



April 5, 2017

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Subject: **Final Report for Fritz-Pak Super Slump Buster, Compliance Verification for Type S Admixture**
AASHTO M194-13 *Standard Specification for Chemical Admixtures for Concrete*
TEC Services Project No: TEC 13-1026
TEC Services Laboratory No: 16-040
CADD-2015-01-099

Dear Mrs. Malusky:

Testing, Engineering and Consulting Services, Inc. (TEC Services) is an AASHTO R18, ANS/ISO/IEC 17025:2005 and Army Corps of Engineers accredited laboratory. TEC Services is pleased to present this report of our compliance verification testing of Super Slump Buster, an ASTM C494-13 *Standard Specification for Chemical Admixtures for Concrete, Type S (Specific Performance)* admixture. Our services were performed in accordance with our service agreement date August 30, 2013.

Sample preparation and testing was performed in accordance with applicable sections of AASHTO M194-13 *Standard Specifications for Chemical Admixtures for Concrete*, ASTM C494 and documents referenced therein. Material and procedures outlined in AASHTO M194 were used. Based on our results to date, Super Slump Buster complies with the requirements in AASHTO M194 and Table 1 of ASTM C494. These test results pertain only to the samples tested.

The compliance verification was performed by TEC Services in Lawrenceville, Georgia. Concrete batching was performed on three different days in March of 2016. One control mixture and one test mixture containing Super Slump Buster, both meeting the requirements of AASHTO M194 and ASTM C494 for fresh concrete properties, were produced each day. One 6-pound sample of Super Slump Buster was supplied to TEC Service by Fritz-Pak Corporation (Fritz-Pak). The air-entraining agent used in this testing was a vinsol resin, meeting the requirements of AASHTO M154-12 *Standard Specification for Air-Entraining Admixtures for Concrete*.

Testing of the concrete's plastic properties, time of setting, compressive strengths, flexural strengths, length change, and freeze thaw resistance were performed by TEC Services. Mixture proportions and results of our testing are given in Tables 1 to 3. Information and test data on fine and coarse aggregates are listed in Tables 4 to 6. Table 7 contains information on Super Slump Buster. Product information and test data on the Type I cement is included in Table 8. Test results for each of the six batches prepared for this report are included in Tables 9 thru 12.



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Table 1: Super Slump Buster performance and ASTM C494 requirements for a Type S admixture

Test Results	Super Slump Buster	Specification Requirements
Time of setting, deviation of control		
Initial (hr:min)	0:10	-1:00 to +1:30
Final (hr:min)	0:09	-1:00 to +1:30
Compressive strength (percent of control)		
3 days	108	90 (min)
7 days	106	90 (min)
28 days	106	90 (min)
56 days	111	90 (min)
90 days	101	90 (min)
6 months	101	90 (min)
1 year	104	90 (min)
Flexural strength (percent of control)		
3 days	107	90 (min)
7 days	104	90 (min)
28 days	105	90 (min)
56 days	101	90 (min)
Length change (increase over control)	0.001	0.010 (max)
Relative durability factor	98	80 (min)

*Provisional Requirement

Table 2: Mixture proportions, fresh concrete properties, and ASTM C494 requirements for Type S admixture

Average of Three Separate Tests	Control Mixture	Super Slump Buster	Specification Requirements
Cement factor (lb/yd ³)	517	516	517 ± 5
Water (lb/yd ³)	280	267	
Water-cement ratio	0.543	0.516	
Coarse aggregate	1849	1848	
Fine aggregate	1173	1209	
Fine aggregate-total aggregate ratio	0.39	0.40	
Super Slump Buster (oz/cwt)	0.00	0.00	
Vinsol Resin (lbs/cwt)	0.48	0.026	
Slump (in.)	4.00	3.00	3 ½ ± ½
Air content (%)	5.5	5.6	5-7 (± 0.5 of control)
Density (lb/ft ³)	141.5	142.2	
Time of setting			
Initial (hr:min)	3:59	4:09	
dev. of control (hr:min)		0:10	-1:00 to +1:30
Final (hr:min)	5:15	5:24	
dev. of control (hr:min)		0:09	-1:00 to +1:30

Table 3: Properties of hardened concrete

	Control Mixture	Super Slump Buster
Compressive strength (psi)		
3 days	3040	3270
7 days	3740	3960
28 days	4560	4840
56 days	4840	5380
90 days	5300	5350
6 months	5400	5450
1 year	5330	5530
Flexural strength (psi)		
3 days	565	605
7 days	605	630
28 days	660	695
56 days	735	740
Length change (%)	-0.015	-0.016
Durability factor (%)	98	96

