AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
· ENVIRONMENTAL
· GEOTECHNICAL
· MATERIALS
· FORENSICS

September 6, 2016

Ms. Katheryn Malusky
NTPEP
444 N Capitol Street NW
Suite 249
Washington DC, 20001

CADD-2015-01-056
Final Compliance Report: Fritz-Pak Corporation, Super Air Plus
ASTM C260/C260M – 10a, "Standard Specification for Air-Entraining Admixtures for Concrete"
AASHTO M154/M154 – 12, "Standard Specification for Air-Entraining Admixture for Concrete"
AET Project No. 29-01922

Dear Ms. Malusky:

American Engineering Testing, Inc. (AET) is pleased to present this report of our compliance verification testing of Fritz-Pak Super Air Plus. The attached report presents the final test results of the referenced admixture. Three 8-oz. bags of the admixture were received on August 25, 2015 and the NTPEP notification to proceed was received on August 7, 2015.

All sample preparation and testing was performed in accordance with the applicable sections of AASHTO M154M/M154M, ASTM C233/C233M – 11, "Standard Test Method for Air-Entraining Admixtures for Concrete" and all referenced documents. Based on our results through 28 days, Fritz-Pak Super Air Plus complies with the requirements in AASHTO M154/M154 and Table 1 of ASTM C260.

Concrete batching and test specimen fabrication was conducted on three consecutive days. One control mixture and one test mixture containing Fritz-Pak Super Air Plus, both meeting the requirements of AASHTO M154 and ASTM C233 for fresh concrete properties, were produced each day. A quart sample of commercially available vinsol resin based air-entraining agent was used for this testing. 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.

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Table 1 Admixture Information

	Reference Admixture	**Test Admixture**
Manufacturer	Commercial Source	Fritz-Pak Corporation
Brand Name	Vinsol Resin	Super Air Plus
NTPEP CADD Number	--	CADD-2015-01-056
Lot Number	E093014	01150622
Quantity Supplied	One Quart	Three 8-oz. Bags
Total Solids, %	15.01	98.61
Specific Gravity	1.044	Not Required for Powder Admixtures
pH	10.7	9.6
Chloride, %	0.009	0.004

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_2)	19.8	Tricalcium silicate (C_3S) (%)	61
Aluminum oxide (Al_2O_3)	4.5	Dicalcium silicate (C_2S) (%)	8
Iron oxide (Fe_2O_3)	3.2	Tricalcium aluminate (C_3A) (%)	6
Magnesium oxide (MgO)	2.7	Tetracalcium alumino ferrite (C_4AF) (%)	9
Sulfur trioxide (SO_3)	3.4	$C_3S + 4.75C_3A$ (%)	90.7
Calcium oxide (CaO)	64.2		
Insoluble Residue (%)	0.47	Loss on Ignition (%)	2.6
Alkalies as Na_2O (%)	0.54		
Physical Analysis			
Fineness, Blaine (m^2/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		

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Table 3 - Properties of Fine and Coarse Aggregates

	Fine Aggregate	Coarse Aggregate
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

Percent passing		
	Fine Aggregate	ASTM C260/AASHTO M154 Requirements
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

Percent passing		
	Coarse Aggregate	ASTM C260 Requirements
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

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TABLE 5 Concrete Mixtures and Testing Results — Super Air Plus added at a rate of 0.4 oz/cwt

