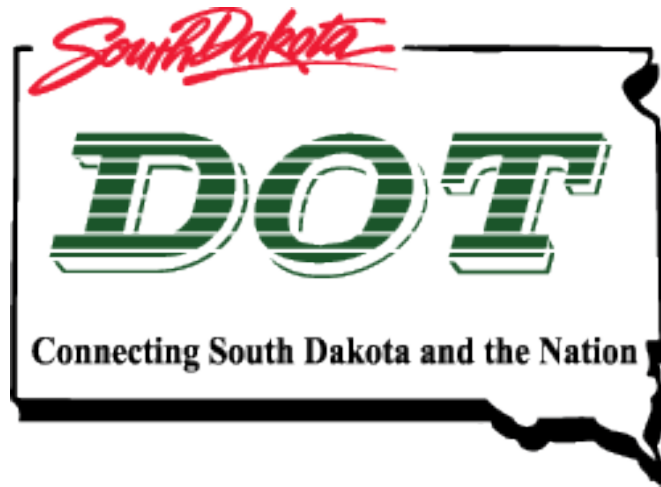


Example Problems Packet

Hot Mix Testing Recertification

Quality Control / Quality Assurance



**PERCENT RECLAIMED ASPHALT PAVEMENT (RAP) IN THE MIX AS
PERCENT OF TOTAL AGGREGATE**

WEIGHT TICKET ENTRIES

$$C = \frac{A \times \left(\frac{B}{100}\right)}{\left[1 + \left(\frac{B}{100}\right)\right]}$$

$$D = A - C$$

$$F = A \times \left(\frac{E}{100}\right)$$

$$H = A \times \left(\frac{G}{100}\right)$$

$$I = D - (F + H)$$

WEIGH BRIDGE ENTRIES

$$L = \frac{J \times \left(\frac{K}{100}\right)}{\left[1 + \left(\frac{K}{100}\right)\right]}$$

$$M = J - L$$

$$P = \frac{N \times \left(\frac{O}{100}\right)}{\left[1 + \left(\frac{O}{100}\right)\right]}$$

$$Q = N - P$$

$$R = M + Q$$

RAP PERCENTAGES

$$S = \left(\frac{Q}{R}\right) \times 100$$

$$T = \left(\frac{Q}{I}\right) \times 100$$

$$U = \left(\frac{I - R}{I}\right) \times 100$$

DOT-86 Equations

Gmm = maximum specific gravity of paving mix

Gmb = bulk specific gravity of compacted mix

Gsb = bulk specific gravity of mineral aggregate

Gb = specific gravity of asphalt binder

Pb = percent asphalt binder content

Gse (Effective specific gravity of mineral aggregate)	=	$\frac{100 - P_b}{\left(\frac{100}{G_{mm}}\right) - \left(\frac{P_b}{G_b}\right)}$
Va (Percent Air Voids)	=	$\left(\frac{G_{mm} - G_{mb}}{G_{mm}}\right) \times 100$
Ps (Percent aggregate content of mixture)	=	100 - Pb
VMA (Voids in the Mineral Aggregate)	=	$100 - \left(\frac{G_{mb} \times P_s}{G_{sb}}\right)$
VFA (Voids Filled with Asphalt)	=	$\left(\frac{VMA - V_a}{VMA}\right) \times 100$
Pba (Percent asphalt absorption)	=	$100 \times \left(\frac{G_{se} - G_{sb}}{G_{se} \times G_{sb}}\right) \times G_b$
Pbe (Percent effective asphalt content)	=	$P_b - \left(\frac{P_{ba} \times P_s}{100}\right)$
Dust to Binder Ratio	=	$\left(\frac{\% - \#200 \text{ material} + \% \text{ hydrated lime}}{P_{be}}\right)$
Gmb x	=	$\left(\frac{G_{mb(\text{measured})} \times \text{height}(\text{measured})}{\text{height} \times}\right)$
Calculation for G_{mb} , bulk specific gravity of compacted mix at any given gyrations point in the compaction process when x is number of gyrations such as at N_{10} or N_{10k} .		
% of Gmm (Percent of mixture theoretical maximum specific gravity)	=	$\left(\frac{G_{mb}}{G_{mm}}\right) \times 100$

Problem #1

Asphalt Binder Content (SD 314)

