14	1.21
11	Wheat Falling Number (sec)	400	400	400	400	400	400
12	SKCS - Hardness Index	87.5	84.6	88.5	79.4	69.5	71.4
13	Vitreous Kernels (%)	87.0	65.8	95.6	49.2	94.9	98.2
	Flour Extraction (%)						
14	Tempered Wheat Basis (%)	68.3	70.9	67.6	71.4	70.0	70.7
15	Total Product Basis (%)	71.7	75	70.6	75	73.6	74.7
16	Flour /Bu Wheat (lbs)	46.8	46.1	46.2	46.8	45.8	43.8
17	Flour Color Brightness (L*)	90.8	90.7	90.7	90.7	90.6	90.5
18	Flour Color Yellowness (b*)	8.9	9.5	8.7	10.4	9.7	9.5
19	Flour Moisture (%)	12.4	12.3	12.6	12.5	12.8	12.9
20	Flour Ash (14%mb)	0.473	0.529	0.418	0.445	0.405	0.438
21	Flour Falling Number (Malted) (sec)	249	244	249	253	249	239
	Farinograph						
22	Water Absorption (500bu)	65.4	62.5	67.0	59.8	64.5	64.7
23	Water Absorption (14%mb)	63.9	61.2	66.0	59.0	63.1	63.0
24	Arrival Time (min)	1.9	1.8	3.0	2.0	5.0	4.5
25	Peak Time (min)	3.3	3.0	5.8	4.3	12.9	9.5
26	Dough Stability (min)	7.2	6.1	7.6	4.9	15.0	10.5
27	MTI (bu)	24.0	33.0	37.0	59.0	14.0	28.0
28	TTB (min)	8.8	7.9	10.7	7.0	20.0	15.1

II. Cooperator Results/Evaluation

29	Bake Absorption (Avg %)	63.1±2.3	60.7±1.9	64.4±2.6	58.7±2.3	63.4±3.4	63.8±3.5
30	Loaf Volume (% of Check)		98.5±6.1		94.3±11.5		99.9±9.4

Quality Trait	II. Cooperator Results/Evaluation	Brookings Glenn	Brookings ND806	Casselton Glenn	Casselton ND806	Williston Glenn	Williston ND806
31	Mixing Requirement	3.7±1.0	3.8±1.1	3.3±0.9	2.2±0.7	4.2±0.8	4.0±0.7
	5 Very Long						
	4 Long						
	3 Medium						
	2 Short						
	1 Very Short						
32	Dough Characteristics	3.8±1.1	3.6±0.9	3.9±0.9	2.0±0.7	4.2±0.8	4.0±1.0
	5 Bucky-Tough						
	4 Strong-Elastic						
	3 Medium-Pliable						
	2 Mellow-Very Pliable						
	1 Weak-Short or Sticky						
33	Mixing Tolerance		2.8±0.7		1.9±1.6		2.7±0.9
	5 Much More Tolerance Than Check						
	4 More Tolerance Than Check						
	3 Tolerance Equivalent To Check						
	2 Less Tolerance Than Check						
	1 Much Less Tolerance Than Check						
34	Internal Crumb Color		3.0±0.5		2.4±0.5		2.8±0.4
	5 Much Brighter Than Check						
	4 Brighter Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
35	Internal Grain and Texture		3.3±1.1		2.6±1.3		2.6±0.9
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
III. Cooperator Quality Assessment							
	Quality Trait 1-2: Protein		2.2±0.4		1.6±0.5		3.3±0.5
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
	Quality Trait 3-21: Milling		3.0±1.1		3.1±1.3		2.7±0.7
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
	Quality Trait 22-35: Baking		3.0±1.1		2.0±0.9		3.1±0.6
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
	Quality Trait 1-35: Overall Comparison		2.8±0.8		2.1±0.9		3.0±0.5
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						

I. USDA/ARS WQL Results/Evaluation

Quality Trait		Brookings		Casselton		Crookston	
		Glenn	06MSP18	Glenn	06MSP18	Glenn	06MSP18
1	Wheat Protein (12% mb)	13.3	11.4	14.3	14.0	14.7	12.1
2	Flour Protein (12% mb)	12.4	10.4	13.4	12.8	14.0	11.1
3	Market Value (Score 1-6)	4.1	3.2	4.3	3.2	4.8	3.5
4	Market Value (Score 1-10)	10.0	7.0	10.0	8.8	10.0	4.2
5	Test Weight (lb/bu)	65.4	62.7	65.2	62.2	65.3	62.4
6	1000 Kernel Weight (g)	33.2	30.2	35.6	35.8	36.8	24.3
7	Kernel Size % Large	77	37	80	71	82	18
8	Kernel Size % Small	5	8	2	4	2	16
9	Wheat Moisture (%)	10.6	10.7	12.1	10.3	10.7	10.4
10	Wheat Ash (14% mb)	1.67	1.59	1.72	1.66	1.37	1.23
11	Wheat Falling Number (sec)	400	400	400	400	400	400
12	SKCS - Hardness Index	87.5	75.0	88.5	86.3	85.9	81.9
13	Vitreous Kernels (%)	87.0	27.1	95.6	79.7	96.6	78.0
	Flour Extraction (%)						
14	Tempered Wheat Basis (%)	68.3	70.8	67.6	69.2	70.7	72.1
15	Total Product Basis (%)	71.7	74.9	70.6	72.8	74.2	75.5
16	Flour /Bu Wheat (lbs)	46.8	46.4	46.2	45.1	48.4	47.0
17	Flour Color Brightness (L*)	90.8	91.1	90.7	90.3	90.9	91.0
18	Flour Color Yellowness (b*)	8.9	10.1	8.7	9.9	8.5	10.3
19	Flour Moisture (%)	12.4	12.3	12.6	12.3	13.3	13.1
20	Flour Ash (14% mb)	0.473	0.432	0.418	0.543	0.403	0.384
21	Flour Falling Number (Malted) (sec)	249	252	249	245	257	250
	Farinograph						
22	Water Absorption (500bu)	65.4	58.8	67.0	65.2	65.1	58.9
23	Water Absorption (14% mb)	63.9	57.9	66.0	63.9	64.3	57.6
24	Arrival Time (min)	1.9	1.5	3.0	2.3	3.2	1.9
25	Peak Time (min)	3.3	2.5	5.8	4.8	9.0	4.9
26	Dough Stability (min)	7.2	5.5	7.6	7.3	12.1	6.2
27	MTI (bu)	24.0	35.0	37.0	28.0	25.0	41.0
28	TTB (min)	8.8	6.8	10.7	10.1	14.8	8.1

II. Cooperator Results/Evaluation

29	Bake Absorption (Avg %)	63.1 ±2.3	58.8 ±3.8	64.4 ±2.6	62.6 ±2.2	63.6 ±2.4	58.9 ±3.4
30	Loaf Volume (% of Check)		96.0 ±12.6		97.9 ±11.9		90.1 ±10.4

Quality Trait	II. Cooperator Results/Evaluation	Brookings Glenn	Brookings 06MSP18	Casselton Glenn	Casselton 06MSP18	Crookston Glenn	Crookston 06MSP18
31	Mixing Requirement	3.7±1.0	3.1±0.8	3.3±0.9	2.6±0.9	3.7±0.9	2.7±1.1
	5 Very Long						
	4 Long						
	3 Medium						
	2 Short						
	1 Very Short						
32	Dough Characteristics	3.8±1.1	3.3±0.9	3.9±0.9	2.9±0.9	3.8±1.0	2.8±1.1
	5 Bucky-Tough						
	4 Strong-Elastic						
	3 Medium-Pliable						
	2 Mellow-Very Pliable						
	1 Weak-Short or Sticky						
33	Mixing Tolerance		2.2±0.4		2.8±0.7		2.3±1.3
	5 Much More Tolerance Than Check						
	4 More Tolerance Than Check						
	3 Tolerance Equivalent To Check						
	2 Less Tolerance Than Check						
	1 Much Less Tolerance Than Check						
34	Internal Crumb Color		2.9±0.6		2.6±0.5		2.2±0.8
	5 Much Brighter Than Check						
	4 Brighter Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
35	Internal Grain and Texture		3.2±1.2		3.0±1.2		2.8±1.1
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
III. Cooperator Quality Assessment							
	Quality Trait 1-2: Protein		1.9±1.3		2.6±0.5		1.7±1.0
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
	Quality Trait 3-21: Milling		3.4±1.1		2.8±1.0		3.0±1.1
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
	Quality Trait 22-35: Baking		2.6±1.0		2.9±1.1		1.8±0.7
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
	Quality Trait 1-35: Overall Comparison		2.6±1.2		2.7±0.7		1.9±0.6
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						

I. USDA/ARS WQL Results/Evaluation

Quality Trait		Casselton		Williston	
		Glenn	NDSW0601	Glenn	NDSW0601
1	Wheat Protein (12%mb)	14.3	13.0	16.9	18.1
2	Flour Protein (12%mb)	13.4	12.4	16.2	17.8
3	Market Value (Score 1-6)	4.3	3.2	4.4	4.1
4	Market Value (Score 1-10)	10.0	6.8	10.0	8.4
5	Test Weight (lb/bu)	65.2	61.2	61.7	58.0
6	1000 Kernel Weight (g)	35.6	34.8	24.8	26.9
7	Kernel Size % Large	80	76	5	15
8	Kernel Size % Small	2	3	18	15
9	Wheat Moisture (%)	12.1	10.3	9.4	9.5
10	Wheat Ash (14%mb)	1.72	1.66	1.14	1.35
11	Wheat Falling Number (sec)	400	344	400	400
12	SKCS - Hardness Index	88.5	82.0	69.5	68.3
13	Vitreous Kernels (%)	95.6	77.6	94.9	92.0
	Flour Extraction (%)				
14	Tempered Wheat Basis (%)	67.6	70.5	70.0	70.5
15	Total Product Basis (%)	70.6	74.7	73.6	75.1
16	Flour /Bu Wheat (lbs)	46.2	45.2	45.8	43.7
17	Flour Color Brightness (L*)	90.7	90.7	90.6	89.6
18	Flour Color Yellowness (b*)	8.7	11.0	9.7	11.1
19	Flour Moisture (%)	12.6	12.5	12.8	12.4
20	Flour Ash (14%mb)	0.418	0.637	0.405	0.529
21	Flour Falling Number (Malted) (sec)	249	270	249	250
	Farinograph				
22	Water Absorption (500bu)	67.0	64.5	64.5	69.2
23	Water Absorption (14%mb)	66.0	63.7	63.1	67.4
24	Arrival Time (min)	3.0	3.5	5.0	6.9
25	Peak Time (min)	5.8	6.2	12.9	11.4
26	Dough Stability (min)	7.6	8.5	15.0	13.0
27	MTI (bu)	37.0	27.0	14.0	14.0
28	TTB (min)	10.7	9.8	20.0	20.0

II. Cooperator Results/Evaluation

29	Bake Absorption (Avg %)	64.4±2.6	62.0±2.3	63.4±3.4	66.6±3.4
30	Loaf Volume (% of Check)		98.1±11.5		101.9±6.6

Quality Trait	II. Cooperator Results/Evaluation	Casselton Glenn	Casselton NDSW0601	Williston Glenn	Williston NDSW0601
31	**Mixing Requirement**	3.3 ±0.9	2.6 ±0.7	4.2 ±0.8	4.2 ±1.0
	5 Very Long				
	4 Long			———	———
	3 Medium	———			
	2 Short		———		
	1 Very Short				
32	**Dough Characteristics**	3.9 ±0.9	2.7 ±1.0	4.2 ±0.8	4.2 ±0.8
	5 Bucky-Tough				
	4 Strong-Elastic	———		———	———
	3 Medium-Pliable				
	2 Mellow-Very Pliable		———		
	1 Weak-Short or Sticky				
33	**Mixing Tolerance**		2.8 ±1.0		3.2 ±1.0
	5 Much More Tolerance Than Check				
	4 More Tolerance Than Check				
	3 Tolerance Equivalent To Check				———
	2 Less Tolerance Than Check		———		
	1 Much Less Tolerance Than Check				
34	**Internal Crumb Color**		2.0 ±0.5		2.7 ±0.7
	5 Much Brighter Than Check				
	4 Brighter Than Check				
	3 Equivalent To Check				
	2 Poorer Than Check				———
	1 Much Poorer Than Check		———		
35	**Internal Grain and Texture**		2.8 ±1.3		2.4 ±0.9
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				
	2 Poorer Than Check		———		———
	1 Much Poorer Than Check				
III. Cooperator Quality Assessment					
	Quality Trait 1-2: Protein		2.0 ±0.7		3.7 ±1.2
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				———
	2 Poorer Than Check				
	1 Much Poorer Than Check		———		
	Quality Trait 3-21: Milling		2.7 ±1.4		2.8 ±1.3
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				
	2 Poorer Than Check		———		———
	1 Much Poorer Than Check				
	Quality Trait 22-35: Baking		2.6 ±1.0		3.1 ±1.1
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				———
	2 Poorer Than Check		———		
	1 Much Poorer Than Check				
	Quality Trait 1-35: Overall Comparison		2.3 ±0.9		3.1 ±1.1
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				———
	2 Poorer Than Check		———		
	1 Much Poorer Than Check				

I. USDA/ARS WQL Results/Evaluation

Quality Trait		Casselton		Williston	
		Glenn	Samson	Glenn	Samson
1	Wheat Protein (12%mb)	14.3	13.1	16.9	17.5
2	Flour Protein (12%mb)	13.4	12.8	16.2	17.1
3	Market Value (Score 1-6)	4.3	3.5	4.4	3.7
4	Market Value (Score 1-10)	10.0	6.4	10.0	8.2
5	Test Weight (lb/bu)	65.2	61.0	61.7	57.4
6	1000 Kernel Weight (g)	35.6	31.0	24.8	23.6
7	Kernel Size % Large	80	54	5	10
8	Kernel Size % Small	2	6	18	22
9	Wheat Moisture (%)	12.1	10.5	9.4	9.3
10	Wheat Ash (14%mb)	1.72	1.68	1.14	1.30
11	Wheat Falling Number (sec)	400	400	400	400
12	SKCS - Hardness Index	88.5	77.2	69.5	63.9
13	Vitreous Kernels (%)	95.6	48.8	94.9	95.6
	Flour Extraction (%)				
14	Tempered Wheat Basis (%)	67.6	72.5	70.0	70.7
15	Total Product Basis (%)	70.6	76.5	73.6	75.2
16	Flour /Bu Wheat (lbs)	46.2	46.3	45.8	43.4
17	Flour Color Brightness (L*)	90.7	90.2	90.6	90.4
18	Flour Color Yellowness (b*)	8.7	11.7	9.7	11.6
19	Flour Moisture (%)	12.6	12.1	12.8	12.3
20	Flour Ash (14%mb)	0.418	0.537	0.405	0.471
21	Flour Falling Number (Malted) (sec)	249	256	249	250
	Farinograph				
22	Water Absorption (500bu)	67.0	63.9	64.5	63.3
23	Water Absorption (14%mb)	66.0	62.4	63.1	61.4
24	Arrival Time (min)	3.0	2.1	5.0	4.5
25	Peak Time (min)	5.8	3.8	12.9	10.2
26	Dough Stability (min)	7.6	5.8	15.0	14.9
27	MTI (bu)	37.0	40.0	14.0	23.0
28	TTB (min)	10.7	7.9	20.0	17.6

II. Cooperator Results/Evaluation

29	Bake Absorption (Avg %)	64.4±2.6	62.4±3.1	63.4±3.4	62.6±3.5
30	Loaf Volume (% of Check)		102.4±9.0		100.8±4.9

Quality Trait	II. Cooperator Results/Evaluation	Casselton Glenn	Casselton Samson	Williston Glenn	Williston Samson
31	**Mixing Requirement**	3.3 ±0.9	2.8 ±1.0	4.2 ±0.8	4.8 ±0.7
	5 Very Long				
	4 Long			———	———
	3 Medium	———			
	2 Short		———		
	1 Very Long				
32	**Dough Characteristics**	3.9 ±0.9	3.2 ±1.0	4.2 ±0.8	4.0 ±1.3
	5 Bucky-Tough				
	4 Strong-Elastic	———		———	———
	3 Medium-Pliable		———		
	2 Mellow-Very Pliable				
	1 Weak-Short or Sticky				
33	**Mixing Tolerance**		2.9 ±0.6		3.6 ±0.7
	5 Much More Tolerance Than Check				
	4 More Tolerance Than Check				
	3 Tolerance Equivalent To Check				———
	2 Less Tolerance Than Check		———		
	1 Much Less Tolerance Than Check				
34	**Internal Crumb Color**		2.3 ±1.2		2.2 ±0.8
	5 Much Brighter Than Check				
	4 Brighter Than Check				
	3 Equivalent To Check				
	2 Poorer Than Check		———		———
	1 Much Poorer Than Check				
35	**Internal Grain and Texture**		3.3 ±1.2		2.6 ±0.9
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check		———		
	2 Poorer Than Check				———
	1 Much Poorer Than Check				
III.	**Cooperator Quality Assessment**				
	Quality Trait 1-2: Protein		2.6 ±1.0		3.6 ±0.7
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				———
	2 Poorer Than Check		———		
	1 Much Poorer Than Check				
	Quality Trait 3-21: Milling		2.9 ±1.5		2.9 ±0.9
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				
	2 Poorer Than Check		———		———
	1 Much Poorer Than Check				
	Quality Trait 22-35: Baking		3.0 ±1.1		3.0 ±1.0
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				
	2 Poorer Than Check		———		———
	1 Much Poorer Than Check				
	Quality Trait 1-35: Overall Comparison		2.9 ±1.2		2.9 ±1.1
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				
	2 Poorer Than Check		———		———
	1 Much Poorer Than Check				

I. USDA/ARS WQL Results/Evaluation

Quality Trait		Casselton		Crookston	
		Glenn	MN03358-4	Glenn	MN03358-4
1	Wheat Protein (12%mb)	14.3	14.1	14.7	13.6
2	Flour Protein (12%mb)	13.4	13.2	14.0	13.1
3	Market Value (Score 1-6)	4.3	3.9	4.8	4.0
4	Market Value (Score 1-10)	10.0	8.8	10.0	6.8
5	Test Weight (lb/bu)	65.2	62.4	65.3	62.4
6	1000 Kernel Weight (g)	35.6	33.0	36.8	30.7
7	Kernel Size % Large	80	61	82	56
8	Kernel Size % Small	2	5	2	5
9	Wheat Moisture (%)	12.1	10.4	10.7	10.3
10	Wheat Ash (14%mb)	1.72	1.80	1.37	1.31
11	Wheat Falling Number (sec)	400	400	400	400
12	SKCS - Hardness Index	88.5	95.3	85.9	95.3
13	Vitreous Kernels (%)	95.6	93.4	96.6	96.1
	Flour Extraction (%)				
14	Tempered Wheat Basis (%)	67.6	67.1	70.7	68.7
15	Total Product Basis (%)	70.6	70.6	74.2	72.5
16	Flour /Bu Wheat (lbs)	46.2	43.9	48.4	45.0
17	Flour Color Brightness (L*)	90.7	90.1	90.9	90.0
18	Flour Color Yellowness (b*)	8.7	10.1	8.5	10.2
19	Flour Moisture (%)	12.6	12.6	13.3	12.5
20	Flour Ash (14%mb)	0.418	0.603	0.403	0.474
21	Flour Falling Number (Malted) (sec)	249	261	257	251
	Farinograph				
22	Water Absorption (500bu)	67.0	67.6	65.1	66.9
23	Water Absorption (14%mb)	66.0	65.9	64.3	65.1
24	Arrival Time (min)	3.0	1.9	3.2	2.8
25	Peak Time (min)	5.8	3.8	9.0	5.8
26	Dough Stability (min)	7.6	5.1	12.1	6.4
27	MTI (bu)	37.0	46.0	25.0	37.0
28	TTB (min)	10.7	7.3	14.8	9.6

II. Cooperator Results/Evaluation

29	Bake Absorption (Avg %)	64.4±2.6	64.4±2.9	63.6±2.4	63.9±3.0
30	Loaf Volume (% of Check)		98.2±7.3		91.9±9.3

Quality Trait	II. Cooperator Results/Evaluation	Casselton Glenn	Casselton MN03358-4	Crookston Glenn	Crookston MN03358-4
31	Mixing Requirement	3.3±0.9	3.0±1.1	3.7±0.9	3.6±1.1
	5 Very Long				
	4 Long				
	3 Medium	———	———	———	———
	2 Short				
	1 Very Short				
32	Dough Characteristics	3.9±0.9	3.8±1.0	3.8±1.0	3.7±1.4
	5 Bucky-Tough				
	4 Strong-Elastic	———	———	———	———
	3 Medium-Pliable				
	2 Mellow-Very Pliable				
	1 Weak-Short or Sticky				
33	Mixing Tolerance		2.7±0.9		2.6±0.9
	5 Much More Tolerance Than Check				
	4 More Tolerance Than Check				
	3 Tolerance Equivalent To Check		———		———
	2 Less Tolerance Than Check				
	1 Much Less Tolerance Than Check				
34	Internal Crumb Color		3.0±1.0		2.8±0.7
	5 Much Brighter Than Check				
	4 Brighter Than Check				
	3 Equivalent To Check		———		———
	2 Poorer Than Check				
	1 Much Poorer Than Check				
35	Internal Grain and Texture		2.8±1.4		3.0±1.0
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check		———		———
	2 Poorer Than Check				
	1 Much Poorer Than Check				
III. Cooperator Quality Assessment					
	Quality Trait 1-2: Protein		3.1±0.6		2.7±0.7
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check		———		———
	2 Poorer Than Check				
	1 Much Poorer Than Check				
	Quality Trait 3-21: Milling		2.3±0.9		2.1±0.3
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				
	2 Poorer Than Check		———		———
	1 Much Poorer Than Check				
	Quality Trait 22-35: Baking		2.7±0.7		2.7±0.7
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				
	2 Poorer Than Check		———		———
	1 Much Poorer Than Check				
	Quality Trait 1-35: Overall Comparison		2.7±0.7		2.8±0.7
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				
	2 Poorer Than Check		———		———
	1 Much Poorer Than Check				

I. USDA/ARS WQL Results/Evaluation

Quality Trait		Brookings		Casselton	
		Glenn	01S0042-10	Glenn	01S0042-10
1	Wheat Protein (12%mb)	13.3	13.0	14.3	13.7
2	Flour Protein (12%mb)	12.4	12.2	13.4	13.2
3	Market Value (Score 1-6)	4.1	3.7	4.3	4.0
4	Market Value (Score 1-10)	10.0	8.8	10.0	8.6
5	Test Weight (lb/bu)	65.4	63.9	65.2	63.4
6	1000 Kernel Weight (g)	33.2	28.8	35.6	31.8
7	Kernel Size % Large	77	73	80	69
8	Kernel Size % Small	5	4	2	4
9	Wheat Moisture (%)	10.6	10.3	12.1	11.0
10	Wheat Ash (14%mb)	1.67	1.58	1.72	1.67
11	Wheat Falling Number (sec)	400	400	400	400
12	SKCS - Hardness Index	87.5	81.3	88.5	81.2
13	Vitreous Kernels (%)	87.0	72.7	95.6	62.2
	Flour Extraction (%)				
14	Tempered Wheat Basis (%)	68.3	68.7	67.6	70.3
15	Total Product Basis (%)	71.7	72.2	70.6	73.5
16	Flour /Bu Wheat (lbs)	46.8	46.1	46.2	46.7
17	Flour Color Brightness (L*)	90.8	91.0	90.7	90.8
18	Flour Color Yellowness (b*)	8.9	10.7	8.7	10.8
19	Flour Moisture (%)	12.4	13.3	12.6	13.6
20	Flour Ash (14%mb)	0.473	0.470	0.418	0.471
21	Flour Falling Number (Malted) (sec)	249	252	249	251
	Farinograph				
22	Water Absorption (500bu)	65.4	64.2	67.0	66.1
23	Water Absorption (14%mb)	63.9	63.3	66.0	65.4
24	Arrival Time (min)	1.9	3.2	3.0	2.8
25	Peak Time (min)	3.3	5.5	5.8	5.2
26	Dough Stability (min)	7.2	6.0	7.6	6.4
27	MTI (bu)	24.0	50.0	37.0	41.0
28	TTB (min)	8.8	9.0	10.7	9.2

II. Cooperator Results/Evaluation

29	Bake Absorption (Avg %)	63.1±2.3	62.2±2.3	64.4±2.6	63.8±2.8
30	Loaf Volume (% of Check)		97.7±9.9		97.7±8.8

Quality Trait	II. Cooperator Results/Evaluation	Brookings Glenn	Brookings 01S0042-10	Casselton Glenn	Casselton 01S0042-10
31	Mixing Requirement	3.7 ±1.0	3.3 ±1.2	3.3 ±0.9	3.0 ±1.0
	5 Very Long				
	4 Long				
	3 Medium				
	2 Short				
	1 Very Short				
32	Dough Characteristics	3.8 ±1.1	4.0 ±1.0	3.9 ±0.9	2.9 ±1.2
	5 Bucky-Tough				
	4 Strong-Elastic				
	3 Medium-Pliable				
	2 Mellow-Very Pliable				
	1 Weak-Short or Sticky				
33	Mixing Tolerance		3.0 ±0.7		2.7 ±0.5
	5 Much More Tolerance Than Check				
	4 More Tolerance Than Check				
	3 Tolerance Equivalent To Check				
	2 Less Tolerance Than Check				
	1 Much Less Tolerance Than Check				
34	Internal Crumb Color		2.6 ±0.7		2.2 ±1.0
	5 Much Brighter Than Check				
	4 Brighter Than Check				
	3 Equivalent To Check				
	2 Poorer Than Check				
	1 Much Poorer Than Check				
35	Internal Grain and Texture		2.9 ±0.9		2.8 ±1.1
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				
	2 Poorer Than Check				
	1 Much Poorer Than Check				
III. Cooperator Quality Assessment					
	Quality Trait 1-2: Protein		2.9 ±0.6		2.8 ±0.7
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				
	2 Poorer Than Check				
	1 Much Poorer Than Check				
	Quality Trait 3-21: Milling		3.0 ±0.7		3.2 ±0.8
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				
	2 Poorer Than Check				
	1 Much Poorer Than Check				
	Quality Trait 22-35: Baking		2.6 ±0.9		2.7 ±0.7
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				
	2 Poorer Than Check				
	1 Much Poorer Than Check				
	Quality Trait 1-35: Overall Comparison		2.8 ±1.1		2.6 ±0.5
	5 Much Better Than Check				
	4 Better Than Check				
	3 Equivalent To Check				
	2 Poorer Than Check				
	1 Much Poorer Than Check				

I. USDA/ARS WQL Results/Evaluation

Quality Trait		Casselton		Crookston		Williston	
		Glenn	ND809	Glenn	ND809	Glenn	ND809
1	Wheat Protein (12%mb)	14.3	13.8	14.7	13.8	16.9	17.8
2	Flour Protein (12%mb)	13.4	13.1	14.0	13.1	16.2	17.0
3	Market Value (Score 1-6)	4.3	4.0	4.8	4.7	4.4	4.4
4	Market Value (Score 1-10)	10.0	8.6	10.0	9.0	10.0	9.4
5	Test Weight (lb/bu)	65.2	63.2	65.3	63.8	61.7	60.5
6	1000 Kernel Weight (g)	35.6	31.6	36.8	40.3	24.8	24.9
7	Kernel Size % Large	80	75	82	82	5	9
8	Kernel Size % Small	2	3	2	2	18	18
9	Wheat Moisture (%)	12.1	10.5	10.7	10.5	9.4	9.8
10	Wheat Ash (14%mb)	1.72	1.70	1.37	1.39	1.14	1.28
11	Wheat Falling Number (sec)	400	400	400	400	400	400
12	SKCS - Hardness Index	88.5	88.2	85.9	90.2	69.5	79.4
13	Vitreous Kernels (%)	95.6	78.5	96.6	92.6	94.9	97.6
	Flour Extraction (%)						
14	Tempered Wheat Basis (%)	67.6	68.5	70.7	71.8	70.0	70.3
15	Total Product Basis (%)	70.6	72.2	74.2	75.8	73.6	74.2
16	Flour /Bu Wheat (lbs)	46.2	45.2	48.4	47.8	45.8	45.2
17	Flour Color Brightness (L*)	90.7	90.5	90.9	90.4	90.6	90.3
18	Flour Color Yellowness (b*)	8.7	9.5	8.5	9.4	9.7	10.1
19	Flour Moisture (%)	12.6	12.6	13.3	12.5	12.8	12.7
20	Flour Ash (14%mb)	0.418	0.471	0.403	0.411	0.405	0.414
21	Flour Falling Number (Malted) (sec)	249	249	257	246	249	234
	Farinograph						
22	Water Absorption (500bu)	67.0	68.0	65.1	69.3	64.5	68.1
23	Water Absorption (14%mb)	66.0	67.0	64.3	68.3	63.1	66.8
24	Arrival Time (min)	3.0	2.8	3.2	3.0	5.0	6.3
25	Peak Time (min)	5.8	5.9	9.0	5.3	12.9	10.8
26	Dough Stability (min)	7.6	6.4	12.1	7.5	15.0	13.6
27	MTI (bu)	37.0	43.0	25.0	30.0	14.0	11.0
28	TTB (min)	10.7	8.9	14.8	10.5	20.0	20.0

II. Cooperator Results/Evaluation

29	Bake Absorption (Avg %)	64.4±2.6	64.7±2.9	63.6±2.4	64.8±3.7	63.4±3.4	65.8±3.6
30	Loaf Volume (% of Check)		100.0±9.7		92.8±8.5		102.9±7.1

Quality Trait	II. Cooperator Results/Evaluation	Casselton Glenn	Casselton ND809	Crookston Glenn	Crookston ND809	Williston Glenn	Williston ND809
31	**Mixing Requirement**	3.3±0.9	2.9±0.9	3.7±0.9	2.8±1.0	4.2±0.8	4.4±1.0
	5 Very Long						
	4 Long						
	3 Medium						
	2 Short						
	1 Very Short						
32	**Dough Characteristics**	3.9±0.9	3.4±1.0	3.8±1.0	2.9±1.1	4.2±0.8	4.1±0.8
	5 Bucky-Tough						
	4 Strong-Elastic						
	3 Medium-Pliable						
	2 Mellow-Very Pliable						
	1 Weak-Short or Sticky						
33	**Mixing Tolerance**		2.6±0.5		2.3±0.9		3.3±0.9
	5 Much More Tolerance Than Check						
	4 More Tolerance Than Check						
	3 Tolerance Equivalent To Check						
	2 Less Tolerance Than Check						
	1 Much Less Tolerance Than Check						
34	**Internal Crumb Color**		2.9±0.8		2.6±0.5		3.1±0.6
	5 Much Brighter Than Check						
	4 Brighter Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
35	**Internal Grain and Texture**		2.8±1.1		2.9±0.6		2.7±0.9
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
III.	**Cooperator Quality Assessment**						
	Quality Trait 1-2: Protein		2.8±0.7		2.3±0.5		3.6±0.9
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
	Quality Trait 3-21: Milling		2.9±0.8		3.2±0.7		3.0±0.5
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
	Quality Trait 22-35: Baking		3.0±1.0		2.3±0.7		3.4±0.7
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						
	Quality Trait 1-35: Overall Comparison		2.9±0.9		2.7±0.9		3.4±0.7
	5 Much Better Than Check						
	4 Better Than Check						
	3 Equivalent To Check						
	2 Poorer Than Check						
	1 Much Poorer Than Check						

I. USDA/ARS WQL Results/Evaluation

Quality Trait		Williston	
		Glenn	CO1320W
1	Wheat Protein (12%mb)	16.9	17.0
2	Flour Protein (12%mb)	16.2	16.6
3	Market Value (Score 1-6)	4.4	3.8
4	Market Value (Score 1-10)	10.0	8.0
5	Test Weight (lb/bu)	61.7	57.5
6	1000 Kernel Weight (g)	24.8	24.5
7	Kernel Size % Large	5	14
8	Kernel Size % Small	18	17
9	Wheat Moisture (%)	9.4	9.5
10	Wheat Ash (14%mb)	1.14	1.41
11	Wheat Falling Number (sec)	400	400
12	SKCS - Hardness Index	69.5	63.3
13	Vitreous Kernels (%)	94.9	98.2
	Flour Extraction (%)		
14	Tempered Wheat Basis (%)	70.0	69.7
15	Total Product Basis (%)	73.6	74.2
16	Flour /Bu Wheat (lbs)	45.8	42.7
17	Flour Color Brightness (L*)	90.6	90.7
18	Flour Color Yellowness (b*)	9.7	7.9
19	Flour Moisture (%)	12.8	12.4
20	Flour Ash (14%mb)	0.405	0.446
21	Flour Falling Number (Malted) (sec)	249	251
	Farinograph		
22	Water Absorption (500bu)	64.5	63.8
23	Water Absorption (14%mb)	63.1	61.9
24	Arrival Time (min)	5.0	5.0
25	Peak Time (min)	12.9	9.5
26	Dough Stability (min)	15.0	14.9
27	MTI (bu)	14.0	11.0
28	TTB (min)	20.0	20.0

II. Cooperator Results/Evaluation

29	Bake Absorption (Avg %)	63.4±3.4	62.9±3.9
30	Loaf Volume (% of Check)		102.7±5.2

Quality Trait	II. Cooperator Results/Evaluation	Williston Glenn	Williston CO1320W
31	**Mixing Requirement**	4.2 ±0.8	4.2 ±1.4
	5 Very Long		
	4 Long	_____	_____
	3 Medium		
	2 Short		
	1 Very Short		
32	**Dough Characteristics**	4.2 ±0.8	4.3 ±0.7
	5 Bucky-Tough		
	4 Strong-Elastic	_____	_____
	3 Medium-Pliable		
	2 Mellow-Very Pliable		
	1 Weak-Short or Sticky		
33	**Mixing Tolerance**		3.1 ±0.8
	5 Much More Tolerance Than Check		
	4 More Tolerance Than Check		
	3 Tolerance Equivalent To Check		_____
	2 Less Tolerance Than Check		
	1 Much Less Tolerance Than Check		
34	**Internal Crumb Color**		3.8 ±0.7
	5 Much Brighter Than Check		
	4 Brighter Than Check		
	3 Equivalent To Check		_____
	2 Poorer Than Check		
	1 Much Poorer Than Check		
35	**Internal Grain and Texture**		2.7 ±1.0
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		_____
	1 Much Poorer Than Check		
III.	**Cooperator Quality Assessment**		
	Quality Trait 1-2: Protein		3.1 ±0.6
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		_____
	2 Poorer Than Check		
	1 Much Poorer Than Check		
	Quality Trait 3-21: Milling		2.7 ±0.9
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		
	2 Poorer Than Check		_____
	1 Much Poorer Than Check		
	Quality Trait 22-35: Baking		3.3 ±1.0
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		_____
	2 Poorer Than Check		
	1 Much Poorer Than Check		
	Quality Trait 1-35: Overall Comparison		3.2 ±1.1
	5 Much Better Than Check		
	4 Better Than Check		
	3 Equivalent To Check		_____
	2 Poorer Than Check		
	1 Much Poorer Than Check		

Appendix

Source of Wheat

Source – Breeding Program	Code#	Identification
AgriPro	1	00S0291-3
North Dakota State University (B)	2	NDSW0449 *
South Dakota State University	3	SD3851
North Dakota State University (M)	4	ND806
Trigen	5	06MSP18
North Dakota State University (B)	6	NDSW0601
Westbred	7	Sampson
University of Minnesota	9	MN03358-4
AgriPro	10	01S0042-10
North Dakota State University (M)	11	ND809 *
WWW	12	CO1320W
North Dakota State University	8	Glenn Check

*Second year of testing in WQC trials

Field Plot Locations and Procedures

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

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

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

2008 Hard Spring Wheat Production Sites*

Entry #	Entry	Reference	Brookings	Casselton	Crookston	Minot	Williston
1	00S0291-3	AgriPro			X	na	
2	NDSW0449	NDSU (B)				na	X
3	SD3851	SDSU	X	X	X	na	
4	ND806	NDSU (M)	X	X		na	X
5	06MSP18	Trigen	X	X	X		
6	NDSW0601	NDSU (B)		X		na	X
7	Samson	Westbred		X		na	X
8	Glenn	Check	X	X	X	na	X
9	MN03358-4	Un of MN		X	X		
10	01S0042-10	AgriPro	X	X			
11	ND809	NDSU (M)		X	X	na	X
12	COI320W	WWW				na	X

***WQC entries from Minot were sprout-damaged and not harvested. Quality test results are not available (na).**

Description of 2008 Hard Spring Wheat Lines

00S0291-3 – SWQAC 1

00S0291-3 is a hard red spring wheat developed by AgriPro of Syngenta Seeds. It was named and released as "Jenna" to AgriPro Associates for planting in the spring of 2009. Limited quantities of certified seed will be available for growers in 2010. Jenna was derived from the cross "N98-0178/97S0212-08". Varieties in its parentage include Krona, Bergen, Dalen and Amidon. It has med-late maturity and good test weight. It is a semidwarf with height slightly taller than Kuntz. Straw strength is good, between Knudson and Kuntz. It is resistant to stem rust and moderately resistant to leaf rust. Protection to foliar diseases has been very good. Tolerance to FHB has been intermediate. Protein has been med-high, similar to Freyr. Jenna is best adapted for the northern areas of the spring wheat growing region of the Northern Plains.

