

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION  
**CONTRACTOR HOT MIX ASPHALT DESIGN DATA**

CEM-3512 (REV 8/2014)

HOT MIX ASPHALT PRODUCER NAME AND ADDRESS Dutra Materials - Richmond 961 Stenmark Drive Richmond, CA 94801	QUALIFIED LABORATORY NAME, ADDRESS, AND PHONE NUMBER Pavement Engineering Inc. 20260 Skypark Dr. Redding, CA 96002	HMA TYPE AND GRADING 3/8-inch HMA-A SP 15% RAP	DATE March 1, 2021
HMA PRODUCER PHONE NUMBER (510) 970-7710	QUALIFIED LABORATORY PHONE NUMBER (530) 224-4535	PRODUCER MIX IDENTIFICATION NUMBER L210142	
		DATE TEST PERFORMED February 25, 2021	
		DATE AASHTO T 283 AND T 324 TEST RESULTS SUBMITTED <sup>1</sup>	

The information provided in this form must be in accordance with "Hot Mix Asphalt, Superpave" of the *Standard Specifications* and the California Test Method indicated. For information concerning this form, contact the METS Office of Roadway Materials Testing at (916) 227-7303.

**AGGREGATE GRADATION**

Bin	1	2	3	4	5	Combined Reclaimed Asphalt Pavement	Lime	Combined Gradation
Material Size	3/8"	Dust						
Bin %	35	50				15		100
Sieve Size	<b>% Passing</b>							
2"	100	100				100		100
1½"	100	100				100		100
1"	100	100				100		100
¾"	100	100				100		100
½"	100	100				100		100
⅜"	92	100				98		97
No. 4	9	81				78		55
No. 8	2	45				59		32
No. 16	1	29				44		21
No. 30	1	21				33		16
No. 50	1	16				23		12
No. 100	1.0	12.0				13.5		8.4
No. 200	0.4	8.9				8.9		5.9

LIST AGGREGATE SOURCES, CALIFORNIA MINE, AND SMARA IDENTIFICATION NUMBERS FOR EACH BIN:

Bin #1	Bin #2	Bin #3	Bin #4	Bin #5
San Rafael Rock Quarry 91-21-0008	San Rafael Rock Quarry 91-21-0008			

