

Specialty Products Group
Vapor Lock 20/20
ASTM C494 - Type S Compliance Testing
Final Report

Prepared for:
Specialty Products Group

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February 24, 2014
TCG # 13001

Report Prepared by:
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Introduction

Tourney Consulting Group (TCG) is pleased to present this report for ASTM C494 - Type S (Specific performance admixtures) compliance testing of Vapor Lock 20/20, as supplied by Specialty Products Group.

This work was requested and authorized by Scott Bergsbaken of Specialty Products Group. The scope of our work was to perform laboratory testing of concrete, batched with and without chemical admixtures in accordance with the requirements of ASTM C494 "Standard Specification for Chemical Admixtures for Concrete."

All sample preparation and testing was performed in accordance with the applicable sections of ASTM C494 and the documents referenced therein. Materials and procedures outlined in ASTM C494) were used.

Test Procedures

Testing was initiated on 1/14/2013 and subsequent dates based on the requirements of ASTM C494; Sections 11-17, All samples were prepared using concrete fabricated by TCG personnel at our laboratory facilities in Kalamazoo, Michigan. TCG laboratories are AASHTO accredited, CCRL inspected, and USACE validated. In addition, TCG participates in the AMRL and CCRL Proficiency Sample Testing Programs.

The ASTM C494 Standard requires production of 3 unique concrete batches for each test condition (each admixture assessed); with a companion reference concrete produced for each test condition. Table #1 presents the mix identifications and test matrix used.

Table #1 – Mix Identifications and Test Matrix

	CONTROL			Vapor Lock 20/20		
ID	C2-1	C2-2	C2-3	VL-1	VL-2	VL-3
Cast Date	1/14/2012	1/15/2012	1/16/2012	1/14/2012	1/15/2012	1/16/2012

The averaged results of the testing are presented in Table 2. The overall mix design, average mix proportions, and average plastic properties are presented in Tables 3, and 4. Information and test data on fine and coarse aggregates are listed in Tables 5-7. Table #8 contains the admixture information supplied by Grace. Cement information and test data is included in Table #9.

Conclusions

Based on the results of the concrete properties testing (as summarized below), Vapor Lock 20/20 meets the physical requirements of ASTM C494 Type S and qualifies for compliance. Please note that samples will be discarded at the completion of testing.

Table #2 - Summary of Averaged Test Results for Vapor Lock 20/20

Vapor Lock 20/20					
	Control	Vapor Lock 20/20	Relative to Control	ASTM C494 Type S Requirements	Results
Water Content (PCY)	257	253	98.4%	-	-
Initial Set (Minutes)	292	291	-1	Not more than 60 minutes earlier nor than 90 minutes later	Meets Requirement
Final Set (Minutes)	396	394	-2		Meets Requirement
Compressive Strength					
1-Day (psi)	1330	1343	101%	-	-
3-Day (psi)	3020	3027	100%	Min 90% of Control	Meets Requirement
7-Day (psi)	3767	3673	98%	Min 90% of Control	Meets Requirement
28-Day (psi)	5043	4953	98%	Min 90% of Control	Meets Requirement
56-Day (psi)	5510	5420	98%	-	-
90-Day (psi)	5733	5583	97%	-	-
6-Month (psi)	6030	6050	100%	Min 90% of Control	Meets Requirement
1-Year (psi)	6413	6017	94%	Min 90% of Control	Meets Requirement
Flexural Strength					
3-Day (psi)	470	480	102%	Min 90% of Control	Meets Requirement
7-Day (psi)	547	567	104%	Min 90% of Control	Meets Requirement
28-Day (psi)	692	695	101%	Min 90% of Control	Meets Requirement
Length Change (%)	-0.0200%	-0.0217%	.001	Less than 0.010 percent units	Meets Requirement
Freeze/Thaw Durability	98%	99%	101%	RDF 80%	Meets Requirement

Table #3 – Mix Design & Requirements

	Control	Vapor Lock 20/20	ASTM 494 Requirements
Portland Cement (lb/cy)	517	517	517 +/- 5
Water (lb/cy)	As needed for Slump	As needed for Slump	<i>To achieve Slump</i>
Water (lb/cy)	257	253	<i>To achieve Slump</i>
Coarse Aggregate (lb/cy)	1812	1812	<i>ACI 211 – Trial Mix proportions</i>
Fine Aggregate (lb/cy)	1261	1261	
Slump (inches)	3" -4"	3" -4"	3" – 4"
Air Content (%)	6%	6%	6% ± 1%