NDSW0449 - SWQAC 2

NDSW0449 was selected from the cross (Ernest//ND622/Keene /3/*2//SD3310/SD3414). It is a hard red spring wheat developed primarily for its resistance to the wheat stem sawfly. It is medium-tall height, awned, and matures approximately 2 days later than Reeder. NDSW0449 is susceptible to FHB, moderately susceptible to leaf rust, and resistant to moderately resistant to stem rust. It has excellent resistance to wheat stem sawfly infestation despite exhibiting less stem-solidity compared with the variety Choteau. NDSW0449 has exhibited excellent milling and baking characteristics, with generally better than average grain protein content, higher loaf volume, and stronger mix characteristics compared with other hard red spring wheat varieties.

SD3851 – SWQAC 3

SD3851 (ND2897/SD3219//SD3414) is an experimental hard red spring wheat breeding line developed by the South Dakota Agricultural Experiment Station. It was originally derived as a single plant from within an F_4 plant population created in the spring of 1999. It has been tested within South Dakota State University Advanced Yield Trials (AYT) from 2004 - 2008. SD3851 was tested in both the Uniform Regional Spring Wheat Nursery (URSWN) in 2005 and 2006 as well as the South Dakota Crop Performance Testing trials in 2005 through 2008. In addition, SD3851 was evaluated by the Wheat Quality Council in 2008. Pending approval of the SDSU Variety Review and Release Committee, SD3851 should be made available to Registered seed producers in spring 2009. Coverage under the United States Plant Variety Protection Act will be sought.

Points of note associated with SD3851 include: Good yield potential; Exceptionally heavy test weight; Early heading date; Possesses Fhb1 QTL which confers good level of Fusarium Head Blight resistance; and Moderate to highly resistant ratings for both leaf and stem rust.

ND806 – SWQAC 4

ND 806 is selected from a 3-way cross involving the NDSU cultivar 'Reeder' and experimental line ND 721 that traces its parentage to the high protein NDSU cultivar "Glupro"; and the SDSU cultivar 'Walworth' (SD3348). ND 806 has been tested in the ND Variety trials and the regional trials since 2005. It is a medium early line similar to Faller with medium straw strength and semi-dwarf comparable to Parshall. ND 806 has high grain yield, superior to Alsen and Glenn, similar to Reeder particularly in the Western parts of the State.

ND 806 has excellent resistance to foliar diseases particularly, leaf and stem rusts. It is medium susceptible to scab or Fusarium head blight.
ND 806 has good test weight and grain protein content. Overall, ND 806 has good milling and baking qualities similar to Reeder. In Western regions however, ND 806 is in general, comparable to most of NDSU checks such as Alsen and Steele-ND.

06MSP18 – SWQAC 5

O6 MSP 18 is the experimental designation for a hard red spring wheat line developed by Trigen seed LLC derived from a cross Alsen//Buck Antorcha/Norm. The objective of this cross was to combine the tolerance to Fusarium Head Blight and other characteristics from the NDSU Alsen (50%) with desirable traits from the Argentine variety Buck Antorcha and the UMN variety Norm. This selection has a medium-early maturity, and a yield potential similar to that of Faller with better resistance to lodging. It has shown strong flour rheological properties and good bread-making characteristics in small plot samples. We have named this wheat Albany and will have production in 2009.

NDSW0601 – SWQAC 6

NDSW0601 was selected from the cross N97-0117//MT9420/3/971//IDO533/9747. It is a hard white spring wheat developed for high yield potential and bread making applications. NDSW0601 is a semi-dwarf and awned breeding line, and it matures on average 2 days later than Alpine, a hard white spring wheat, and 3 days later than Glenn, a hard red spring wheat. It has good straw strength, but is more adapted to western North Dakota production conditions due to the potential for more pre-harvest sprouting and disease in the east. NDSW0601 is susceptible to FHB, moderately susceptible to moderately resistant to prevalent races of leaf rust, and resistant to very resistant to prevalent races of stem rust. NDSW0601 does not exhibit low PPO, but at 15.4% protein, a 70/30 flour blend of NDSW0601 with soft white wheat was considered to provide acceptable quality for Taiwan raw noodles (2008 Asian Products Collaborative Project Summary).

Samson – SWQAC 7

"Samson" HRSW is derived from the cross "Express" X "Knudson". Samson is a medium height, medium early maturing semi-dwarf. Standability and yield potential are excellent. Samson is moderately resistant-moderately susceptible to leaf rust and foliar disease (Tan Spot and Septoria tritici). Samson is resistant to the prevalent races of stem rust. However, Samson is susceptible to scab (Fusarium Head Blight) so fungicide application at heading is a must. Samson produces medium protein, medium test weight seed, with SDS Sedimentation values averaging about 115 mm.

MN03358-4 – SWQAC 9

MN03358-4 is a mid-maturity hard red spring wheat with high grain yields and good scab resistance. The pedigree of MN03358-4 is MN98389/MN97518. MN03358-4 has been a consistently high yielder in Minnesota and the hard red spring wheat region, performing well in the 2006 and 2007 regional performance nurseries. Grain protein and test weight are average compared to other cultivars. MN03358-4 is moderately resistant to pre-harvest sprouting with good falling numbers. Straw strength is below average. MN03358-4 is resistant to stem rust and moderately resistant to prevalent races of leaf rust and other leaf diseases. MN03358-4 has moderate resistance to Fusarium head blight (scab), comparable to ‘Tom’ and better than ‘RB07’.

01S0042-10 - SWQAC 10

01S0042-10 is a hard red spring wheat developed by AgriPro of Syngenta Seeds. It was named and released as "Brennan" to AgriPro associates for planting in spring of 2009. Limited quantities of certified seed will be available for growers in 2010. Brennan was derived from the cross "Reeder//CHISCAB#140/N90-0190". Other varieties in its parentage include Amidon, Norseman and Coteau. It has early maturity and very good test weight. It is a short semidwarf with height similar to Kelby. Straw strength is very good. It is resistant to stem rust and moderately resistant to leaf rust. Protection to foliar diseases has been very good. Tolerance to FHB has been intermediate. Protein levels have been high, slightly lower than Kelby. Brennan is best adapted for the southern areas of the spring wheat growing region of the Northern Plains.

ND809 – SWQAC 11

ND 809 was selected from a 3-way cross involving an NDSU experimental line (ND 2831) that is derived from "Sumai 3", a major source of resistance to Fusarium head blight (FHB) or scab. Therefore, ND 809 has medium resistance to FHB. It has very good resistance to other foliar diseases including stem and leaf rusts. It is an early line with medium straw strength and semi-dwarf. ND 809 has high grain yield comparable to Faller but superior to Alsen, Reeder, and Parshall. It has high test weight and grain protein content compared to Alsen. ND 809 has high protein and very good milling and baking characteristics.

COI320W – SWQAC 12

COI320W is an early-maturing hard white spring wheat, developed by World Wide Wheat LLC (W^3), using male sterile facilitated recurrent selection (MSFRS) population breeding. A hard white variety from Pakistan, Sonalika, with large hard white seed and superior protein quality was used for recurrent topcrossing in a W^3 low input population.

COI320W originated as an F_2 head selection. A single F_2 head selection from this continuing population was increased in Moscow, Idaho with a sever Hessian fly infestation. A single F_3 head tolerant to Hessian Fly was harvested. Single head selection continued through the F4 generation.

COI320W has been evaluated for yield and quality at several global locations for several years with much success. The line possesses a high-yielding potential under adequate moisture conditions. COI320W is tolerant to Hessian fly and moderately resistant to stripe rust.

Grain Cleaning and Milling Procedures

Wheat (approximately 6 bu/variety) was cleaned in a Carter-Day Bulldog seed cleaner that was equipped with two rotating indent cylinders (#24 – coarse and #16 fine), a sizer cylinder (#5), vibrator, and air aspiration. Sixty pounds of cleaned wheat was tempered to 16.5% moisture basis and conditioned 16-18 hours. The tempered wheat was milled in a Buhler Experimental Mill, MLU, at an average feed rate of 175 g/min. Flour from three break (B1, B2, B3) and three reduction (R1, R2, R3) sections of the mill were combined to straight grade flour. Prior to milling the experimental lines, the Buhler Experimental Mill was adjusted to optimize mill extraction of the Glenn check that was grown at Crookston, which represented the highest quality check among the 5 growing locations. No further adjustments were made to optimize mill extraction for the

experimental lines, thus, flour extraction of individual samples was relative to flour extraction of the Crookston Glenn check.

Methods of Analyses

Wheat Market Value Score

Test Weight (AACC Method 55-10)

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

Wheat and Flour Ash (AACC Method 08-01)

Kernel Size (Sieving according to USDA/ARS WQL)

Wheat Falling Number (Perten Falling Number Instrument)

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

Flour Color (Minolta Colorimeter L* b* values)

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

Farinograph

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

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

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

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

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

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

Mixograph

Bake Cooperator Results/Evaluation:
Bake Absorption (Actual - %)
Loaf Volume (% of Check)
Mixing Requirement

Dough Characteristics
Mixing Tolerance
Internal Crumb Color
Internal Crumb Grain and Texture

Bake Cooperator Quality Assessment:
Protein Content
Milling
Baking
Overall Comparison

C-Cell Bread Descriptors

Cell
This displays the individual cells within the product slice. Each one is colour coded according to its prominence. This is based on a combination of its area and depth. Small cells are colored in dark blue and larger ones are shown in lighter shades of blue, green and yellow. Cells large enough to be classified as holes are outlined in red.

Volume contours
This displays contours of the coarseness of the texture, based on volume measurements of cells. The coarsest 50% of the slice area is shaded in red and the finest regions are shaded in blue. The range of values displayed in this image is used for calculation of cell size measurements on the Coarse/Fine Clustering. The shape of the red and blue regions is used for calculation of the Circularity measurement.

Brightness correction
This image shows a view of the slice, corrected to remove any differences in overall product reflectance. The image is shaded in brown to avoid confusion with the raw image.

Elongation
This image represents the orientation and elongation of cells. Short red lines are drawn parallel to the long axis of cells at each point in the slice. The length of the lines indicates the degree of elongation of the cells. For regions that show some curvature, green lines are also drawn that point towards the centre of the curvature. The length of the green lines indicates the degree of local curvature. Yellow lines are also shown that divide regions of the slice that show curvature in opposite directions. Regions of the slice that show a complete 360 degree rotational structure are shaded in bright blue. Those that show a rotational structure that turns through 180 degrees are shaded in pale blue. Those showing no full rotation are left in grey.

Shape
This shows a view of the slice with particular shape features shown in color. A white rectangular box is shown enclosing the slice. The corners of the slice are also identified and are connected by white lines to each other and to the centre of the slice. Concavities in the sides of the slice are shown in blue for the bottom, green for the sides and red for the top. Where oven spring is detected, this is shown in yellow. The points used for measuring the slice height are marked as yellow points on the top edge. High points are identified at either side of the top edge and the lowest point between them is

also marked. Where there is no clear dip in the top, some of these points may coincide and it may not be possible to see three distinct points.

Raw Image
A raw image of a slice selected for analysis

Test Bake Procedures

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

Bake Cooperators*

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

*The WQC acknowledges the dedication and sacrifice of time by those individuals who are involved in test baking samples of Hard Spring Wheat. 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.

Production: Climate, Disease, and Field Conditions

Brookings	Casselton	Crookston	Minot	Williston
At Planting				
Ideal Conditions planted on well drained soils with an excellent seed bed	Moist seed bed following light showers provided a nearly ideal seedbed, but a .33 inch rainfall interrupted seeding after the first 3 entries. Seeding resumed 2 days later and emergence of all entries was uniform and quick. (6-7 days)	The 2008 Spring Wheat Quality Trial was planted into some of our lighter soil. The soil conditions were moist at planting and made for an excellent seed bed.	Soil conditions for the Wheat Quality Trial were adequate at the time of planting.	Planted in extremely dry soil and cool conditions. The soil is average for what is here at the center.
During Growth				
Excess moisture and cool throughout June	Although monthly rainfall totals look adequate, most of Junes rainfall was early and July's was mid month which gave us a three week period that was on the verge of stressing the plants. Cooler than normal temps gave an overall excellent vegetative period, promoting above average tillering.	The spring wheat trial continued to develop with no apparent problems observed.	The growing conditions for the trial in Minot for the most part were favorable. The rains were spaced out leading to some plant stress.	Cool growing conditions and extremely dry during the growing season.
At Flowering				
No rain for five weeks from June 12-July 17	Relatively dry weather and low humidity promoted low FHB and leaf diseases.	The plants progressed rapidly and the environment at flowering and previous to that time, was not conducive to the development of leaf diseases or Fusarium head blight.	Minot location had dry conditions at flowering, very little disease present at flowering.	Crops were stressed do to extensive drought conditions.
During Maturation				
Dry, Free of Diseases except for a bacterial blight caused by early winds and excess moisture	Mostly dry weather except for two 1.5 inch rains as the crop was just beginning to dry down.	Some lodging due to strong wind and rain.	Intermitant rainfall which cause slow maturation.	Dry, disease free, and dried down quickly.
At Harvest				
Harvested dry and cooled by aeration.	Swathed and combined the same afternoon. No lodged lines, good yields and quality. Moisture content was under 13.5 on all lines except OVA 20, the seed of which came in 2 weeks after the others were seeded.	There were no apparent problems at harvest and the trial was taken off in a timely manner to ensure the best possible grain quality.	Excessive wet period at harvest time caused severe seed damage. Hand threshed heads were showing visible sprout damage averaging between 25-30%. At that time the decision was made to abandon harvest due to the low seed quality.	Dry harvest conditions, thin stand, low test weight, thin kernels, and poorer grain quality.

2008 Spring Wheat Field Production Data

Location					
Variable	Brookings	Casselton	Crookston	Williston	Minot
Planting Date	4/22/2008	5/6 to 5/8, 2008	5/5/2008	5/14/2008	5/16/2008
Harvest Date	8/8/2008	8/25/2008	8/20/2008	8/21/2008	No Harvest**
Fertilizer (lb/A)					
N	110	100	16 + 140	100	100
P	80	40	10	0	30
K	50	0	254	0	0
Herbicide/rate					
Broadleaf	Brox M Ultra/12.8 oz.	Bison Adv/0.8 pt.	Bronate/1 pt/A	Bison Advance/1.2pt/A	1pt Widematch, 2/10oz Harmony GT
Grass	Puma/10.5 oz.	Puma/0.6 pt.	Puma/1/2 pt/A	Puma/1/2ptA	.66 pt/ac.
Fungicide	**Quilt/4 oz., Folicur-Proline 3+3 oz.**	*	*	None	*
* = No Application, **No harvest was made due to rain during harvest time and quality loss including sprouting in the head. .					

Climatologic Data					
Month	Average Temperature (^{0}F)/Precipitation (in)				
	Brookings	Casselton	Crookston	Williston	Minot
April	40/0.83 (4/22-30)	40.20/1.72	40.2/1.02	44.2/0.28	40.4/.49
May	53/3.04	53.0/2.10	51.2/0.90	55.9/1.40	51.5/2.64
June	65/5.96	63.3/6.03	62.7/3.87	63.2/2.31	60.5/5.53
July	71/1.89	69.0/3.44	67.9/2.14	74.1/0.84	68.2/2.64
August	76/0.05 (8/1-8)	68.5/3.34	68.3/3.6	73.1/1.40	68.1/3.20
* = Not Applicable					

Yield Data					
Cultivar	Yield (bu/acre) / Test Wt / % Moisture				
	Brookings	Casselton	Crookston	Williston (yield)	Minot
SWQAC 1	*	*	60.1/61/14.52	*	*
SWQAC 2	*	*	*	18.3	**
SWQAC 3	58.25/62.4 /12.7	84.21/62.0/13.0	67.3/62.3/12.88	*	**
SWQAC 4	55.17/59.3/12.2	68.47/61.0/13.2	*	8.1	**
SWQAC 5	72.33/61.3 /12.9	77.99/61.0/12.5	67.2/60.5/13.08	7.8	*
SWQAC 6	*	68.08/58.0/13.2	*	17.6	**
SWQAC 7	*	78.78/58.5/13.0	*	12.4	**
SWQAC 8	63.00/62.8/12.7	78.70/63.0/12.2	63.2/64.3/12.78	**	**
SWQAC 9	*	79.56/61.5/12.7	68.9/60.4/12.67	*	*
SWQAC 10	63.67/62.1/12.2	83.58/61.0/13.1	*	6.9	**
SWQAC 11	*	76.65/62.0/12.7	71.1/61.9/14.11	5.2	**
SWQAC 12	*	*	*	**	**

* Not Increased at this site ** = No data available ***Planted late on 5/20/2008

Wheat Marketing Score

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

Wheat Marketing Score – Method #1

WHEAT MARKETING SCORE or EXPORT MARKETING SCORE

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

Wheat Marketing Score = (TW*2) + (1000KWT*2) + (FN*2) + (Protein*3) + (Ash*1)/10

Wheat Marketing Score – Method #2

Rules for Score Calculation

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

Entered Line minus Check value equals difference (Diff)

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

Component Score	10	8	6	4	2	0
Protein	-0.501<Di	2<Diff<3.001	3<Diff<4.001	4<Diff<5.001	5<Diff<6.001	Diff>6
TestWeight	-1.001<Di	2<Diff<4.001	4<Diff<6.001	6<Diff<8.001	8<Diff<10.001	Diff>10
Falling Number	-25.01<Diff					
Thousand Kernel Weight	-2.001<Di	4<Diff<8.001	8<Diff<12.001	12<Diff<16.001	16<Diff<20.001	Diff>20
Wheat Ash	Diff<0.101	0.1<Diff<0.201	0.2<Diff<0.301	0.3<Diff<0.401	0.4<Diff<0.501	Diff>0.5

Wheat Quality by Location

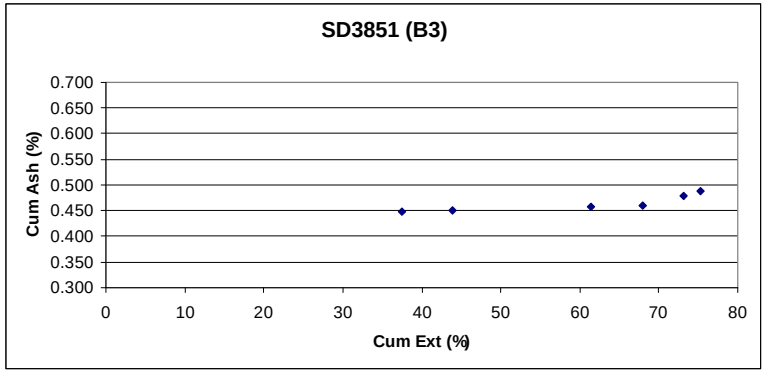
Entry	ID	Wheat Protein 12%mb	Flour Protein 12%mb	Wheat Market Score 1 to 6	Wheat Market Score 1 to 10	Test Weight lb/bu	Kernel Weight g/1000	Kernel Size large (g)	Kernel Size small (g)	Wheat Moisture %	Wheat Ash 14%mb	Wheat Falling Number sec	SKCS Hardness HI	Vitreous Kernels %
SD3851	B3	11.3	10.9	3.6	7.8	63.8	37.2	70	4	10.7	1.60	388	81.9	46.9
ND806	B4	12.4	11.3	3.6	8.2	62.2	33.6	72	4	10.6	1.65	400	84.6	65.8
06MSP18	B5	11.4	10.4	3.2	7.0	62.7	30.2	37	8	10.7	1.59	400	75.0	27.1
Glenn	**B8**	**13.3**	**12.4**	**4.1**	**10.0**	**65.4**	**33.2**	**77**	**5**	**10.6**	**1.67**	**400**	**87.5**	**87.0**
01S0042-10	B10	13.0	12.2	3.7	8.8	63.9	28.8	73	4	10.3	1.58	400	81.3	72.7
SD3851	C3	13.8	12.9	4.2	9.0	63.9	34.2	72	4	10.6	1.48	400	80.4	73.2
ND806	C4	12.2	11.1	3.7	5.6	62.6	28.0	22	13	10.6	1.42	400	79.4	49.2
06MSP18	C5	14.0	12.8	3.2	8.8	62.2	35.8	71	4	10.3	1.66	400	86.3	79.7
NDSW0601	C6	13.0	12.4	3.2	6.8	61.2	34.8	76	3	10.3	1.66	344	82.0	77.6
Samson	C7	13.1	12.8	3.5	6.4	61.0	31.0	54	6	10.5	1.68	400	77.2	48.8
Glenn	**C8**	**14.3**	**13.4**	**4.3**	**10.0**	**65.2**	**35.6**	**80**	**2**	**12.1**	**1.72**	**400**	**88.5**	**95.6**
MN03358-4	C9	14.1	13.2	3.9	8.8	62.4	33.0	61	5	10.4	1.80	400	95.3	93.4
01S0042-10	C10	13.7	13.2	4.0	8.6	63.4	31.8	69	4	11.0	1.67	400	81.2	62.2
ND809	C11	13.8	13.1	4.0	8.6	63.2	31.6	75	3	10.5	1.70	400	88.2	78.5
00S0291-3	K1	13.7	13.0	4.3	8.2	62.2	36.5	76	3	11.3	1.36	400	78.1	80.7
SD3851	K3	13.5	13.0	4.4	8.4	64.1	36.5	68	5	10.5	1.21	387	85.9	79.3
06MSP18	K5	12.1	11.1	3.5	4.2	62.4	24.3	18	16	10.4	1.23	400	81.9	78.0
Glenn	**K8**	**14.7**	**14.0**	**4.8**	**10.0**	**65.3**	**36.8**	**82**	**2**	**10.7**	**1.37**	**400**	**85.9**	**96.6**
MN03358-4	K9	13.6	13.1	4.0	6.8	62.4	30.7	56	5	10.3	1.31	400	95.3	96.1
ND809	K11	13.8	13.1	4.7	9.0	63.8	40.3	82	2	10.5	1.39	400	90.2	92.6
NDSW0449	W2	17.4	17.1	3.9	8.0	57.8	22.3	3	31	9.5	1.36	400	62.7	88.2
ND806	W4	17.3	16.5	3.9	8.4	58.1	22.5	9	19	9.5	1.21	400	71.4	98.2
NDSW0601	W6	18.1	17.8	4.1	8.4	58.0	26.9	15	15	9.5	1.35	400	68.3	92.0
Samson	W7	17.5	17.1	3.7	8.2	57.4	23.6	10	22	9.3	1.30	400	63.9	95.6
Glenn	**W8**	**16.9**	**16.2**	**4.4**	**10.0**	**61.7**	**24.8**	**5**	**18**	**9.4**	**1.14**	**400**	**69.5**	**94.9**
ND809	W11	17.8	17.0	4.4	9.4	60.5	24.9	9	18	9.8	1.28	400	79.4	97.6
COI320W	W12	17.0	16.6	3.8	8.0	57.5	24.5	14	17	9.5	1.41	400	63.3	98.2

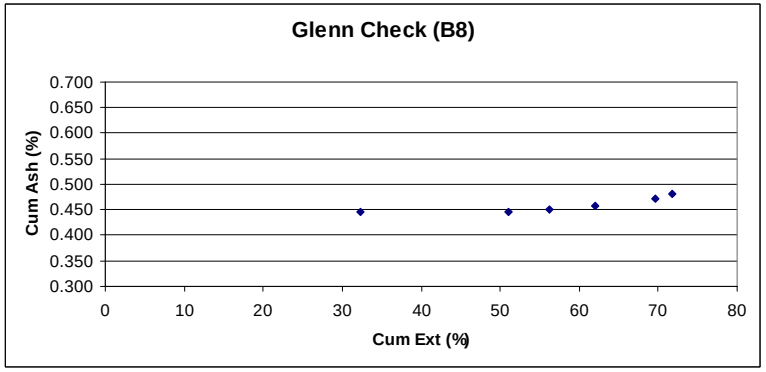
		Flour Extraction					Flour	Flour	Flour FN
		TWB	TPB	Flour/bu wheat	Flour Color		Moisture	Ash	Malted
Entry	ID	%	%	Lbs	L*	b*	%	14%mb	sec
SD3851	B3	71.8	75.3	47.9	90.9	10.5	13.0	0.493	250
ND806	B4	70.9	75.0	46.1	90.7	9.5	12.3	0.529	244
06MSP18	B5	70.8	74.9	46.4	91.1	10.1	12.3	0.432	252
Glenn	**B8**	**68.3**	**71.7**	**46.8**	**90.8**	**8.9**	**12.4**	**0.473**	**249**
01S0042-10	B10	68.7	72.2	46.1	91.0	10.7	13.3	0.470	252
SD3851	C3	72.0	75.8	48.2	90.4	10.0	12.2	0.496	245
ND806	C4	71.4	75.0	46.8	90.7	10.4	12.5	0.445	253
06MSP18	C5	69.2	72.8	45.1	90.3	9.9	12.3	0.543	245
NDSW0601	C6	70.5	74.7	45.2	90.7	11.0	12.5	0.637	270
Samson	C7	72.5	76.5	46.3	90.2	11.7	12.1	0.537	256
Glenn	**C8**	**67.6**	**70.6**	**46.2**	**90.7**	**8.7**	**12.6**	**0.418**	**249**
MN03358-4	C9	67.1	70.6	43.9	90.1	10.1	12.6	0.603	261
01S0042-10	C10	70.3	73.5	46.7	90.8	10.8	13.6	0.471	251
ND809	C11	68.5	72.2	45.2	90.5	9.5	12.6	0.471	249
00S0291-3	K1	73.5	77.5	47.8	90.5	9.8	13.0	0.474	247
SD3851	K3	72.3	75.7	48.5	90.4	10.1	12.3	0.458	252
06MSP18	K5	72.1	75.5	47.0	91.0	10.3	13.1	0.384	250
Glenn	**K8**	**70.7**	**74.2**	**48.4**	**90.9**	**8.5**	**13.3**	**0.403**	**257**
MN03358-4	K9	68.7	72.5	45.0	90.0	10.2	12.5	0.474	251
ND809	K11	71.8	75.8	47.8	90.4	9.4	12.5	0.411	246
NDSW0449	W2	70.2	74.5	43.2	90.0	10.6	12.3	0.418	238
ND806	W4	70.7	74.7	43.8	90.5	9.5	12.9	0.438	239
NDSW0601	W6	70.5	75.1	43.7	89.6	11.1	12.4	0.529	250
Samson	W7	70.7	75.2	43.4	90.4	11.6	12.3	0.471	250
Glenn	**W8**	**70.0**	**73.6**	**45.8**	**90.6**	**9.7**	**12.8**	**0.405**	**249**
ND809	W11	70.3	74.2	45.2	90.3	10.1	12.7	0.414	234
COI320W	W12	69.7	74.2	42.7	90.7	7.9	12.4	0.446	251

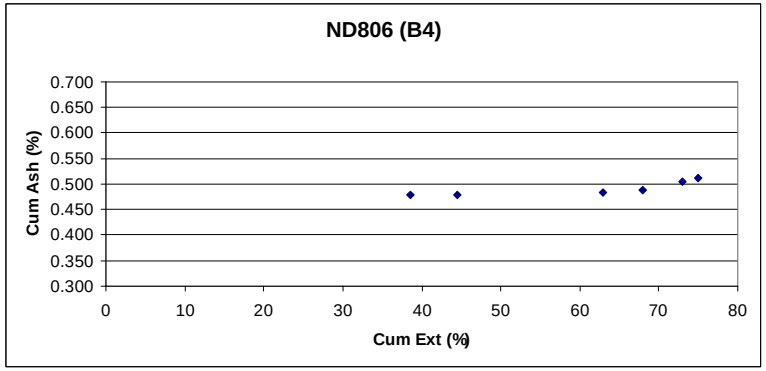
		Farinograph						
Entry	ID	Water Abs 500 bu %	Water Abs 14%mb %	Arrival Time min	Peak Time min	Dough Stability min	MTI bu	TTB min
SD3851	B3	62.1	61.2	1.3	1.8	5.4	34.0	6.2
ND806	B4	62.5	61.2	1.8	3.0	6.1	33.0	7.9
06MSP18	B5	58.8	57.9	1.5	2.5	5.5	35.0	6.8
Glenn	**B8**	**65.4**	**63.9**	**1.9**	**3.3**	**7.2**	**24.0**	**8.8**
01S0042-10	B10	64.2	63.3	3.2	5.5	6.0	50.0	9.0
SD3851	C3	65.6	64.4	3.3	6.7	6.2	51.0	9.5
ND806	C4	59.8	59.0	2.0	4.3	4.9	59.0	7.0
06MSP18	C5	65.2	63.9	2.3	4.8	7.3	28.0	10.1
NDSW0601	C6	64.5	63.7	3.5	6.2	8.5	27.0	9.8
Samson	C7	63.9	62.4	2.1	3.8	5.8	40.0	7.9
Glenn	**C8**	**67.0**	**66.0**	**3.0**	**5.8**	**7.6**	**37.0**	**10.7**
MN03358-4	C9	67.6	65.9	1.9	3.8	5.1	46.0	7.3
01S0042-10	C10	66.1	65.4	2.8	5.2	6.4	41.0	9.2
ND809	C11	68.0	67.0	2.8	5.9	6.4	43.0	8.9
00S0291-3	K1	65.4	64.9	3.8	6.7	6.7	33.0	10.9
SD3851	K3	63.3	62.3	2.0	6.7	10.1	23.0	12.1
06MSP18	K5	58.9	57.6	1.9	4.9	6.2	41.0	8.1
Glenn	**K8**	**65.1**	**64.3**	**3.2**	**9.0**	**12.1**	**25.0**	**14.8**
MN03358-4	K9	66.9	65.1	2.8	5.8	6.4	37.0	9.6
ND809	K11	69.3	68.3	3.0	5.3	7.5	30.0	10.5
NDSW0449	W2	65.7	64.0	5.0	7.5	9.7	21.0	14.8
ND806	W4	64.7	63.0	4.5	9.5	10.5	28.0	15.1
NDSW0601	W6	69.2	67.4	6.9	11.4	13.0	14.0	20.0
Samson	W7	63.3	61.4	4.5	10.2	14.9	23.0	17.6
Glenn	**W8**	64.5	**63.1**	**5.0**	**12.9**	**15.0**	**14.0**	**20.0**
ND809	W11	68.1	66.8	6.3	10.8	13.6	11.0	20.0
COI320W	W12	63.8	61.9	5.0	9.5	14.9	11.0	20.0