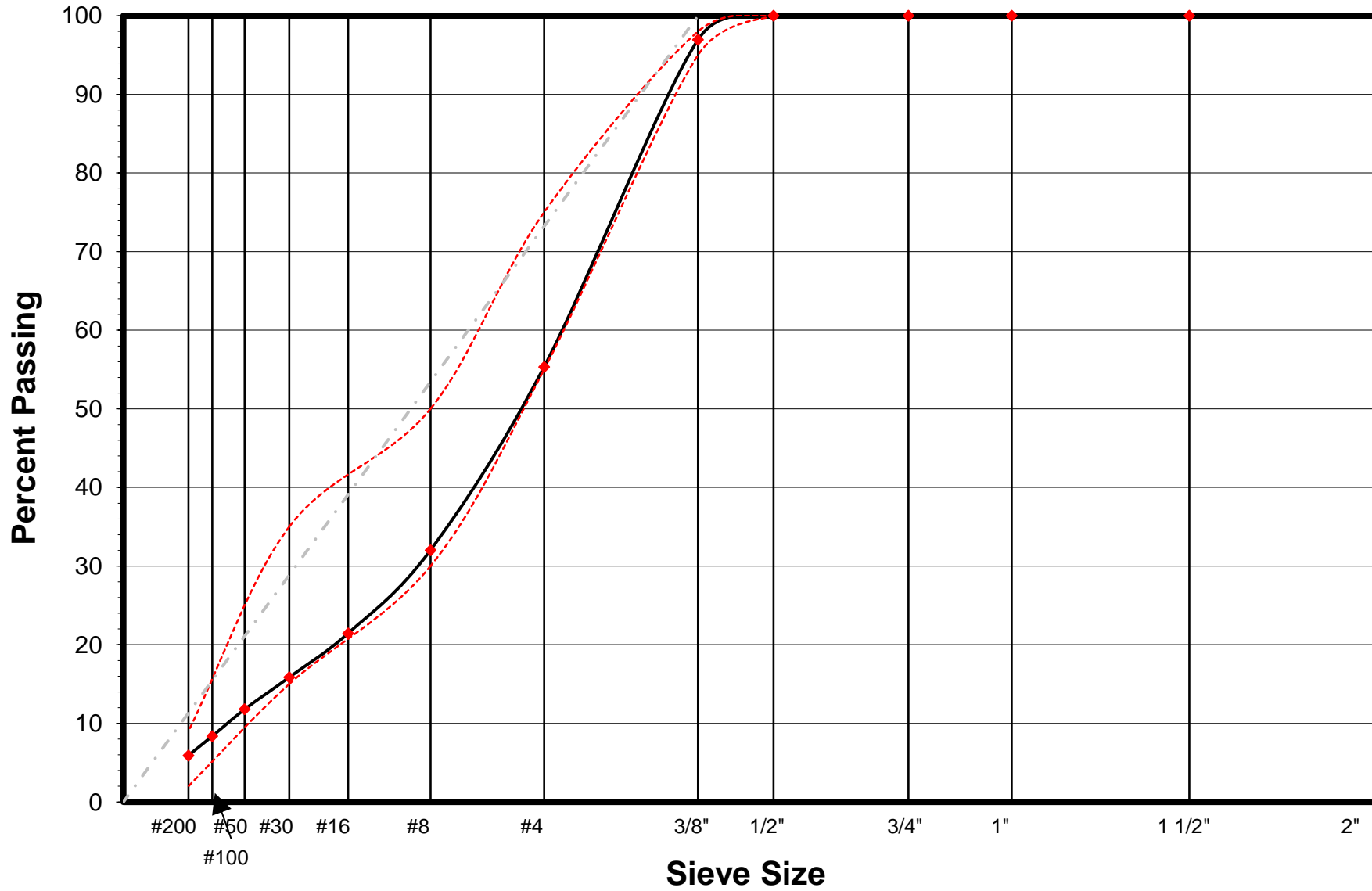
Note:

<sup>1</sup> If Submitting AASHTO T 283 and T 324 test results separately from initial CEM 3512, resubmit pages 1, 7 and 8 with test results

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### FHWA 0.45 Power Gradation Chart



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**AGGREGATE QUALITY <sup>1</sup>**

Quality Characteristic/Property	Test Method	Test Result			
Crushed particles, coarse aggregate One fractured face (%)	AASHTO T 335 Method 2	100%			
Crushed particles, coarse aggregate Two fractured faces (%)	AASHTO T 335 Method 2	100%			
Crushed particles, fine aggregate (Passing No. 4 sieve and retained on No. 8 sieve) One fractured face (%)	AASHTO T 335 Method 2	100%			
Los Angeles Rattler, Loss at 100 Rev. (%)	AASHTO T 96	6.1%			
Los Angeles Rattler, Loss at 500 Rev. (%)	AASHTO T 96	20.2%			
Sand equivalent	AASHTO T 176	55	54	55	Average: 55
Fine aggregate angularity (%)	AASHTO T 304 (Method A)	48.1			
Flat and elongated particles (% by mass at 3:1)	ASTM D 4791				
Flat and elongated particles (% by mass at 5:1)	ASTM D 4791	1%			
Plasticity Index	California Test 204	NP			
Bulk specific gravity (oven dry) of coarse aggregate	AASHTO T 85	2.625			
Absorption of coarse aggregate	AASHTO T 85	1.43%			
Bulk specific gravity (SSD) of fine aggregate	AASHTO T 84	2.637			
Bulk specific gravity (oven dry) of fine aggregate	AASHTO T 84	2.589			
Absorption of fine aggregate	AASHTO T 84	1.84%			
Apparent specific gravity of supplemental fines	AASHTO T 84				
Bulk specific gravity of the aggregate blend	SP-2 Asphalt Mixtures	2.618			

