

Arizona Chapter AGC Pavement Preservation Series

Surface Seal Guide for Application and Construction

*Presented by the Pavement Preservation Committee
through the Arizona Chapter
Associated General Contractors*



Developed by the



*Pavement Preservation Committee
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Forward

The Arizona AGC Pavement Preservation guides are collections of best practices and recommendations for the state of Arizona. Surface seals are important pavement preservation tools, and when constructed properly increase the life of a pavement. Following these guidelines and using a reputable AGC member contractor will also contribute to the overall success of the project.

There will be instances where conditions or materials dictate the need to deviate from these guides. It is important that contractors, suppliers, and agencies work together and use common sense to modify these recommendations as needed.

The Arizona Chapter of the Associated General Contractor's Pavement Preservation committee developed this guideline to identify “best practices” to be used during the application of fog and seal coats.

The committee is comprised of contractors, material suppliers, aggregate producers and agency personnel. Special thanks to our partners in the Arizona Department of Transportation: Bill Hurguy, State Materials Engineer and Janet Doerstling Pavement Materials Testing Manager for their contributions.

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1 - Introduction

This document is provided as a guide for suppliers, contractors, agencies and owners.

Surface seals are applications of emulsion sprayed on existing pavements to coat and protect the surface. A surface seal is a generic term that may include: fog, flush, provisional, and rejuvenating coats and seals. These guidelines apply to all of these treatments and provide general best practice information.

Surface seals can be used on chip seals, open grade pavements, and new or weathered hot-mix surfaces. They can also be utilized to renew oxidized asphalt surfaces that have become dry and brittle. Surface treatments coat aggregate particles at the surface to improve chip retention, prevent raveling, seal very small cracks and surface voids, waterproof, and improve aesthetics.

This guide contains best practice information to improve consistency. These variables will be discussed in more detail:

- Existing Surface Conditions
- Surface Preparation
- Materials
- Equipment
- Construction Procedures

2 - Surface Conditions and Preparation

2.1 Surface Conditions

2.1.1 Fog and seal coats can be used to address surface issues in pavements or to mitigate and prevent surface distresses. In addition, they provide limited fine crack protection.

2.1.2 They will not address pavement issues deeper than the surface.

2.2 Preparation

2.2.1 Significant deficiencies in the pavement surface should be repaired before applying surface treatments.

2.2.2 Cracks ¼ inch or wider should be filled. It is recommended that the crack or joint be slightly overfilled then leveled with a 3" sealing disk or v-shaped squeegee to create a neat band aid extending 1" on each side of the crack or joint for surface strength and waterproofing.

2.2.3 Patching and crack seal materials should be given time to cure before fog sealing.

2.2.4 Loose material at the surface should be swept clean and removed prior to sealing.

2.2.5 The surface should be dry and clean prior to applying surface treatments.



Dry



Loose Rock

3 - Materials

3.1 Emulsions

3.1.1 There are many emulsions that can be used for fog and seal coats. Each type of emulsion can affect the breaking and curing process as well as the residual properties of the fog seal.

3.1.2 The manufacturer's guidelines should be followed to ensure proper storage, handling, and dilution (if possible). Typical commodity fog seal emulsions include:

- Unmodified emulsions such as CQS-1h, CSS-1, CSS-1h, SS-1, and SS-1h. These emulsions are also used for other purposes, but work effectively as fog and seal coats.
- Modified versions of the above emulsion types including; latex, co-milled polymers and tire rubber.