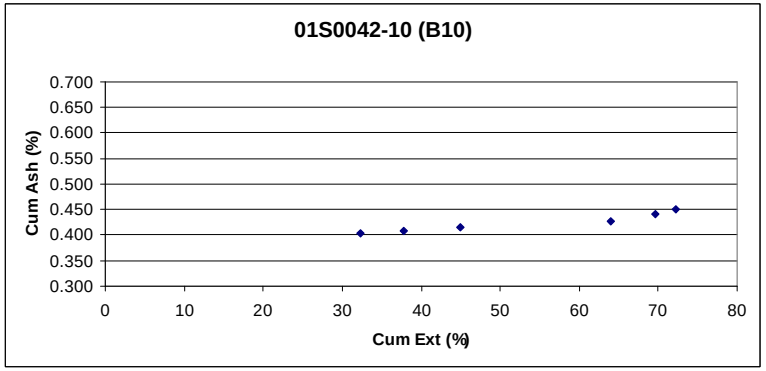
		Mixograph						
Entry	ID	Envelop Peak Time Min	Envelop Peak Value %	Envelop Peak Width %	Midline Peak Time Min	Midline Peak Value %	Midline Peak Width %	Midline Peak Integral %tq*min
SD3851	B3	5.5	67.6	29.7	5.4	52.7	29.7	237.6
ND806	B4	4.3	59.6	20.2	4.9	49.5	17.2	202.9
06MSP18	B5	3.8	56.8	21.1	4.3	47.1	16.3	172.7
Glenn	**B8**	**4.9**	**65.7**	**26.0**	**5.9**	**53.4**	**21.7**	**273.4**
01S0042-10	B10	3.4	69.1	24.8	3.7	56.5	21.5	174.4
SD3851	C3	3.1	78.2	28.3	3.3	64.3	24.9	159.0
ND806	C4	2.6	64.9	24.4	3.2	53.2	17.6	135.1
06MSP18	C5	2.7	63.8	19.6	3.1	54.6	15.6	134.3
NDSW0601	C6	2.8	65.2	16.8	3.0	56.8	16.1	133.6
Samson	C7	3.0	62.1	23.1	3.5	51.6	16.6	150.9
Glenn	**C8**	**4.3**	**68.3**	**24.3**	**4.6**	**55.7**	**23.0**	**212.5**
MN03358-4	C9	3.2	65.3	21.4	3.0	54.3	20.2	134.8
01S0042-10	C10	2.7	75.5	26.8	2.7	61.2	26.8	128.0
ND809	C11	2.7	80.3	28.7	2.8	66.2	27.7	145.6
00S0291-3	K1	2.3	74.7	28.9	2.6	61.6	22.6	122.4
SD3851	K3	4.5	70.9	30.8	4.9	55.1	20.3	219.3
06MSP18	K5	2.9	61.2	22.2	3.4	50.9	18.0	146.0
Glenn	**K8**	**3.7**	**73.2**	**34.9**	**4.8**	**59.6**	**20.2**	**228.5**
MN03358-4	K9	2.2	68.0	29.6	3.6	56.0	18.2	171.0
ND809	K11	3.1	68.2	16.9	3.1	59.1	16.9	148.1
NDSW0449	W2	3.1	76.6	25.5	3.4	64.7	22.5	160.8
ND806	W4	4.6	74.0	23.7	4.6	61.3	23.5	211.2
NDSW0601	W6	3.9	89.2	32.9	4.2	73.9	27.7	213.9
Samson	W7	8.4	69.9	30.5	8.6	54.6	30.1	363.1
Glenn	**W8**	**5.2**	**74.2**	**26.9**	**5.6**	**61.0**	**23.7**	**243.9**
ND809	W11	4.4	86.0	32.7	4.4	68.9	32.6	214.6
COI320W	W12	5.2	73.8	21.4	5.1	63.0	21.4	222.5

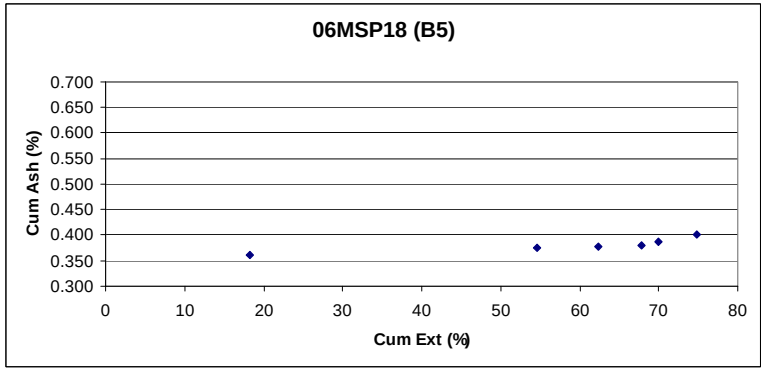
Cumulative Ash Curve – Brookings, SD



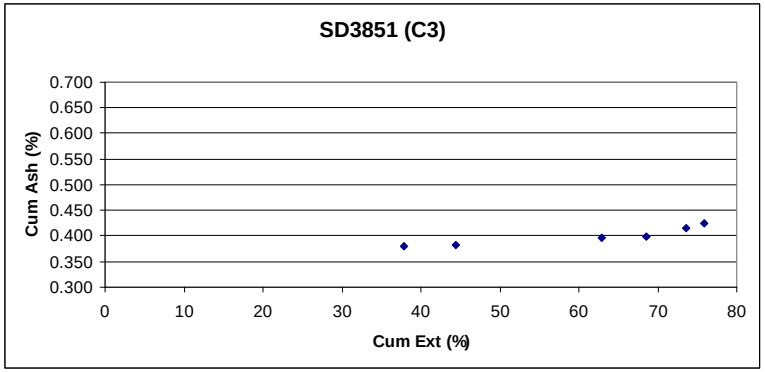


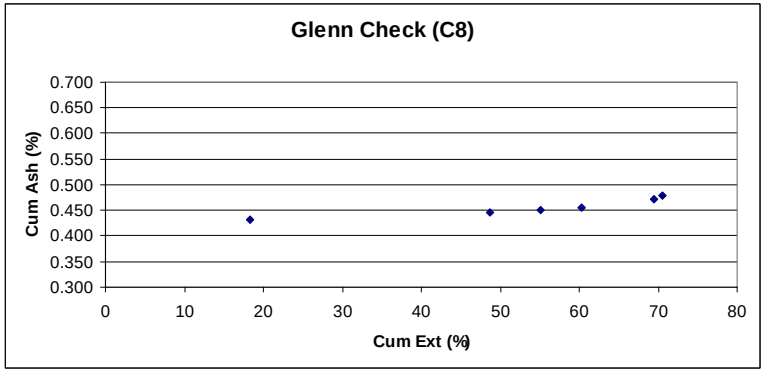


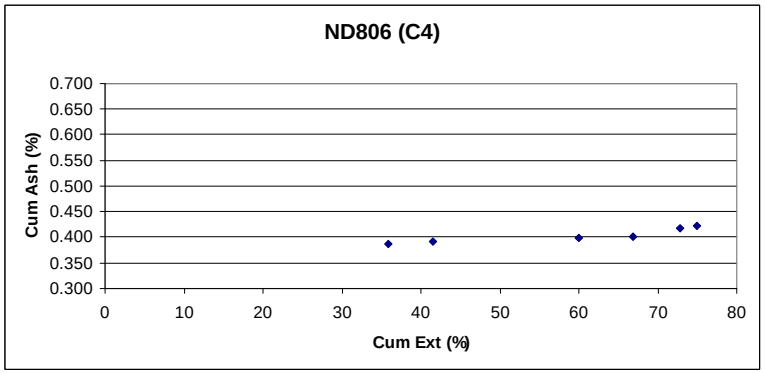


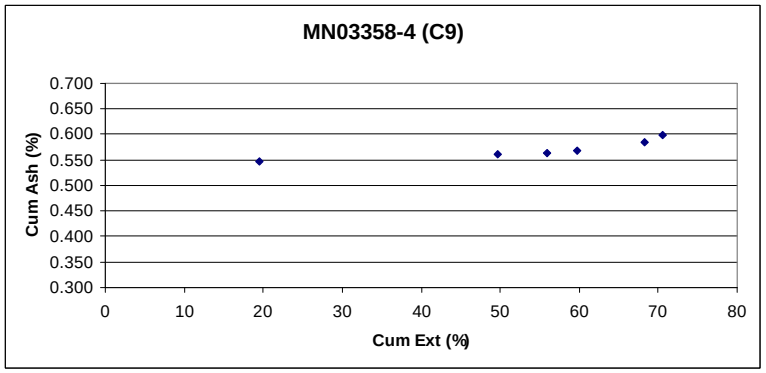


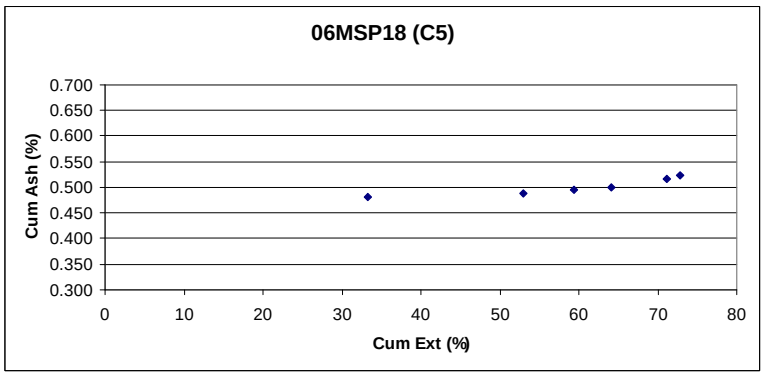
Cumulative Ash Curve – Casselton, ND

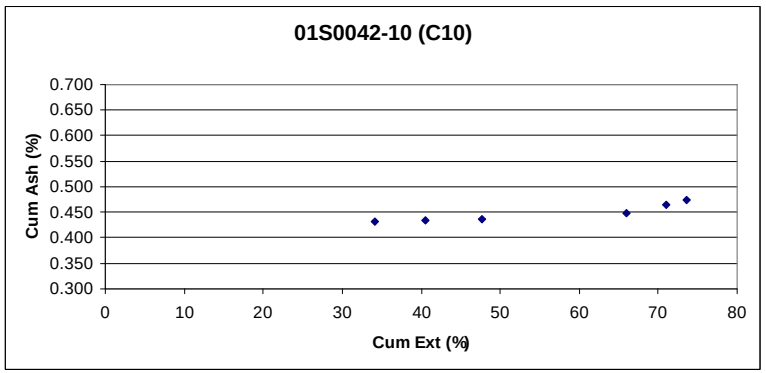


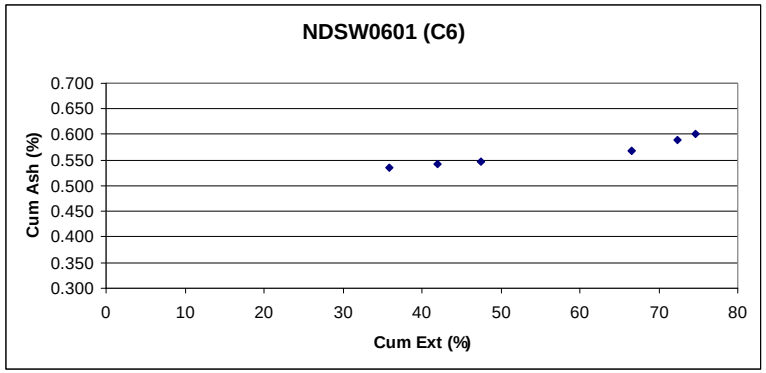


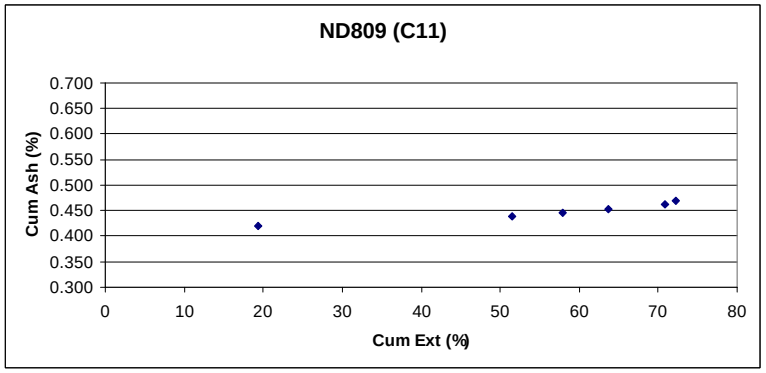


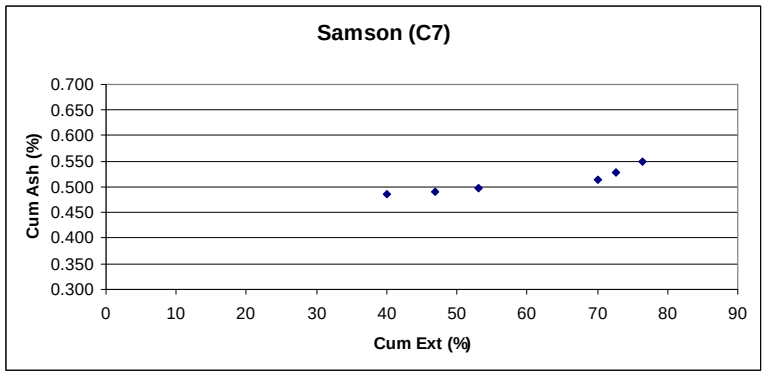




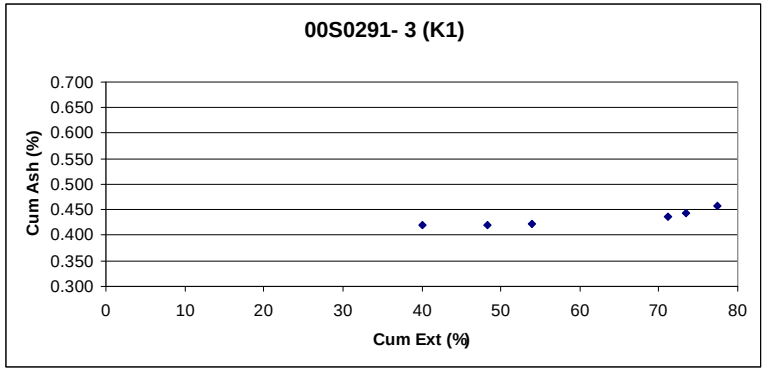


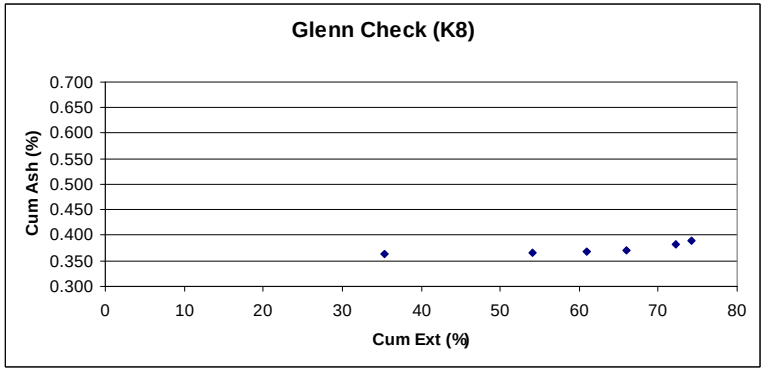

NDSW0601 (C6)
Cum Ash (%)
0.700
0.650
0.600
0.550
0.500
0.450
0.400
0.350
0.300
0
10
20
30
40
50
60
70
80
Cum Ext (%)

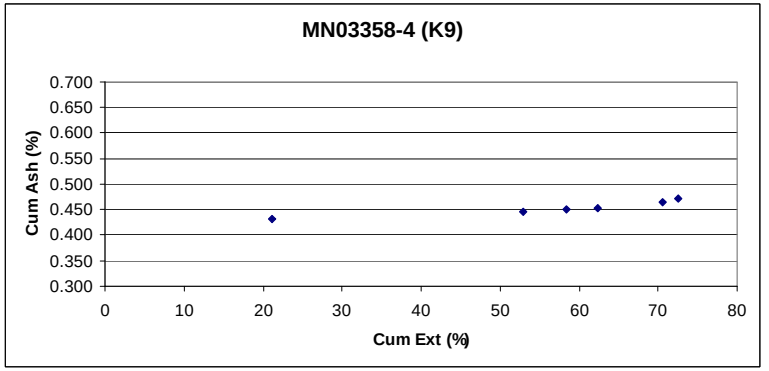

ND809 (C11)
Cum Ash (%)
0.700
0.650
0.600
0.550
0.500
0.450
0.400
0.350
0.300
0
10
20
30
40
50
60
70
80
Cum Ext (%)

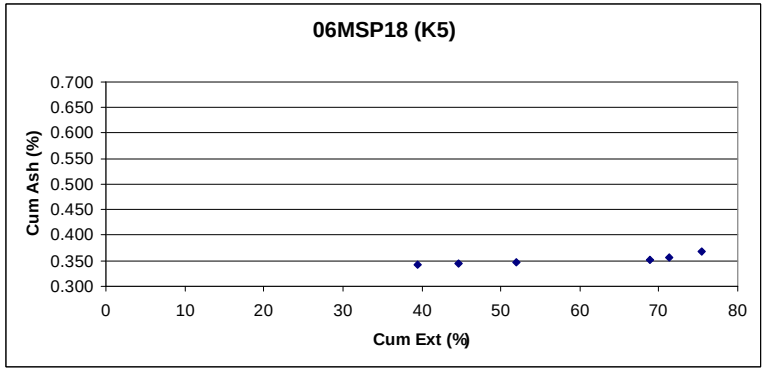

Samson (C7)
Cum Ash (%)
0.700
0.650
0.600
0.550
0.500
0.450
0.400
0.350
0.300
0
10
20
30
40
50
60
70
80
90
Cum Ext (%)

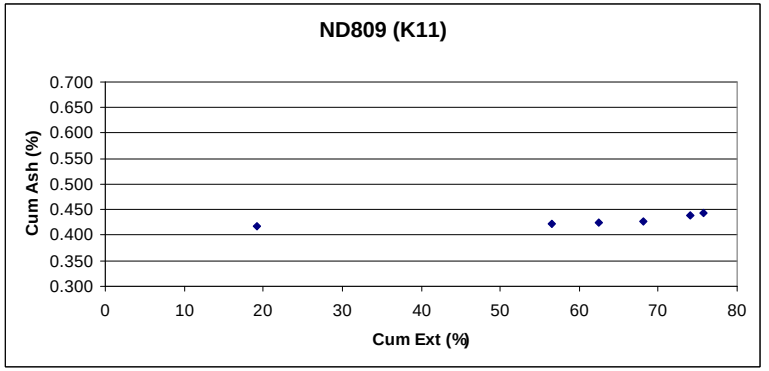
Cumulative Ash Curve – Crookston, MN



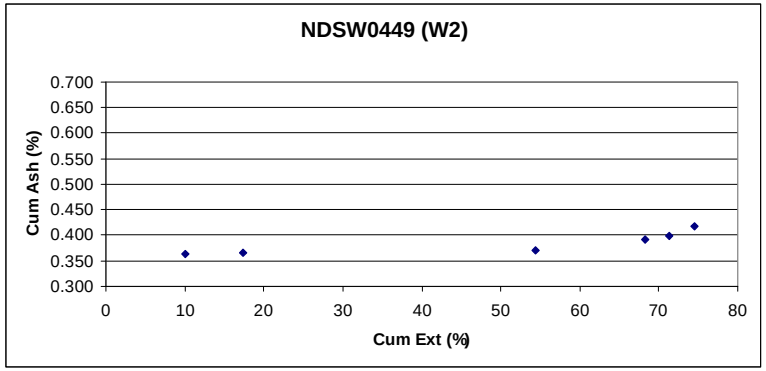


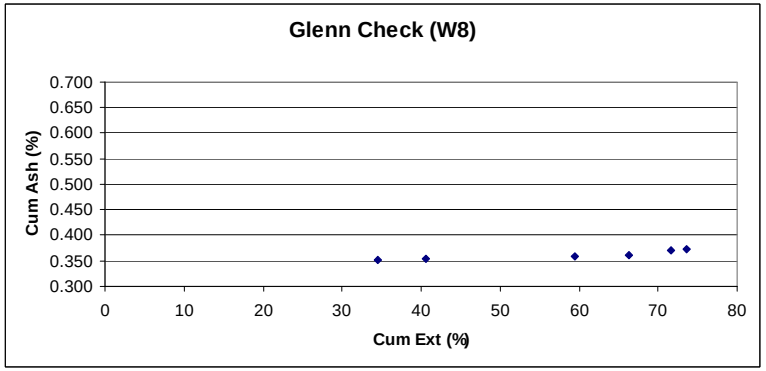


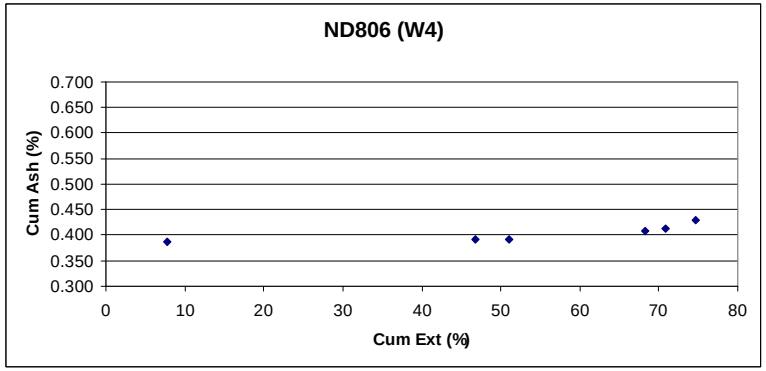


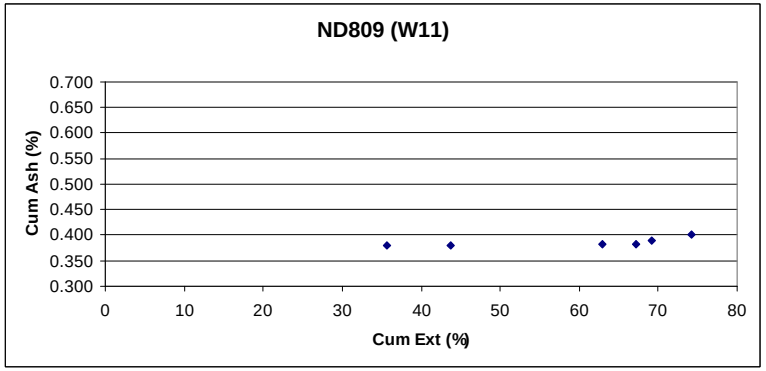


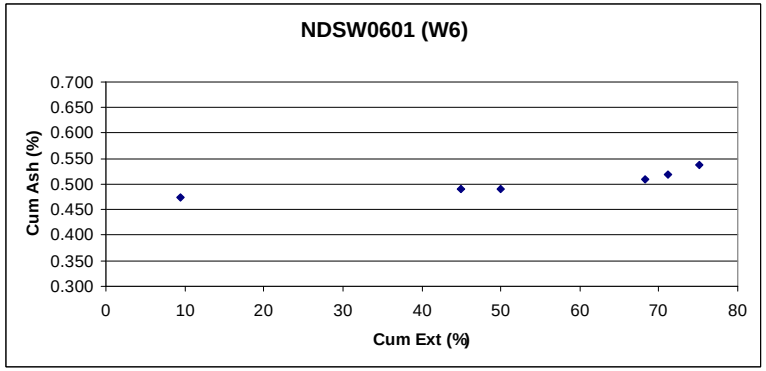
Cumulative Ash Curve – Williston, ND

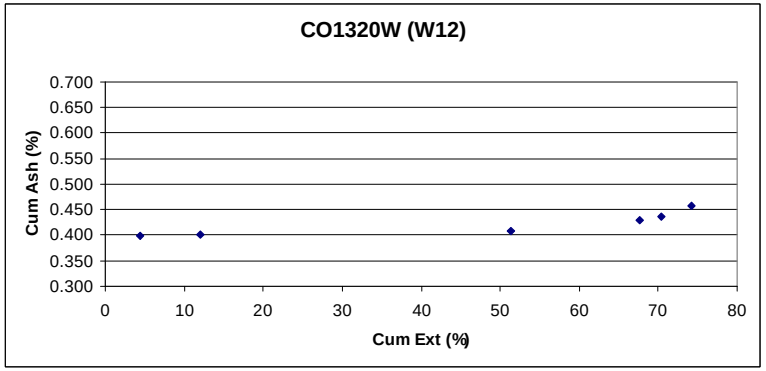


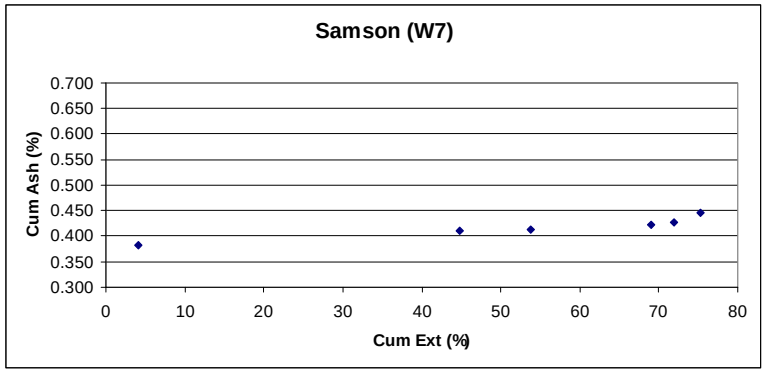






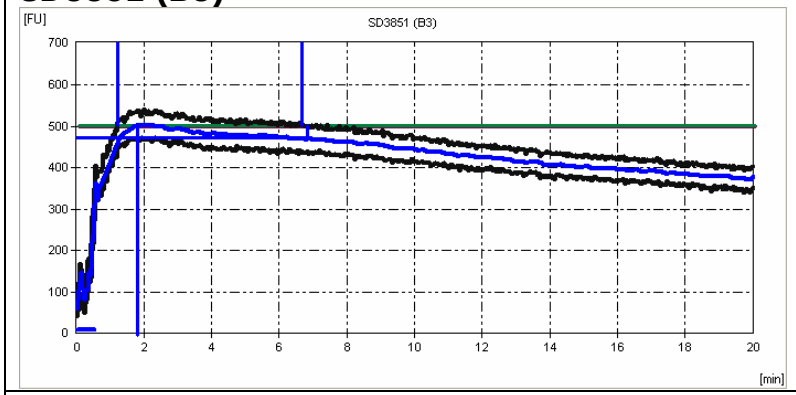




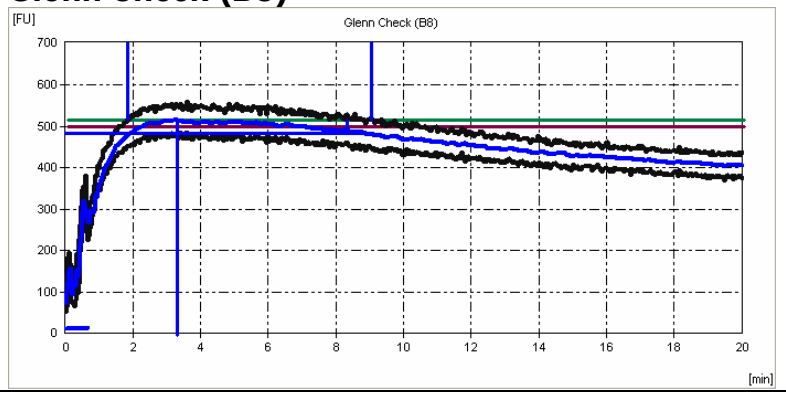

Samson (W7)
Cum Ash (%)
0.700
0.650
0.600
0.550
0.500
0.450
0.400
0.350
0.300
0
10
20
30
40
50
60
70
80
Cum Ext (%)

Farinograms

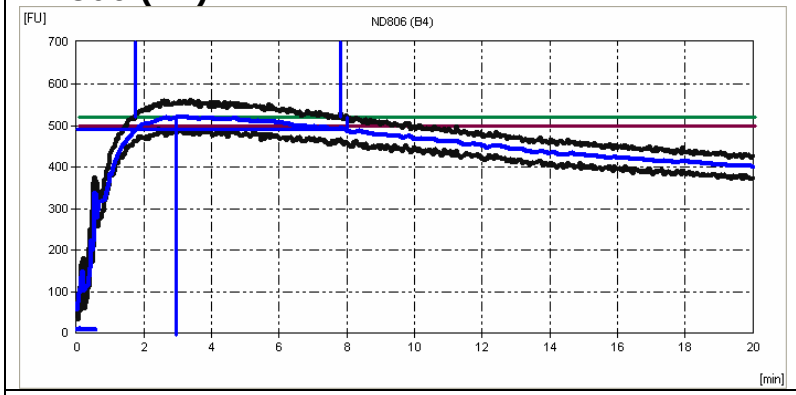
SD3851 (B3)



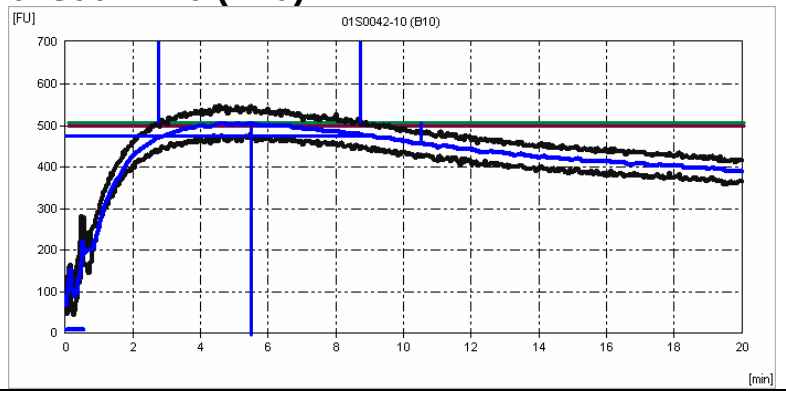
Glenn Check (B8)



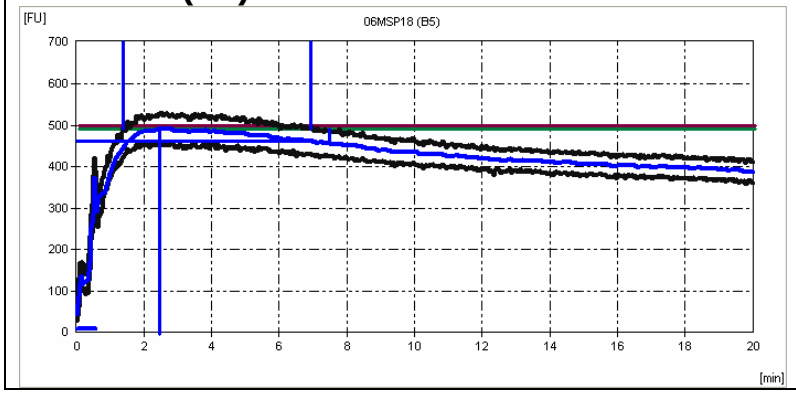
ND806 (B4)



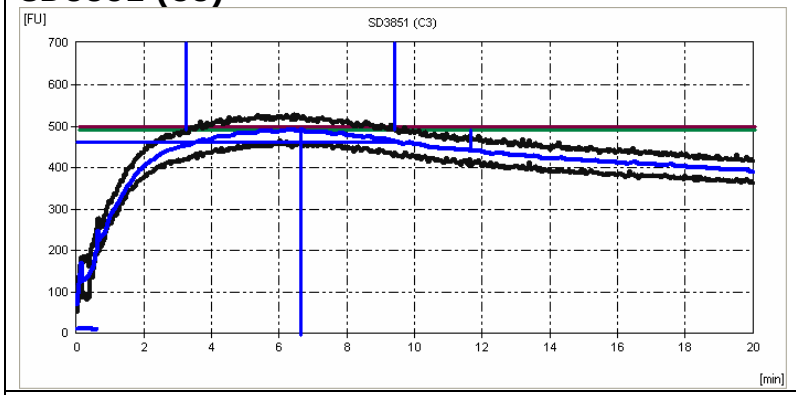
01S0042-10 (B10)



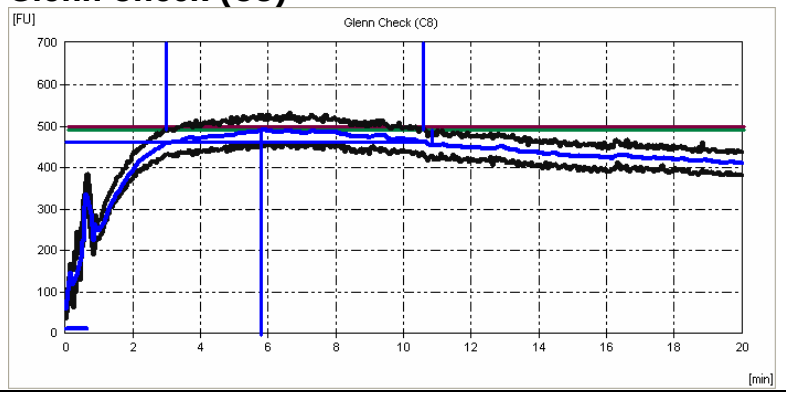
06MSP18 (B5)