**PROJECT SPECIFIED AGGREGATE QUALITY CHARACTERISTICS**

Sodium Sulfate Soundness	AASHTO T 104	
Cleaness Value	California Test 227	
Fine aggregate Durability Index	AASHTO T 210	64
Coarse aggregate Durability Index	AASHTO T 210	59

Note:

<sup>1</sup> Aggregate must comply with the quality specifications before it is treated with lime.

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CEM-3512 (NEW 8/2014)

HMA TYPE/GRADING 3/8-inch HMA-A SP 15% RAP	PRODUCER NAME Dutra Materials - Richmond	PRODUCER MIX IDENTIFICATION NUMBER L210142	RAP SOURCE Stockpile at Plant	DATE March 1, 2021
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**RECLAIMED ASPHALT PAVEMENT AGGREGATE GRADATION, ASPHALT BINDER CONTENT, AND THE THEORETICAL MAXIMUM SPECIFIC GRAVITY**

Sieve Size	ASTM D 2172 (Method B), California Test 202, and AASHTO T 209 <sup>1</sup>				AASHTO T 308 (Method A) and California Test 202 <sup>2</sup>				Aggregate Gradation Correlation Factor <sup>3</sup>	
	Sample 1	Sample 2	Sample 3	Average <sup>4</sup>	Sample 1	Sample 2	Sample 3	Average		
% Passing	2"	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
	1½"	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
	1"	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
	¾"	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
	½"	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
	⅜"	98.5	98.2	98.4	98.4	98.0	97.7	97.8	97.8	0.6
	No. 4	77.9	77.9	78.0	77.9	77.0	80.8	79.0	79.0	-1.1
	No. 8	58.8	58.9	58.9	58.9	57.3	63.1	59.8	60.1	-1.2
	No. 16	44.1	44.2	44.2	44.1	42.6	48.1	44.3	45.0	-0.9
	No. 30	33.3	33.6	33.4	33.4	32.4	36.4	34.7	34.5	-1.1
	No. 50	22.7	23.2	22.9	23.0	22.9	24.7	23.7	23.8	-0.8
No. 100	13.2	13.9	13.5	13.5	14.0	14.1	14.3	14.1	-0.6	
No. 200	8.5	9.2	9.0	8.9	9.3	8.9	9.2	9.1	-0.2	
Asphalt Binder Content	5.05	5.28	5.17	5.17	Report Only 6.33	Report Only 6.84	Report Only 6.55	Report Only 6.57		
Maximum Specific Gravity	2.487	2.487	2.487	2.487						

Note:  
<sup>1</sup> A minimum of three samples are required. Determine the asphalt binder content of each RAP sample under ASTM D 2172, Method B. Perform a sieve analysis on each sample of recovered aggregate under California Test 202, Appendix A. Determine the theoretical maximum specific gravity (Rice) of each RAP sample under AASHTO T 209.  
<sup>2</sup> A minimum of 3 samples are required. Burn asphalt from each RAP sample in accordance with AASHTO T 308 Method A. Calculate and report asphalt binder content for information only. Perform a sieve analysis on each sample of recovered aggregate in accordance with California Test 202, Appendix A.  
<sup>3</sup> The correlation factor for each sieve is determined by taking the average gradation of the ASTM D 2172 samples minus the average gradation of the AASHTO T 308 Method A samples.  
<sup>4</sup> Average gradation used to calculate the combined gradation.