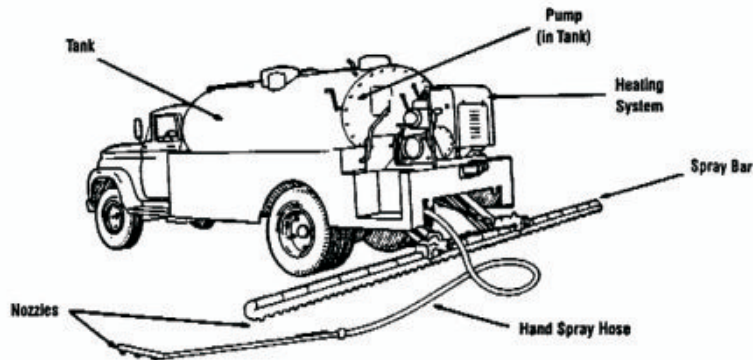
CQS-1h



Modified Tire Rubber Version

4 - Equipment

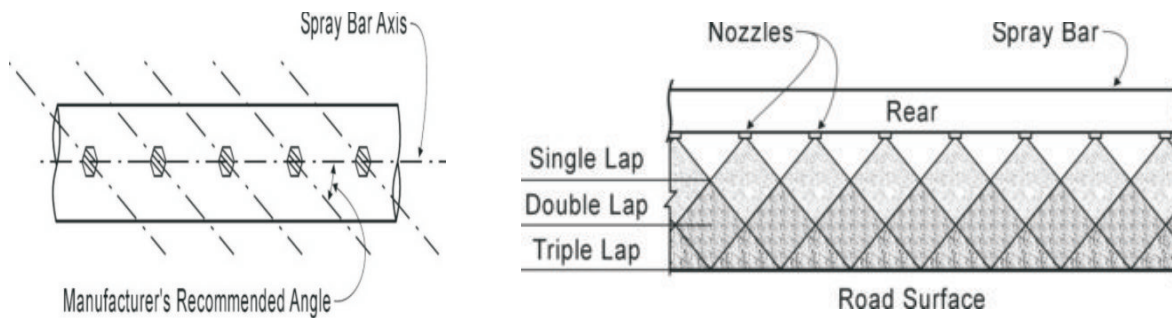
All equipment, tools and machines used in the application of surface seals shall be maintained in satisfactory working condition at all times.



4.1 It is important that the distributor truck be in good working order. Distributor trucks should be “certified” as described in ADOT specification 404-3.02. The distributor must be capable of applying the binder uniformly in both transverse and longitudinal directions at the desired rate. The distributor must be in good mechanical condition, and must be equipped with a functioning computer rate control (CRC). The spreader bar must be properly adjusted for height, contain the correct size of spray nozzles for the type of binder being applied, and the nozzles must be set at the angle recommended by the manufacturer, for efficient coverage. The binder must be at the application temperature recommended by the supplier.

4.2 The spray bar height, nozzle size and orientation affect spray rates and coverage. If adequate coverage isn't achieved, nozzles should be checked for plugs and may need to be adjusted for better coverage.





5 - Construction Procedures

5.1 Prior to the application of the binder, the existing surface must be cleaned of all foreign materials. Mechanical sweepers or brooms and air blowing if necessary, will usually accomplish this cleaning. Once the surface is sufficiently clean and dry, the emulsion can be applied. Surface seals should normally be applied when the ambient temperature is 50 F and rising.

5.2 Proceed with caution when ambient temperatures begin to fall below 50° F before the application has a chance to cure. No material should be applied when rain is imminent or when the wind is excessive.

Volume Measurement

5.3 The volume of material in the distributor truck must be determined in advance so that you can keep track of how much material is used. To determine the volume of material in the distributor truck;

- Make sure that the distributor is on level ground.
- Read the volume gauge
- Read the temperature gauge.
- Correct the volume reading for the temperature of the material using the Temperature - Volume Corrections for Emulsified Asphalts in Appendix B or the Temperature - Volume Corrections for Hot Asphaltic Materials shown in Appendix C.

Traffic Control



5.4 All traffic, with the exception of necessary construction equipment, should be kept off the newly applied chip seal until it has had time to properly set. Traveling speed should not exceed 15 mph over a freshly sealed surface until the loose aggregate is removed. Special care should be taken at intersections to prevent dislodging of chip seal aggregate. Turning should be limited until the initial sweeping is completed. Note: Barricades, signage and traffic control will follow current MUTCD (Manual on Uniform Traffic Control Devices) standards.

Construction Checklist

	YES	/ NO
Project Preview:		
Is the project a good candidate for a fog seal?	<input type="checkbox"/>	<input type="checkbox"/>
What is the existing surface type?	<input type="checkbox"/>	<input type="checkbox"/>
Has an assessment been made of the surface absorption?	<input type="checkbox"/>	<input type="checkbox"/>
Has much stone been lost?	<input type="checkbox"/>	<input type="checkbox"/>
How much bleeding or flushing exists?	<input type="checkbox"/>	<input type="checkbox"/>
Material Checks:		
Asphalt Emulsion: type and dilution rate (if required)	<input type="checkbox"/>	<input type="checkbox"/>
The water that is used is compatible with the emulsion	<input type="checkbox"/>	<input type="checkbox"/>
The emulsion is within application temperature specifications	<input type="checkbox"/>	<input type="checkbox"/>
Sand, if required, is within specifications and dry	<input type="checkbox"/>	<input type="checkbox"/>
Pre-application Inspection Responsibilities:		
Surface Preparation:		
The surface is clean and dry.. . . .	<input type="checkbox"/>	<input type="checkbox"/>
All pavement distresses have been repaired.	<input type="checkbox"/>	<input type="checkbox"/>
The existing surface has been inspected for drainage problems.	<input type="checkbox"/>	<input type="checkbox"/>
Equipment Inspection:		
All Equipment is calibrated and clean	<input type="checkbox"/>	<input type="checkbox"/>