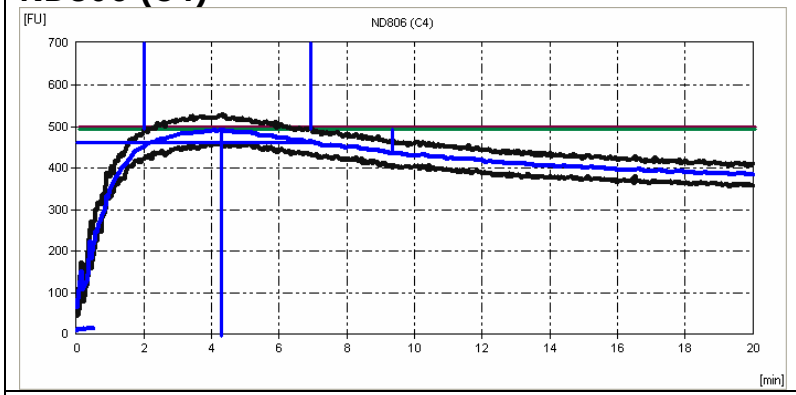
SD3851 (C3)



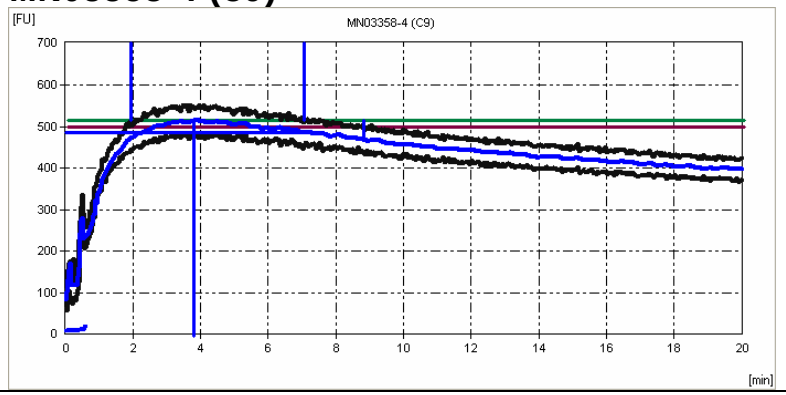
Glenn Check (C8)



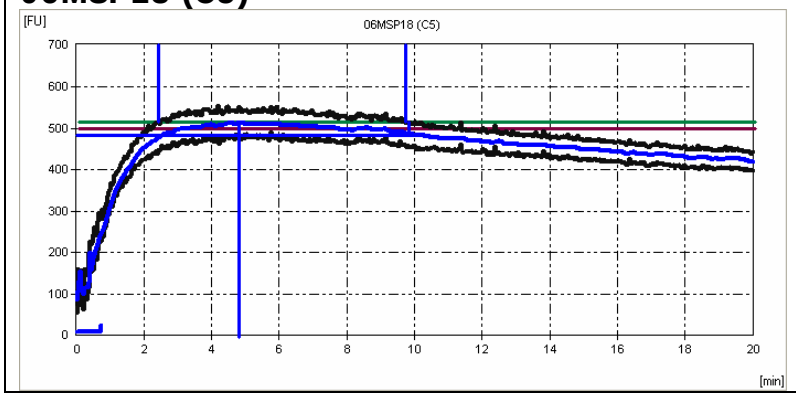
ND806 (C4)



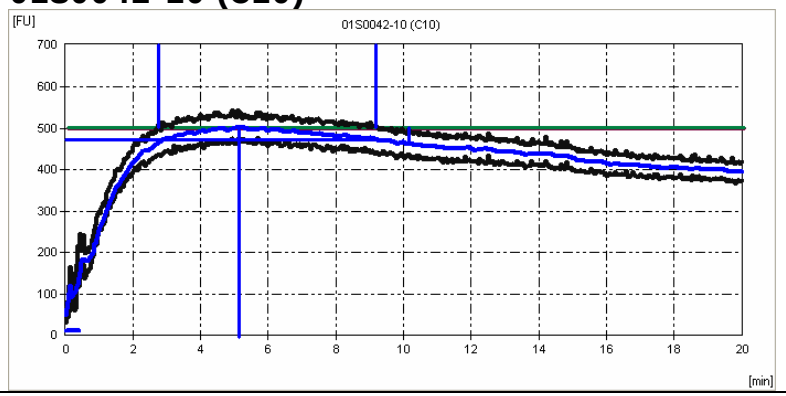
MN03358-4 (C9)



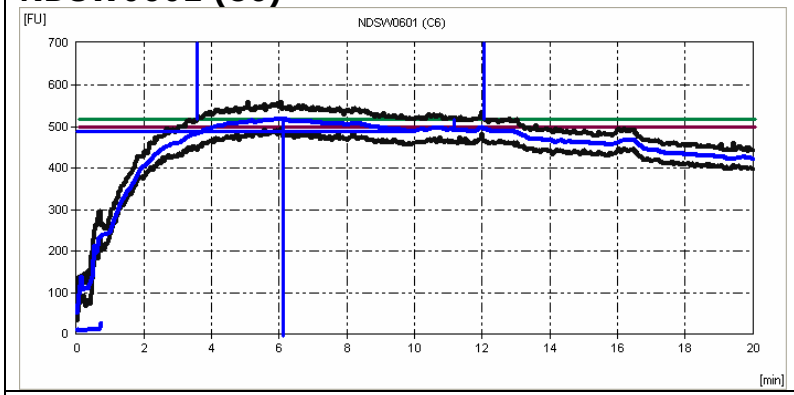
06MSP18 (C5)



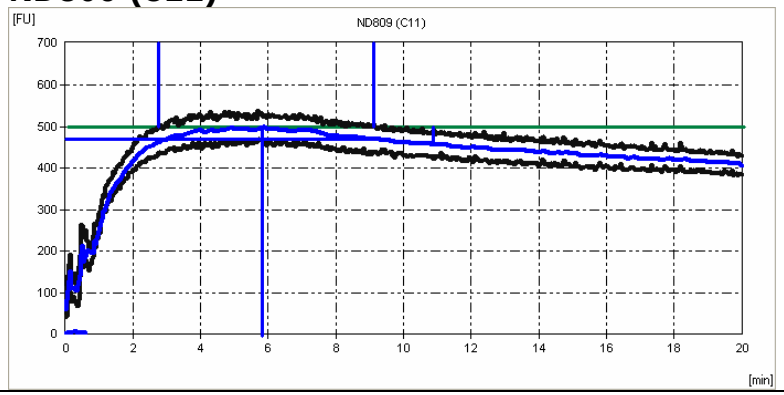
01S0042-10 (C10)



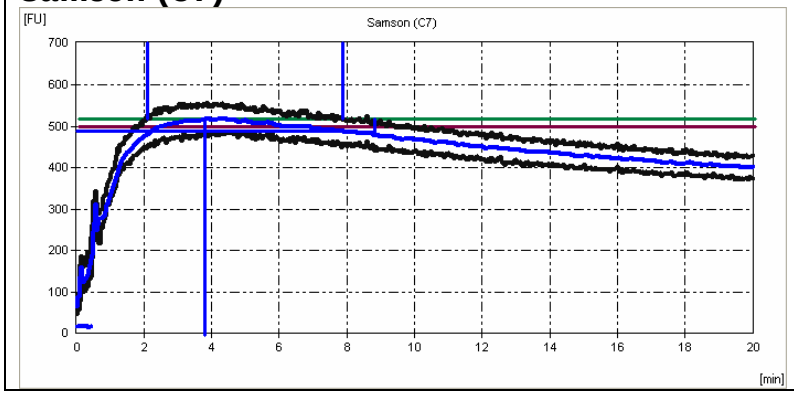
NDSW0601 (C6)



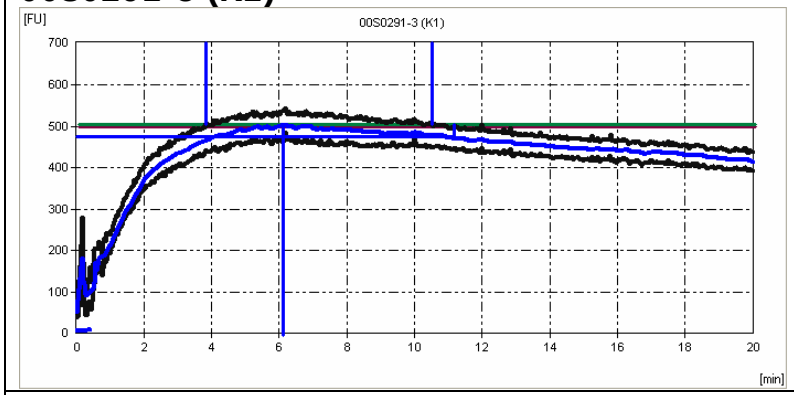
ND809 (C11)



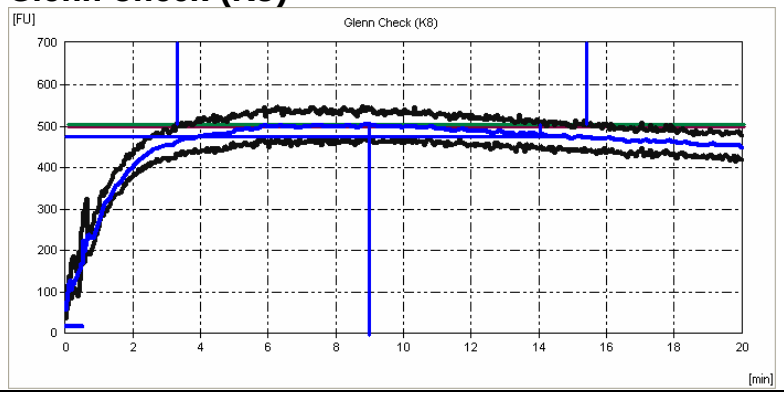
Samson (C7)



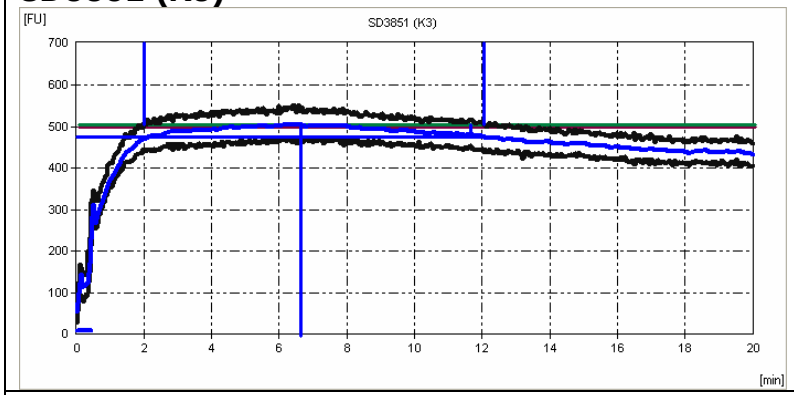
00S0291-3 (K1)



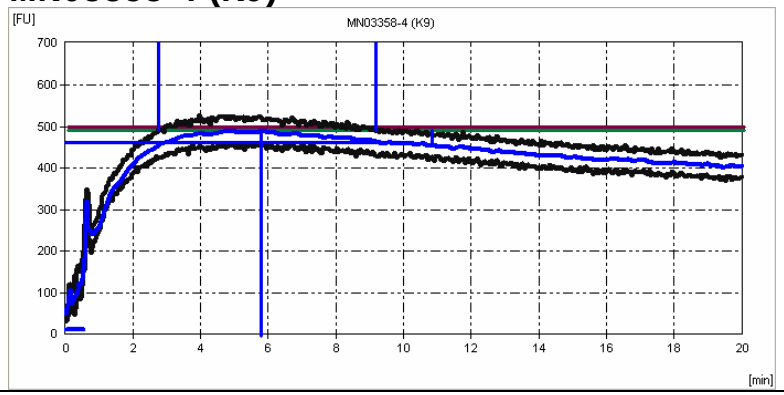
Glenn Check (K8)



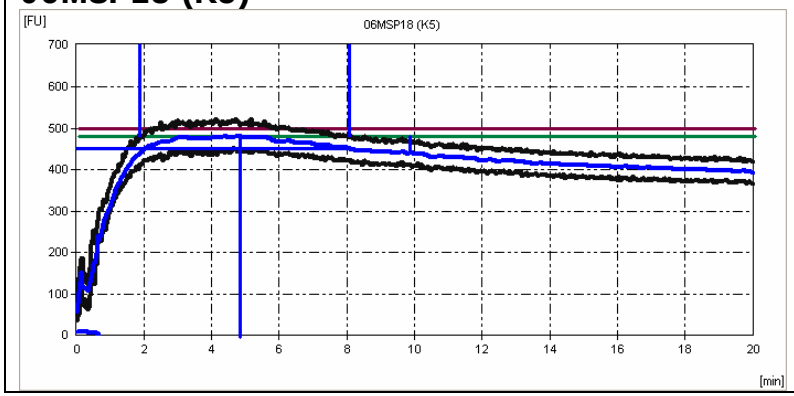
SD3851 (K3)



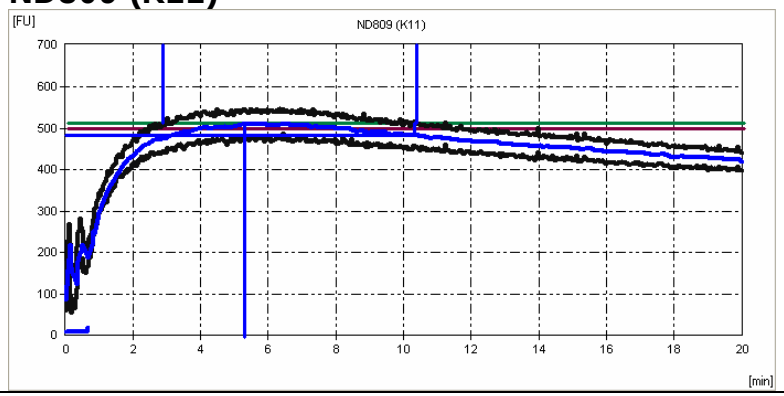
MN03358-4 (K9)



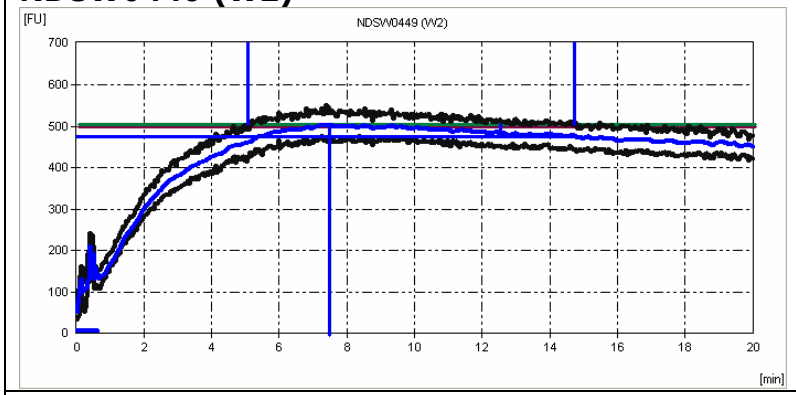
06MSP18 (K5)



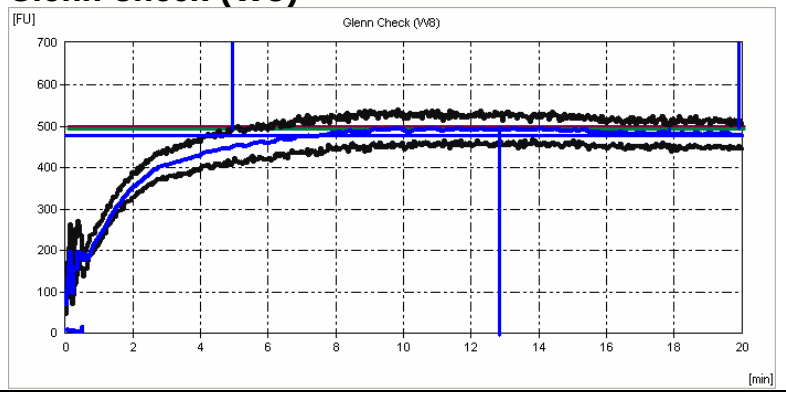
ND809 (K11)



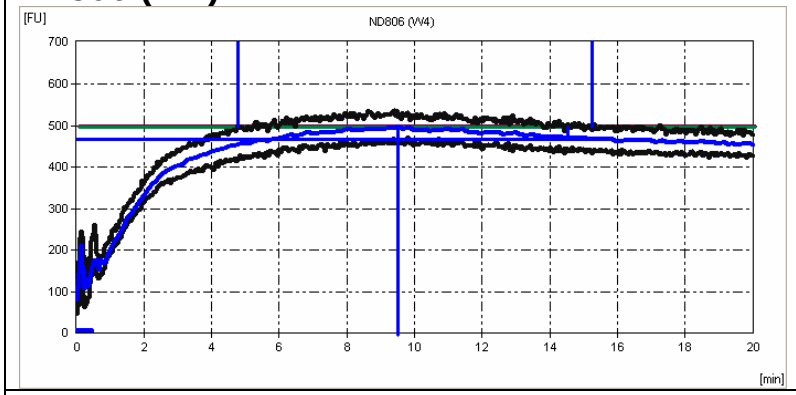
NDSW0449 (W2)



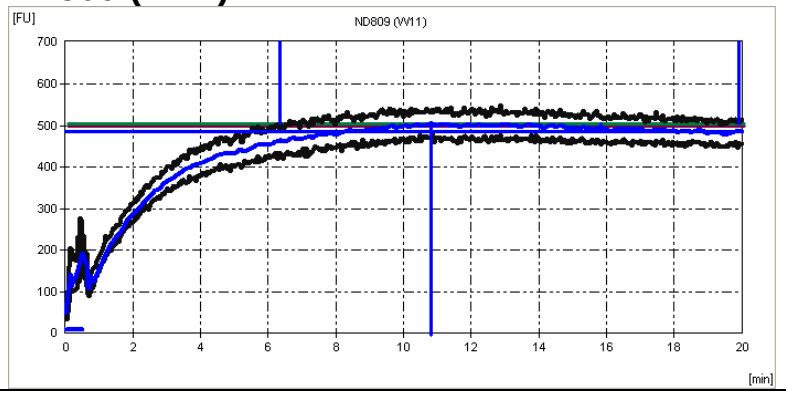
Glenn Check (W8)



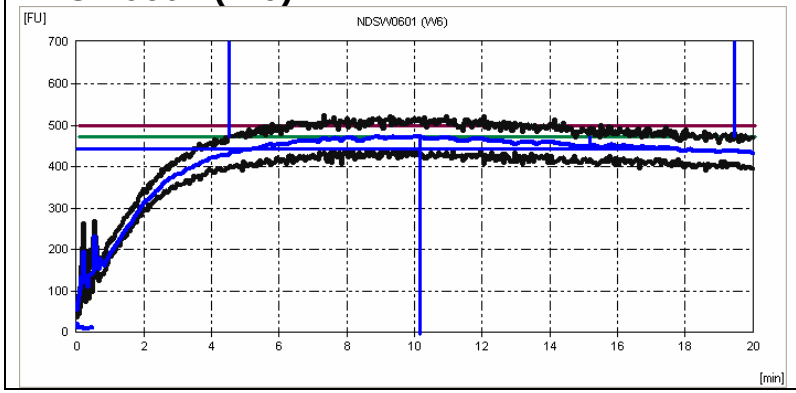
ND806 (W4)



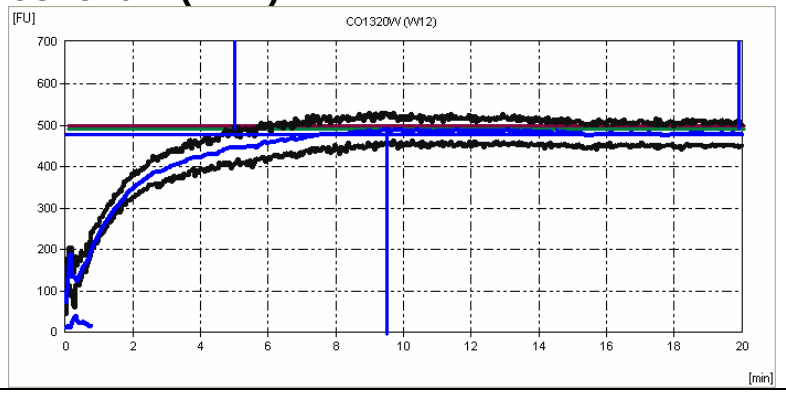
ND809 (W11)



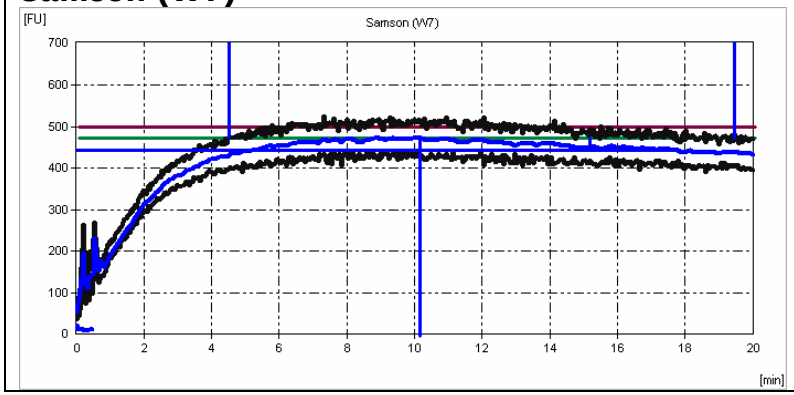
NDSW0601 (W6)



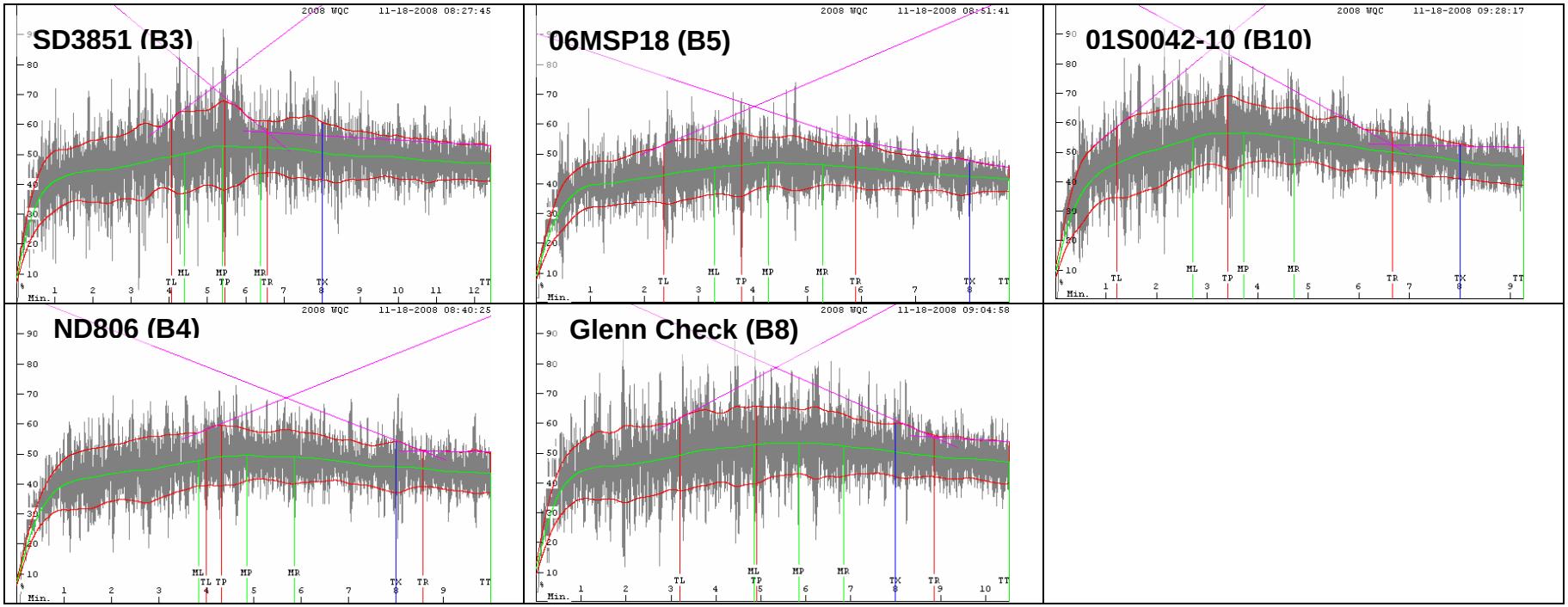
CO1320W (W12)



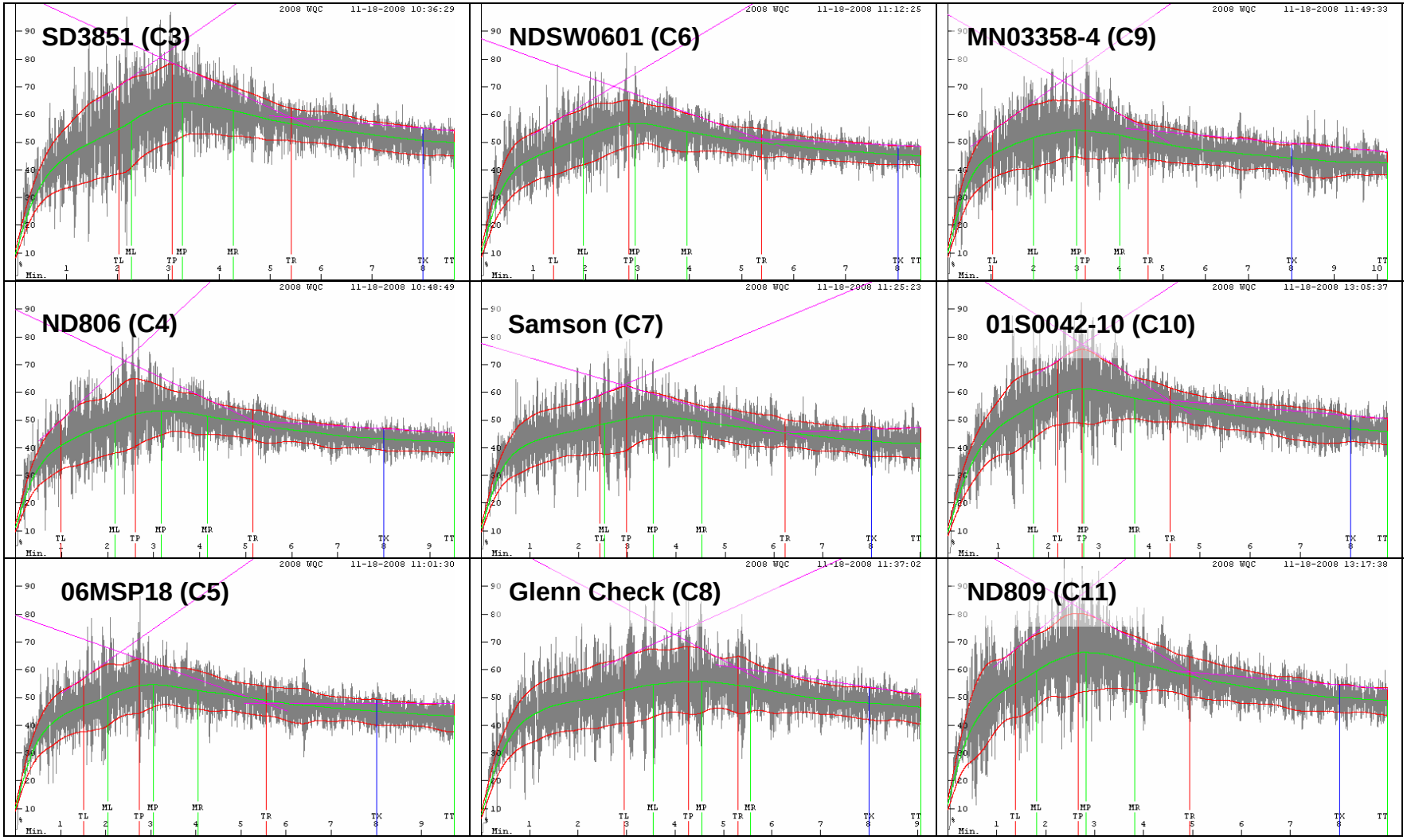
Samson (W7)


[FU]
Samson (W7)
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
14
16
18
20
[min]

