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· MATERIALS  
· FORENSICS

December 13, 2016

Ms. Katheryn Malusky  
NTPEP  
444 N Capitol Street NW  
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Washington DC, 20001

**CADD-2015-01-062**

**Final Compliance Report: Fritz-Pak Corporation, Slick-Pak, Type S**

ASTM C494/C494M – 13, “Standard Specification for Chemical Admixtures for Concrete”  
AASHTO M194/M194 – 12, “Standard Specification for Chemical Admixtures for Concrete”  
AET Project No. 29-01968

Dear Ms. Malusky:

American Engineering Testing, Inc. (AET) is pleased to present this report of our compliance verification testing of Fritz-Pak Corp. Slick-Pak Pump Primer & Pumping Aid. The attached report presents the final test results of the referenced admixture. Three 8-oz. bags of the admixture were received on September 28, 2015 and the NTPEP notification to proceed was received on September 23, 2015.

All sample preparation and testing was performed in accordance with the applicable sections of AASHTO M194M/M194M, ASTM C494/C494M – 13, “Standard Specification for Chemical Admixtures for Concrete” and all referenced documents. Based on our results through one year, Slick-Pak, Type S complies with the requirements in AASHTO M194/M194 and Table 1 of ASTM C494 for a Type S, specific performance admixture.

Concrete batching and test specimen fabrication was conducted on three consecutive days. One control mixture and one test mixture containing Slick-Pak, both meeting the requirements of AASHTO M194 and ASTM C494 for fresh concrete properties, were produced each day. A commercially available vinsol resin air-entraining admixture was used for the concrete mixtures. Holcim Type I/II portland cement from the St. Genevieve plant was used for all concrete mixtures.

Product information and cement chemical and physical properties are presented in Table 1 and 2. Aggregate properties and gradations are presented in Tables 3 and 4. Mixture proportions and results of testing are given in Tables 5 and 6.

If there are any questions with regard to this report, please contact me.

Sincerely,  
American Engineering Testing, Inc.

A handwritten signature in black ink that reads 'Willy Morrison'.

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A handwritten signature in black ink that reads 'Dan Vruno'.

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Table 1 Admixture Information

	Reference Admixture	Test Admixture
Manufacturer	General Resource Technology	Fritz-Pak Corporation
Brand Name	Vinsol Resin	Slick-Pak
NTPEP CADD Number	--	CADD-2015-01-062
Lot Number	E093014	01150825
Quantity Supplied	1 Quart	Three 8-oz. Bags
Total Solids, %	15.01	95.24
Specific Gravity	1.044	Not Required for Powder Admixtures
pH	10.7	11.4
Chloride, %	0.009	0.034

Table 2 Portland Cement Analysis – Chemical and Physical

ASTM C150 Type I/II Cement			
Brand Name	St. Genevieve		
Manufacturer	Holcim (US) Inc.		
Chemical Analysis, %			
Silicon dioxide (SiO <sub>2</sub> )	19.8	Tricalcium silicate (C <sub>3</sub> S) (%)	61
Aluminum oxide (Al <sub>2</sub> O <sub>3</sub> )	4.5	Dicalcium silicate (C <sub>2</sub> S) (%)	8
Iron oxide (Fe <sub>2</sub> O <sub>3</sub> )	3.2	Tricalcium aluminate (C <sub>3</sub> A) (%)	6
Magnesium oxide (MgO)	2.7	Tetracalcium alumino ferrite (C <sub>4</sub> AF) (%)	9
Sulfur trioxide (SO <sub>3</sub> )	3.4	C <sub>3</sub> S + 4.75C <sub>3</sub> A (%)	90.7
Calcium oxide (CaO)	64.2		
Insoluble Residue (%)	0.47	Loss on Ignition (%)	2.6
Alkalies as Na <sub>2</sub> O (%)	0.54		
Physical Analysis			
Fineness, Blaine (m <sup>2</sup> /kg)	379	Air Content (%)	7
Vicat Time of Set (Initial), minutes	90	Autoclave Expansion (%)	0.04
Compressive Strength			
3 Day (psi)	4330	7 Day (psi)	5360
Mortar Bar Expansion (%) (C 1038)	0.013		

**Table 3 - Properties of Fine and Coarse Aggregates**

	<b>Fine Aggregate</b>	<b>Coarse Aggregate</b>
Manufacturer	Aggregate Industries	Aggregate Industries
Aggregate type, ID	Natural Sand, Elk River	River Gravel, Lakeville #57
Specific gravity, SSD	2.675	2.740
Absorption %	0.6	1.1

