

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 1/2-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 L210141	
		DATE TEST PERFORMED February 25, 2021	
		DATE AASHTO T 283 AND T 324 TEST RESULTS SUBMITTED ¹ September 14, 2020	

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	1/2"	3/8"	Dust					
Bin %	12	23	50			15		100
Sieve Size	% Passing							
2"	100	100	100			100		100
1 1/2"	100	100	100			100		100
1"	100	100	100			100		100
3/4"	100	100	100			100		100
1/2"	86	100	100			100		98
3/8"	27	92	100			98		89
No. 4	4	9	81			78		55
No. 8	3	4	49			59		35
No. 16	3	1	29			44		22
No. 30	2	1	21			33		16
No. 50	2	1	16			23		12
No. 100	1.0	1.0	12.0			13.5		8.4
No. 200	0.7	0.4	8.9			8.9		6.0

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	San Rafael Rock Quarry 91-21-0008		

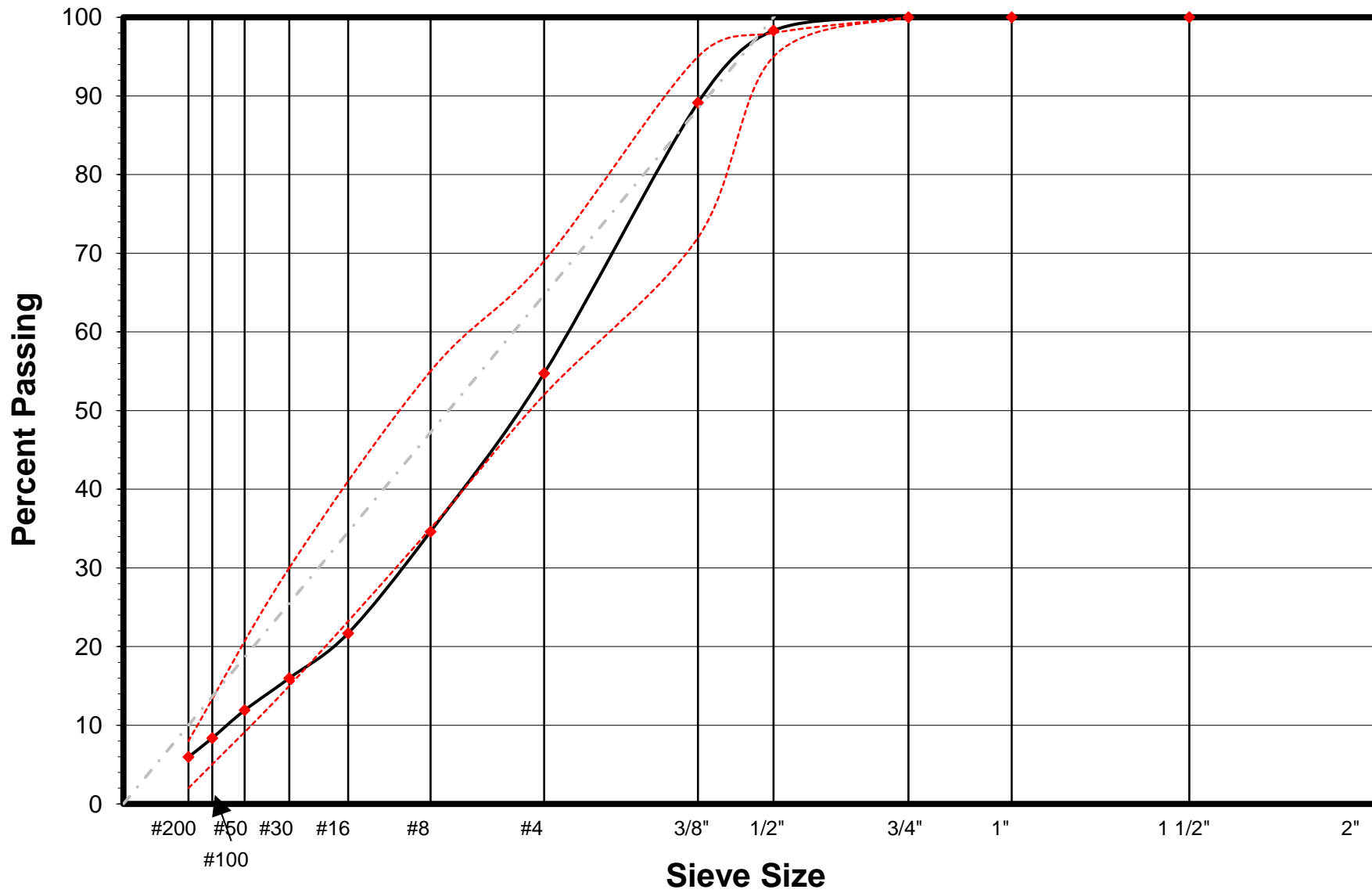
Note:

¹ 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 ¹

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	5.4%			
Los Angeles Rattler, Loss at 500 Rev. (%)	AASHTO T 96	17.6%			
Sand equivalent	AASHTO T 176	54	52	54	Average: 54
Fine aggregate angularity (%)	AASHTO T 304 (Method A)	47.0			
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	2.621			
Absorption of coarse aggregate	AASHTO T 85	1.40%			
Bulk specific gravity (SSD) of fine aggregate	AASHTO T 84	2.62			
Bulk specific gravity (oven dry) of fine aggregate	AASHTO T 84	2.563			
Absorption of fine aggregate	AASHTO T 84	2.21%			
Apparent specific gravity of supplemental fines	AASHTO T 84				
Bulk specific gravity of the aggregate blend	SP-2 Asphalt Mixtures	2.605			

PROJECT SPECIFIED AGGREGATE QUALITY CHARACTERISTICS

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

Note:

¹ Aggregate must comply with the quality specifications before it is treated with lime.

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STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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CEM-3512 (NEW 8/2014)

HMA TYPE/GRADING 1/2-inch HMA-A SP 15% RAP	PRODUCER NAME Dutra Materials - Richmond	PRODUCER MIX IDENTIFICATION NUMBER L210141	RAP SOURCE	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 ¹				AASHTO T 308 (Method A) and California Test 202 ²				Aggregate Gradation Correlation Factor ³	
	Sample 1	Sample 2	Sample 3	Average ⁴	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:
¹ 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.
² 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.
³ 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.
⁴ Average gradation used to calculate the combined gradation.

HMA TYPE/GRADING	PRODUCER NAME	PRODUCER MIX IDENTIFICATION NUMBER	DATE
1/2-inch HMA-A SP 15% RAP	Dutra Materials - Richmond	L210141	March 1, 2021

ASPHALT BINDER ^{1,2}

Asphalt binder supplier: [Valero - Benicia](#)
 Asphalt binder grade: [PG 64-16](#)
 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:

¹ Including base asphalt in asphalt rubber binder.

² 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: ^{3,4}
 Method of antistrip addition:

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

Note:

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

⁴ 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 ⁵:

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:

⁵ Water injection technology is not required for mix design

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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 ² /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 ¹						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:							

¹ 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 ¹

Quality Characteristic	Test Method	Test Result			
Asphalt binder content (%)	AASHTO T 308 Method A	5.40			
Briquette bulk specific gravity	AASHTO T 275	1	2	3	Average 2.352
		2.352	2.350	2.353	
Maximum specific gravity	AASHTO T 209	2.450			
Air voids content (%)	SP-2 Asphalt Mixtures	1	2	3	Average 4.0
		4.0	4.1	4.0	
Voids in mineral aggregate (%)	SP-2 Asphalt Mixtures	1	2	3	Average 14.6
		14.6	14.7	14.6	
Effective specific gravity of RAP aggregate	SP-2 Asphalt Mixtures	2.687			
Dust proportion	SP-2 Asphalt Mixtures	1.3			
Effective specific gravity of aggregate	SP-2 Asphalt Mixtures	2.657			
Moisture Susceptibility (minimum dry strength, psi) untreated ² <input type="checkbox"/> ³ 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 ² <input type="checkbox"/> ³ Results to be submitted with verification sample. Prior Resident engineer's approval required.	AASHTO T 283	208			Date Submitted: September 14, 2020
Moisture Susceptibility (minimum wet strength, psi) untreated ² <input type="checkbox"/> ³ 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 ² <input type="checkbox"/> ³ Results to be submitted with verification sample. Prior Resident engineer's approval required.	AASHTO T 283	170			Date Submitted: September 14, 2020
Hamburg Wheel Track (minimum number of passes at 0.5inch average rut depth) <input type="checkbox"/> ³ Results to be submitted with verification sample. Prior Resident engineer's approval required.	AASHTO T 324 (modified)	25,000+			Date Submitted: September 14, 2020
Hamburg Wheel Track (inflection point minimum number of passes) <input type="checkbox"/> ³ Results to be submitted with verification sample. Prior Resident engineer's approval required.	AASHTO T 324 (modified)	NO SIP			Date Submitted: September 14, 2020