HMA TYPE/GRADING	PRODUCER NAME	PRODUCER MIX IDENTIFICATION NUMBER	DATE
3/8-inch HMA-A SP 15% RAP	Dutra Materials - Richmond	L210142	March 1, 2021

**ASPHALT BINDER <sup>1,2</sup>**

Asphalt binder supplier: [Valero - Benicia](#)

Asphalt binder grade: [PG 64-10](#)

Supplier recommended mixing temperature: [300 - 310 °F](#)

Quality Characteristic	Test Method	Test Result
Specific gravity	AASHTO T 228	1.036
Dynamic Shear (RTFO residue), Test Temp. at 10 rad/s, 60°C	AASHTO T 315	4.31

Note:

<sup>1</sup> Including base asphalt in asphalt rubber binder.

<sup>2</sup> Asphalt binder treated with liquid antistrip must comply with Section 92, "Asphalts," of the *Standard Specifications* for the grade specified.

**ANTISTRIP ADDITIVES**

Antistrip type:

Antistrip source:

Antistrip percentage: <sup>3,4</sup>

Method of antistrip addition:

Quality Characteristics	Test Method	Test Result
Liquid antistrip (LAS) total amine value (min.)	ASTM D 2074	

Note:

<sup>3</sup> Liquid Antistrip must be between 0.5 and 1.0 percent by weight of asphalt binder.

<sup>4</sup> Combined lime ratio must be between 0.8 and 1.5 by weight of dry aggregate (may be reduced to 0.5 to 1.0 for OGFC).

**WARM MIX ASPHALT TECHNOLOGY**

Warm Mix Asphalt Technology Type:

Warm Mix Asphalt Technology Product Name:

Warm Mix Asphalt Product Source:

Warm Mix Asphalt Additive Percentage:

Method of adding Warm Mix Asphalt Additive Technology in the Mix Design <sup>5</sup>:

**Foaming Bitumen**

Quality Characteristic	Test Method	Test Result	Specification Limits
Expansion Ratio (minimum)	Laboratory Procedure LP-12		4
Half Life (second minimum)	Laboratory Procedure LP-12		4

Note:

<sup>5</sup> Water injection technology is not required for mix design

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3/8-inch HMA-A SP 15% RAP	Dutra Materials - Richmond	L210142	March 1, 2021

**Asphalt Rubber Binder**

**ASPHALT MODIFIER**

Asphalt modifier supplier

Asphalt modifier percentage (2.0% - 6.0% by weight of asphalt binder)

Base asphalt and asphalt modifier percentage (78.0% - 82.0% by weight of asphalt rubber binder)

Quality Characteristics	Test Method	Test Result	Specification Limit
Viscosity, m <sup>2</sup> /s (x 10-6) at 100°C	ASTM D 445		19 to 36 (± 3)
Flash Point, CL.O.C., °C (min.)	ASTM D 92		207
Asphaltenes, % by mass (max.)	ASTM D 2007		0.1
Aromatics, % by mass (min.)	ASTM D 2007		55

**CRUMB RUBBER MODIFIER**

Scrap tire CRM supplier

High natural CRM supplier

Scrap tire CRM percentage (73.0% - 77.0% by total weight of CRM)

High natural CRM percentage (23.0% - 27.0% by total weight of CRM)

Combined scrap tire and high natural CRM percentage (18.0% - 22.0% by weight of binder)

Quality Characteristic	Test Method	Test Result	Specification Limits
Scrap tire CRM gradation (% passing No. 8 sieve)	LP-10		100
High natural CRM gradation (% passing No. 10 sieve)	LP-10		100
Wire in CRM (% max.)	LP-10		0.01
Fabric in CRM (% max.)	LP-10		0.05
CRM particle length (inch max.)	----		3/16
CRM specific gravity	California Test 208		1.1 - 1.2
Natural rubber content in high natural CRM (%)	ASTM D 297		40.0 - 48.0