Complete the DOT-89 form below. What is the Job Mix Formula Tolerance? _____

TANK METHOD

A. Beginning Specific Gravity of Bitumen @ 60°F	<u>1.035</u>
B. Beginning Weight Per Gallon @ 60°F	<u>8.630</u>
C. Temperature of Bitumen in Tank When Check Starts	<u>295*</u>
D. Weight Per Gallon of Bitumen at Temperature	<u> </u>
E. Gallons in Tank When Check Starts (calibrated stick)	<u>29272</u>
Gallons at Start (at start of tank use)	<input type="checkbox"/>
f. Weight of Bitumen in Tank (start check) (D x E / 2000)	<u> </u>
G. Weight of Bitumen Added to Tank(s)	<u> </u>
H. Temperature of Bitumen in Tank When Check Ends	<u>295*</u>
I. Gallons in Tank When Check Ends (calibrated stick)	<u>29094</u>
J. Ending Specific Gravity of Bitumen @ 60°F	<u>1.035</u>
K. Ending Weight Per Gallon @ 60°F	<u>8.630</u>
L. Weight Per Gallon at Temperature	<u> </u>
M. Weight of Bitumen in Tank (end check) (I x L / 2000)	<u> </u>
Left in Storage (at end of tank use)	<input type="checkbox"/>
N. Weight of Bitumen Used (F + G - M)	<u> </u>
O. Weight of Mix Produced (Tons)	<u> </u>
P. Percent Bitumen in Mix (N / O x 100)	<u> </u>

*Temp. Correction
Factor Chart in SD 314

G.	Load #	Invoice #	Tons
	<u>1</u>	<u>10007</u>	<u>26.80</u>
	<u>2</u>	<u>10009</u>	<u>26.47</u>
	<u>3</u>	<u>10012</u>	<u>33.79</u>
	<u>4</u>	<u>10017</u>	<u>40.64</u>
	<u>5</u>	<u>10019</u>	<u>25.65</u>

Summary of Mix Produced

To Road	<u>3707.24</u>	Tons
Plant Waste	<u>0.0</u>	Tons
Road Waste	<u>0.0</u>	Tons
To Others	<u>0.0</u>	Tons
Produced	<u>3707.24</u>	Tons

Problem #2

Hydrated Lime

Complete the DOT-33Q form below. What is the Job Mix Formula Tolerance? _____

TANK METHOD

A. Weight of Lime in Tank at Start (Tons)	<u>41.23</u>
<input type="checkbox"/> Tons at Start (at start of project only)	_____
B. Weight of Lime Added to Tank (Tons)	_____
C. Weight of Lime in Tank at End (Tons)	<u>39.37</u>
<input type="checkbox"/> Left in Storage (at end of project only)	_____
D. Weight of Lime Used (A + B - C) (Tons)	_____
E. Weight of Mix Produced (Tons)	_____
F. Percent of Lime in Mix (D / E x 100)	_____

B.	Load #	Invoice #	Tons	Summary of Mix Produced	
	<u>2</u>	<u>5552</u>	<u>34.90</u>	To Road	<u>3707.24</u>
	_____	_____	_____	Plant Waste	<u>0.0</u>
	_____	_____	_____	Road Waste	<u>0.0</u>
	_____	_____	_____	To Others	<u>0.0</u>
	_____	_____	_____	Produced	<u>3707.24</u>

Problem #3

Moisture in the Mix

Complete the calculations below. What is the max % moisture allowed? _____

A.	Container Number:	1
B.	Weight of container and cover (g):	222.3
C.	Weight of container, cover and sample (g):	1723.7
D.	Apparent dry weight (g): (C - B)	
E.	Actual dry weight (g): (J - B)	
F.	Moisture in material (g): (D - E)	
G.	% Moisture in the Mix: (F / E) * 100	

DRYING WEIGH BACK AREA (H)

	Time	Weight (g)
	12:00 PM	1722.1
	2:00 PM	1721.9
	3:00 PM	1721.8
J.	Weight of material and pan:	1721.8

Percent Moisture in the Mix:

Spec:

Problem #4

RAP Content

Complete the DOT-93 form below. Use the RAP equation sheet found in the Problems Packet. What is the Job Mix Formula Tolerance? _____

WEIGH TICKET ENTRIES

A.	Total of hot mix produced by tickets (tons)	3707.24
B.	Moisture in the mix percentage (most recent one tested)	0.13
C.	Moisture in the mix (tons)	
D.	Total dry amount of hot mix produce for the day (tons)	
E.	Added binder percentage by cutoff (DOT-89)	4.20
F.	Total amount of added binder (tons)	
G.	Added lime percentage by cutoff (DOT-33Q)	0.99
H.	Total amount of added lime (tons)	
I.	Total dry Virgin MA and RAP from tickets & cutoffs (tons)	