YES / NO

- The spray bar is at the proper height.
- All nozzles are uniformly angled 15° to 30° from the spray bar.
- All nozzles are free of clogs
- The spray pattern for uniformity and proper overlap (double or triple) has been checked.
- Application pressure has been checked.
- There is a working and calibrated thermometer on site.
- Water has been added to the emulsion in correct proportion and circulated.
- There is no foam.

Weather Requirements:

- The minimum surface and air temperature requirements have been met.
- Air and surface temperatures have been checked at the coolest location on the project.
- Air and surface temperatures meet agency requirements.

Note: High winds can create problems with the diluted emulsion application.

Note: High temperatures, humidity, and wind will affect how long the emulsion takes to break.

- The application of emulsion does not begin if rain is likely.

YES / NO

Determining Application Rates:

-
- Agency guidelines and requirements are being followed.
- The absorption ability of the surface has been checked.
- More emulsion can be applied to dried-out and porous surfaces.
- More emulsion can be applied on roads with low traffic volumes.
- Do not apply to smooth, nonporous, and asphalt-rich surfaces.
- Less emulsion must be applied on roads with high traffic volumes.
- Does the emulsion soak into the surface?
- If the texture is high, spray should be in both directions to avoid rain-shadow effects.

Project Inspection:

Emulsion Application:

-
- Emulsion is within the required application temperature range. .
- Application appears uniform.
- Checks are made for drilling and streaking.
- Nozzles are checked for plugging.
- Random application rate checks are performed.
- The distributor is stopped if any problems are observed.



Shoulder Seal



Shoulder Seal over Rumble Strips



Modified Surface Sealing-
Residential Dense Grade



Modified Surface Sealing-
Residential Open Grade



Surface Seal-with sand blotter



Surface Seal

Appendix A

TEMPERATURE-VOLUME CORRECTIONS FOR EMULSIFIED ASPHALTS

LEGEND: t = observed temperature in degrees Fahrenheit

M = multiplier for correcting volumes to the basis of 60 degrees Fahrenheit

t	M	t	M	t	M
50	1.00250	92	0.99200	134	0.98150
51	1.00225	93	0.99175	135	0.98125
52	1.00200	94	0.99150	136	0.98100
53	1.00175	95	0.99125	137	0.98075
54	1.00150	96	0.99100	138	0.98050
55	1.00125	97	0.99075	139	0.98025
56	1.00100	98	0.99050	140	0.98000
57	1.00075	99	0.99025	141	0.97975
58	1.00050	100	0.99000	142	0.97950
59	1.00025	101	0.98975	143	0.97925
60	1.00000	102	0.98950	144	0.97900
61	0.99975	103	0.98925	145	0.97875
62	0.99950	104	0.98900	146	0.97850
63	0.99925	105	0.98875	147	0.97825
64	0.99900	106	0.98850	148	0.97800
65	0.99875	107	0.98825	149	0.97775
66	0.99850	108	0.98800	150	0.97750
67	0.99825	109	0.98775	151	0.97725
68	0.99800	110	0.98750	152	0.97700
69	0.99775	111	0.98725	153	0.97675
70	0.99750	112	0.98700	154	0.97650
71	0.99725	113	0.98675	155	0.97625
72	0.99700	114	0.98650	156	0.97600
73	0.99675	115	0.98625	157	0.97575
74	0.99650	116	0.98600	158	0.97550
75	0.99625	117	0.98575	159	0.97525
76	0.99600	118	0.98550	160	0.97500
77	0.99575	119	0.98525	161	0.97475
78	0.99550	120	0.98500	162	0.97450
79	0.99525	121	0.98475	163	0.97425
80	0.99500	122	0.98450	164	0.97400
81	0.99475	123	0.98425	165	0.97375
82	0.99450	124	0.98400	166	0.97350
83	0.99425	125	0.98375	167	0.97325
84	0.99400	126	0.98350	168	0.97300
85	0.99375	127	0.98325	169	0.97275
86	0.99350	128	0.98300	170	0.97250
87	0.99325	129	0.98275	171	0.97225
88	0.99300	130	0.98250	172	0.97200
89	0.99275	131	0.98225	173	0.97175
90	0.99250	132	0.98200	174	0.97150
91	0.99225	133	0.98175	175	0.97125

