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September 6, 2016

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

CADD-2015-01-057

Final Compliance Report: Fritz-Pak Corporation, 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 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 20, 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 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 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.

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

Willy Morrison
Manager, Concrete Materials Laboratory
D: 651-659-1333
C: 847-902-7548
wmorrison@amengtest.com

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

Daniel M. Vruno, P.E.
Principal Engineer
D: 651-659-1334
C: 651-356-9309
dvrano@amengtest.com

Table 1 Admixture Information

	Reference Admixture	Test Admixture
Manufacturer	Commercial Source	Fritz-Pak Corporation
Brand Name	Vinsol Resin	Air Plus
NTPEP CADD Number	--	CADD-2015-01-057
Lot Number	E093014	01150608
Quantity Supplied	One Quart	Three 8-oz. Bags
Total Solids, %	15.01	99.37
Specific Gravity	1.044	Not Required for Powder Admixtures
pH	10.7	9.8
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.		
<i>Chemical Analysis, %</i>			
Silicon dioxide (SiO ₂)	19.8	Tricalcium silicate (C ₃ S) (%)	61
Aluminum oxide (Al ₂ O ₃)	4.5	Dicalcium silicate (C ₂ S) (%)	8
Iron oxide (Fe ₂ O ₃)	3.2	Tricalcium aluminate (C ₃ A) (%)	6
Magnesium oxide (MgO)	2.7	Tetracalcium aluminoferrite (C ₄ AF) (%)	9
Sulfur trioxide (SO ₃)	3.4	C ₃ S + 4.75C ₃ A (%)	90.7
Calcium oxide (CaO)	64.2		
Insoluble Residue (%)	0.47	Loss on Ignition (%)	2.6
Alkalies as Na ₂ O (%)	0.54		
<i>Physical Analysis</i>			
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		

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

TABLE 5 Laboratory Data	Concrete Mixtures and Testing Results									Air Plus added at a rate of 0.7 oz/cwt
	Air Plus									
	Batch No. Cast Date	GRT Vinsol Resin				Air Plus				ASTM C260, Type Air AASHTO M154
	Control #1 8/31/2015	Control #2 9/1/2015	Control #3 9/2/2015	AVER. (Test Value)	Test #1 8/31/2015	Test #2 9/1/2015	Test #3 9/2/2015	AVER. (Test Value)		
Cement, pcy	517	519	519	518	519	519	517	518	517 ± 5	
Sand, pcy	1,300	1,303	1,303	1,302	1,303	1,303	1,300	1,302		
Gravel, pcy	1,789	1,794	1,794	1,792	1,794	1,794	1,789	1,792		
Water, pcy	282	283	283	283	283	283	282	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	Air Plus									
Admixture Dosage, oz/cwt	---	---	---	---	0.7	0.7	0.7	0.7		
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	3.75	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	144.0	144.3		
Bleedwater, %	9.4%	4.6%	5.8%	6.6%	3.1%	5.3%	5.3%	4.6%		
Bleeding of the net amount of mix water, max percent over control	---	---	---	---	-6.3%	0.7%	-0.5%	-2.0%	≤2%	
SETTING TIME										
Initial, hr:mn	4:00	4:19	3:58	4:05	3:18	3:32	3:29	3:26		
Final, hr:mn	5:22	5:46	5:17	5:28	4:24	4:49	4:43	4:38		
TIME of SETTING (deviation from reference)										
Initial, hr:mn	---	---	---	---	-0:42	-0:47	-0:29	-0:39	Not more than 1:15 earlier nor 1:15 later	
Final, hr:mn	---	---	---	---	-0:58	-0:57	-0:34	-0:50	Not more than 1:15 earlier nor 1:15 later	
COMPRESSIVE STRENGTH										
3 Days, psi	2,550	2,250	2,180	2,330	3,120	2,740	2,950	2,940		
7 Days, psi	3,150	2,430	3,150	2,910	4,250	3,110	3,610	3,660		
28 Days, psi	4,160	3,100	3,650	3,640	4,850	3,940	4,320	4,370		
3 Days, % reference	---	---	---	---	122	122	135	126	≥90%	
7 Days, % reference	---	---	---	---	135	128	115	126	≥90%	
28 Days, % reference	---	---	---	---	117	127	118	120	≥90%	
FLEXURAL STRENGTH										
3 Days, psi	515	515	485	505	590	485	555	545		
7 Days, psi	615	490	505	535	645	540	575	585		
28 Days, psi	700	760	630	695	690	685	715	695		
3 Days, % reference	---	---	---	---	115	94	114	108	≥90%	
7 Days, % reference	---	---	---	---	105	110	114	109	≥90%	
28 Days, % reference	---	---	---	---	99	90	113	100	≥90%	
LENGTH CHANGE, %										
Increase over control	-0.022	-0.010	-0.017	-0.016	-0.023	-0.011	-0.019	-0.018	≤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	
	36	cycles	97/97	97/99	96/97	97	98/98	99/97	98/99	
	72	cycles	97/96	96/97	97/97	97	98/98	97/97	96/99	
	108	cycles	97/96	96/97	97/96	97	98/98	99/97	96/98	
	144	cycles	97/95	96/97	97/97	97	99/99	97/96	96/100	
	180	cycles	97/95	96/99	99/97	97	99/99	99/96	98/99	
	216	cycles	97/95	96/97	97/97	97	99/99	97/96	96/99	
	252	cycles	96/94	96/97	97/96	96	99/99	97/96	98/98	
	288	cycles	96/92	96/99	97/96	96	100/100	97/97	95/100	
	324	cycles	96/91	96/97	97/95	95	100/100	96/95	94/99	
RELATIVE DURABILITY FACTOR								102	min 80	

A. Increased shrinkage over control.

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

MIXTURE DESIGNATION	<u>CONTROL</u>	<u>AIR PLUS</u>	CHANGE vs. <u>CONTROL</u>	<u>SPECIFICATION REQUIREMENT</u>
MIXTURE PROPORTIONS				
CEMENT, pcy	518	518	0	517 ± 5
SAND, pcy	1,302	1,302		
GRAVEL, pcy	1,792	1,792		
NET WATER, pcy	283	283		
AEA (Vinsol Resin), oz/cwt	0.5	---		
ADMIXTURE DOSAGE, oz/cwt	---	0.7		
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	144.3		
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	3:26	-0:39	Not more than 1:15 earlier nor 1:15 later
FINAL	5:28	4:38	-0:50	
COMPRESSIVE STRENGTH, psi				
3 DAYS	2,330	2,940	126%	≥90%
7 DAYS	2,910	3,660	126%	≥90%
28 DAYS	3,640	4,370	120%	≥90%
FLEXURAL STRENGTH, psi				
3 DAYS	505	545	108%	≥90%
7 DAYS	535	585	109%	≥90%
28 DAYS	695	695	100%	≥90%
LENGTH CHANGE				
Increase over control	-0.016	-0.018	0.002	≤0.006^A
RELATIVE DURABILITY FACTOR, %			102	≥80%

A. Increased shrinkage over control.