Table 4: Properties of fine and coarse aggregates

Aggregate Information	Fine aggregate	Coarse aggregate
Manufacturer	Lambert Sand, Shorter	Vulcan, Lithonia
Aggregate Type	Natural sand	Crushed Granite
Specific Gravity _{SSD}	2.62	2.63
Absorption (%)	0.58	0.43

Table 5: Gradation of fine aggregate and ASTM C494 requirements

Percent passing		
Sieve	Fine Aggregate	Specifications Requirements
No. 4 (4.75 mm)	100	100
No. 16 (2.36 mm)	74	65 to 75
No. 50 (300 μm)	14	12 to 20
No. 100 (150 μm)	5	2 to 5

Table 6: Gradation of coarse aggregate and ASTM C494 requirements

Percent passing		
Sieve	Coarse Aggregate	Specifications Requirements
1.5 in. (37.5 mm)	100	100
1.0 in. (25.4 mm)	100	95 to 100
0.5 in. (12.5 mm)	43	25 to 60
No. 4 (4.75 mm)	1	0 to 10
No. 8 (2.36 mm)	1	0 to 5

Table 7: Admixture information

Information	Admixture Information
Brand Name	Super Slump Buster
Manufacturer	Fritz-Pak Corporation
Lot Identification Number	01151005
Lot Size	2000 pounds
Solids content (%)	98.100
Chloride Content (%)	0.0120

Table 8: Cement information and test data

ASTM C 150 Type I/II cement			
Brand name	Portland Type I/II		
Manufacturer	Holcim Cement – Genevieve Plant		
<i>Chemical Analyses by Mass (%)</i>			
Silicon dioxide (SiO ₂)	19.9	Sulfur trioxide (SO ₃)	3.5
Aluminum oxide (Al ₂ O ₃)	4.5	Loss on ignition (950°C)	2.6
Iron oxide (Fe ₂ O ₃)	3.3	Insoluble residue	0.53
Calcium oxide (CaO)	64.8	Alkalies as Na ₂ O	0.50
Magnesium oxide (MgO)	2.7		
<i>Calculated Potential Compounds as per ASTM C 150-05 (%)</i>			
Tricalcium silicate (C ₃ S)	62	Tricalcium aluminate (C ₃ A)	6
Dicalcium silicate (C ₂ S)	7	Tetracalcium aluminoferrite (C ₄ AF)	10
<i>Physical Testing and Results</i>			
Fineness Specific Surface (Blaine)	386 m ² /Kg	Air Content (%)	6.0
Setting Times (Vicat) Initial	90 minutes	Autoclave Expansion (%)	0.05
Compressive 3 Day Strength (psi)	4120	Compressive 7 Day Strength (psi)	5210
C1038 Expansion @ 3.3% SO ₃ (%)	0.010	False Set (%)	81

*Information provided by Holcim

Table 9: Yield adjusted mixture proportions, fresh concrete properties, and time of set for three control batches

	Control 1	Control 2	Control 3	Average
Cement factor (lb/yd ³)	516	517	517	517
Water (lb/yd ³)	280	280	281	280
Water-cement ratio	0.542	0.542	0.544	0.543
Coarse aggregate (lb/yd ³)	1848	1851	1849	1849
Fine aggregate (lb/yd ³)	1173	1175	1171	1173
Fine aggregate-total aggregate ratio	0.388	0.388	0.388	0.388
Super Slump Buster, (lbs/cwt)	0.00	0.00	0.00	0.00
Vinsol Resin (oz/cwt)	0.47	0.47	0.50	0.48
Slump (in.)	4.00	3.75	4.00	4.00
Air content (%)	5.6	5.4	5.6	5.5
Density (lb/ft ³)	141.4	141.6	141.4	141.5
Time of setting				
Initial (hr:min)	3:52	4:06	3:59	3:59
Final (hr:min)	5:00	5:29	5:16	5:15

Table 10: Yield adjusted mixture proportions, fresh concrete properties, and time of set for three test batches containing Super Slump Buster