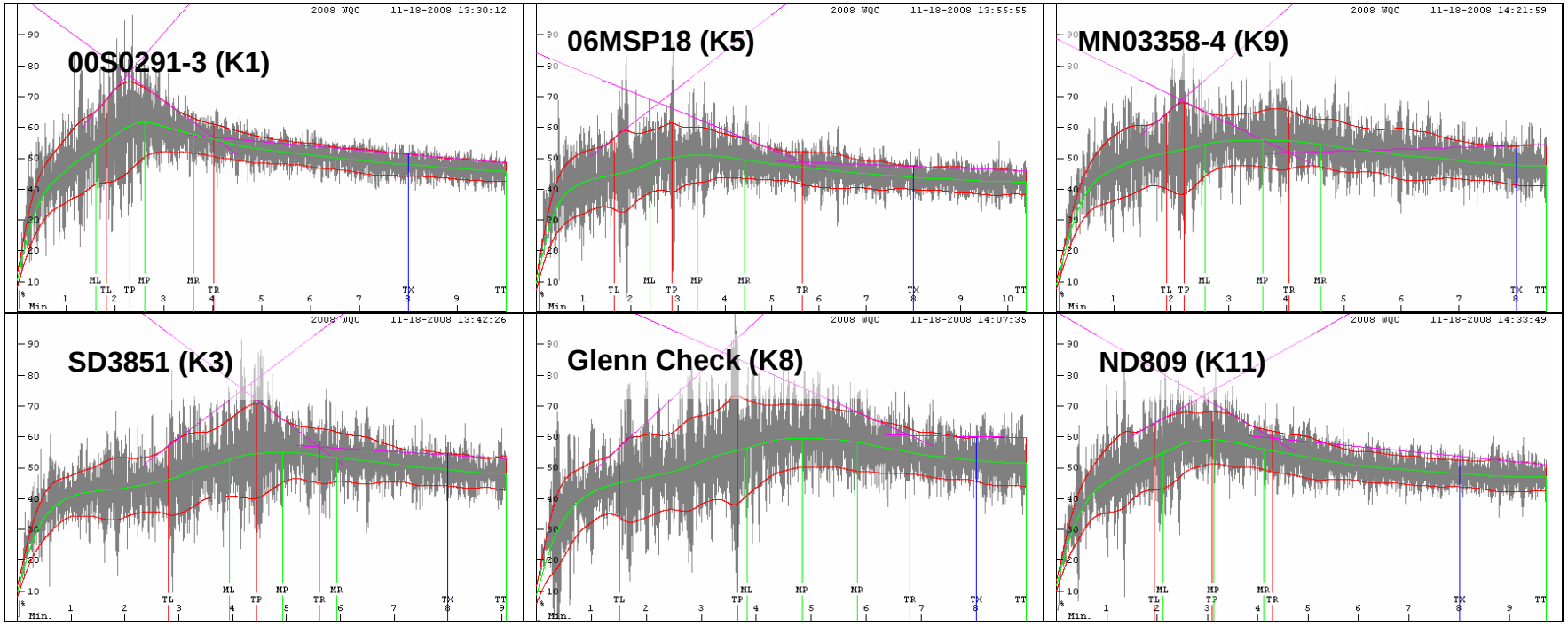
Brookings Mixograms



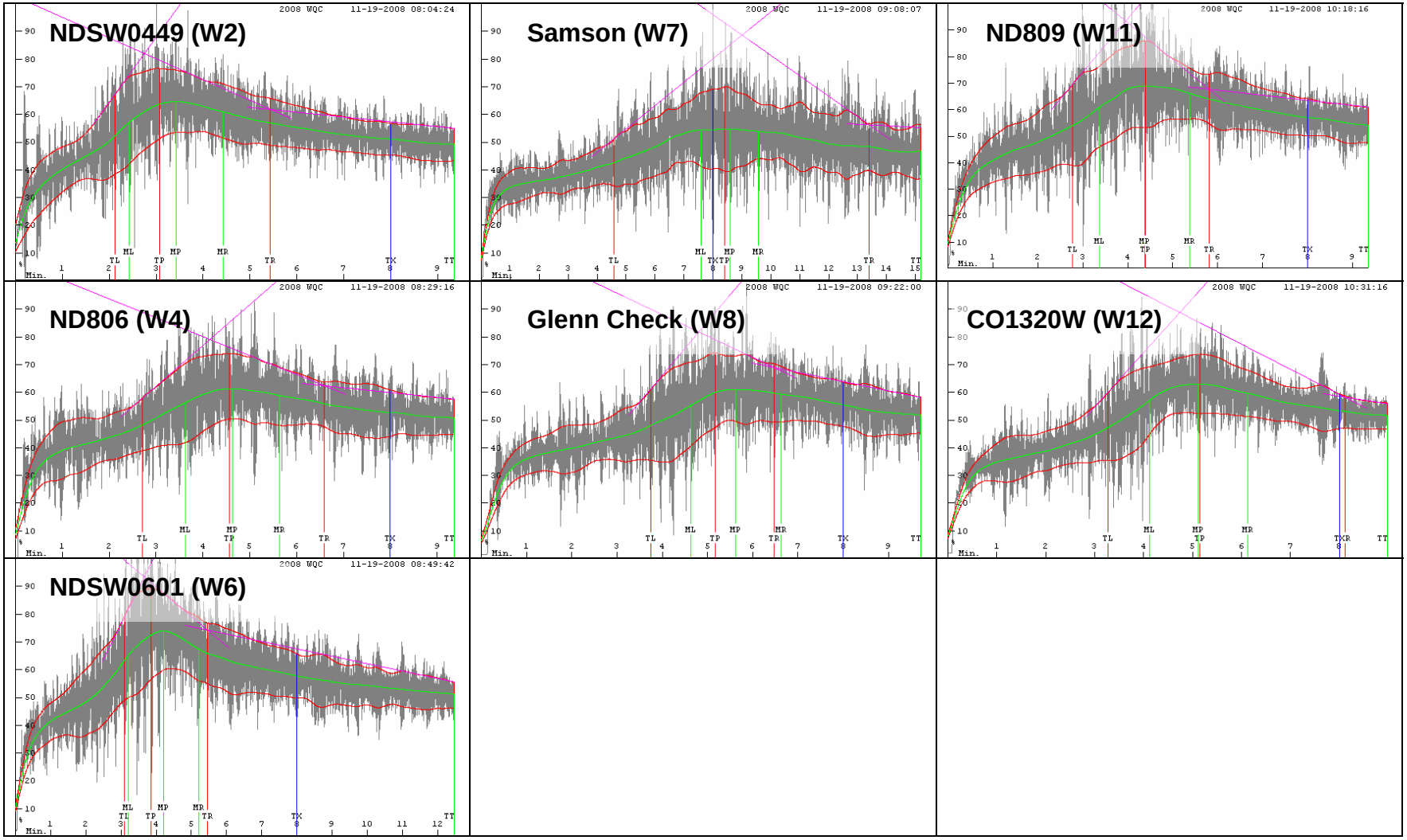
Casselton Mixograms



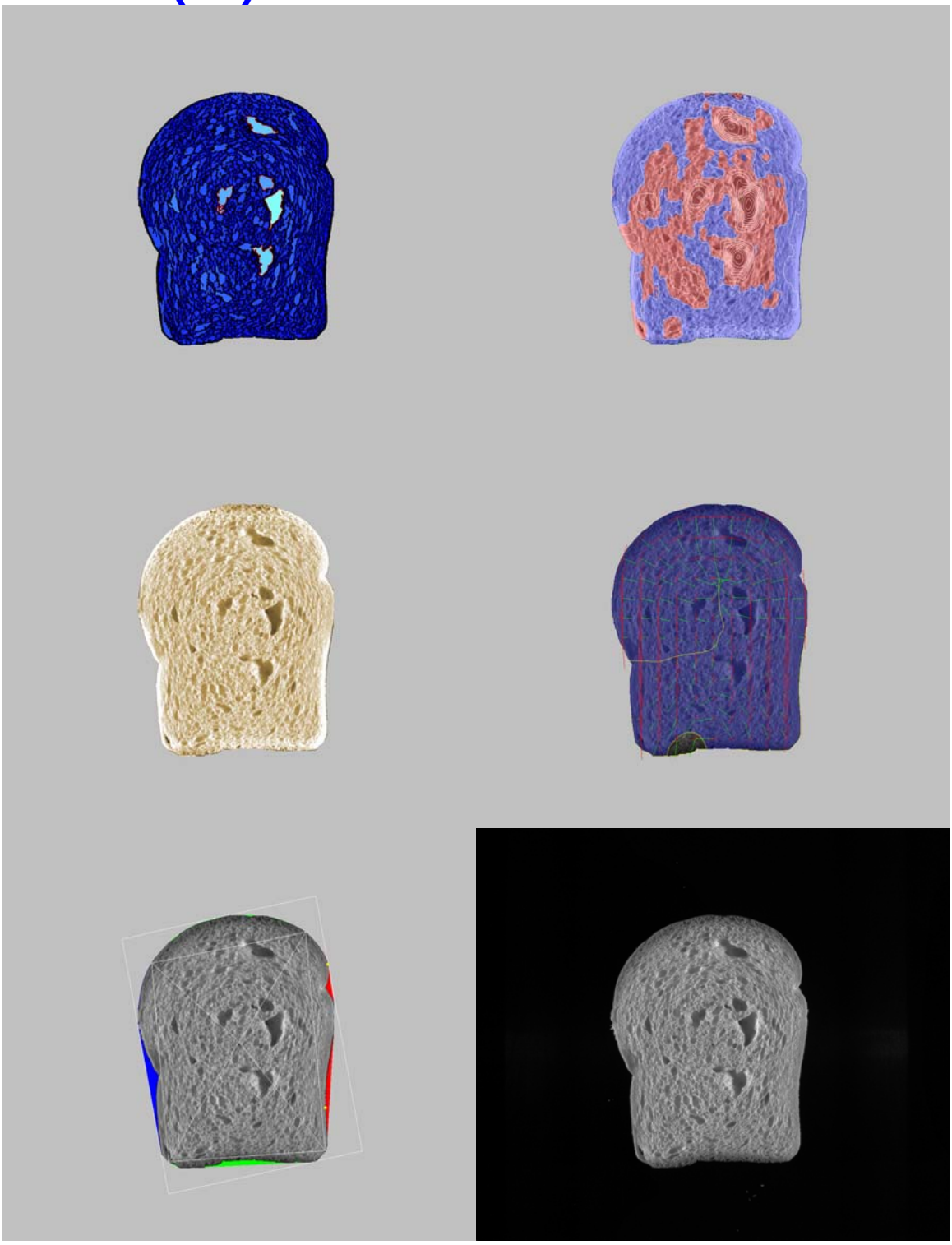
Crookston Mixograms



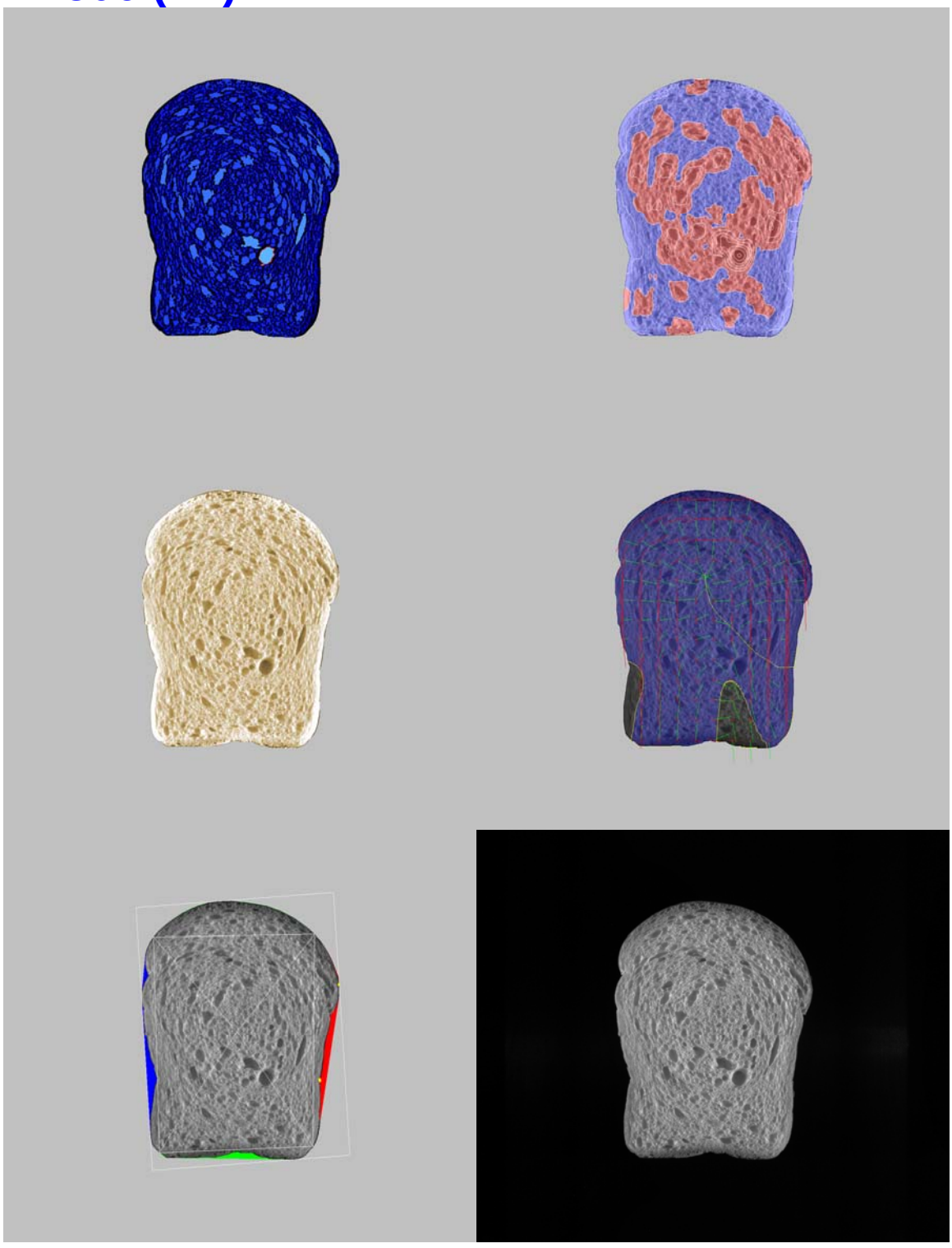
Williston Mixograms



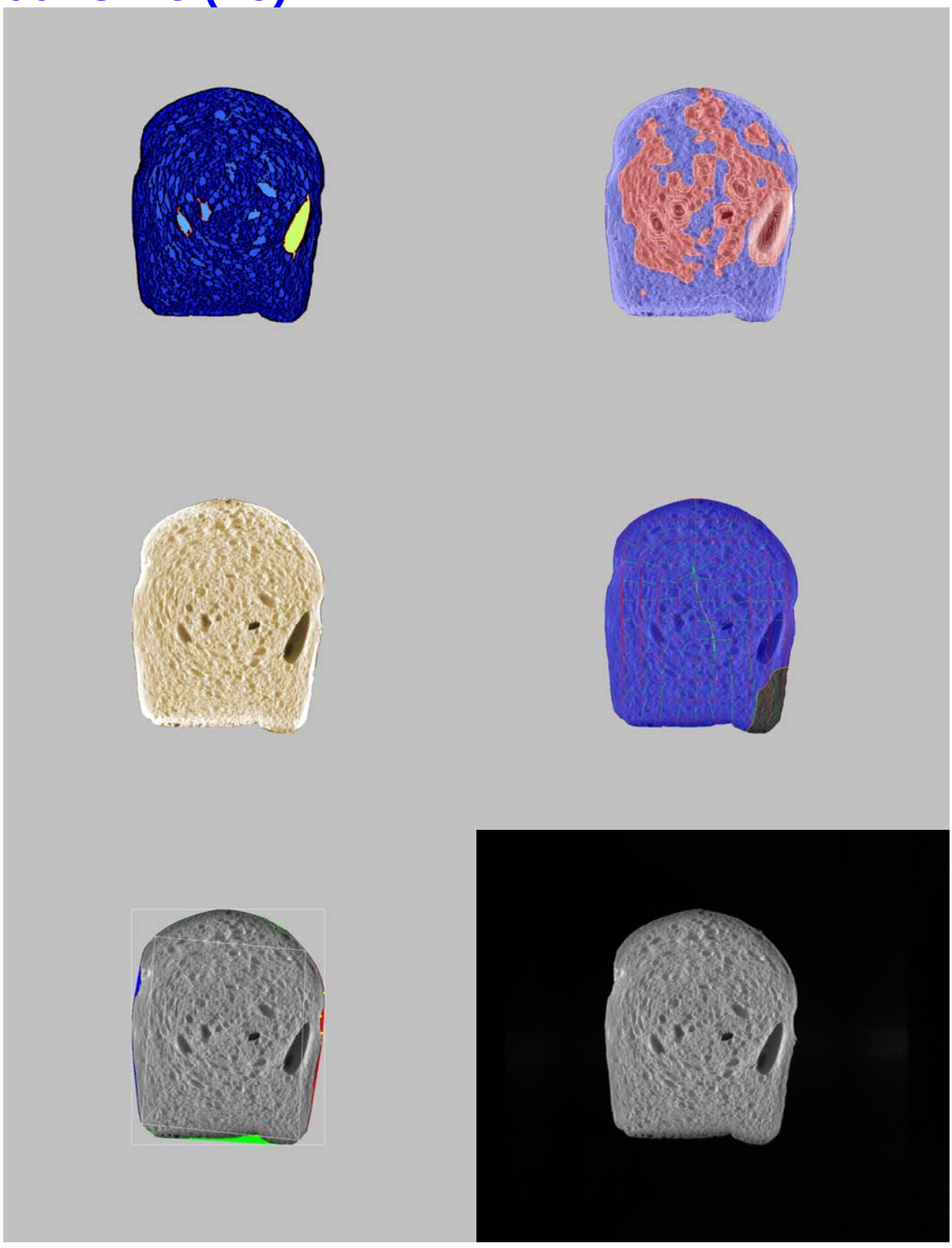
SD3851 (B3)



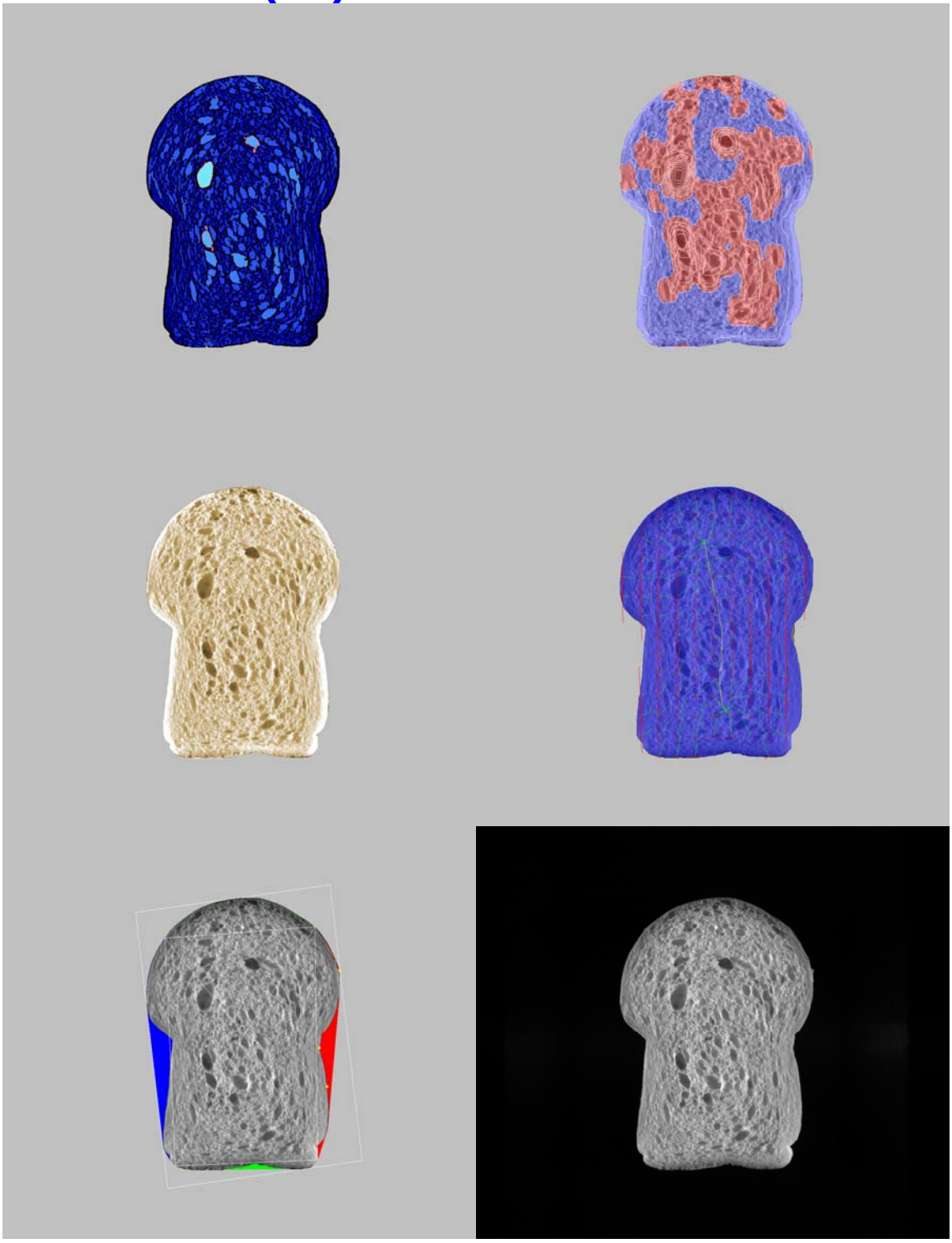
ND806 (B4)



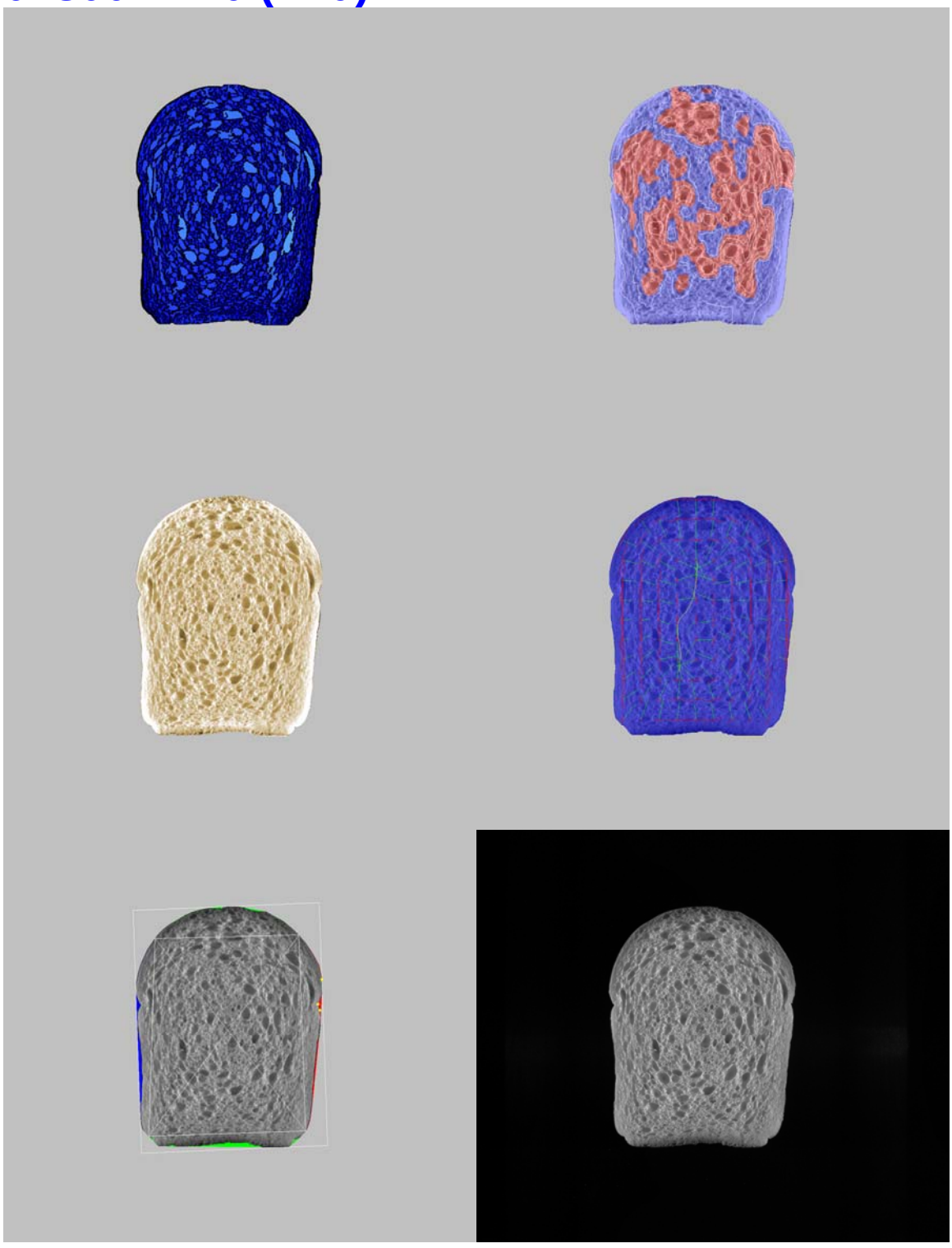
06MSP18 (B5)



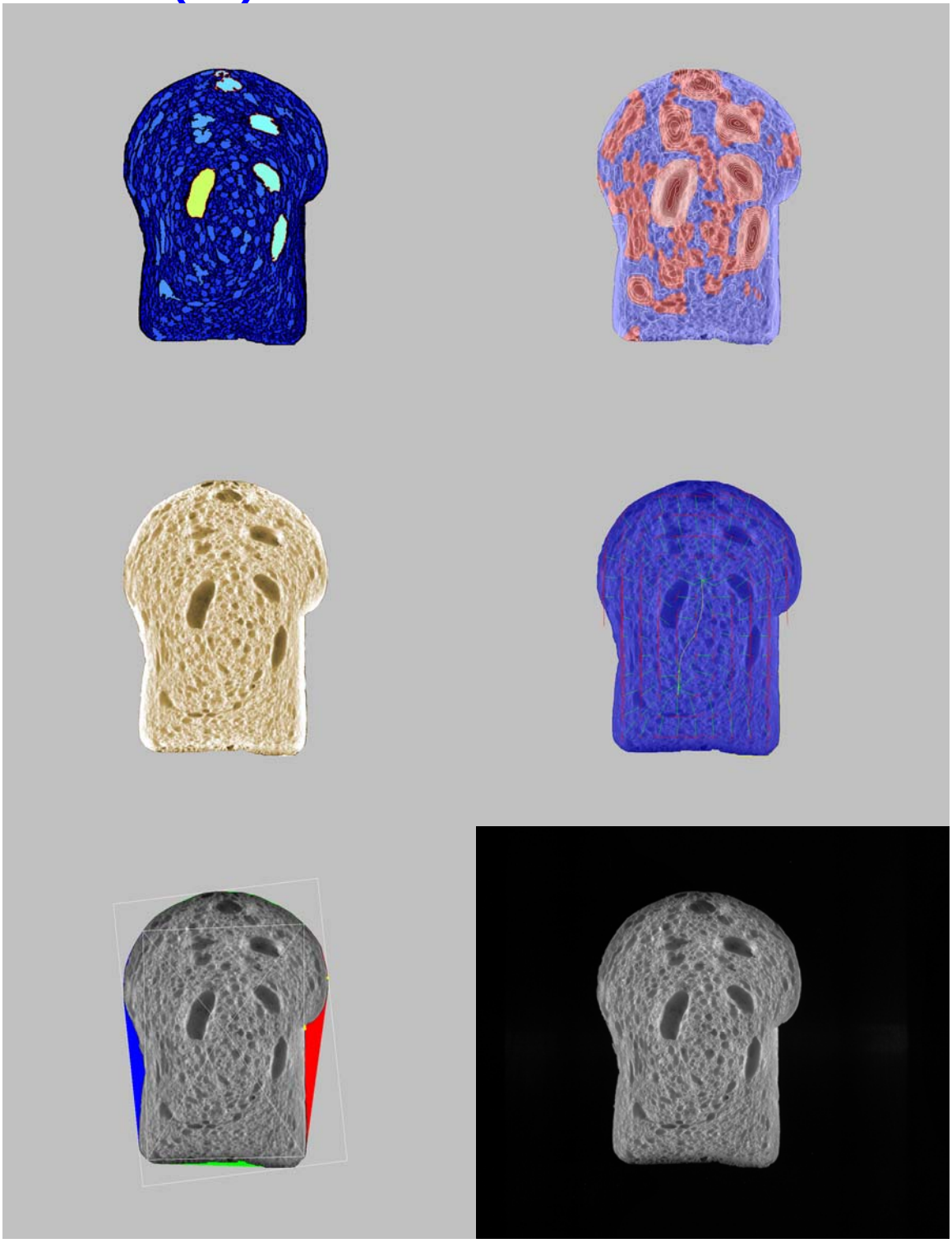
Glenn Check (B8)



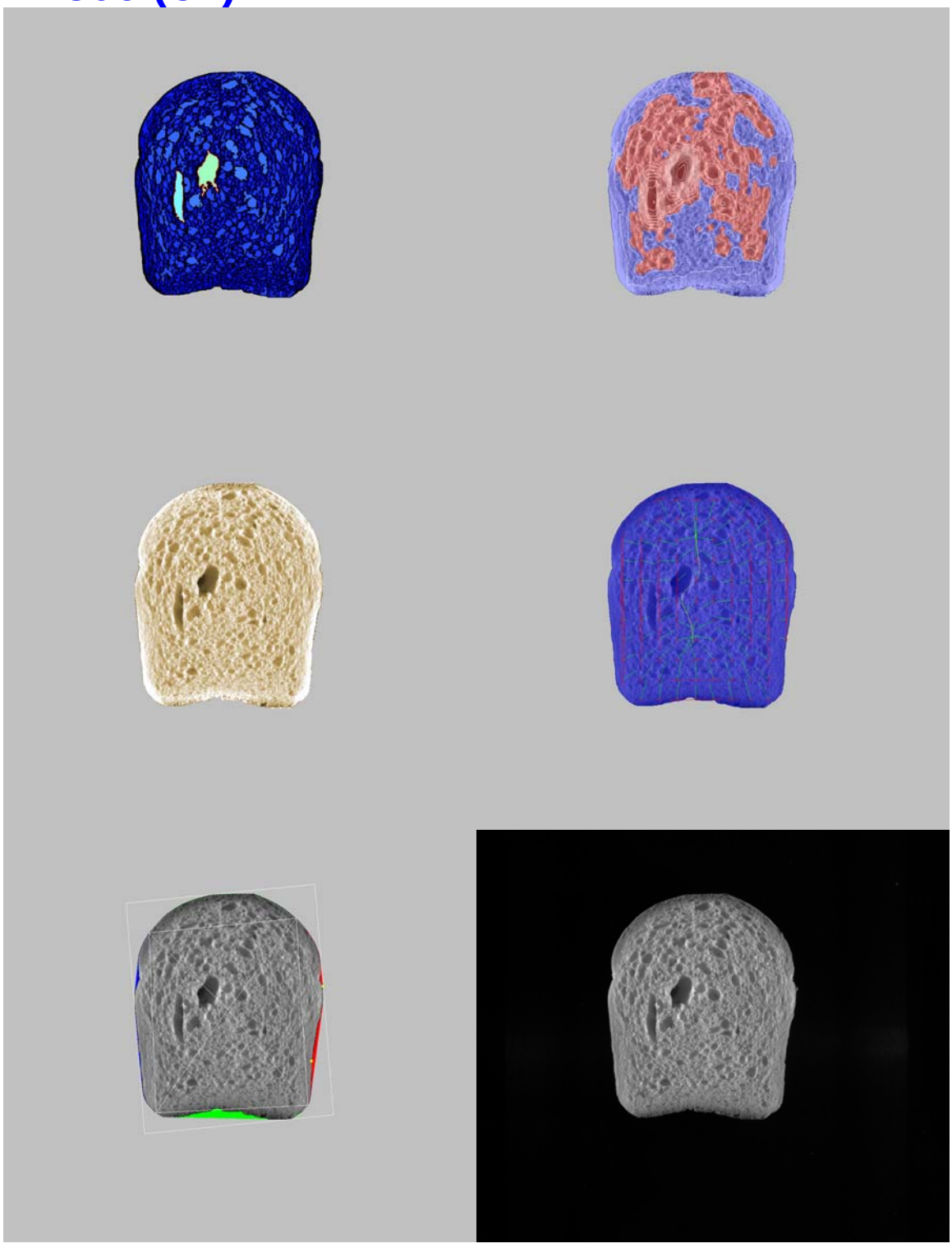
01S0042-10 (B10)



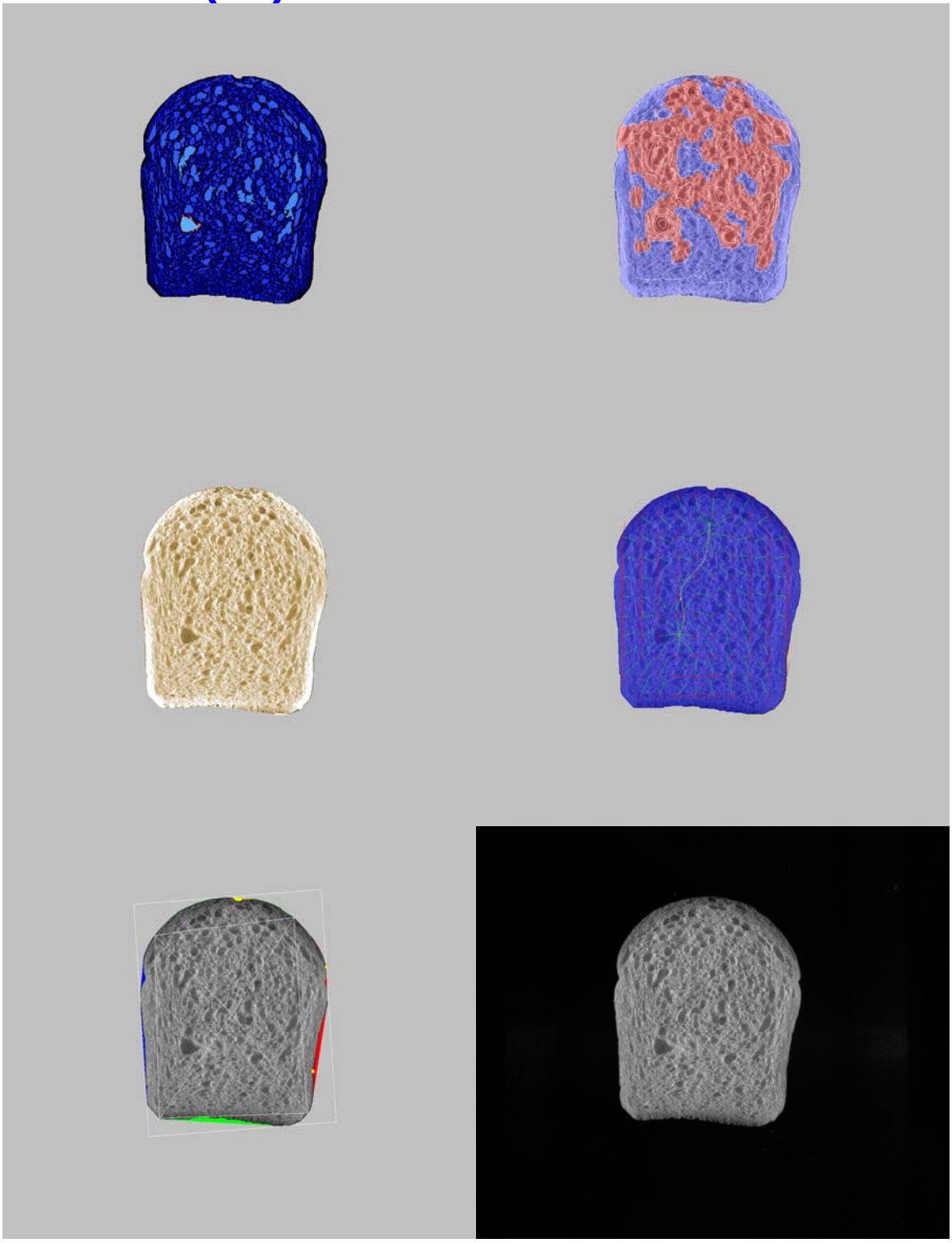
SD3851 (C3)



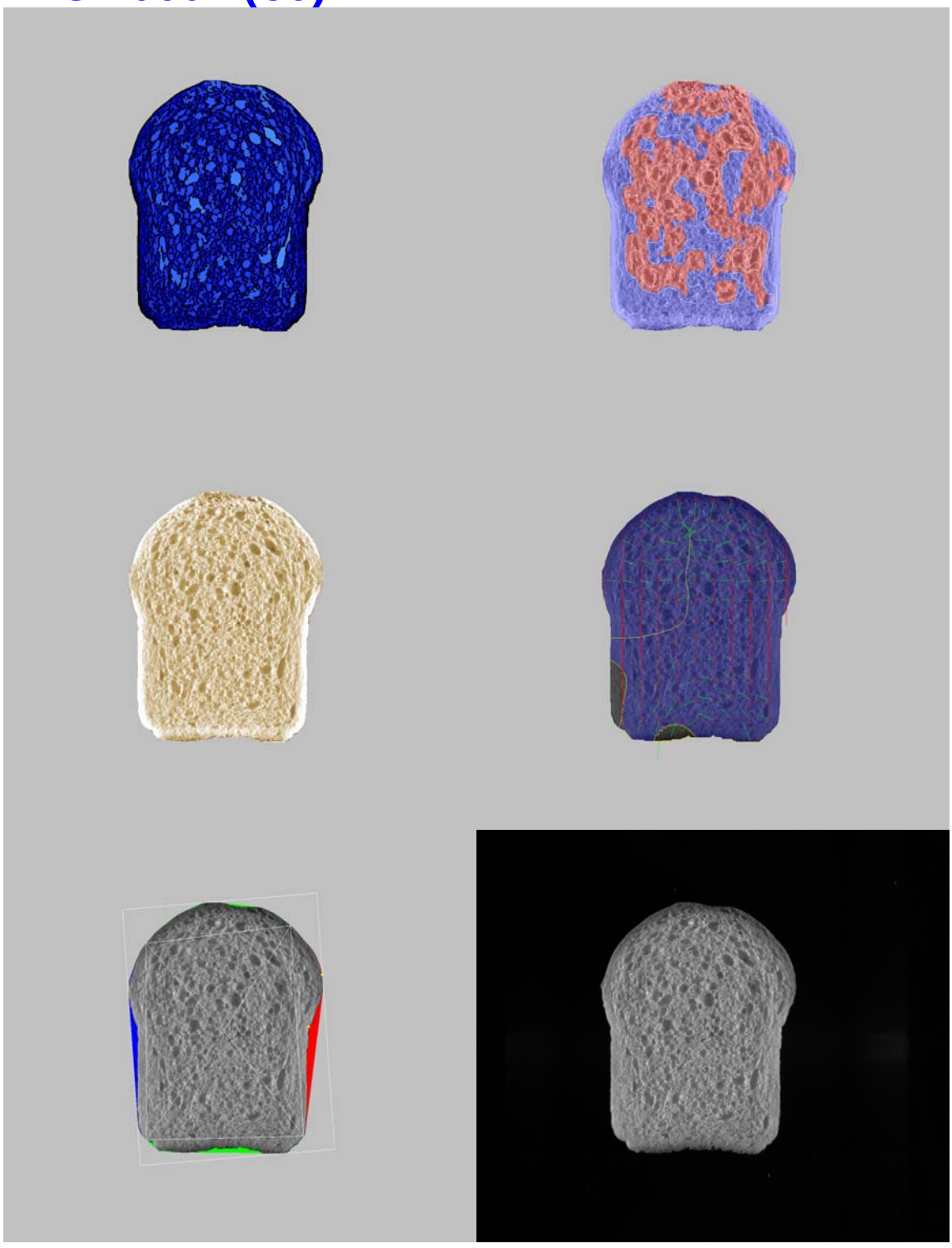
ND806 (C4)