**ASPHALT RUBBER BINDER DESIGN AND PROFILE**

Quality Characteristic	Test Method	Minutes of Reaction <sup>1</sup>						Specification Limits	
		45	60	90	120	240	360		1440
Cone penetration @ 77 °F, (0.10-mm)	ASTM D 217								25 - 70
Resilience @ 77 °F, % rebound (min.)	ASTM D 5329								18
Field softening point, °F	ASTM D 36								125 - 165
Viscosity, centipoises	LP-11								1,500 - 4,000
Reaction Temperature:		Reaction temperature from 1320 minutes to 1440 minutes:							

<sup>1</sup> Six hours (360) minutes after CRM addition, reduce the oven temperature to 275 degrees F for a period of 16 hours. After the 16-hour cooldown (1320 minutes after CRM addition), reheat the binder to the reaction temperature expected during production (350 °F) for sampling and testing at 24 hours (1440 minutes).

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**HOT MIX ASPHALT DESIGN DATA AT JOB MIX FORMULA <sup>1</sup>**

Quality Characteristic	Test Method	Test Result			
Asphalt binder content (%)	AASHTO T 308 Method A	5.70			
Briquette bulk specific gravity	AASHTO T 275	1	2	3	Average 2.342
		2.340	2.342	2.343	
Maximum specific gravity	AASHTO T 209	2.440			
Air voids content (%)	SP-2 Asphalt Mixtures	1	2	3	Average 4.0
		4.1	4.0	4.0	
Voids in mineral aggregate (%)	SP-2 Asphalt Mixtures	1	2	3	Average 15.7
		15.7	15.6	15.6	
Effective specific gravity of RAP aggregate	SP-2 Asphalt Mixtures	2.687			
Dust proportion	SP-2 Asphalt Mixtures	1.2			
Effective specific gravity of aggregate	SP-2 Asphalt Mixtures	2.658			
Moisture Susceptibility (minimum dry strength, psi) untreated <sup>2</sup> <input type="checkbox"/> <sup>3</sup> Results to be submitted with verification sample. Prior Resident engineer's approval required.	AASHTO T 283				Date Submitted:
Moisture Susceptibility (minimum dry strength, psi) treated <sup>2</sup> <input checked="" type="checkbox"/> <sup>3</sup> Results to be submitted with verification sample. Prior Resident engineer's approval required.	AASHTO T 283				Date Submitted:
Moisture Susceptibility (minimum wet strength, psi) untreated <sup>2</sup> <input type="checkbox"/> <sup>3</sup> Results to be submitted with verification sample. Prior Resident engineer's approval required.	AASHTO T 283				Date Submitted:
Moisture Susceptibility (minimum wet strength, psi) treated <sup>2</sup> <input checked="" type="checkbox"/> <sup>3</sup> Results to be submitted with verification sample. Prior Resident engineer's approval required.	AASHTO T 283				Date Submitted:
Hamburg Wheel Track (minimum number of passes at 0.5inch average rut depth) <input checked="" type="checkbox"/> <sup>3</sup> Results to be submitted with verification sample. Prior Resident engineer's approval required.	AASHTO T 324 (modified)				Date Submitted:
Hamburg Wheel Track (inflection point minimum number of passes) <input checked="" type="checkbox"/> <sup>3</sup> Results to be submitted with verification sample. Prior Resident engineer's approval required.	AASHTO T 324 (modified)				Date Submitted:

Note:  
<sup>1</sup> For mix design, prepare 3 briquettes separately at the proposed job mix formula and test for compliance. Report the average of 3 tests. Prepare new briquettes and test if the range of bulk specific gravity for the 3 briquettes is more than 0.02.  
<sup>2</sup> Attach Table 1 from AASHTO T 283  
<sup>3</sup> JMF Submittal is not complete until all required test results are submitted

Notes/Remarks:

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**HOT MIX ASPHALT DESIGN DATA AT JOB MIX FORMULA <sup>1</sup>**