Table #4 - Average Mix Proportions & Fresh Concrete Properties

	Control	Vapor Lock 20/20
Portland Cement (lb/cy)	518	521
Water (lb/cy)	257	253
Water/Cement Ratio	0.497	0.489
Coarse Aggregate (lb/cy)	1812	1812
Fine Aggregate (lb/cy)	1261	1261
Fine Agg/Coarse Agg Ratio	0.44	0.44
Admixture (oz/cwt)	-	10.0
AEA Dosage (oz/cwt)	1.13	1.27
Density(lb/ft3)	145.4	144.3
Slump (inches)	3.83	3.83
Air Content (%)	6.7	7.0
Initial Set (minutes)	292	291
Final Set (minutes)	396	394

Table #5 – Properties of Fine and Coarse Aggregate

	Fine Aggregate	Coarse Aggregate
Manufacturer	Byholt - 2NS Concrete Sand - 4th Street Pit	Cedarville #57 Pit 49-65
Aggregate Type	Natural Sand	Crushed Limestone
Specific Gravity _{SSD}	2.63	2.80
Absorption (%)	1.7	0.61

Table #6 – Gradation of Fine Aggregate

% Passing		
Sieve	Fine Aggregate	ASTM C494
#4 (4.75mm)	100	100
#8 (2.36mm)	87	-
#16 (1.8mm)	71	65-75
#30 (600µm)	51	-
#50 (300µm)	19	12-20
#100 (150µm)	3	2-5

Table #7 – Gradation of Coarse Aggregate

% Passing		
Sieve	Coarse Aggregate	ASTM C494 Requirements
1½" (37.5mm)	100	100
1" (25mm)	100	95-100
½" (12.5mm)	50	25-60
#4 (4.75mm)	2	0-10
#8 (2.36mm)	2	0-5

Table #8 - Admixture Information

Product Name	Vapor Lock 20/20
Supplier	Specialty Products Group
Lot ID	Batch #396
Sp. G.	1.07 – 1.10
Total Solids	
Lot Size	
Sample Size	5 gallons

Table #9 – Cement Information

ASTM C150 Type I Cement			
Brand Name		Lafarge I/II Alpena 9/12	
Manufacturer		Lafarge	
Chemical Analysis (per Mill Certificate) %			
Silicon dioxide (SiO ₂)	19.8	Loss on ignition	2.8
Aluminum oxide (Al ₂ O ₃)	4.9	Insoluble residue	0.48
Iron oxide (Fe ₂ O ₃)	2.9	Equivalent Alkalis	0.62
Calcium oxide (CaO)	63.3	CO ₂	1.8
Magnesium oxide (MgO)	2.3	Limestone	4.2
Sulfur trioxide (SO ₃)	2.8	CaCO ₃ in Limestone	97
Calculated potential compounds as per ASTM C 150 (%)			
Tricalcium silicate (C ₃ S)	54	Tricalcium aluminate (C ₃ A)	8
Physical Testing and Results			
Fineness Specific Surface (Blaine) – sq. cm./gr		Air Content (%)	5.6
Setting Times (Vicat)	Initial Set (minutes)	Autoclave Expansion (%) ASTM C151	0.01
	Final Set (minutes)		
Compressive 3 Day Strength (psi)		Compressive 7 Day Strength (psi)	4370

List of Attachments

#1 – Detailed/Individual Batches & Detailed Strength Data (Compressive & Flexural)

#2 – Detailed Shrinkage Data

#3 - Detailed Freeze/Thaw Data

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 me.