Laboratory Data — Super Air Plus

		GRT Vinsol Resin				Super Air Plus				
	Batch No.	Control #1	Control #2	Control #3	AVER.	Test #1	Test #2	Test #3	AVER.	ASTM C260, Type Air
	Cast Date	8/31/2015	9/1/2015	9/2/2015	(Test Value)	8/31/2015	9/1/2015	9/2/2015	(Test Value)	AASHTO M154
Cement, pcy		517	519	519	**518**	519	519	520	**519**	**517 ± 5**
Sand, pcy		1,300	1,303	1,303	**1,302**	1,303	1,303	1,307	**1,304**	
Gravel, pcy		1,789	1,794	1,794	**1,792**	1,794	1,794	1,799	**1,796**	
Water, pcy		282	283	283	**283**	283	283	284	**283**	
Water Content (Percent of Control)		---	---	---	**---**	100	100	100	**100**	
AEAName		GRT Vinsol Resin				---				
AEA Dosage, oz/cwt		0.5	0.5	0.5	**0.5**	---	---	---	**---**	
Admixture Name		---	---	---	**---**	Super Air Plus				
Admixture Dosage, oz/cwt		---	---	---	**---**	0.4	0.4	0.4	**0.4**	
WATER CEMENT RATIO		0.55	0.55	0.55	**0.55**	0.55	0.55	0.55	**0.55**	
Slump, inches		4.00	4.00	4.00	**4.00**	4.00	4.00	4.00	**4.00**	**3.5 ± 0.5**
Air Content, %		6.0	5.5	5.9	**5.8**	6.0	6.0	6.0	**6.0**	**± 0.5**
Density, pcf		144.0	144.4	144.4	**144.3**	144.4	144.4	144.8	**144.5**	
Bleedwater, %		9.4%	4.6%	5.8%	**6.6%**	3.8%	3.8%	6.0%	**4.6%**	
Bleeding of the net amount of mix water, max percent over control		---	---	---	**---**	-5.6%	-0.8%	0.2%	**-2.0%**	**≤2%**
SETTING TIME										
Initial, hr:mn		4:00	4:19	3:58	**4:05**	3:19	3:13	3:17	**3:16**	
Final, hr:mn		5:22	5:46	5:17	**5:28**	4:29	4:23	4:32	**4:28**	
TIME of SETTING (deviation from reference)										
Initial, hr:mn		---	---	---	**---**	-0:41	-1:06	-0:41	**-0:49**	**Not more than 1:15 earlier nor 1:15 later**
Final, hr:mn		---	---	---	**---**	-0:53	-1:23	-0:45	**-1:00**	**Not more than 1:15 earlier nor 1:15 later**
COMPRESSIVE STRENGTH										
3 Days, psi		2,550	2,250	2,180	**2,330**	2,970	2,610	4,130	**3,240**	
7 Days, psi		3,150	2,430	3,150	**2,910**	3,010	2,800	4,890	**3,570**	
28 Days, psi		4,160	3,100	3,650	**3,640**	4,530	3,580	5,570	**4,560**	
3 Days, % reference		---	---	---	**---**	116	116	189	**139**	**≥90%**
7 Days, % reference		---	---	---	**---**	96	115	155	**123**	**≥90%**
28 Days, % reference		---	---	---	**---**	109	115	153	**125**	**≥90%**
FLEXURAL STRENGTH										
3 Days, psi		515	515	485	**505**	515	460	635	**535**	
7 Days, psi		615	490	505	**535**	665	555	600	**605**	
28 Days, psi		700	760	630	**695**	690	715	740	**715**	
3 Days, % reference		---	---	---	**---**	100	89	131	**106**	**≥90%**
7 Days, % reference		---	---	---	**---**	108	113	119	**113**	**≥90%**
28 Days, % reference		---	---	---	**---**	99	94	117	**103**	**≥90%**
LENGTH CHANGE, %		-0.022	-0.010	-0.017	**-0.016**	-0.019	-0.022	-0.019	**-0.020**	
Increase over control		---	---	---	**---**	-0.003	0.012	0.002	**0.004**	**≤0.006**[A]
RESISTANCE TO FREEZING AND THAWING										
Relative Dynamic Modulus, %										
0	cycles	100/100	100/100	100/100	100	100/100	100/100	100/100	100	
36	cycles	97/97	97/99	96/97	97	99/98	99/96	98/98	98	
72	cycles	97/96	96/97	97/97	97	99/99	99/96	99/96	98	
108	cycles	97/96	96/97	97/96	97	99/95	97/96	97/98	97	
144	cycles	97/95	96/97	97/97	97	97/96	99/96	97/96	97	
180	cycles	97/95	96/99	99/97	97	96/98	97/97	97/98	97	
216	cycles	97/95	96/97	97/97	97	99/98	97/97	97/99	98	
252	cycles	96/94	96/97	97/96	96	99/98	97/96	98/96	97	
288	cycles	96/92	96/99	97/96	96	99/98	99/97	98/98	98	
324	cycles	96/91	96/97	97/95	95	99/96	99/97	98/98	98	
RELATIVE DURABILITY FACTOR									**103**	**min 80**

A. Increased shrinkage over control.

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TABLE 6
TESTS OF CHEMICAL ADMIXTURES FOR CONCRETE
SUPER AIR PLUS
ASTM SPECIFICATION C260 / AASHTO M154
AIR ENTRAINING (ASTM C260)

MIXTURE DESIGNATION	CONTROL	SUPER AIR PLUS	CHANGE vs. CONTROL	SPECIFICATION REQUIREMENT
MIXTURE PROPORTIONS				
CEMENT, pcy	518	519	1	**517 ± 5**
SAND, pcy	1,302	1,304		
GRAVEL, pcy	1,792	1,796		
NET WATER, pcy	283	283		
AEA (Vinsol Resin), oz/cwt	0.5	---		
ADMIXTURE DOSAGE, oz/cwt	---	0.4		
RATIO OF FINE TO TOTAL AGG., %	42	42		
WATER/CEMENT RATIO, lb./lb.	0.55	0.55		
SLUMP, inches	4.00	4.00	0.00	**3.5 ± 0.5**
ENTRAINED AIR, %	5.8	6.0	0.2	**± 0.5**
UNIT WEIGHT, pcf	144.3	144.5		
BLEEDWATER	6.6%	4.6%		
BLEEDING OF THE NET AMOUNT OF MIX WATER, MAX PERCENT OVER CONTROL	---	-2.0%		**≤2%**
SET TIME, hr:min				
INITIAL	4:05	3:16	-0:49	**Not more than 1:15 earlier nor 1:15 later**
FINAL	5:28	4:28	-1:00	**Not more than 1:15 earlier nor 1:15 later**
COMPRESSIVE STRENGTH, psi				
3 DAYS	2,330	3,240	139%	**≥90%**
7 DAYS	2,910	3,570	123%	**≥90%**
28 DAYS	3,640	4,560	125%	**≥90%**
FLEXURAL STRENGTH, psi				
3 DAYS	505	535	106%	**≥90%**
7 DAYS	535	605	113%	**≥90%**
28 DAYS	695	715	103%	**≥90%**
LENGTH CHANGE				
Increase over control	-0.016	-0.020	0.004	**≤0.006**[A]
RELATIVE DURABILITY FACTOR, %			103	**≥80%**

A. Increased shrinkage over control.

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