Appendix B

TEMPERATURE-VOLUME CORRECTIONS FOR HOT ASPHALTIC MATERIALS GROUP 0 – SPECIFIC GRAVITY AT 60 °F ABOVE 0.966

LEGEND: t = observed temperature in degrees Fahrenheit
M = multiplier for correcting volumes to the basis of 60 degrees Fahrenheit

t	M	t	M	t	M	t	M	t	M	t	M	t	M	t	M
100	0.9861	150	0.9689	200	0.9520	250	0.9352	300	0.9187	350	0.9024	400	0.8864	450	0.8705
101	0.9857	151	0.9686	201	0.9516	251	0.9349	301	0.9184	351	0.9021	401	0.8861	451	0.8702
102	0.9854	152	0.9682	202	0.9513	252	0.9346	302	0.9181	352	0.9018	402	0.8857	452	0.8699
103	0.9851	153	0.9679	203	0.9509	253	0.9342	303	0.9177	353	0.9015	403	0.8854	453	0.8696
104	0.9847	154	0.9675	204	0.9506	254	0.9339	304	0.9174	354	0.9011	404	0.8851	454	0.8693
105	0.9844	155	0.9672	205	0.9503	255	0.9336	305	0.9171	355	0.9008	405	0.8848	455	0.8690
106	0.9840	156	0.9669	206	0.9499	256	0.9332	306	0.9167	356	0.9005	406	0.8845	456	0.8687
107	0.9837	157	0.9665	207	0.9496	257	0.9329	307	0.9164	357	0.9002	407	0.8841	457	0.8683
108	0.9833	158	0.9662	208	0.9493	258	0.9326	308	0.9161	358	0.8998	408	0.8838	458	0.8680
109	0.9830	159	0.9658	209	0.9489	259	0.9322	309	0.9158	359	0.8995	409	0.8835	459	0.8677
110	0.9826	160	0.9655	210	0.9486	260	0.9319	310	0.9154	360	0.8992	410	0.8832	460	0.8674
111	0.9823	161	0.9652	211	0.9483	261	0.9316	311	0.9151	361	0.8989	411	0.8829	461	0.8671
112	0.9819	162	0.9648	212	0.9479	262	0.9312	312	0.9148	362	0.8986	412	0.8826	462	0.8668
113	0.9816	163	0.9645	213	0.9476	263	0.9309	313	0.9145	363	0.8982	413	0.8822	463	0.8665
114	0.9813	164	0.9641	214	0.9472	264	0.9306	314	0.9141	364	0.8979	414	0.8819	464	0.8661
115	0.9809	165	0.9638	215	0.9469	265	0.9302	315	0.9138	365	0.8976	415	0.8816	465	0.8658
116	0.9806	166	0.9635	216	0.9466	266	0.9299	316	0.9135	366	0.8973	416	0.8813	466	0.8655
117	0.9802	167	0.9631	217	0.9462	267	0.9296	317	0.9132	367	0.8969	417	0.8810	467	0.8652
118	0.9799	168	0.9628	218	0.9459	268	0.9293	318	0.9128	368	0.8966	418	0.8806	468	0.8649
119	0.9795	169	0.9624	219	0.9456	269	0.9289	319	0.9125	369	0.8963	419	0.8803	469	0.8646
120	0.9792	170	0.9621	220	0.9452	270	0.9286	320	0.9122	370	0.8960	420	0.8800	470	0.8643
121	0.9788	171	0.9618	221	0.9449	271	0.9283	321	0.9118	371	0.8957	421	0.8797	471	0.8640
122	0.9785	172	0.9614	222	0.9446	272	0.9279	322	0.9115	372	0.8953	422	0.8794	472	0.8636
123	0.9782	173	0.9611	223	0.9442	273	0.9276	323	0.9112	373	0.8950	423	0.8791	473	0.8633