	Test 1	Test 2	Test 3	Average
Cement factor (lb/yd ³)	516	517	516	516
Water (lb/yd ³)	267	267	266	267
Water-cement ratio	0.516	0.516	0.516	0.516
Coarse aggregate (lb/yd ³)	1848	1851	1845	1848
Fine aggregate (lb/yd ³)	1208	1210	1207	1209
Fine aggregate-total aggregate ratio	0.395	0.395	0.395	0.395
Super Slump Buster (lbs/cwt)	0.029	0.025	0.025	0.026
Vinsol Resin (oz/cwt)	0.70	0.70	0.70	0.70
Slump (in.)	3.00	3.00	3.00	3.00
Air content (%)	5.6	5.5	5.8	5.6
Density (lb/ft ³)	142.2	142.4	142.0	142.2
Time of setting				
Initial (hr:min)	4:04	4:15	4:09	4:09
Final (hr:min)	5:09	5:38	5:27	5:24

Table 11: Properties of hardened concrete from three control test batches

	Control 1		Control 2		Control 3		Average
Compressive strength (psi)							
3 days	3210		3000		2910		3040
7 days	3700		3770		3740		3740
28 days	4590		4690		4410		4560
56 days	5050		4870		4590		4840
90 days	5460		5300		5150		5300
6 months	5380		5410		5560		5400
1 year	5280		5310		5400		5330
Flexural strength (psi)							
3 days	505		625		565		565
7 days	640		625		555		605
28 days	670		635		675		660
56 days	800		700		700		735
Length change (%)	-0.008		-0.017		-0.021		-0.015
Durability Factor (%)	99		96		98		98
Approximate Total Cycles Completed	Fundamental Transverse Frequency, kHz			Relative Dynamic Modulus, (%) Average of 2 Beams per Mix			Average
	Control 1	Control 2	Control 3	Control 1	Control 2	Control 3	
0 cycles	1.895	1.973	1.914	NA	NA	NA	NA
32 cycles	1.895	1.973	1.905	100	100	99	100
66 cycles	1.895	1.963	1.905	100	99	99	99
96 cycles	1.895	1.953	1.905	100	98	99	99
128 cycles	1.895	1.953	1.905	100	98	99	99
162 cycles	1.895	1.953	1.905	100	98	99	99
192 cycles	1.895	1.953	1.905	100	98	99	99
220 cycles	1.895	1.953	1.905	100	98	99	99
253 cycles	1.895	1.953	1.905	100	98	99	99
287 cycles	1.895	1.934	1.895	100	96	98	98
300 cycles	1.885	1.934	1.895	99	96	98	98

Table 12: Properties of hardened concrete from three batches containing Super Slump Buster

	Test 1		Test 2		Test 3		Average
Compressive strength (psi)							
3 days	3240		3340		3240		3270
7 days	4000		3880		4000		3960
28 days	4970		4690		4860		4840
56 days	5190		5410		5530		5380
90 days	5250		5310		5480		5350
6 months	5380		5410		5560		5450
1 year	5530		5420		5650		5530
Flexural strength (psi)							
3 days	600		590		620		605
7 days	615		645		625		630
28 days	660		710		715		695
56 days	730		765		720		740
Length change (%)	-0.013		-0.017		-0.019		-0.016
Durability Factor (%)	97		94		96		96
Approximate Total Cycles Completed	Fundamental Transverse Frequency, kHz			Relative Dynamic Modulus, (%) Average of 2 Beams per Mix			Average
	Test 1	Test 2	Test 3	Test 1	Test 2	Test 3	
0 cycles	1.934	2.002	1.953	NA	NA	NA	NA
32 cycles	1.934	1.973	1.953	100	97	100	99
66 cycles	1.924	1.944	1.953	99	94	100	98
96 cycles	1.924	1.944	1.944	99	94	99	97
128 cycles	1.924	1.944	1.944	99	94	99	97
162 cycles	1.924	1.944	1.944	99	94	99	97
192 cycles	1.924	1.944	1.944	99	94	99	97
220 cycles	1.924	1.944	1.944	99	94	99	97
253 cycles	1.915	1.944	1.934	98	94	98	97
287 cycles	1.905	1.944	1.914	97	94	96	96
300 cycles	1.905	1.944	1.914	97	94	96	96

We appreciate the opportunity to provide our services to you on this project. Should you have any questions or comments regarding this report, please feel free to contact us at your convenience.

Sincerely,

Testing, Engineering, & Consulting Services, Inc.



Pat Ebersole
 Administrator



Shawn P. McCormick
 Laboratory Principal