Quality Characteristic	Test Method	Test Result			
Aggregate mixing temperature		320 - 330 °F			
Binder Mixing Temperature (±5°C)		300 - 310 °F			
Mixture Compaction Temperature		285 °F			
HMS-Type A-SP	AASHTO T 312	Mass (g)	Air Voids (%)		
N <sub>initial</sub> (8 Gyrations)		4695	12.4		
HMS-Type A-SP	AASHTO T 312	Mass (g)	Air Voids (%)		
N <sub>design</sub> (85 Gyrations)		4695	4.0		
HMS-Type A-SP	AASHTO T 312	Mass (g)	Air Voids (%)		
N <sub>final</sub> (130 Gyrations)		4695	2.3		
RHMA-G-SP	AASHTO T 312	# Gyrations	Mass (g)	Air Voids (%)	
N <sub>design</sub> (50-150 Gyrations)					
Hamburg Wheel Track Test Specimens	AASHTO T 312	1	2	3	4
Gyrations					
Height (mm)					
Mass (g)					

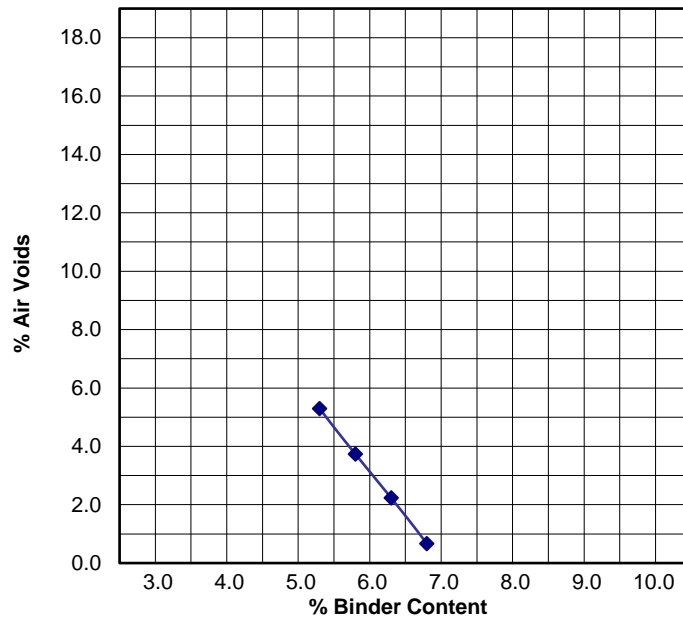
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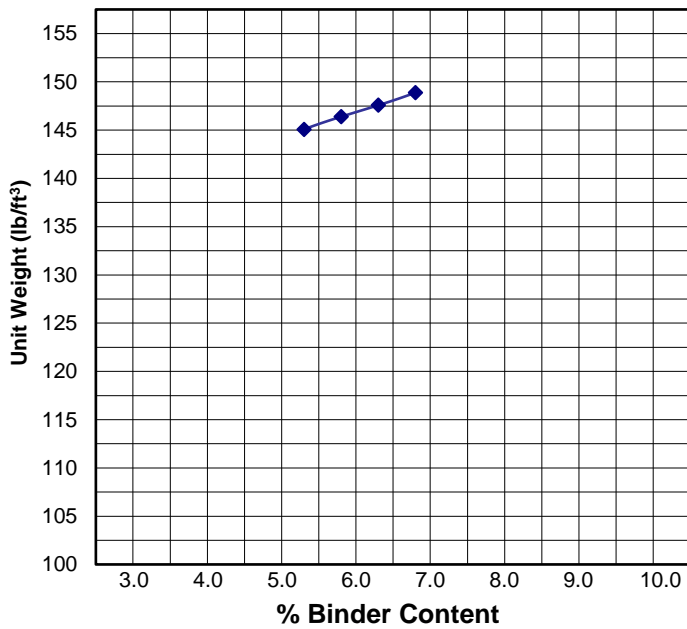
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**AIR VOIDS**



**UNIT WEIGHT**



**VOIDS IN MINERAL AGGREGATE**