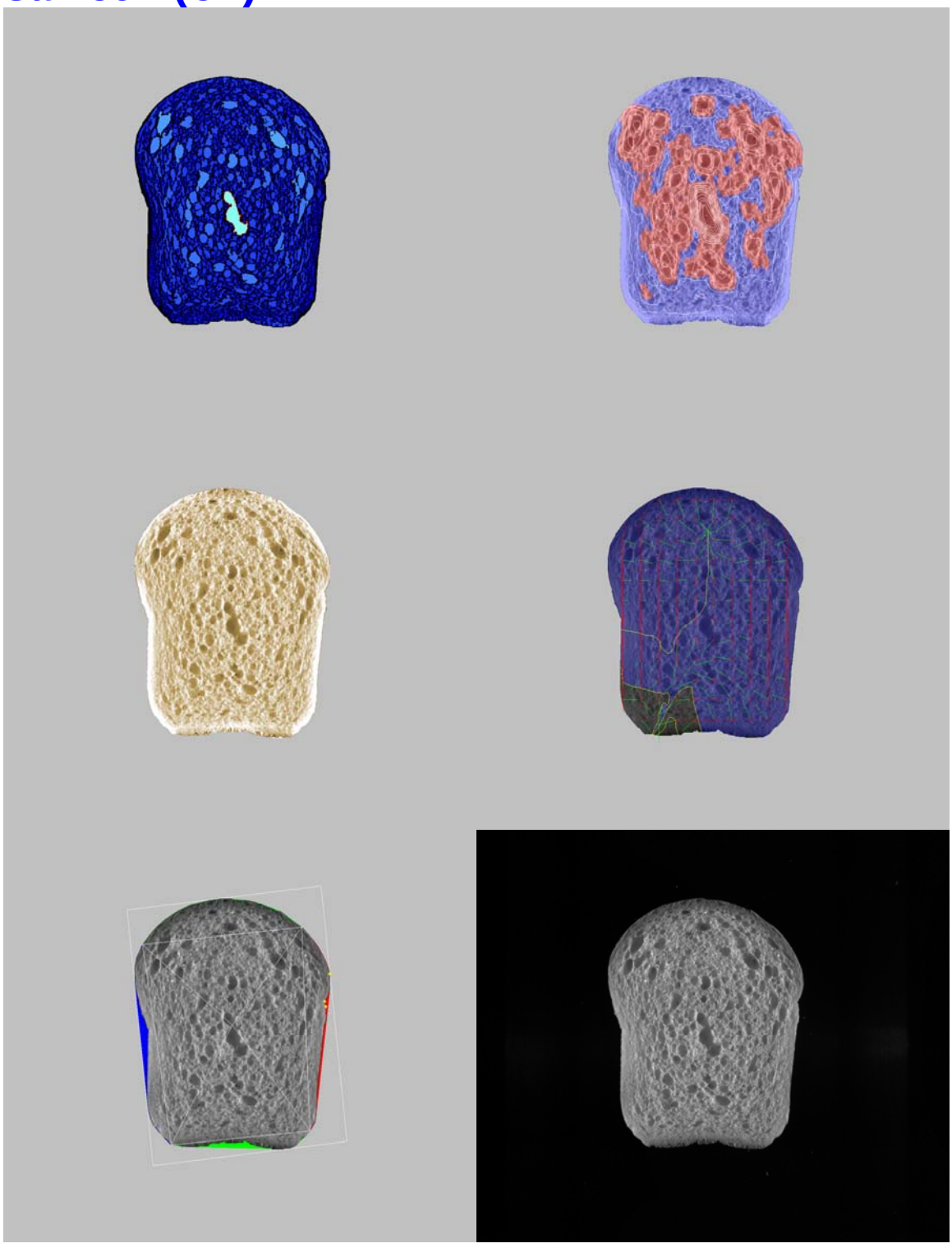
06MSP18 (C5)



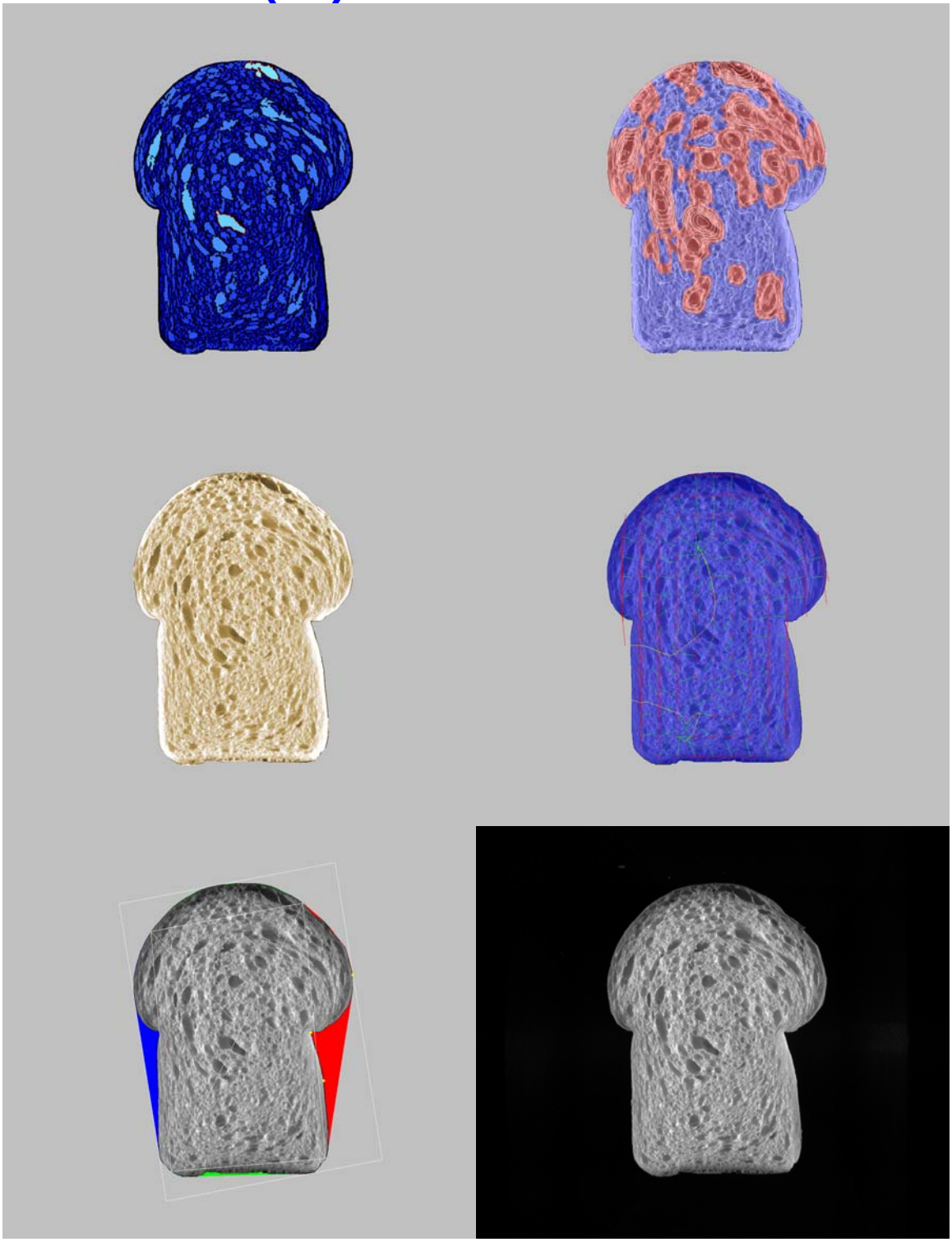
NDSW0601 (C6)



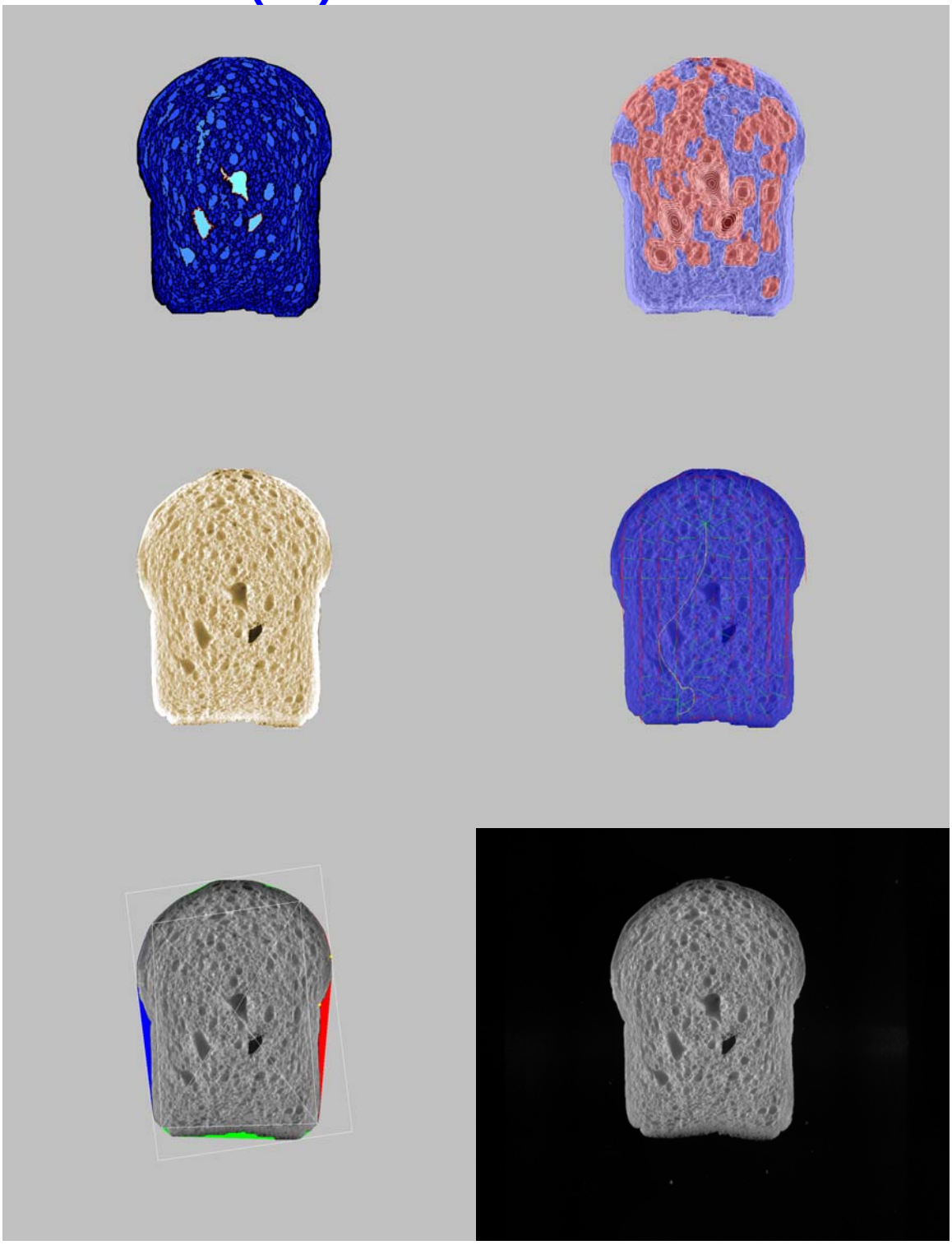
Samson (C7)



Glenn Check (C8)



MN03358-4 (C9)



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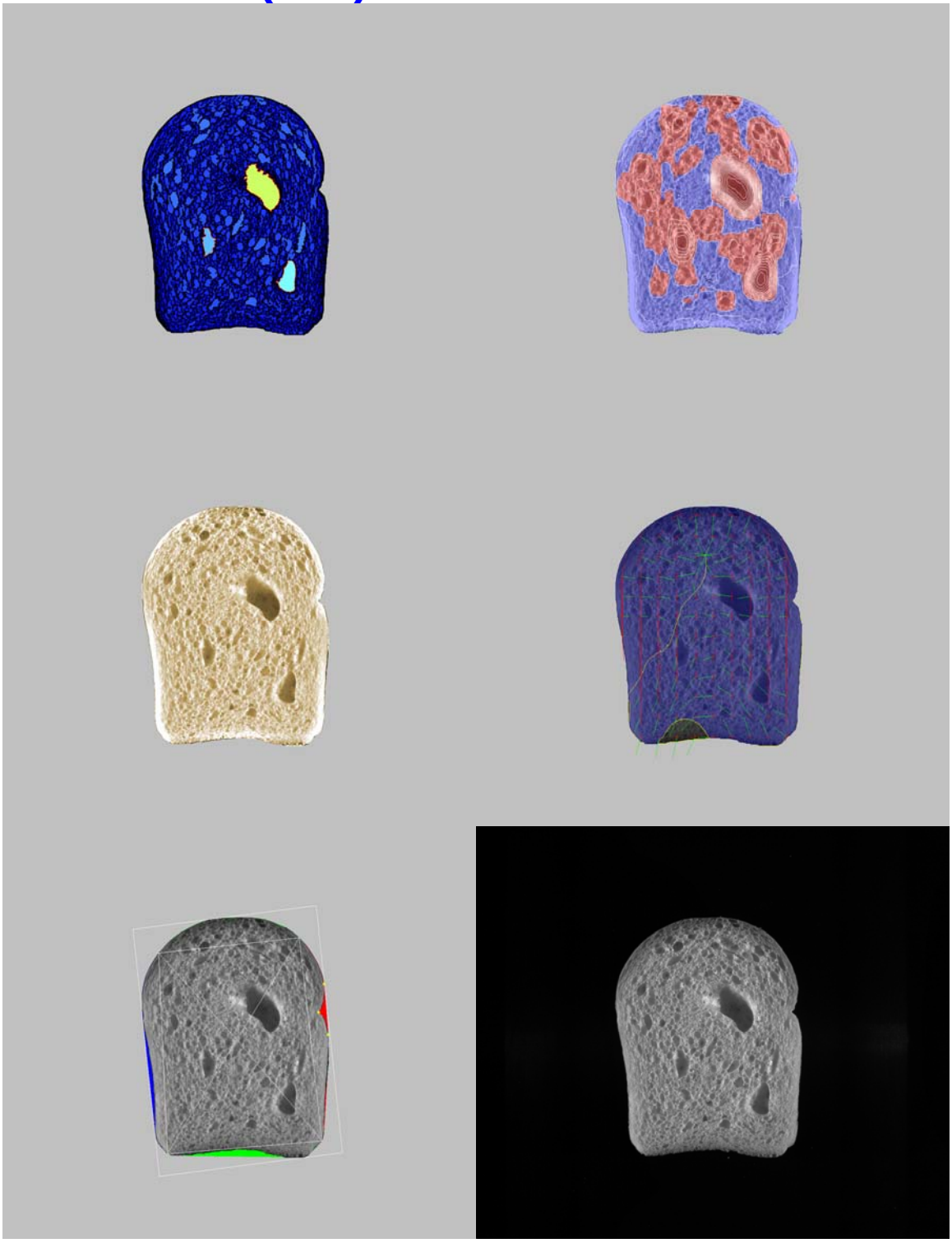

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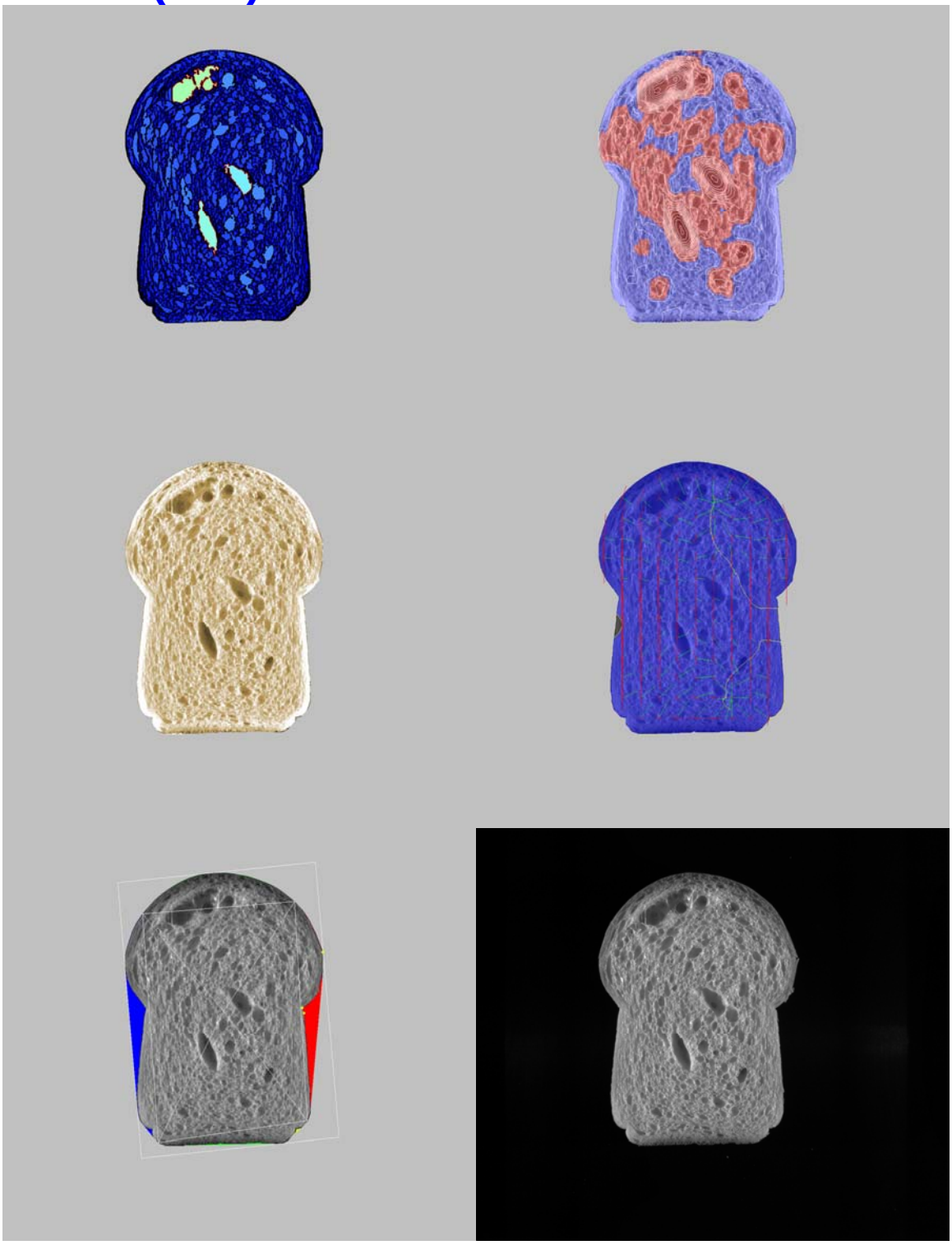
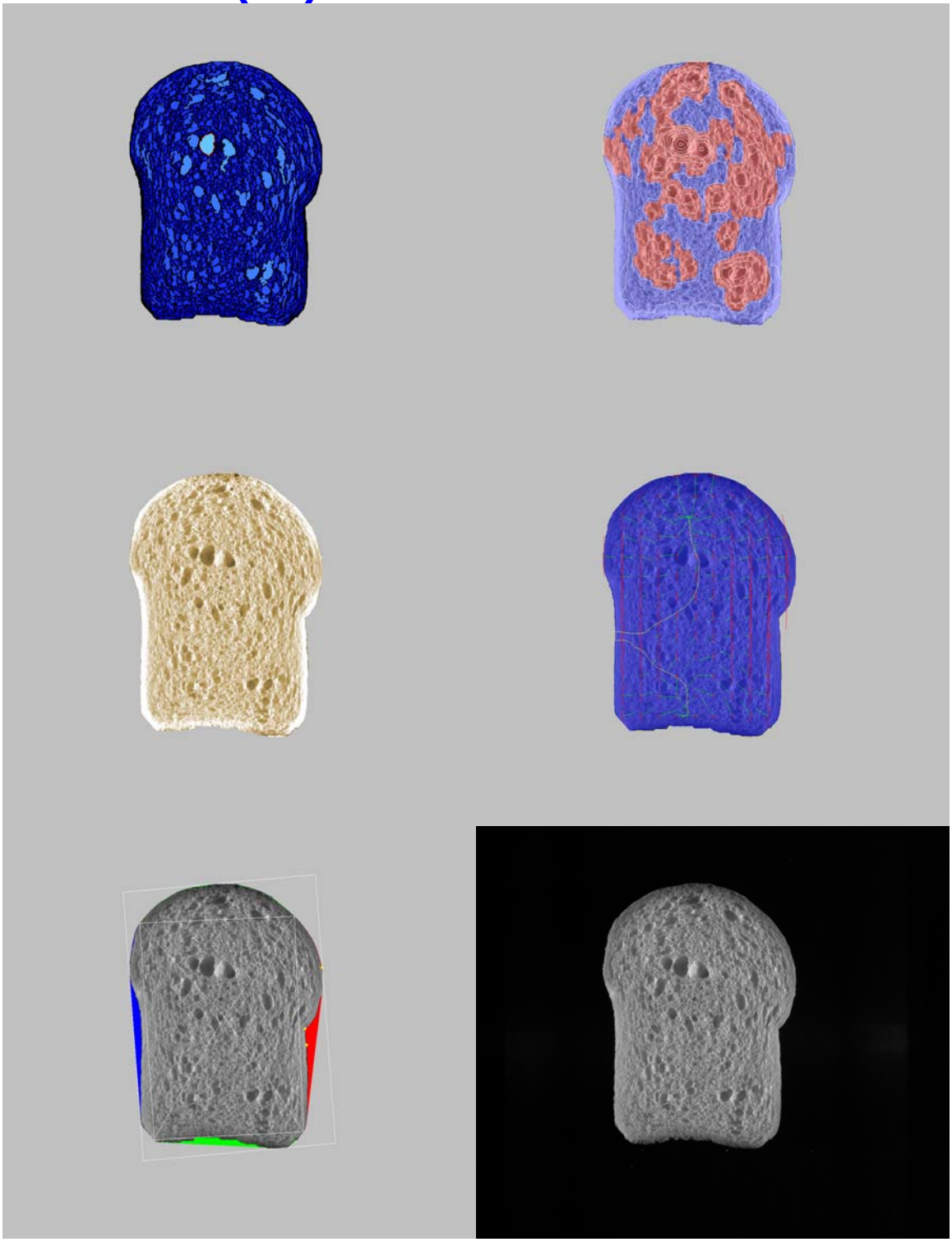


00S0291-3 (K1)



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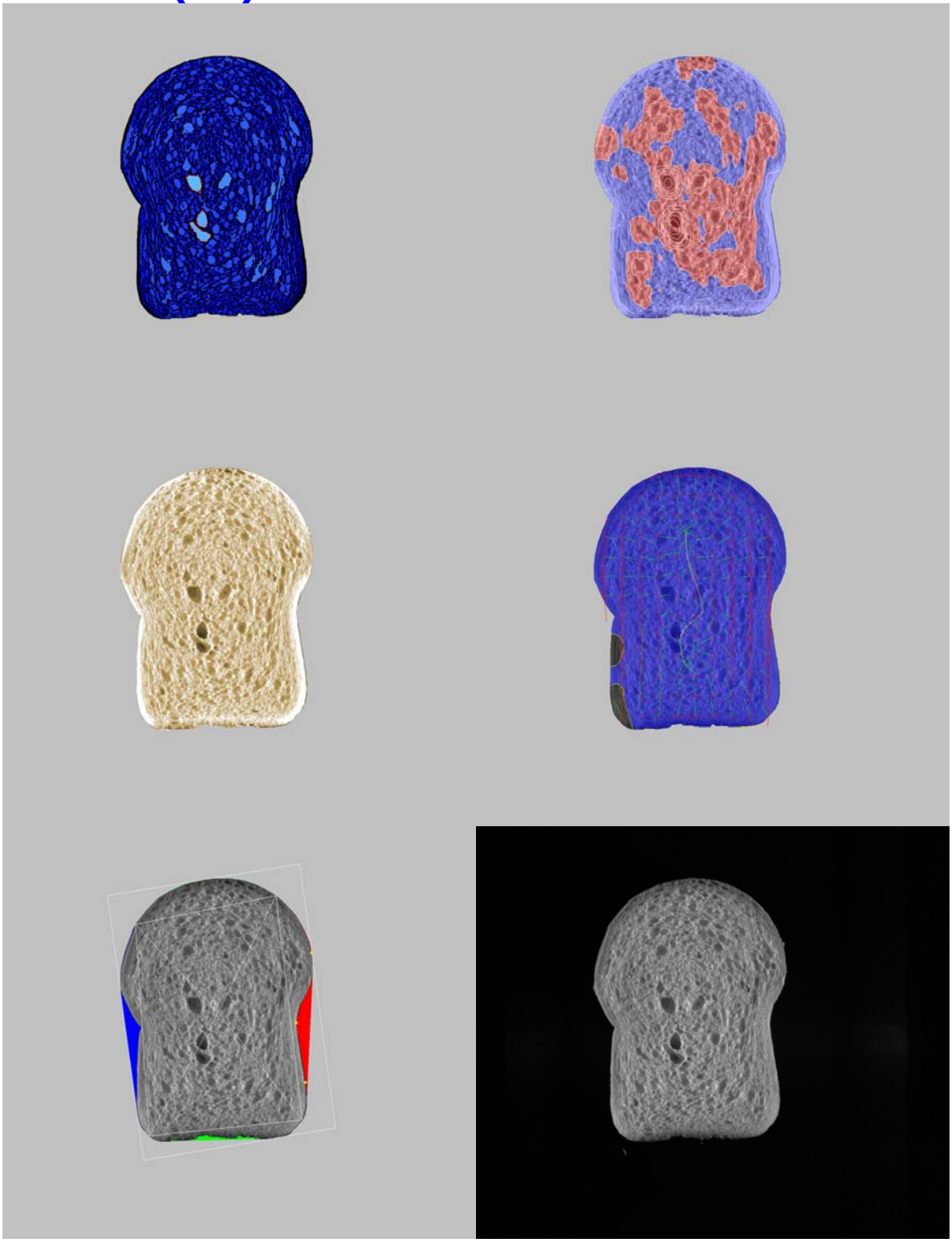

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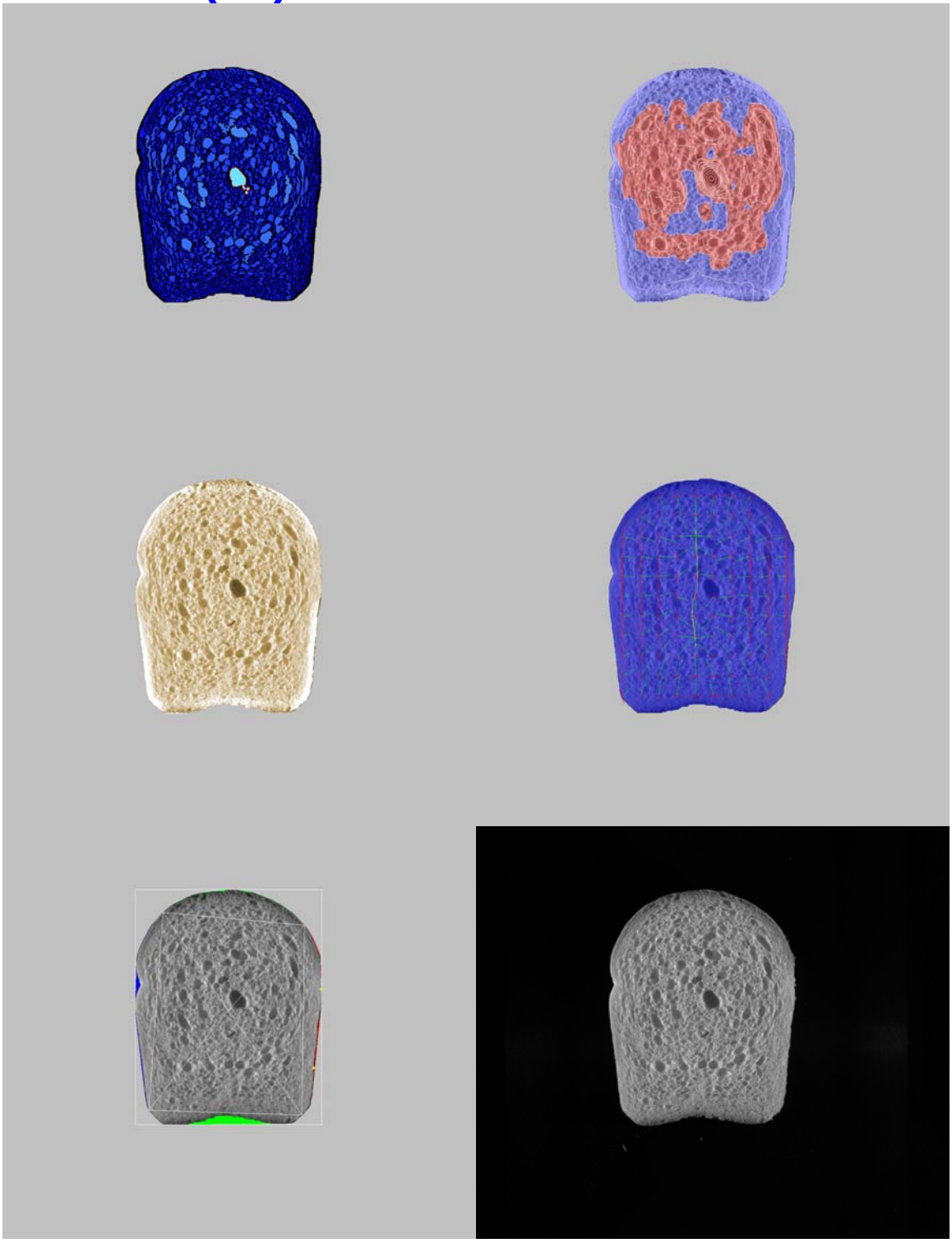
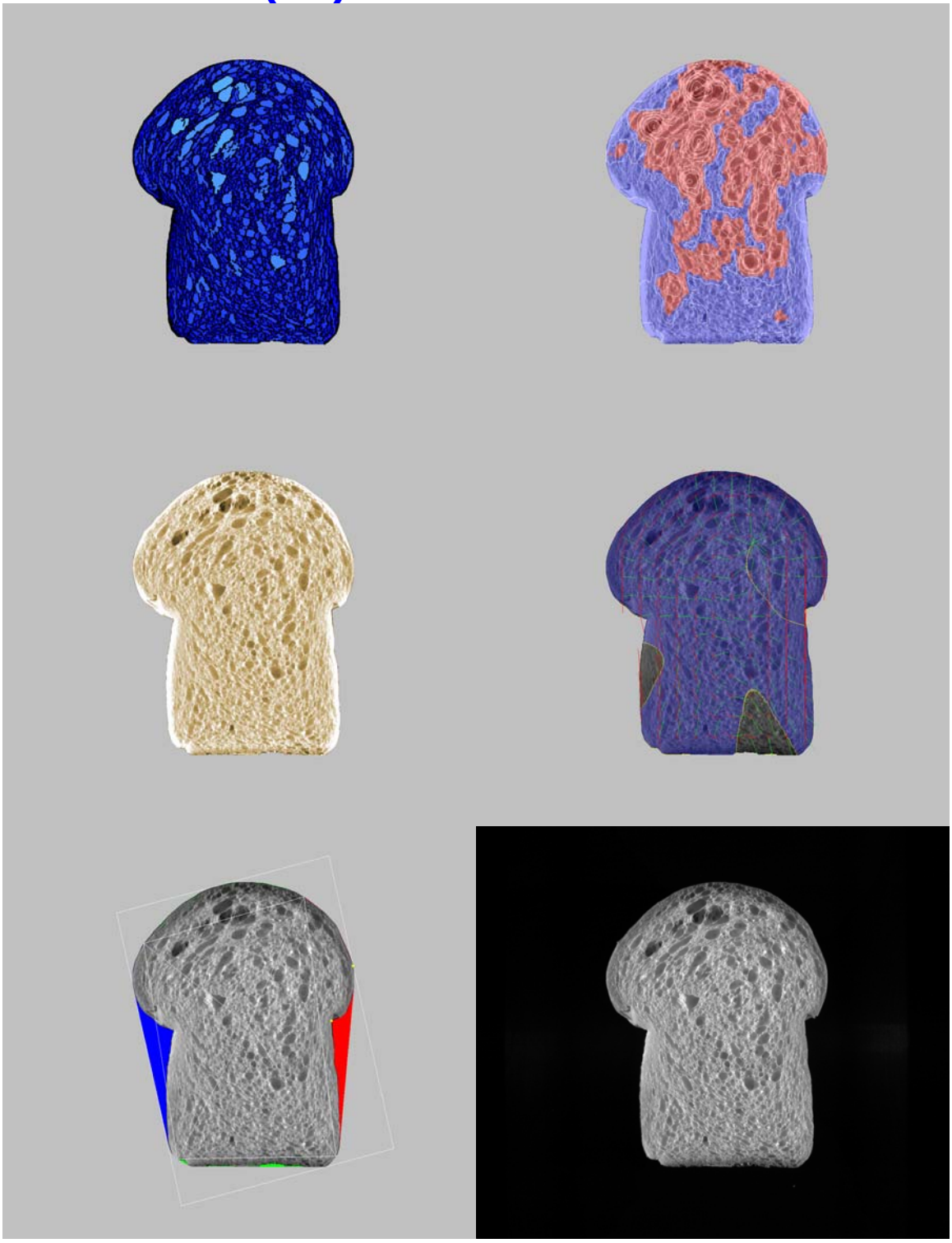