**Table 4 – Gradations of Fine and Coarse Aggregates**

**ASTM C136, Gradation of fine aggregate**

<b>Percent passing</b>		
	<b>Fine Aggregate</b>	<b>ASTM C494/AASHTO M194 Requirements</b>
No. 4 [4.75 mm]	100	100
No. 16 [1.18 mm]	72	65 to 75
No. 50 [300 µm]	13	12 to 20
No. 100 [150 µm]	2	2 to 5

**ASTM C136, Gradation of coarse aggregate**

<b>Percent passing</b>		
	<b>Coarse Aggregate</b>	<b>ASTM C494 Requirements</b>
1.5 in. [37.5 mm]	100	100
1.0 in. [25.0 mm]	100	95 to 100
0.5 in. [12.5 mm]	58	25 to 60
No. 4 [4.75 mm]	9	0 to 10
No. 8 [2.36 mm]	1	0 to 5

TABLE 5 Laboratory Data	Concrete Mixtures and Testing Results								Slick-Pak added at a rate of 0.2 oz/cwt	
	Slick-Pak				Slick-Pak					
	Batch No. Cast Date	Control #1 10/12/2015	Control #2 10/13/2015	Control #3 10/14/2015	AVER. (Test Value)	Test #1 10/12/2015	Test #2 10/13/2015	Test #3 10/14/2015	AVER. (Test Value)	ASTM C494, Type S AASHTO M194
Cement, pcy	513	519	516	516	520	519	519	519	517 ± 5	
Sand, pcy	1,289	1,303	1,296	1,296	1,307	1,303	1,303	1,304		
Gravel, pcy	1,774	1,794	1,784	1,784	1,799	1,794	1,794	1,796		
Water, pcy	280	283	281	281	284	283	283	283		
<b>Water Content (Percent of Control)</b>	---	---	---	---	101	100	101	101		
AEAName	Vinsol Resin				Vinsol Resin					
AEA Dosage, oz/cwt	0.5	0.5	0.5	0.5	0.8	0.8	0.8	0.8		
Admixture Name	---				Slick-Pak					
Admixture Dosage, oz/cwt	---	---	---	---	0.2	0.2	0.2	0.2		
WATER CEMENT RATIO	0.55	0.55	0.54	0.55	0.55	0.55	0.55	0.55		
Slump, inches	4.00	4.00	3.50	3.75	3.50	4.00	3.25	3.50	3.5 ± 0.5	
Air Content, %	6.0	6.2	6.0	6.1	5.6	6.4	5.8	5.9	± 0.5	
Density, pcf	142.8	144.4	143.6	143.6	144.8	144.4	144.4	144.5		
<b>SETTING TIME</b>										
Initial, hr:mn	4:01	4:18	4:00	4:06	3:57	4:17	3:44	3:59		
Final, hr:mn	5:36	5:58	5:36	5:43	5:39	6:01	5:11	5:37		
<b>TIME of SETTING (deviation from reference)</b>										
Initial, hr:mn	---	---	---	---	-0:04	-0:01	-0:16	-0:07	Not more than 1:00 earlier nor 1:30 later	
Final, hr:mn	---	---	---	---	0:03	0:03	-0:25	-0:06	Not more than 1:00 earlier nor 1:30 later	
<b>COMPRESSIVE STRENGTH</b>										
3 Days, psi	3,120	3,260	3,540	3,310	3,730	2,830	3,470	3,340		
7 Days, psi	4,070	4,440	4,360	4,290	4,500	3,840	4,500	4,280		
28 Days, psi	5,220	5,620	5,540	5,460	5,890	<sup>B</sup>	5,390	5,640		
90 Days, psi	5,790	6,180	5,860	5,940	6,680	4,960	5,980	5,870		
6 Months, psi	6,000	6,210	6,520	6,240	7,020	5,130	6,420	6,190		
1 Year, psi	6,290	6,740	6,630	6,550	7,770	5,630	6,990	6,800		
3 Days, % reference	---	---	---	---	120	87	98	101	≥90%	
7 Days, % reference	---	---	---	---	111	86	103	100	≥90%	
28 Days, % reference	---	---	---	---	113	<sup>B</sup>	97	103	≥90%	
90 Days, % reference	---	---	---	---	115	80	102	99	N/A	
6 Months, % reference	---	---	---	---	117	83	98	99	≥90%	
1 Year, % reference	---	---	---	---	124	84	105	104	≥90%	
<b>FLEXURAL STRENGTH</b>										
3 Days, psi	590	615	545	585	580	505	595	560		
7 Days, psi	680	650	735	690	670	610	665	650		
28 Days, psi	850	850	760	820	900	830	930	885		
3 Days, % reference	---	---	---	---	98	82	109	96	≥90%	
7 Days, % reference	---	---	---	---	99	94	90	94	≥90%	
28 Days, % reference	---	---	---	---	106	98	122	108	≥90%	
<b>LENGTH CHANGE, %</b>										
Increase over control	-0.019	-0.013	0.000	-0.011	-0.014	-0.010	-0.016	-0.013	≤0.010 <sup>A</sup>	
<b>RESISTANCE TO FREEZING AND THAWING</b>										
Relative Dynamic Modulus, %										
0	cycles	100/100	100/100	100/100	100	100/100	100/100	100/100	100	
36	cycles	96/94	99/98	99/99	98	100/99	99/99	99/98	99	
72	cycles	98/94	100/99	98/98	98	100/99	98/98	99/99	99	
108	cycles	95/94	99/98	99/96	97	100/99	96/96	99/99	98	
144	cycles	95/93	99/98	99/96	97	100/99	95/96	98/99	98	
180	cycles	94/93	100/99	99/95	97	100/99	95/96	99/99	98	
216	cycles	95/93	100/99	99/95	97	100/99	94/95	99/99	98	
252	cycles	93/90	99/99	99/95	96	100/98	94/94	100/99	98	
288	cycles	89/95	98/98	97/94	95	100/98	99/93	99/99	98	
324	cycles	89/95	99/98	95/91	95	100/96	98/91	99/100	97	
<b>RELATIVE DURABILITY FACTOR</b>									103	min 80