124	0.9778	174	0.9607	224	0.9439	274	0.9273	324	0.9109	374	0.8947	424	0.8787	474	0.8630
125	0.9775	175	0.9604	225	0.9436	275	0.9269	325	0.9105	375	0.8944	425	0.8784	475	0.8627
126	0.9771	176	0.9601	226	0.9432	276	0.9266	326	0.9102	376	0.8941	426	0.8781	476	0.8624
127	0.9768	177	0.9597	227	0.9429	277	0.9263	327	0.9099	377	0.8937	427	0.8778	477	0.8621
128	0.9764	178	0.9594	228	0.9426	278	0.9259	328	0.9096	378	0.8934	428	0.8775	478	0.8618
129	0.9761	179	0.9590	229	0.9422	279	0.9256	329	0.9092	379	0.8931	429	0.8772	479	0.8615
130	0.9758	180	0.9587	230	0.9419	280	0.9253	330	0.9089	380	0.8928	430	0.8768	480	0.8611
131	0.9754	181	0.9584	231	0.9416	281	0.9250	331	0.9086	381	0.8924	431	0.8765	481	0.8608
132	0.9751	182	0.9580	232	0.9412	282	0.9246	332	0.9083	382	0.8921	432	0.8762	482	0.8605
133	0.9747	183	0.9577	233	0.9409	283	0.9243	333	0.9079	383	0.8918	433	0.8759	483	0.8602
134	0.9744	184	0.9574	234	0.9405	284	0.9240	334	0.9076	384	0.8915	434	0.8756	484	0.8599
135	0.9740	185	0.9570	235	0.9402	285	0.9236	335	0.9073	385	0.8912	435	0.8753	485	0.8596
136	0.9737	186	0.9567	236	0.9399	286	0.9233	336	0.9070	386	0.8908	436	0.8749	486	0.8593
137	0.9734	187	0.9563	237	0.9395	287	0.9230	337	0.9066	387	0.8905	437	0.8746	487	0.8590
138	0.9730	188	0.9560	238	0.9392	288	0.9227	338	0.9063	388	0.8902	438	0.8743	488	0.8587
139	0.9727	189	0.9557	239	0.9389	289	0.9223	339	0.9060	389	0.8899	439	0.8740	489	0.8583
140	0.9723	190	0.9553	240	0.9385	290	0.9220	340	0.9057	390	0.8896	440	0.8737	490	0.8580
141	0.9720	191	0.9550	241	0.9382	291	0.9217	341	0.9053	391	0.8892	441	0.8734	491	0.8577
142	0.9716	192	0.9547	242	0.9379	292	0.9213	342	0.9050	392	0.8889	442	0.8731	492	0.8574
143	0.9713	193	0.9543	243	0.9375	293	0.9210	343	0.9047	393	0.8886	443	0.8727	493	0.8571
144	0.9710	194	0.9540	244	0.9372	294	0.9207	344	0.9044	394	0.8883	444	0.8724	494	0.8568
145	0.9706	195	0.9536	245	0.9369	295	0.9204	345	0.9040	395	0.8880	445	0.8721	495	0.8565
146	0.9703	196	0.9533	246	0.9365	296	0.9200	346	0.9037	396	0.8876	446	0.8718	496	0.8562
147	0.9699	197	0.9530	247	0.9362	297	0.9197	347	0.9034	397	0.8873	447	0.8715	497	0.8559
148	0.9696	198	0.9526	248	0.9359	298	0.9194	348	0.9031	398	0.8870	448	0.8712	498	0.8556
149	0.9693	199	0.9523	249	0.9356	299	0.9190	349	0.9028	399	0.8867	449	0.8709	499	0.8552

Appendix C

Gallons of Emulsified Asphalt Required per 100 Linear Feet For Various Widths and Applications Rates