Glenn Check (K8)



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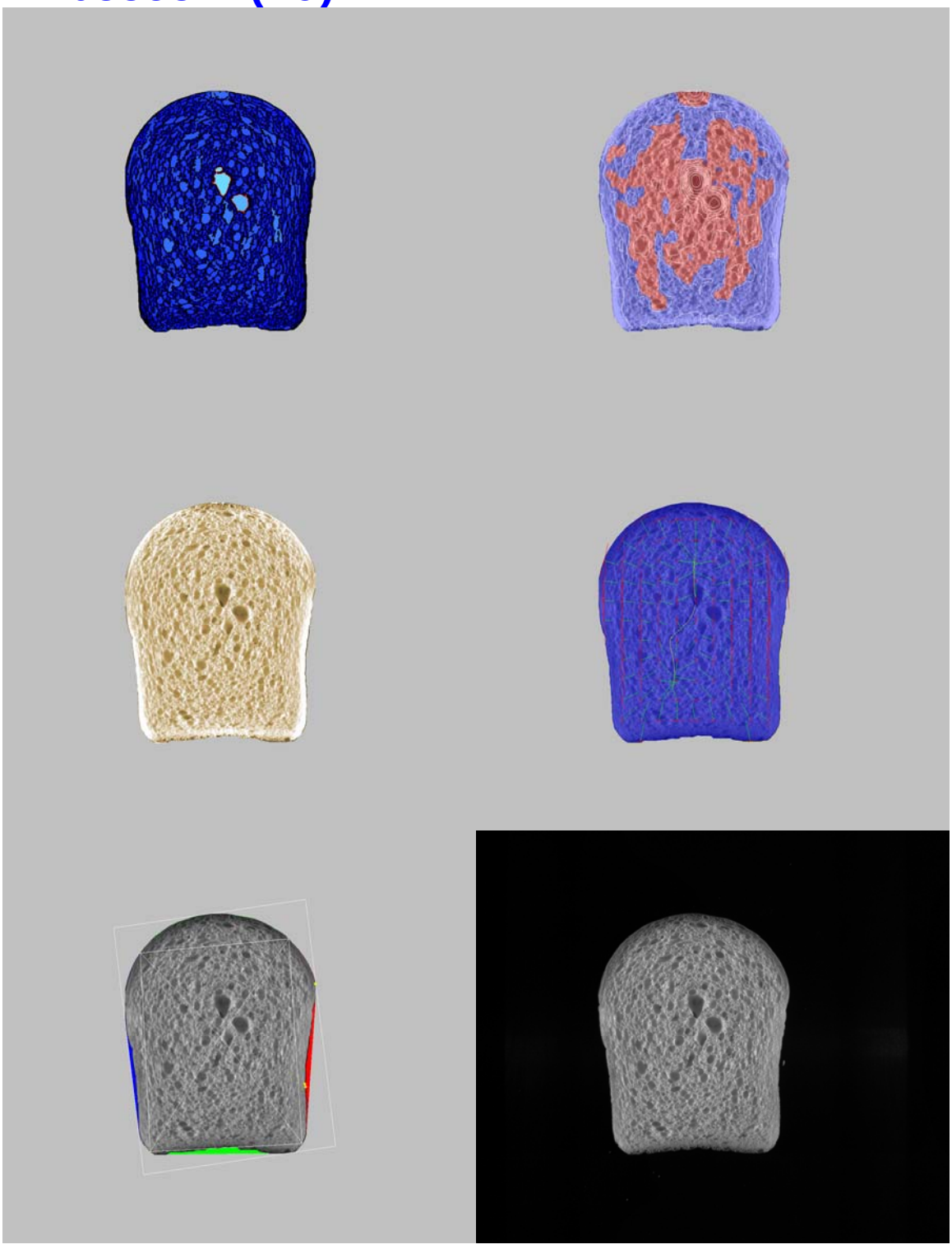

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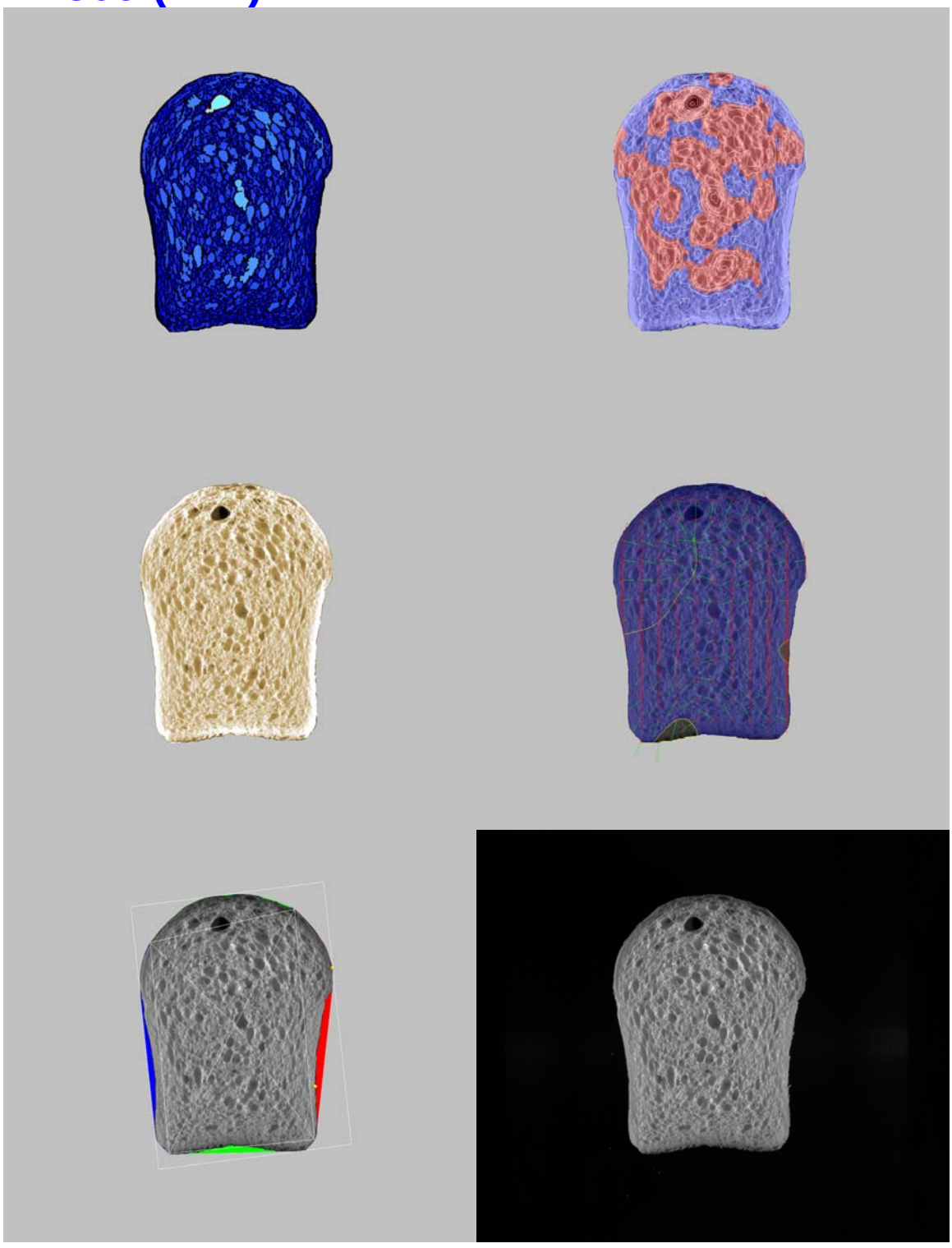

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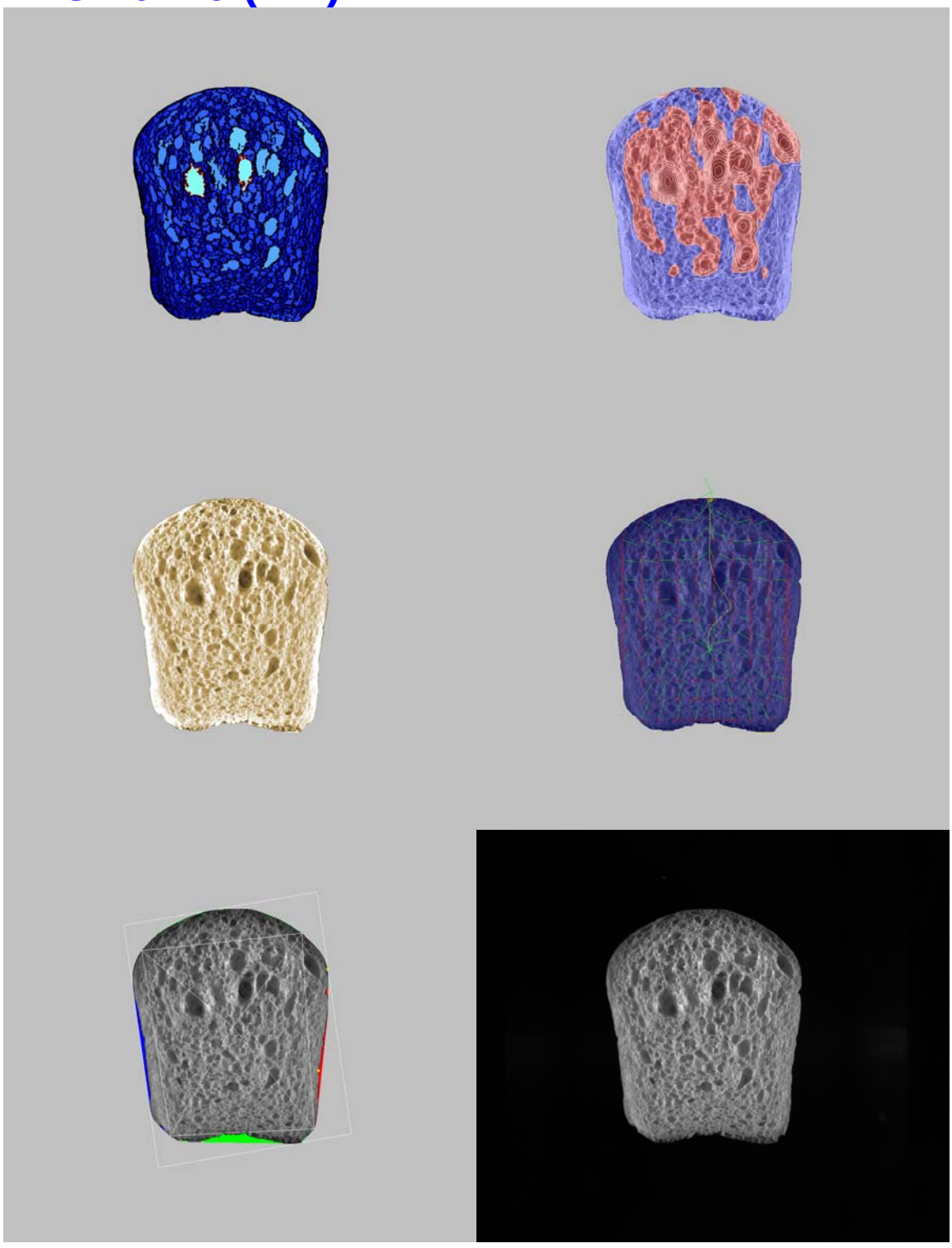

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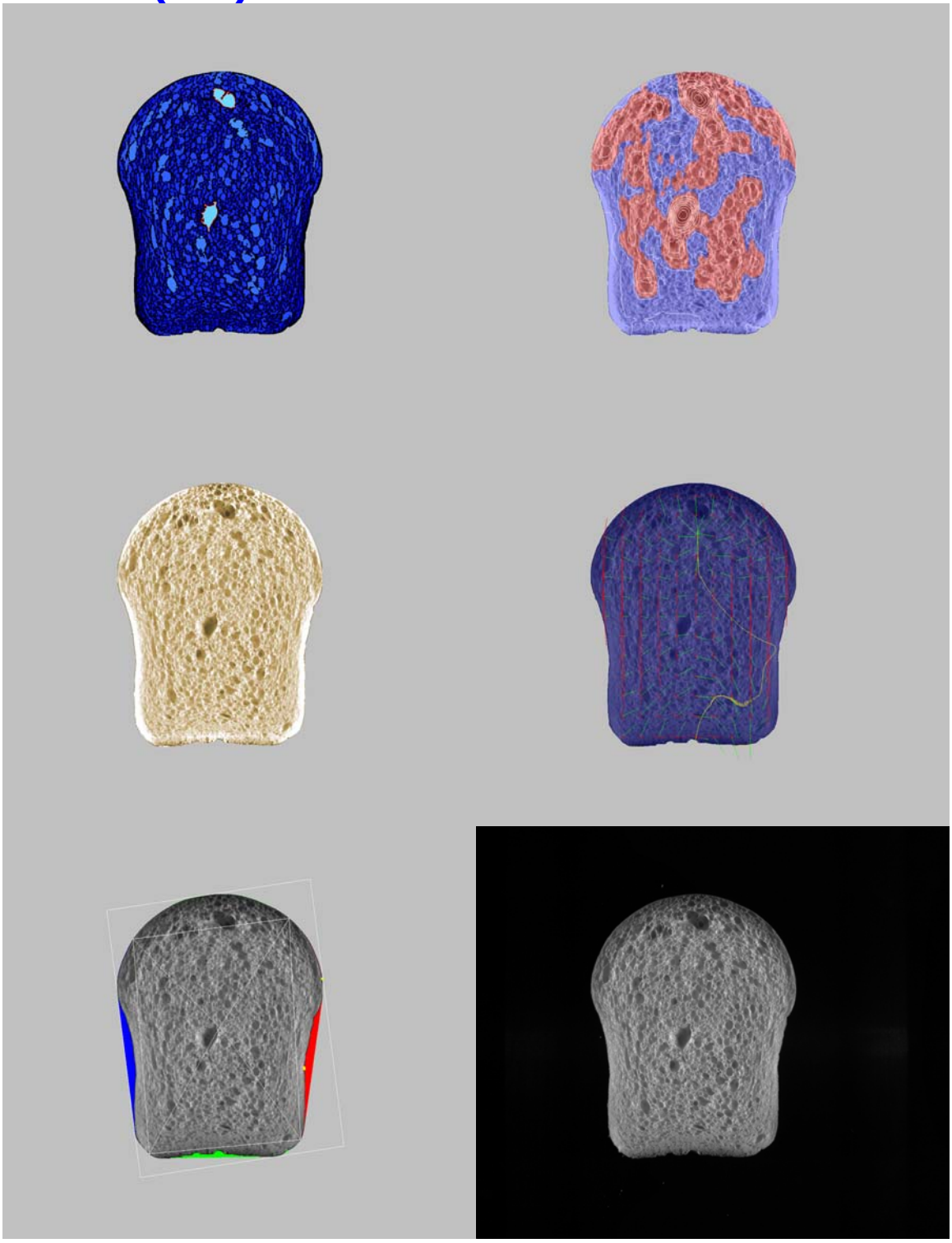
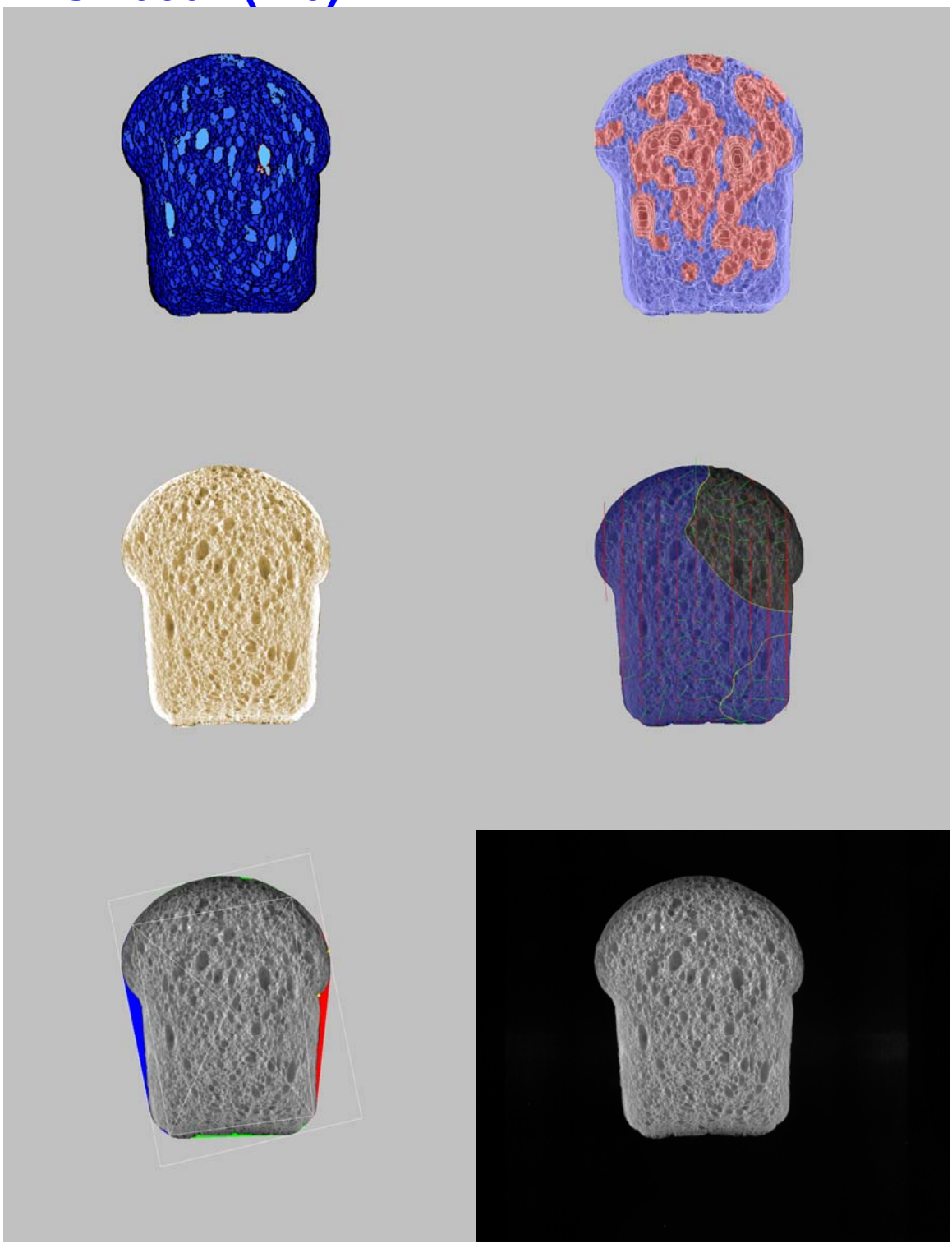
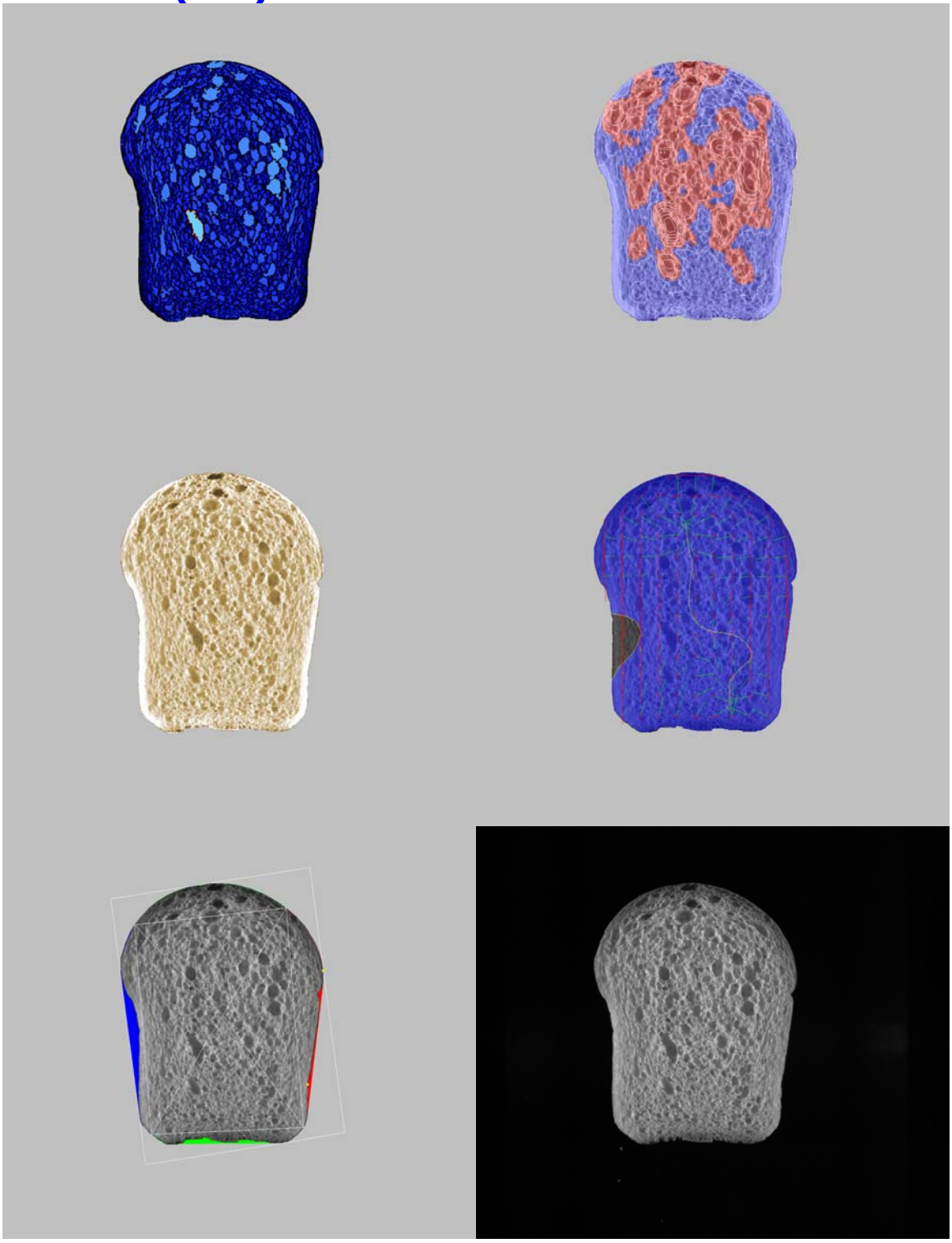


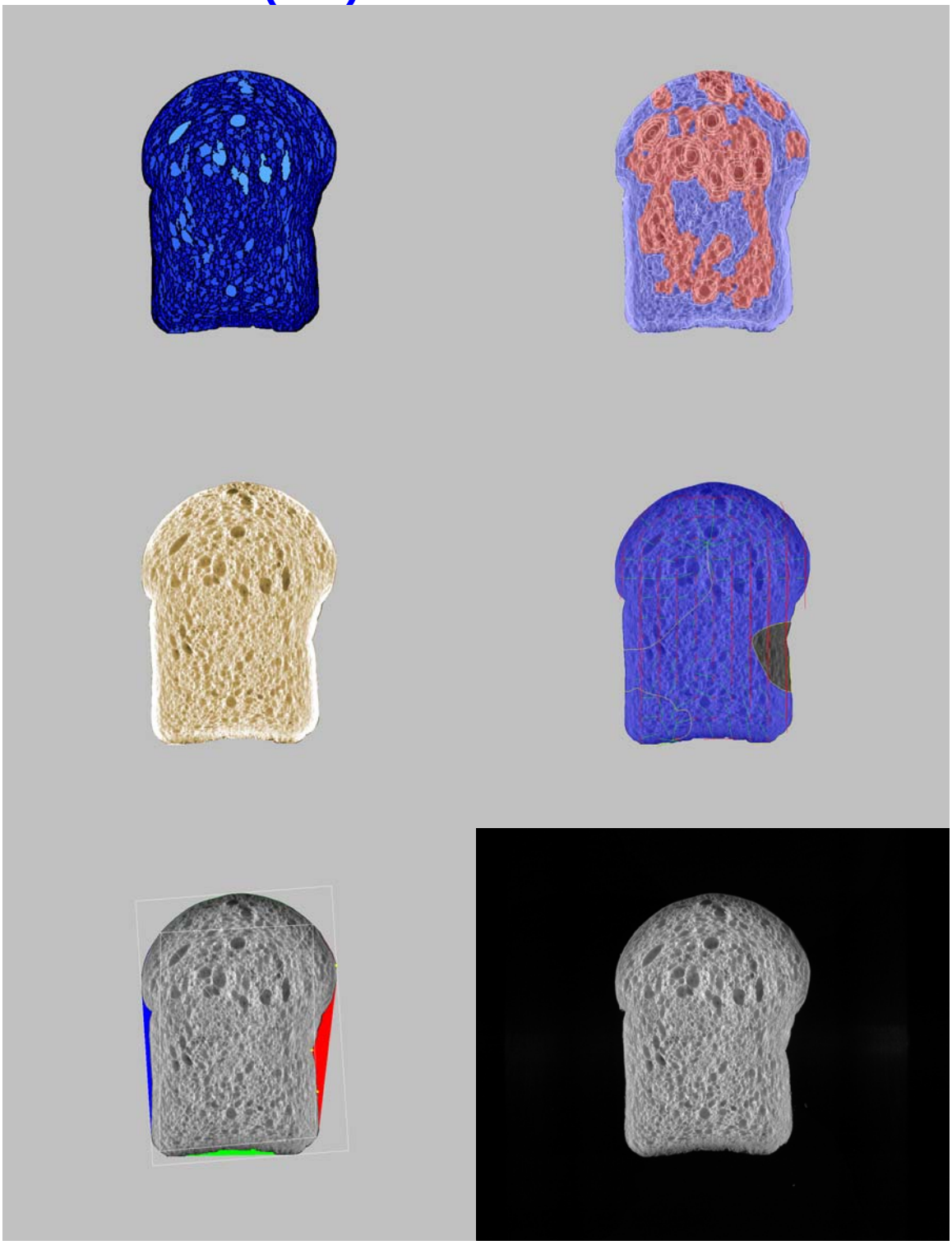
NDSW0601 (W6)



Samson (W7)



Glenn Check (W8)



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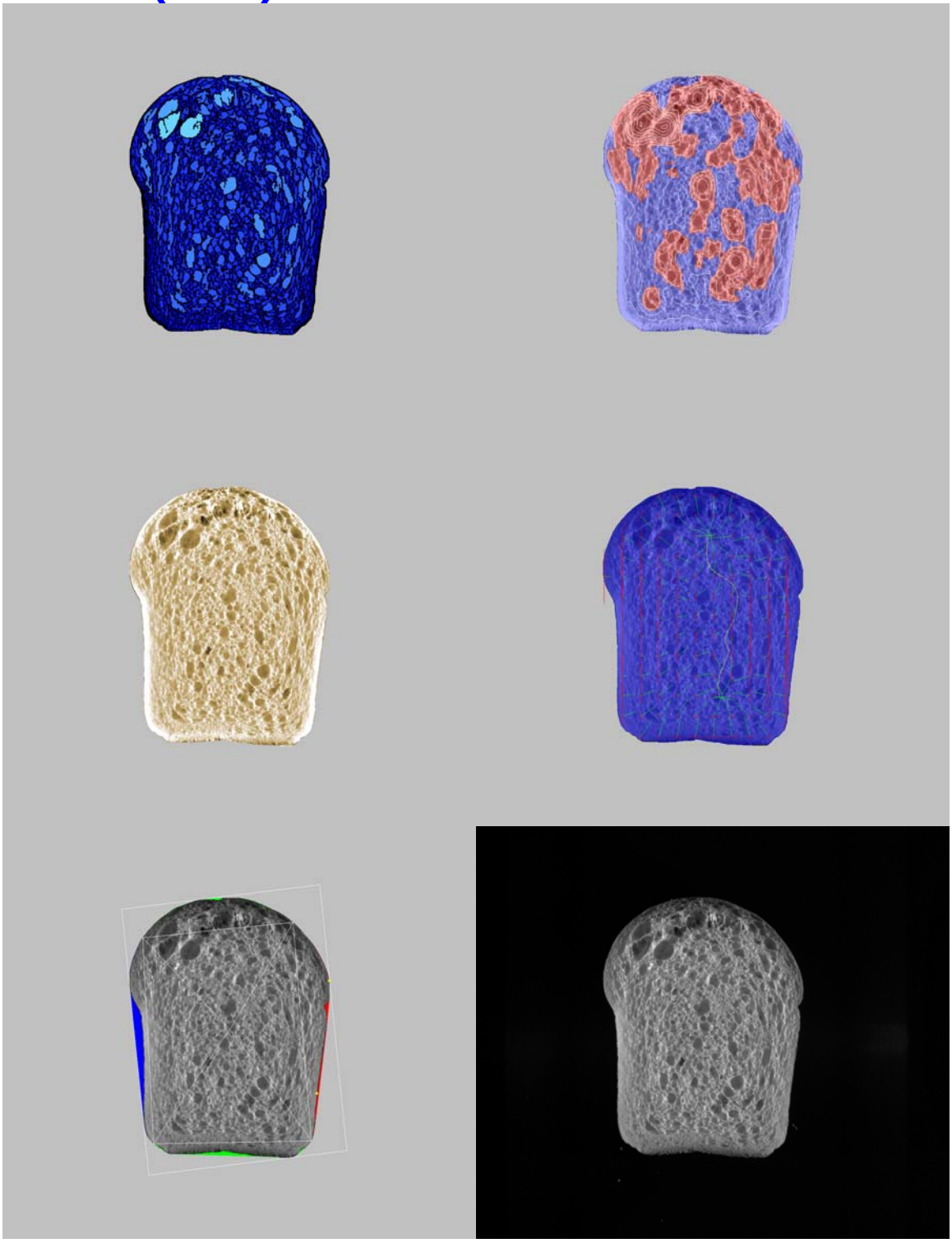
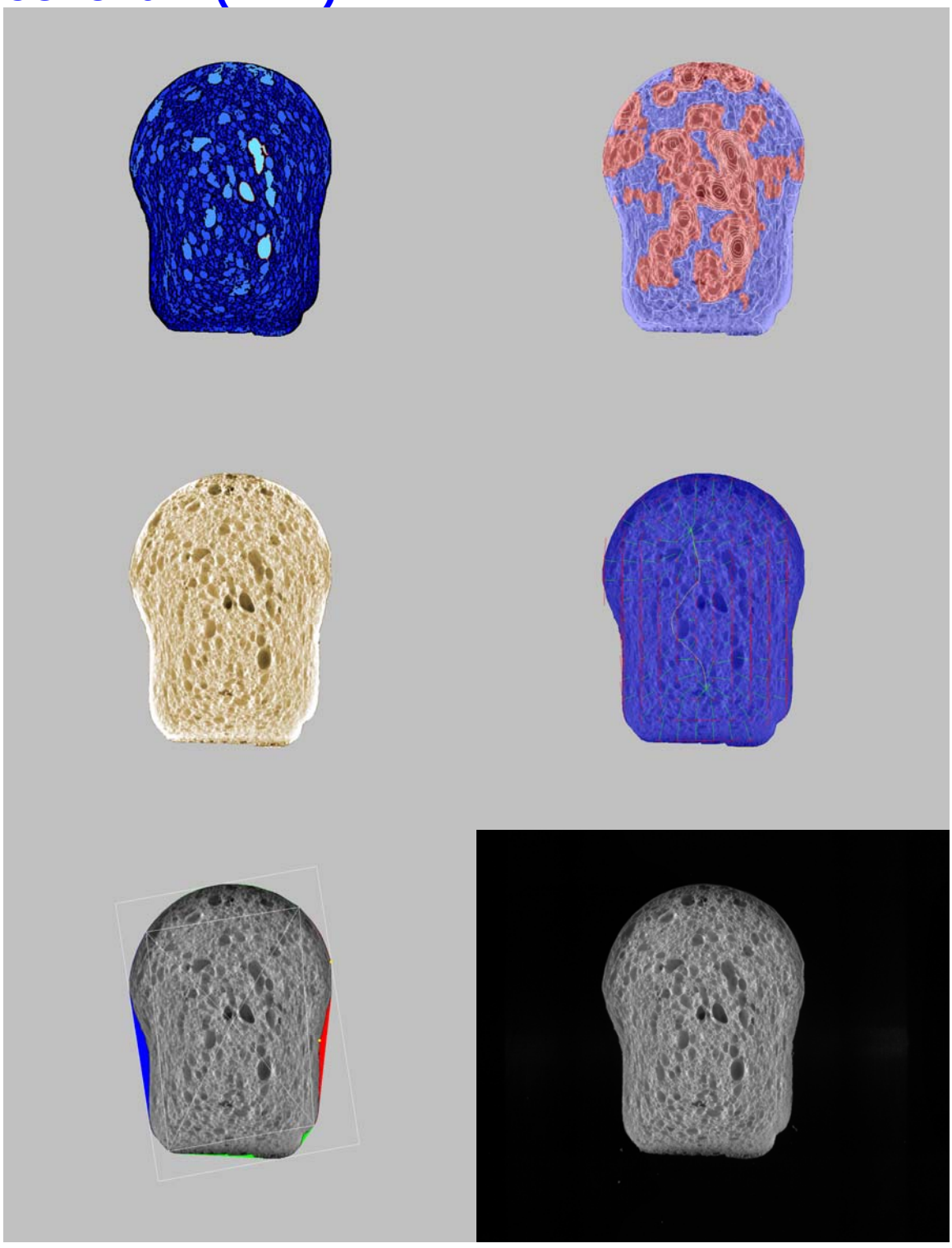