Sincerely,



Glenn E. Schaefer

VP of Operations

Tourney Consulting Group



Attachment #1

ASTM C494 Matched Set Data

TCG Project No.: 13001

Description Special Products Group C494 Compliance Testing

Admixture Test VL 20/20

Test Series ID	VL1-1	VL1-2	VL1-3
Control ID	C1-1	C1-2	C1-3

	Control Batch				VL 20/20				Vs. Reference	
	C1-1	C1-2	C1-3	Average	VL1-1	VL1-2	VL1-3	Average		
Date Batched	1/14/2013	1/15/2013	1/16/2013	N/A	1/14/2013	1/15/2013	1/16/2013	N/A		
Batch Time	9:00 AM	8:22 AM	8:35 AM	-	9:48 AM	9:17 AM	9:35 AM	-		
Temperature (°F)	71.0	71.0	71.0	-	71.0	71.0	71.0	-		
Relative Yield (cf/cy)	26.86	27.19	27.06	27.04	27.06	27.32	27.22	27.20		
Cement Factor(Pcy)	514	521	518	518	518	523	521	521		
Water (pcy)	257	257	257	257	249	254	256	253		
Percent Water Reduction	-	-	-	-	3.1%	1.2%	0.4%	1.6%		
W/C Ratio	0.497	0.497	0.497	0.497	0.482	0.491	0.495	0.489		
Coarse Aggregate (pcy)	1812	1812	1812	1812	1812	1812	1812	1812		
Fine Aggregate (pcy)	1261	1261	1261	1261	1261	1261	1261	1261		
Fine Agg/Coarse Agg Ratio	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44		
SPG VL 20/20 Vapor Lock (oz/cwt)	-	-	-	-	10.00	10.00	10.00	10.00		
AEA (oz/cwt)	1.10	1.20	1.09	1.13	1.30	1.30	1.20	1.27		
Slump (inches)	3.50	4.00	4.00	3.83	3.50	4.00	4.00	3.83		
Air Content (%)	6.5%	6.90%	6.60%	6.7%	7.0%	7.0%	7.0%	7.0%		
Density (pcf)	146.3	144.5	145.3	145.4	144.9	143.7	144.3	144.3		
Initial Set Time (minutes)	282	295	298	292	285	296	291	291	1	Pass
Final Set Time (minutes)	390	396	402	396	389	395	397	394	2	Pass

Compressive Strength

	Control Batch				VL 20/20				% of Reference	
	C1-1	C1-2	C1-3	Average	VL1-1	VL1-2	VL1-3	Average		
1-day Strength (psi)	1360	1200	1430	1330	1380	1220	1430	1343	101.0%	N/A
3-day Strength (psi)	3210	2840	3010	3020	3250	2900	2930	3027	100.2%	Pass
7-day Strength (psi)	3850	3620	3830	3767	3870	3510	3640	3673	97.5%	Pass
28-day Strength (psi)	5170	4810	5150	5043	5190	4820	4850	4953	98.2%	Pass
56-day Strength (psi)	5870	5270	5390	5510	5710	5340	5210	5420	98.4%	Pass
90-day Strength (psi)	6270	5160	5770	5733	5620	5600	5530	5583	97.4%	Pass
6-Month Strength (psi)	6250	5700	6140	6030	6260	5980	5910	6050	100.3%	Pass
1 Year Strength (psi)	6820	6080	6340	6413	6320	5780	5950	6017	93.8%	Pass



Attachment #1

ASTM C494 Matched Set Data

TCG Project No.: 13001

Description Special Products Group C494 Compliance Testing

Admixture Test **VL 20/20**

Test Series ID **VL1-1 VL1-2 VL1-3**

Control ID **C1-1 C1-2 C1-3**

Flexural Strength / Modulus of Rupture @ Failure

	Control Batch				VL 20/20				% of Reference	
	C1-1	C1-2	C1-3	Average	VL1-1	VL1-2	VL1-3	Average		
3-day Strength (psi)	465	475	470	470	505	455	480	480	102.1%	Pass
7-day Strength (psi)	480	580	580	547	570	595	535	567	103.7%	Pass
28-day Strength (psi)	700	680	695	692	710	685	690	695	100.5%	Pass

Freeze-Thaw Durability

	Control Batch				VL 20/20				% of Reference	
	C1-1	C1-2	C1-3	Average	VL1-1	VL1-2	VL1-3	Average		
Average Weight Loss (%)	-0.30	-0.17	-0.27	-0.25	-0.55	-0.95	-0.21	-0.57		
RDME @ 300 cycles (Prism A)	96.8	102.2	96.6	98.5	97.6	102.0	99.2	99.6		
RDME @ 300 cycles (Prism B)	93.8	101.1	97.1	97.3	97.0	100.7	97.9	98.5		
Durability Factor	95.3	101.7	96.9	98.0	97.3	101.3	98.6	99.1	101.1%	Pass