Rate (Gals. Per Sq Yd.)	Width (feet)														
	1	2	6	7	8	9	10	11	12	14	16	18	20	22	24
0.10	1.1	2.2	6.7	7.8	8.9	10.0	11.1	12.2	13.3	15.6	17.8	20.0	22.2	24.4	26.7
0.15	1.7	3.3	10.0	11.7	13.3	15.0	16.7	18.3	20.0	23.3	26.7	30.0	33.3	36.7	40.0
0.20	2.2	4.4	13.3	15.6	17.8	20.0	22.2	24.4	26.7	31.1	35.6	40.0	44.4	48.9	53.3
0.25	2.8	5.6	16.7	19.4	22.2	25.0	27.8	30.6	33.3	38.9	44.4	50.0	55.6	61.1	66.7
0.30	3.3	6.7	20.0	23.3	26.7	30.0	33.3	36.7	40.0	46.7	53.3	60.0	66.7	73.3	80.0
0.35	3.9	7.8	23.3	27.2	31.1	35.0	38.9	42.8	46.7	54.4	62.2	70.0	77.8	85.5	93.3
0.40	4.4	8.9	26.7	31.1	35.6	40.0	44.4	48.9	53.3	62.2	71.1	80.0	88.9	97.8	107.
0.45	5.0	10.0	30.0	35.0	40.0	45.0	50.0	55.0	60.0	70.0	80.0	90.0	100.	110.	120.
0.50	5.6	11.1	33.3	38.9	44.4	50.0	55.5	61.1	66.7	77.8	88.9	100.	111.	122.	133.
0.55	6.1	12.2	36.7	42.8	48.9	55.0	61.1	67.2	73.3	85.5	97.8	110.	122.	134.	147.
0.60	6.7	13.3	40.0	46.7	53.3	60.0	66.7	73.3	80.0	93.3	107.	120.	133.	147.	160.
0.65	7.2	14.4	43.3	50.6	57.8	65.0	72.2	79.4	86.7	101.	115.	130.	144.	159.	173.
0.70	7.8	15.6	46.7	54.4	62.2	70.0	77.8	85.5	93.3	109.	124.	140.	156.	171.	187.
0.75	8.3	16.7	50.0	58.3	66.7	75.0	83.3	91.7	100.	117.	133.	150.	167.	183.	200.
0.80	8.9	17.8	53.3	62.2	71.1	80.0	88.9	97.8	107.	124.	142.	160.	178.	196.	213.
0.85	9.4	18.9	56.7	66.1	75.5	85.0	94.4	104.	113.	132.	151.	170.	189.	208.	227.
0.90	10.0	20.0	60.0	70.0	80.0	90.0	100.	110.	120.	140.	160.	180.	200.	220.	240.
0.95	10.6	21.1	63.3	73.9	84.4	95.0	106.	116.	127.	148.	169.	190.	211.	232.	253.
1.00	11.1	22.2	66.7	77.8	88.9	100.	111.	122.	133.	156.	178.	200.	222.	244.	267.
1.10	12.2	24.4	73.3	85.5	97.8	110.	122.	134.	147.	171.	196.	220.	244.	269.	293.
1.20	13.3	26.7	80.8	93.3	107.	120.	133.	147.	160.	187.	213.	240.	267.	293.	320.
1.25	13.9	27.8	83.3	97.2	111.	125.	139.	153.	167.	194.	222.	250.	278.	306.	333.
1.30	14.4	28.9	86.7	101.	116.	130.	144.	159.	173.	202.	230.	260.	288.	318.	347.
1.40	15.6	31.1	93.3	109.	124.	140.	156.	171.	187.	218.	249.	280.	311.	342.	373.
1.50	16.7	33.3	100.	117.	133.	150.	167.	183.	200.	233.	267.	300.	333.	367.	400.
1.75	19.4	38.9	117.	136.	156.	175.	194.	214.	233.	272.	311.	350.	389.	427.	467.
2.00	22.2	44.4	133.	156.	178.	200.	222.	244.	267.	311.	356.	400.	444.	489.	533.
2.25	25.0	50.0	150.	175.	200.	225.	250.	275.	300.	350.	400.	450.	500.	550.	600.
2.50	27.8	55.6	167.	194.	222.	250.	278.	306.	333.	389.	444.	500.	556.	611.	667.
2.75	30.6	60.1	183.	214.	244.	275.	306.	336.	367.	428.	489.	550.	611.	672.	733.
3.00	33.3	66.7	200.	233.	267.	300.	333.	367.	400.	467.	533.	600.	667.	733.	800.

Note: Formula used for calculation: $Q = 100 \times W \times R$

Q = Quantity of asphalt required in gallons per 100 ft

R = Rate of application in gallons per sq. yd.

W= Width of application in feet

Bibliography

Arizona Department of Transportation, Standard Specifications for Road and Bridge Construction, 2008

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