CO1320W (W12)



Glenn Check Evaluation (by Cooperator)

		2008 Hard Spring Wheat Crop				2007 Hard Spring Wheat Crop			
Brookings B8	Bake	Bake	Loaf	Mixing	Dough	Bake	Loaf	Mixing	Dough
Cooperator	Method	Absorption	Volume	Requirement	Characteristic	Absorption	Volume	Requirement	Characteristic
1	Sponge/Dough	58.0	2725	4	3	58.0	2850	5	5
2	Straight Dough	62.0	2900	3	4	60.7	2700	2	3
3	Sponge/Dough	62.0	967	4	5	61.0	887	2	4
4	Sponge/Dough	65.0	3015	5	5	63.0	3104	5	5
5	Straight Dough	65.9	2950	2	5	64.8	2925	2	3
6	Straight Dough	63.0	3000	3	3	62.0	2450	2	3
7	Straight Dough	63.9	915	4	3	61.3	870	4	4
8	Straight Dough	63.7	710	5	2	65.5	778	4	3
10	Straight Dough	64.4	835	3	4	65.8	725	3	5
Average		**63.1**		**3.7**	**3.8**	**62.5**		**3.2**	**3.9**
± 1 Std Dev		**2.3**		**1.0**	**1.1**	**2.6**		**1.3**	**0.9**

Casselton C8	Bake	Bake	Loaf	Mixing	Dough	Bake	Loaf	Mixing	Dough
Cooperator	Method	Absorption	Volume	Requirement	Characteristic	Absorption	Volume	Requirement	Characteristic
1	Sponge/Dough	59.0	2725	3	3	62.0	2975	5	5
2	Straight Dough	62.0	3150	4	5	62.9	3400	3	2
3	Sponge/Dough	64.0	975	4	3	64.0	998	4	4
4	Sponge/Dough	66.0	2956	5	5	63.0	2986	5	5
5	Straight Dough	68.0	2675	2	5	66.0	3075	3	3
6	Straight Dough	64.0	2750	3	3	64.0	2850	3	3
7	Straight Dough	65.5	950	3	3	62.5	1005	4	4
8	Straight Dough	64.7	915	3	4	67.2	918	5	3
10	Straight Dough	66.0	960	3	4	66.7	800	3	4
Average		**64.4**		**3.3**	**3.9**	**64.3**		**3.9**	**3.7**
± 1 Std Dev		**2.6**		**0.9**	**0.9**	**1.9**		**0.9**	**1.0**

Crookston K8	Bake	Bake	Loaf	Mixing	Dough	Bake	Loaf	Mixing	Dough
Cooperator	Method	Absorption	Volume	Requirement	Characteristic	Absorption	Volume	Requirement	Characteristic
1	Sponge/Dough	60.0	3000	4	4	61.0	3000	5	5
2	Straight Dough	60.0	2900	4	5	64.3	3350	3	3
3	Sponge/Dough	64.0	1075	4	4	62.0	923	3	4
4	Sponge/Dough	65.0	2986	5	5	66.0	2986	5	5
5	Straight Dough	66.3	3125	4	3	68.1	3300	3	4
6	Straight Dough	63.0	3000	4	4	64.0	2450	4	4
7	Straight Dough	63.6	1030	3	3	64.6	1045	3	4
8	Straight Dough	66.7	1020	2	2	69.8	983	4	5
10	Straight Dough	64.1	885	3	4	68.0	880	3	4
Average		**63.6**		**3.7**	**3.8**	**65.3**		**3.7**	**4.2**
± 1 Std Dev		**2.4**		**0.9**	**1.0**	**2.9**		**0.9**	**0.7**

Williston W8	Bake	Bake	Loaf	Mixing	Dough	Bake	Loaf	Mixing	Dough
Cooperator	Method	Absorption	Volume	Requirement	Characteristic	Absorption	Volume	Requirement	Characteristic
1	Sponge/Dough	62.0	2850	5	5	65.0	2925	5	5
2	Straight Dough	58.0	3050	4	5	65.2	3400	3	3
3	Sponge/Dough	64.0	1125	5	5	64.0	1008	4	4
4	Sponge/Dough	63.0	3162	5	5	65.0	3045	5	5
5	Straight Dough	65.1	2850	4	3	67.2	3200	4	3
6	Straight Dough	62.0	2950	5	4	65.0	2600	5	5
7	Straight Dough	63.0	1110	4	3	63.7	1150	3	3
8	Straight Dough	70.7	1130	3	4	70.0	1073	4	3
10	Straight Dough	63.0	825	3	4	65.6	890	3	4
Average		**63.4**		**4.2**	**4.2**	**65.6**		**4.0**	**3.9**
± 1 Std Dev		**3.4**		**0.8**	**0.8**	**1.9**		**0.9**	**0.9**

Bake Evaluation (by Cooperator)

00S0291-3 Crookston - K1 Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	59.0	2900	96.7	1	1	1	3	3	3	5	1	1
2	Straight Dough	60.0	3250	112.1	4	4	4	3	4	2	2	4	3
3	Sponge/Dough	63.0	938	87.3	2	2	1	3	3	2	3	2	1
4	Sponge/Dough	65.0	3104	104.0	3	3	2	2	3	2	3	2	2
5	Straight Dough	66.9	3025	96.8	1	2	2	3	3	3	2	3	3
6	Straight Dough	63.0	2700	90.0	2	2	2	3	3	2	4	3	3
7	Straight Dough	63.9	1010	98.1	2	3	1	3	5	2	4	3	2
8	Straight Dough	65.7	905	88.7	4	3	4	2	2	3	2	2	2
10	Straight Dough	64.2	800	90.4	3	3	2	2	3	3	3	2	3
Average		**63.4**		**96.0**	**2.4**	**2.6**	**2.1**	**2.7**	**3.2**	**2.4**	**3.1**	**2.4**	**2.2**
± 1 Std Dev		**2.6**		**8.1**	**1.1**	**0.9**	**1.2**	**0.5**	**0.8**	**0.5**	**1.1**	**0.9**	**0.8**

NDSW0449 Williston - W2							Factors Compared to Glenn Check						
Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	63.0	2800	98.3	5	5	3	3	1	3	4	3	3
2	Straight Dough	59.0	3350	109.8	4	4	4	4	4	4	3	4	4
3	Sponge/Dough	64.0	1022	90.8	3	4	2	3	2	1	2	1	1
4	Sponge/Dough	64.0	3104	98.2	5	5	4	2	4	4	3	4	3
5	Straight Dough	66.0	3075	107.9	3	4	2	2	3	4	2	4	4
6	Straight Dough	63.0	2750	93.2	4	4	3	4	4	4	3	4	4
7	Straight Dough	64.2	1035	93.2	2	3	1	2	3	4	3	2	2
8	Straight Dough	68.7	1165	103.1	4	4	5	3	2	2	2	2	2
10	Straight Dough	64.2	735	89.1	1	3	2	1	1	3	3	2	3
Average		**64.0**		**98.2**	**3.4**	**4.0**	**2.9**	**2.7**	**2.7**	**3.2**	**2.8**	**2.9**	**2.9**
± 1 Std Dev		**2.6**		**7.4**	**1.3**	**0.7**	**1.3**	**1.0**	**1.2**	**1.1**	**0.7**	**1.2**	**1.1**

SD3851
Brookings - B3

Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	57.0	2725	100.0	3	2	2	3	3	2	5	2	2
2	Straight Dough	59.0	2800	96.6	3	4	3	4	4	1	3	4	3
3	Sponge/Dough	60.0	882	91.2	5	5	3	3	4	2	4	2	2
4	Sponge/Dough	61.0	3104	103.0	5	5	3	2	3	1	3	2	2
5	Straight Dough	63.2	2500	84.7	2	4	2	2	5	2	3	1	2
6	Straight Dough	61.0	2900	96.7	2	3	2	3	4	2	4	5	4
7	Straight Dough	60.6	790	86.3	5	3	2	2	2	1	4	2	1
8	Straight Dough	65.7	785	110.6	4	2	3	3	4	4	4	4	4
10	Straight Dough	61.1	760	91.0	3	3	3	3	3	2	2	2	2
Average		**61.0**		**95.6**	**3.6**	**3.4**	**2.6**	**2.8**	**3.6**	**1.9**	**3.6**	**2.7**	**2.4**
± 1 Std Dev		**2.5**		**8.2**	**1.2**	**1.1**	**0.5**	**0.7**	**0.9**	**0.9**	**0.9**	**1.3**	**1.0**

SD3851
Casselton - C3

Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	59.0	2900	106.3	3	3	3	3	3	3	5	3	3
2	Straight Dough	60.0	3000	95.2	4	4	3	2	2	2	2	3	3
3	Sponge/Dough	63.0	938	96.2	3	3	2	3	4	2	3	2	2
4	Sponge/Dough	65.0	3074	104.0	5	5	3	2	4	2	4	4	4
5	Straight Dough	66.4	3025	113.1	2	3	3	2	3	3	2	4	4
6	Straight Dough	63.0	2750	100.0	3	2	2	4	4	2	4	3	3
7	Straight Dough	64.1	940	98.9	3	2	2	3	3	2	5	2	2
8	Straight Dough	61.7	825	90.2	3	1	2	3	2	2	4	2	2
10	Straight Dough	64.1	870	90.6	3	4	3	3	3	3	3	3	3
Average		**62.9**		**99.4**	**3.2**	**3.0**	**2.6**	**2.8**	**3.1**	**2.3**	**3.6**	**2.9**	**2.9**
± 1 Std Dev		**2.4**		**7.5**	**0.8**	**1.2**	**0.5**	**0.7**	**0.8**	**0.5**	**1.1**	**0.8**	**0.8**

SD3851
Crookston - K3

Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	59.0	2900	96.7	3	3	3	3	3	3	4	3	3
2	Straight Dough	58.0	2800	96.6	4	3	4	2	2	2	2	2	2
3	Sponge/Dough	62.0	985	91.6	3	4	2	3	4	2	3	2	2
4	Sponge/Dough	63.0	3104	104.0	5	5	3	2	4	2	3	3	3
5	Straight Dough	64.3	3050	97.6	2	2	2	4	4	3	2	3	3
6	Straight Dough	61.0	2950	98.3	3	2	3	4	4	2	4	4	4
7	Straight Dough	61.8	945	91.7	4	3	2	3	5	2	4	4	2
8	Straight Dough	61.7	900	88.2	3	3	3	2	2	2	3	2	2
10	Straight Dough	62.3	775	87.6	3	4	3	2	3	2	3	2	2
Average		**61.5**		**94.7**	**3.3**	**3.2**	**2.8**	**2.8**	**3.4**	**2.2**	**3.1**	**2.8**	**2.6**
± 1 Std Dev		**1.9**		**5.3**	**0.9**	**1.0**	**0.7**	**0.8**	**1.0**	**0.4**	**0.8**	**0.8**	**0.7**

ND806
Brookings - B4

Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	57.0	2800	102.8	5	5	4	3	3	2	5	3	3
2	Straight Dough	59.0	2850	98.3	3	4	3	4	4	2	2	4	2
3	Sponge/Dough	60.0	922	95.3	4	3	3	3	3	3	3	2	2
4	Sponge/Dough	61.0	3045	101.0	5	5	2	2	1	2	3	2	2
5	Straight Dough	63.2	2750	93.2	2	3	3	3	5	2	2	2	3
6	Straight Dough	61.0	2900	96.7	3	3	3	3	4	2	4	5	4
7	Straight Dough	61.0	840	91.8	5	3	2	3	3	2	4	2	2
8	Straight Dough	62.7	795	112.0	4	3	2	3	4	2	2	4	4
10	Straight Dough	61.5	800	95.8	3	3	3	3	3	3	2	3	3
Average		**60.7**		**98.5**	**3.8**	**3.6**	**2.8**	**3.0**	**3.3**	**2.2**	**3.0**	**3.0**	**2.8**
± 1 Std Dev		**1.9**		**6.1**	**1.1**	**0.9**	**0.7**	**0.5**	**1.1**	**0.4**	**1.1**	**1.1**	**0.8**

ND806
Casselton - C4

Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	57.0	2700	99.0	3	2	3	2	1	2	5	2	1
2	Straight Dough	54.0	3100	98.4	2	1	1	3	1	1	3	2	2
3	Sponge/Dough	60.0	918	94.2	2	2	2	3	2	2	1	1	1
4	Sponge/Dough	59.0	3104	105.0	3	3	2	2	3	1	3	2	2
5	Straight Dough	61.0	2800	104.7	1	2	2	3	3	1	2	4	4
6	Straight Dough	59.0	2350	85.5	2	2	2	2	2	2	4	2	2
7	Straight Dough	58.3	870	91.6	3	2	1	3	5	1	4	2	2
8	Straight Dough	61.7	930	101.6	2	1	2	2	2	2	4	2	3
10	Straight Dough	58.3	660	68.8	2	3	2	2	4	2	2	1	2
Average		**58.7**		**94.3**	**2.2**	**2.0**	**1.9**	**2.4**	**2.6**	**1.6**	**3.1**	**2.0**	**2.1**
± 1 Std Dev		**2.3**		**11.5**	**0.7**	**0.7**	**0.6**	**0.5**	**1.3**	**0.5**	**1.3**	**0.9**	**0.9**

ND806
Williston - W4

Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	63.0	2800	98.3	5	5	3	3	1	3	4	3	3
2	Straight Dough	58.0	3400	111.5	4	4	4	3	2	4	2	3	3
3	Sponge/Dough	64.0	1066	94.8	4	4	2	3	3	3	2	3	3
4	Sponge/Dough	63.0	3045	96.3	5	5	3	3	4	4	3	4	3
5	Straight Dough	65.0	3000	105.3	3	2	2	3	2	3	2	4	4
6	Straight Dough	63.0	2400	81.4	4	4	3	2	3	4	3	3	3
7	Straight Dough	63.2	1105	99.5	4	3	1	3	3	3	3	3	3
8	Straight Dough	71.7	1270	112.4	4	5	3	3	2	3	2	2	2
10	Straight Dough	63.2	820	99.4	3	4	3	2	3	3	3	3	3
Average		**63.8**		**99.9**	**4.0**	**4.0**	**2.7**	**2.8**	**2.6**	**3.3**	**2.7**	**3.1**	**3.0**
± 1 Std Dev		**3.5**		**9.4**	**0.7**	**1.0**	**0.9**	**0.4**	**0.9**	**0.5**	**0.7**	**0.6**	**0.5**

06MSP18 Brookings - B5

Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	56.0	2900	106.4	3	2	2	3	3	2	5	2	2
2	Straight Dough	54.0	2800	96.6	3	4	2	4	4	1	4	4	4
3	Sponge/Dough	60.0	920	95.1	2	3	2	3	3	2	3	1	2
4	Sponge/Dough	59.0	3045	101.0	4	4	2	2	1	1	2	2	1
5	Straight Dough	59.9	2950	100.0	3	5	2	3	5	2	3	3	4
6	Straight Dough	58.0	2200	73.3	2	3	2	3	3	1	3	3	3
7	Straight Dough	57.3	855	93.4	4	3	2	2	2	1	4	2	1
8	Straight Dough	67.7	825	116.2	4	3	3	3	4	5	5	4	4
10	Straight Dough	57.8	685	82.0	3	3	3	3	4	2	2	2	2
Average		**58.9**		**96.0**	**3.1**	**3.3**	**2.2**	**2.9**	**3.2**	**1.9**	**3.4**	**2.6**	**2.6**
± 1 Std Dev		**3.8**		**12.6**	**0.8**	**0.9**	**0.4**	**0.6**	**1.2**	**1.3**	**1.1**	**1.0**	**1.2**

06MSP18 Casselton -C5

Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	59.0	3000	110.0	3	3	3	3	1	3	4	3	3
2	Straight Dough	60.0	3300	104.8	3	5	4	3	2	3	2	4	3
3	Sponge/Dough	63.0	908	93.1	2	2	2	3	2	2	3	2	2
4	Sponge/Dough	64.0	2986	101.0	4	3	2	2	4	2	3	2	2
5	Straight Dough	65.9	2750	102.8	2	3	3	2	3	3	1	3	3
6	Straight Dough	63.0	2550	92.7	3	3	3	3	3	2	4	3	2
7	Straight Dough	63.7	975	102.6	3	2	3	3	5	3	3	4	3
8	Straight Dough	60.7	955	104.4	2	3	2	2	3	2	2	4	4
10	Straight Dough	63.7	670	69.8	1	2	3	2	4	3	3	1	2
Average		**62.6**		**97.9**	**2.6**	**2.9**	**2.8**	**2.6**	**3.0**	**2.6**	**2.8**	**2.9**	**2.7**
± 1 Std Dev		**2.2**		**11.9**	**0.9**	**0.9**	**0.7**	**0.5**	**1.2**	**0.5**	**1.0**	**1.1**	**0.7**

06MSP18 Crookston - K5

Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	57.0	2600	86.7	3	2	2	2	2	2	4	2	2
2	Straight Dough	54.0	3200	110.3	3	4	4	2	4	1	4	3	3
3	Sponge/Dough	60.0	920	85.6	1	1	1	2	2	1	1	1	1
4	Sponge/Dough	59.0	2956	99.0	4	3	2	1	2	1	3	2	2
5	Straight Dough	59.6	2725	87.2	1	4	2	4	3	2	3	2	2
6	Straight Dough	58.0	2450	81.7	2	2	2	2	2	1	4	1	2
7	Straight Dough	57.4	860	83.5	3	2	1	3	5	1	4	2	1
8	Straight Dough	66.7	1005	98.5	4	4	5	2	2	4	2	2	2
10	Straight Dough	58.4	690	78.0	3	3	2	2	3	2	2	1	2
Average		**58.9**		**90.1**	**2.7**	**2.8**	**2.3**	**2.2**	**2.8**	**1.7**	**3.0**	**1.8**	**1.9**
± 1 Std Dev		**3.4**		**10.4**	**1.1**	**1.1**	**1.3**	**0.8**	**1.1**	**1.0**	**1.1**	**0.7**	**0.6**

NDSW0601
Casselton - C6

Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	58.0	2750	100.8	2	2	2	3	1	3	5	2	3
2	Straight Dough	60.0	3350	106.3	3	4	3	2	4	2	1	4	2
3	Sponge/Dough	61.0	930	95.4	1	1	1	2	1	1	3	1	1
4	Sponge/Dough	64.0	2780	94.0	3	3	2	1	2	1	2	2	2
5	Straight Dough	65.7	2750	102.8	3	2	4	2	4	3	1	3	3
6	Straight Dough	62.0	2250	81.8	3	3	3	2	2	2	4	2	2
7	Straight Dough	63.0	1075	113.2	3	2	4	2	4	2	4	3	2
8	Straight Dough	61.7	995	108.7	3	4	3	2	3	2	2	4	4
10	Straight Dough	63.0	765	79.7	2	3	3	2	4	2	2	2	2
Average		**62.0**		**98.1**	**2.6**	**2.7**	**2.8**	**2.0**	**2.8**	**2.0**	**2.7**	**2.6**	**2.3**
± 1 Std Dev		**2.3**		**11.5**	**0.7**	**1.0**	**1.0**	**0.5**	**1.3**	**0.7**	**1.4**	**1.0**	**0.9**

NDSW0601
Williston - W6

Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	64.0	2750	96.5	5	5	3	3	1	3	5	3	3
2	Straight Dough	60.0	3300	108.2	5	5	3	3	4	5	1	4	4
3	Sponge/Dough	64.0	1057	94.0	3	3	2	3	2	2	4	2	2
4	Sponge/Dough	66.0	3162	100.0	5	5	4	2	3	4	3	3	3
5	Straight Dough	69.4	3175	111.4	4	3	3	3	2	4	1	4	4
6	Straight Dough	65.0	2800	94.9	5	5	4	4	3	5	3	5	5
7	Straight Dough	67.7	1115	100.5	3	4	2	2	2	5	3	2	2
8	Straight Dough	71.7	1250	110.6	5	4	5	2	2	2	2	2	2
10	Straight Dough	67.7	835	101.2	3	4	3	2	3	3	3	3	3
Average		**66.2**		**101.9**	**4.2**	**4.2**	**3.2**	**2.7**	**2.4**	**3.7**	**2.8**	**3.1**	**3.1**
± 1 Std Dev		**3.4**		**6.6**	**1.0**	**0.8**	**1.0**	**0.7**	**0.9**	**1.2**	**1.3**	**1.1**	**1.1**

Samson Casselton - C7

Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	59.0	2900	106.3	2	3	3	3	1	3	5	3	3
2	Straight Dough	58.0	3150	100.0	3	4	3	1	3	2	2	2	2
3	Sponge/Dough	62.0	1003	102.9	3	3	4	3	4	4	2	4	5
4	Sponge/Dough	63.0	3162	107.0	5	5	3	1	4	1	2	3	2
5	Straight Dough	64.4	2875	107.5	2	3	3	2	3	3	1	4	4
6	Straight Dough	62.0	2900	105.5	2	2	2	5	5	2	4	5	4
7	Straight Dough	62.4	1010	106.3	3	2	2	2	4	2	5	2	2
8	Straight Dough	68.7	980	107.1	3	4	3	2	2	4	3	2	2
10	Straight Dough	62.4	760	79.2	2	3	3	2	4	2	2	2	2
Average		**62.4**		**102.4**	**2.8**	**3.2**	**2.9**	**2.3**	**3.3**	**2.6**	**2.9**	**3.0**	**2.9**
± 1 Std Dev		**3.1**		**9.0**	**1.0**	**1.0**	**0.6**	**1.2**	**1.2**	**1.0**	**1.5**	**1.1**	**1.2**

Samson Williston - W7

Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	63.0	2850	100.0	5	5	3	2	1	3	5	3	3
2	Straight Dough	57.0	3350	109.8	5	4	4	2	3	4	2	2	2
3	Sponge/Dough	64.0	1135	100.9	5	5	3	3	3	4	3	4	4
4	Sponge/Dough	61.0	3133	99.1	5	5	3	1	2	4	3	2	2
5	Straight Dough	63.4	2850	100.0	5	1	4	3	3	4	2	3	3
6	Straight Dough	61.0	2700	91.5	5	5	4	3	4	4	3	5	5
7	Straight Dough	61.7	1165	105.0	5	3	3	2	2	4	3	3	2
8	Straight Dough	70.2	1150	101.8	5	4	5	3	2	2	2	2	2
10	Straight Dough	61.8	820	99.4	3	4	3	1	3	3	3	3	3
Average		**62.6**		**100.8**	**4.8**	**4.0**	**3.6**	**2.2**	**2.6**	**3.6**	**2.9**	**3.0**	**2.9**
± 1 Std Dev		**3.5**		**4.9**	**0.7**	**1.3**	**0.7**	**0.8**	**0.9**	**0.7**	**0.9**	**1.0**	**1.1**

MN03358-4 Casselton - C9							Factors Compared to Glenn Check						
Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	59.0	2800	102.7	3	3	3	3	1	3	3	3	3
2	Straight Dough	61.0	3300	104.8	4	5	4	3	3	3	1	2	3
3	Sponge/Dough	63.0	937	96.1	4	4	3	3	1	3	3	2	1
4	Sponge/Dough	66.0	3104	105.0	5	5	3	3	2	3	2	3	3
5	Straight Dough	67.9	2525	94.4	2	5	3	1	3	4	1	3	3
6	Straight Dough	64.0	2650	96.4	2	3	3	5	5	2	3	4	3
7	Straight Dough	66.1	940	98.9	3	3	1	3	4	3	3	3	3
8	Straight Dough	66.2	945	103.3	2	3	2	3	2	4	2	2	2
10	Straight Dough	66.6	785	81.8	2	3	2	3	4	3	3	2	3
Average		**64.4**		**98.2**	**3.0**	**3.8**	**2.7**	**3.0**	**2.8**	**3.1**	**2.3**	**2.7**	**2.7**
± 1 Std Dev		**2.9**		**7.3**	**1.1**	**1.0**	**0.9**	**1.0**	**1.4**	**0.6**	**0.9**	**0.7**	**0.7**

MN03358-4 Crookston - K9							Factors Compared to Glenn Check						
Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	59.0	2825	94.2	5	5	3	3	3	3	2	3	3
2	Straight Dough	59.0	3000	103.4	3	5	3	3	5	2	2	4	3
3	Sponge/Dough	63.0	952	88.6	4	4	3	3	2	3	2	3	3
4	Sponge/Dough	65.0	3162	105.9	5	5	3	2	3	2	2	3	3
5	Straight Dough	67.1	2600	83.2	2	1	2	4	4	3	2	2	2
6	Straight Dough	64.0	3000	100.0	2	2	2	3	3	2	2	3	4
7	Straight Dough	65.4	905	87.9	4	4	1	3	3	2	2	2	2
8	Straight Dough	66.7	845	82.8	4	4	4	2	2	4	2	2	2
10	Straight Dough	65.9	720	81.4	3	3	2	2	2	3	3	2	3
Average		**63.9**		**91.9**	**3.6**	**3.7**	**2.6**	**2.8**	**3.0**	**2.7**	**2.1**	**2.7**	**2.8**
± 1 Std Dev		**3.0**		**9.3**	**1.1**	**1.4**	**0.9**	**0.7**	**1.0**	**0.7**	**0.3**	**0.7**	**0.7**

01S0042-10 Brookings - B10							Factors Compared to Glenn Check						
Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	58.0	3000	110.1	5	5	4	3	3	3	4	3	3
2	Straight Dough	60.0	2800	96.6	2	3	4	3	3	3	2	3	2
3	Sponge/Dough	61.0	962	99.5	2	3	2	3	3	2	2	1	1
4	Sponge/Dough	63.0	3104	103.0	5	5	3	1	1	2	3	3	3
5	Straight Dough	65.3	2700	91.5	2	5	3	3	4	3	3	2	3
6	Straight Dough	62.0	2500	83.3	3	3	3	3	3	3	3	3	3
7	Straight Dough	62.7	885	96.7	4	3	2	2	2	3	3	2	2
8	Straight Dough	64.7	800	112.7	4	5	3	3	4	4	4	4	5
10	Straight Dough	62.7	720	86.2	3	4	3	2	3	3	3	2	3
Average		**62.2**		**97.7**	**3.3**	**4.0**	**3.0**	**2.6**	**2.9**	**2.9**	**3.0**	**2.6**	**2.8**
± 1 Std Dev		**2.3**		**9.9**	**1.2**	**1.0**	**0.7**	**0.7**	**0.9**	**0.6**	**0.7**	**0.9**	**1.1**

01S0042-10 Casselton - C10							Factors Compared to Glenn Check						
Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	59.0	2825	103.7	3	3	3	3	1	3	4	3	3
2	Straight Dough	60.0	3150	100.0	3	4	2	2	3	2	2	3	3
3	Sponge/Dough	63.0	935	95.9	4	3	3	3	3	3	2	3	2
4	Sponge/Dough	66.0	3074	104.0	5	5	3	1	2	2	3	2	2
5	Straight Dough	67.4	2425	90.7	2	1	3	1	2	4	3	2	2
6	Straight Dough	64.0	2700	98.2	3	3	3	4	4	3	4	4	3
7	Straight Dough	64.6	975	102.6	3	2	2	2	4	2	4	3	2
8	Straight Dough	65.7	975	106.6	2	2	2	2	2	3	4	2	3
10	Straight Dough	64.6	750	78.1	2	3	3	2	4	3	3	2	3
Average		**63.8**		**97.7**	**3.0**	**2.9**	**2.7**	**2.2**	**2.8**	**2.8**	**3.2**	**2.7**	**2.6**
± 1 Std Dev		**2.8**		**8.8**	**1.0**	**1.2**	**0.5**	**1.0**	**1.1**	**0.7**	**0.8**	**0.7**	**0.5**

ND809
Casselton - C11

Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	59.0	2900	106.3	2	2	2	3	1	3	4	2	3
2	Straight Dough	62.0	3050	96.8	3	4	2	2	2	2	2	2	3
3	Sponge/Dough	63.0	968	99.3	3	4	2	3	4	3	2	3	2
4	Sponge/Dough	66.0	3045	103.0	5	5	3	2	2	2	3	2	2
5	Straight Dough	68.0	3125	116.8	2	4	3	4	3	4	3	5	5
6	Straight Dough	65.0	2350	85.5	3	3	3	2	2	3	4	3	2
7	Straight Dough	66.5	920	96.8	3	3	2	3	4	2	3	4	3
8	Straight Dough	66.7	980	107.1	2	2	3	3	3	3	2	3	3
10	Straight Dough	66.5	850	88.5	3	4	3	4	4	3	3	3	3
Average		**64.7**		**100.0**	**2.9**	**3.4**	**2.6**	**2.9**	**2.8**	**2.8**	**2.9**	**3.0**	**2.9**
± 1 Std Dev		**2.9**		**9.7**	**0.9**	**1.0**	**0.5**	**0.8**	**1.1**	**0.7**	**0.8**	**1.0**	**0.9**

ND809
Crookston - K11

Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	59.0	2800	93.3	3	2	2	3	3	3	3	2	2
2	Straight Dough	60.0	3150	108.6	3	4	3	2	2	2	3	3	3
3	Sponge/Dough	63.0	950	88.4	3	3	2	3	4	2	4	2	2
4	Sponge/Dough	65.0	3045	102.0	5	4	3	2	3	2	3	3	2
5	Straight Dough	70.3	2475	79.2	2	1	2	3	3	3	3	1	4
6	Straight Dough	64.0	2650	88.3	2	2	2	3	3	2	4	3	4
7	Straight Dough	67.8	960	93.2	3	3	1	3	3	2	4	3	2
8	Straight Dough	66.7	950	93.1	2	3	4	2	2	2	2	2	2
10	Straight Dough	67.8	790	89.2	2	4	2	2	3	3	3	2	3
Average		**64.8**		**92.8**	**2.8**	**2.9**	**2.3**	**2.6**	**2.9**	**2.3**	**3.2**	**2.3**	**2.7**
± 1 Std Dev		**3.7**		**8.5**	**1.0**	**1.1**	**0.9**	**0.5**	**0.6**	**0.5**	**0.7**	**0.7**	**0.9**

ND809
Williston - W11

Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Factors Compared to Glenn Check: Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	63.0	2800	98.3	5	5	3	3	1	3	4	3	3
2	Straight Dough	60.0	3500	114.8	5	4	4	4	3	5	3	4	4
3	Sponge/Dough	64.0	1135	100.9	5	5	3	3	3	3	3	3	3
4	Sponge/Dough	66.0	3162	100.0	5	5	3	2	2	4	3	3	3
5	Straight Dough	68.8	3200	112.3	5	3	4	3	3	4	2	5	5
6	Straight Dough	65.0	2750	93.2	4	4	3	4	4	4	3	4	4
7	Straight Dough	66.6	1150	103.6	4	3	2	3	2	4	3	3	3
8	Straight Dough	72.7	1205	106.6	5	4	5	3	3	2	3	3	3
10	Straight Dough	66.6	800	97.0	2	4	3	3	3	3	3	3	3
Average		**65.9**		**103.0**	**4.4**	**4.1**	**3.3**	**3.1**	**2.7**	**3.6**	**3.0**	**3.4**	**3.4**
± 1 Std Dev		**3.6**		**7.1**	**1.0**	**0.8**	**0.9**	**0.6**	**0.9**	**0.9**	**0.5**	**0.7**	**0.7**

CO1320W Williston - W12							Factors Compared to Glenn Check						
Cooperator	Bake Method	Bake Absorption	Loaf Volume	LV % of CK	Mixing Requirement	Dough Characteristic	Mix Tolerance	Crumb Color	Grain & Texture	Protein	Milling	Baking	Overall
1	Sponge/Dough	63.0	2875	100.9	5	5	3	3	1	3	4	3	3
2	Straight Dough	57.0	3200	104.9	5	5	4	5	2	3	2	3	3
3	Sponge/Dough	64.0	1120	99.6	4	4	2	3	3	3	3	3	3
4	Sponge/Dough	61.0	3133	99.1	5	5	3	4	3	3	3	2	2
5	Straight Dough	63.9	3225	113.2	5	4	4	4	4	4	1	5	5
6	Straight Dough	61.0	2950	100.0	5	5	4	4	4	4	3	5	5
7	Straight Dough	62.3	1205	108.6	3	3	3	4	2	3	3	3	2
8	Straight Dough	71.7	1095	96.9	5	4	2	3	3	2	2	3	3
10	Straight Dough	62.3	835	101.2	1	4	3	4	2	3	3	3	3
Average		**62.9**		**102.7**	**4.2**	**4.3**	**3.1**	**3.8**	**2.7**	**3.1**	**2.7**	**3.3**	**3.2**
± 1 Std Dev		**3.9**		**5.2**	**1.4**	**0.7**	**0.8**	**0.7**	**1.0**	**0.6**	**0.9**	**1.0**	**1.1**