Length Change

	Control Batch				VL 20/20				Vs. Reference	
	C1-1	C1-2	C1-3	Average	VL1-1	VL1-2	VL1-3	Average		
14 Day in Air (Total 28 days)	-0.020%	-0.021%	-0.019%	-0.0200%	-0.021%	-0.023%	-0.021%	-0.0217%	108%	Pass

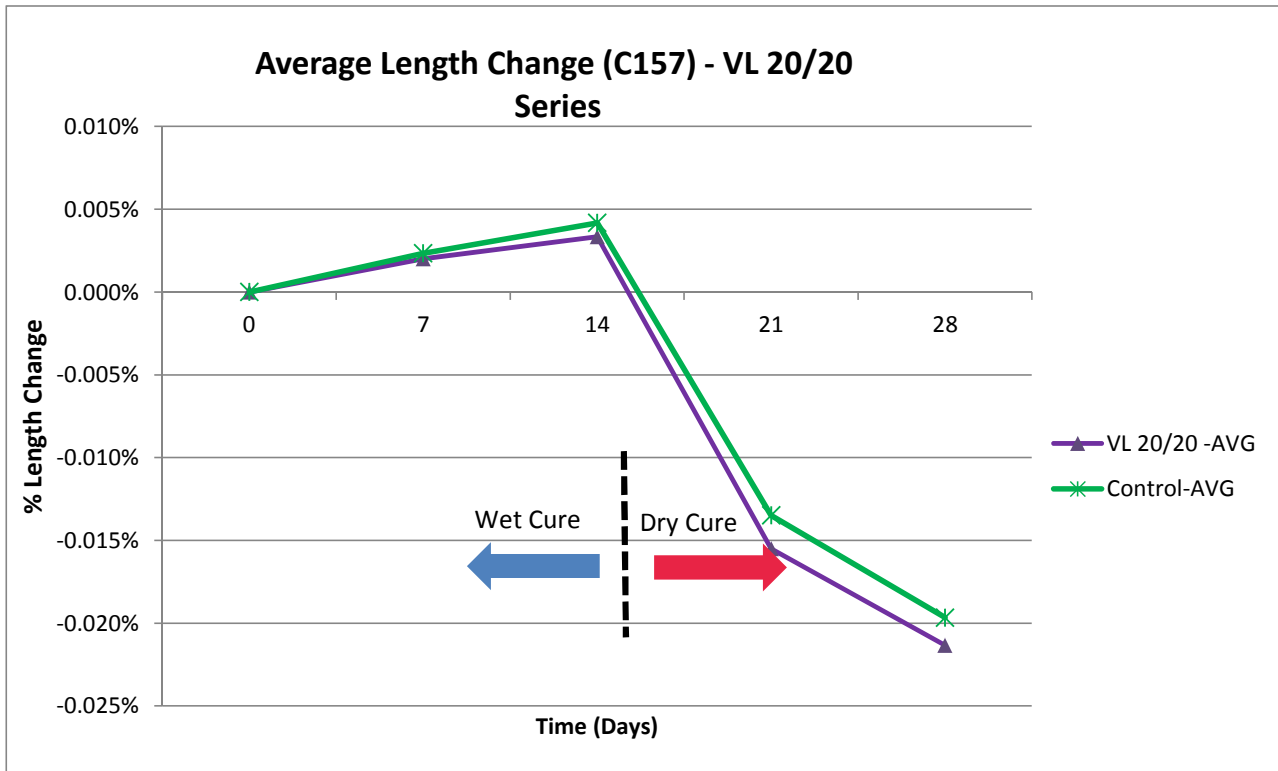
Attachment #2

ASTM C494 Matched Set Data

TCG Project No. 13001
Description Special Products Group C494 Compliance Testing
Admixture Test VL 20/20