A. Increased shrinkage over control.  
B. Data eliminated as suspicious. The average compressive strength reported is the average of two test specimens.

**TABLE 6**  
**TESTS OF CHEMICAL ADMIXTURES FOR CONCRETE**  
**SLICK-PAK**  
**ASTM SPECIFICATION C494 / AASHTO M194**  
**TYPE S, SPECIFIC PERFORMANCE**

MIXTURE DESIGNATION	<u>CONTROL</u>	<u>SLICK-PAK</u>	<u>CHANGE vs. CONTROL</u>	<u>SPECIFICATION REQUIREMENT</u>
<b>MIXTURE PROPORTIONS</b>				
CEMENT, pcy	516	519	3	<b>517 ± 5</b>
SAND, pcy	1,296	1,304		
GRAVEL, pcy	1,784	1,796		
NET WATER, pcy	281	283		
AEA (Vinsol Resin), oz/cwt	0.5	0.8		
ADMIXTURE DOSAGE, oz/cwt	---	0.2		
<b>RATIO OF FINE TO TOTAL AGG., %</b>				
WATER/CEMENT RATIO, lb./lb.	42	42		
	0.55	0.55		
<b>SLUMP, inches</b>				
	3.75	3.50	-0.25	<b>3.5 ± 0.5</b>
<b>ENTRAINED AIR, %</b>				
	6.1	5.9	-0.2	<b>± 0.5</b>
<b>UNIT WEIGHT, pcf</b>				
	143.6	144.5		
<b>SET TIME, hr:min</b>				
INITIAL	4:06	3:59	-0:07	<b>Not more than 1:00 earlier nor 1:30 later</b>
FINAL	5:43	5:37	-0:06	<b>Not more than 1:00 earlier nor 1:30 later</b>
<b>COMPRESSIVE STRENGTH, psi</b>				
3 DAYS	3,310	3,340	101%	<b>≥90%</b>
7 DAYS	4,290	4,280	100%	<b>≥90%</b>
28 DAYS	5,460	5,640	103%	<b>≥90%</b>
90 DAYS	5,940	5,870	99%	<b>N/A</b>
180 DAYS	6,240	6,190	99%	<b>≥90%</b>
365 DAYS	6,550	6,800	104%	<b>≥90%</b>
<b>FLEXURAL STRENGTH, psi</b>				
3 DAYS	585	560	96%	<b>≥90%</b>
7 DAYS	690	650	94%	<b>≥90%</b>
28 DAYS	820	885	108%	<b>≥90%</b>
<b>LENGTH CHANGE</b>				
Increase over control	-0.011	-0.013	0.002	<b>≤0.010<sup>A</sup></b>
<b>RELATIVE DURABILITY FACTOR, %</b>				
			103	<b>≥80%</b>

A. Increased shrinkage over control.