Note:
¹ 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.
² Attach Table 1 from AASHTO T 283
³ JMF Submittal is not complete until all required test results are submitted

Notes/Remarks:
 AASHTO T 283 Ratio: 81

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HOT MIX ASPHALT DESIGN DATA AT JOB MIX FORMULA ¹

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 _{initial} (8 Gyrations)		4690	12.5		
HMS-Type A-SP	AASHTO T 312	Mass (g)	Air Voids (%)		
N _{design} (85 Gyrations)		4690	4.0		
HMS-Type A-SP	AASHTO T 312	Mass (g)	Air Voids (%)		
N _{final} (130 Gyrations)		4690	2.4		
RHMA-G-SP	AASHTO T 312	# Gyrations	Mass (g)	Air Voids (%)	
N _{design} (50-150 Gyrations)					
Hamburg Wheel Track Test Specimens	AASHTO T 312	1	2	3	4
Gyrations		82	79	88	92
Height (mm)		60.0	60.0	60.0	60.0
Mass (g)		2349	2348	2350	2350

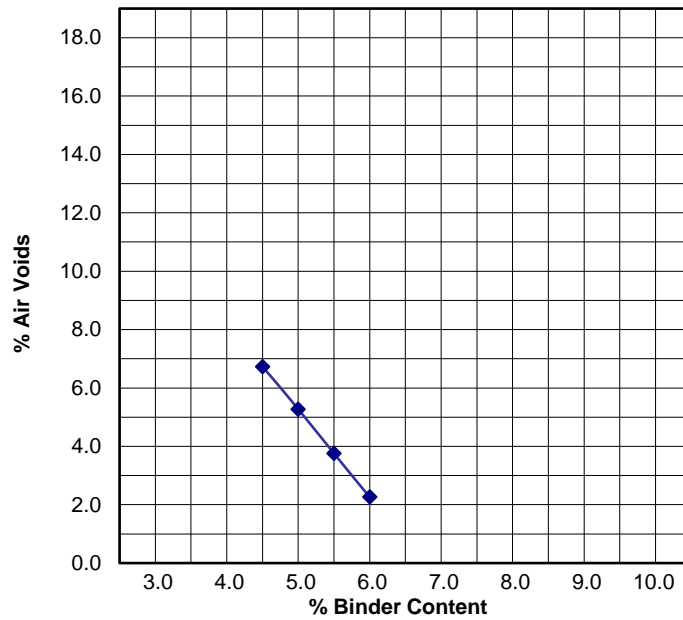
Notes:

Samples held in Compactor for 5 minutes prior to removal.

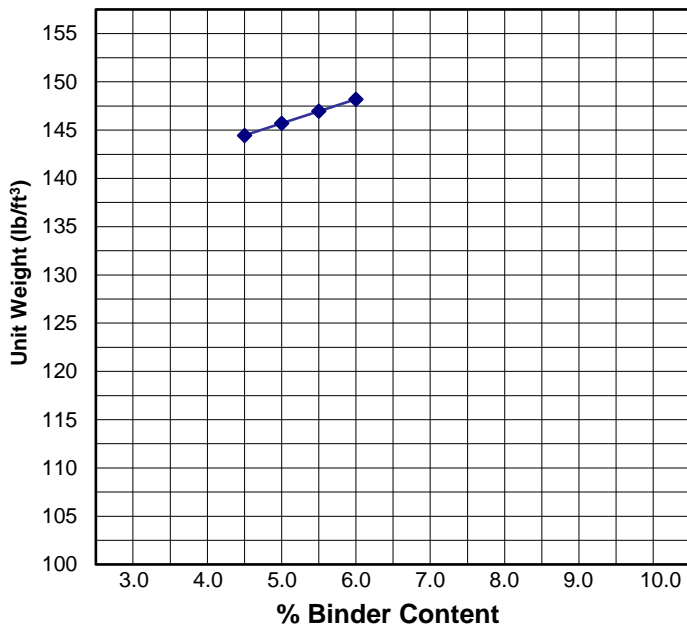
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AIR VOIDS



UNIT WEIGHT



VOIDS IN MINERAL AGGREGATE