		Initial	WET		DRY	
		0	7	14	21	28
VL1-1	VL 20/20	0.000%	0.003%	0.003%	-0.016%	-0.021%
VL1-2	VL 20/20	0.000%	0.000%	0.002%	-0.017%	-0.023%
VL1-3	VL 20/20	0.000%	0.004%	0.005%	-0.014%	-0.021%
C1-1	Control	0.000%	0.003%	0.003%	-0.014%	-0.020%
C1-2	Control	0.000%	0.001%	0.004%	-0.015%	-0.021%
C1-3	Control	0.000%	0.003%	0.006%	-0.012%	-0.019%
VL 20/20 -AVG		0.000%	0.002%	0.003%	-0.016%	-0.021%
Control-AVG		0.000%	0.002%	0.004%	-0.014%	-0.020%
% or Increase over Control						108.5%
Percentage Units Difference						0.001

Note: Since Reference Length change is <0.03%, the test specimen length change must be no more than 0.010 percentage units greater than the reference concrete





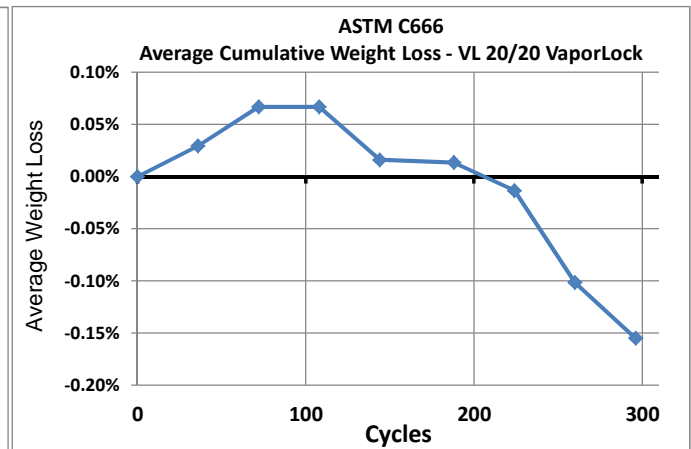
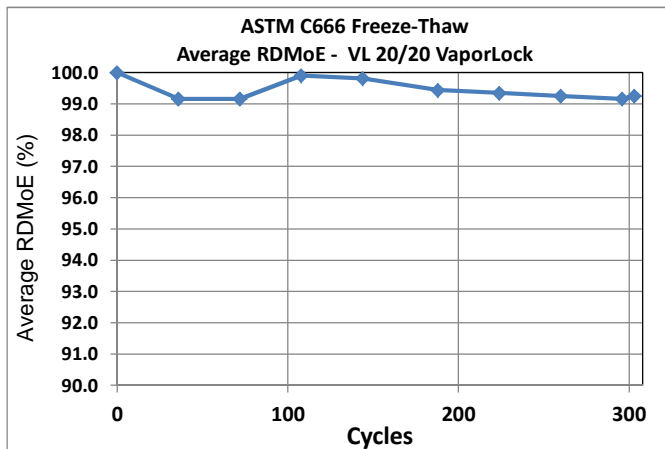
Vapor Lock 20/20

Freeze-Thaw
 Durability:

Relative Dynamic Modulus of Elasticity (RDMoE), % at No. Cycles Listed									
No. F/Thaw Cycles	Bar 1	Bar 2	No. F/Thaw Cycles	Bar 3	Bar 4	No. F/Thaw Cycles	Bar 5	Bar 6	Average
0	100.0	100.0	0	100.0	100.0	0	100.0	100.0	
36	96.6	95.6	36	101.3	101.6	36	99.2	98.2	98.8
72	96.5	96.7	72	101.6	101.9	72	99.2	98.2	99.0
108	97.4	97.8	108	102.9	103.0	108	99.9	98.5	99.9
144	98.7	98.0	152	103.0	101.0	144	99.8	98.3	99.8
188	98.4	97.4	188	103.0	101.0	180	99.4	98.0	99.5
224	97.9	97.4	224	102.8	100.9	216	99.3	97.8	99.4
260	97.8	97.3	260	102.5	100.9	252	99.3	98.0	99.3
296	97.6	97.1	296	102.1	100.7	291	99.2	97.8	99.1
303	97.6	97.0	302	102.0	100.7	301	99.3	97.9	99.1
Durability Factor (DF)									
300	97.6	97.0	300	102.0	100.7	300	99.2	97.9	99.1

Mass Loss:

Cumulative Weight Loss									
No. F/Thaw Cycles	Bar 1	Bar 2	No. F/Thaw Cycles	Bar 3	Bar 4	No. F/Thaw Cycles	Bar 5	Bar 6	Average
0	0.00%	0.00%	0	0.00%	0.00%	0	0.00%	0.00%	0.00%
36	0.08%	0.06%	36	0.06%	0.06%	36	0.03%	0.00%	0.05%
72	0.09%	0.08%	72	0.06%	0.01%	72	0.07%	0.05%	0.06%
108	-0.03%	0.01%	108	0.02%	0.00%	108	0.07%	0.04%	0.02%
144	-0.11%	-0.08%	152	0.80%	-0.95%	144	0.02%	0.02%	-0.05%
188	-0.21%	-0.30%	188	-0.17%	-1.05%	180	0.01%	0.02%	-0.28%
224	-0.27%	-0.39%	224	-0.32%	-1.20%	216	-0.01%	-0.03%	-0.37%
260	-0.35%	-0.54%	260	-0.41%	-1.30%	252	-0.10%	-0.17%	-0.48%
296	-0.47%	-0.64%	296	-0.52%	-1.40%	291	-0.15%	-0.28%	-0.58%
303	-0.46%	-0.64%	302	-0.51%	-1.39%	301	-0.15%	-0.27%	-0.57%





Control

Freeze-Thaw Durability:

Relative Dynamic Modulus of Elasticity (RDMoE), % at No. Cycles Listed									
No. F/Thaw Cycles	Bar 1	Bar 2	No. F/Thaw Cycles	Bar 3	Bar 4	No. F/Thaw Cycles	Bar 5	Bar 6	Average
0	100.0	100.0	0	100.0	100.0	0	100.0	100.0	100.0
36	97.5	96.7	36	101.5	101.3	36	97.9	97.3	98.7
72	97.6	97.3	72	102.5	101.8	72	97.8	97.4	99.1
108	98.3	97.2	108	102.6	102.8	108	97.4	97.3	99.3
144	97.3	94.3	152	102.5	101.6	144	97.4	97.2	98.4
188	97.5	97.7	188	102.9	101.8	180	97.2	96.9	99.0
224	97.3	94.1	224	102.6	102.0	216	96.9	96.9	98.3
260	97.0	93.8	260	102.5	101.6	252	96.9	97.0	98.2
296	96.8	93.8	296	102.3	101.1	291	96.7	97.0	97.9
303	96.8	93.8	300	102.2	101.1	301	96.6	97.1	97.9
Durability Factor (DF)									
300	96.8	93.8	300	102.2	101.1	300	96.6	97.1	97.9

Mass Loss:

Cumulative Weight Loss									
No. F/Thaw Cycles	Bar 1	Bar 2	No. F/Thaw Cycles	Bar 3	Bar 4	No. F/Thaw Cycles	Bar 5	Bar 6	Average
0	0.00%	0.00%	0	0.00%	0.00%	0	0.00%	0.00%	0.00%
36	0.08%	0.09%	36	0.04%	0.05%	36	0.01%	0.06%	0.05%
72	0.13%	0.08%	72	0.07%	0.04%	72	-0.01%	0.06%	0.06%
108	0.10%	0.08%	108	0.08%	0.05%	108	-0.01%	0.05%	0.06%
144	0.00%	0.03%	152	0.07%	-0.03%	144	-0.04%	0.07%	0.02%
188	-0.17%	-0.01%	188	0.05%	-0.08%	180	-0.14%	0.01%	-0.06%
224	-0.20%	-0.09%	224	0.01%	-0.10%	216	-0.19%	-0.03%	-0.10%
260	-0.26%	-0.19%	260	-0.05%	-0.13%	252	-0.30%	-0.12%	-0.17%
296	-0.32%	-0.26%	296	-0.14%	-0.20%	291	-0.33%	-0.21%	-0.24%
303	-0.32%	-0.27%	300	-0.14%	-0.21%	301	-0.32%	-0.22%	-0.25%