WEIGH BRIDGE ENTRIES

J.	Weight of Virgin MA from weight bridge totalizer (tons)	2761.1
K.	Percentage moisture in Virgin MA	3.9
L.	Weight of water in in Virgin MA (tons)	
M.	Weight of dry Virgin MA (tons)	
N.	Weight of RAP from weigh bridge totalizer (tons)	830.2
O.	Percent moisture in RAP	0.2
P.	Weight of water in the RAP mixture (tons)	
Q.	Weight of dry RAP from weigh bridge totalizer (tons)	
R.	Total dry Virgin MA and RAP from weigh bridges (tons)	

RAP PERCENTAGES

S.	Percentage of RAP based on weigh bridges	
T.	Percentage of RAP based on weigh tickets	
U.	% difference between scale tickets and weigh bridges	

Problem #5

Draindown

Calculate the draindown percentage on the DOT-91 form below.

Sample ID	Asphalt Draindown Worksheet			DOT - 91	
File No.				9-15	
PROJECT _____	COUNTY _____			PCN _____	
Field # _____	Date Sampled _____			Date Tested _____	
Sampled By _____	Tested By _____			Checked By _____	
MixType _____	Class S _____	Asphalt Cement _____	Cellulose Fibers _____		
Weight of test sample _____		1327.4	grams		
Weight of container empty _____	52.3	grams	Weight of container after test _____	53.1	grams
Draindown _____	≤ 0.3%	Temperature of test sample _____	300	°F	

Problem #6

DOT-86
Gyratory Worksheet

Complete the DOT-86 for
a Q2R Mix.

Use the equation sheet in
the Problems Packet.

Mix Temp	275						
% binder Pb	5.4		N initial	[]		Gse	[]
Gsb	2.609		N design	[]		Pba	[]
binder Gb	1.035		N max	[]		Pbe	[]
dust (- #200)	3.70						
lime	0.99						
dust(-#200) + lime	[]						
			Spec. A (Ndes)		Spec. B (Ndes)		
a) Height, mm			@ N ini	@ N des	@ N ini	@ N des	
b) Weight in air			124.2	115.7	124.6	115.9	
c) Weight in water				4738.1		4746.5	
d) SSD Weight				2724.9		2729.9	
e) Gmb (measured) b / (d - c)				4741.8		4749.6	
f) Gmb (calculated)	[]			[]		[]	

	Gmm #1	Gmm #2
Weight of sample in air	1505.3	1523.9
Weight of canister + H ₂ O	1275.3	1275.3
Weight of canister + H ₂ O + sample	2166.6	2177.5
Temperature of water	24.4	24.4
H ₂ O correction factor	1.0001	1.0001
Rice SpGr (Gmm)	[]	[]
Average Max SpGr (Gmm)	[]	

	N initial	N design
Average Gmb	[]	[]
% of Rice SpGr (Gmm)	[]	[]

% Air Voids (Va)	[]	% VMA	[]	% VFA	[]	Dust to Binder Ratio	[]
Specs:	[]	[]	[]	[]			

Problem #7

Core Dryback

Complete the DOT-42-Q form below.

Theoretical Maximum Specific Gravity

Sublot No.	1	2	3	4	5			
Max. Sp. Gr.	2.447	2.452	2.452	2.450	2.441			

Lot Average Maximum Specific Gravity (Standard) _____

In-Place Density Measurement

Percent of Standard = $[(\text{Core Bulk Specific Gravity} / \text{Lot Average Maximum Specific Gravity})] \times 100$

Core Sublot No.	Core Height	Rand Nbr.	Cumulative Tonnage	Station for Core	Rand Nbr	Paving Width	Distance from C/L	Actual Dry Weight	Weight in Water	SSD Weight	Reheat Correction Factor	Core Bulk Specific Gravity	Percent of Standard	Average Percent Standard
1 A	2.00	.61	305	165+52	.28	11	3.1 LT	1340.3	757.7	1351.7	X	2.256		
1 B	2.25	.99	995	123+71	.65	11	7.2 LT	1430.2	808.0	1440.2	X	2.262		
2 A	2.13	.06	1,030	121+59	.17	11	1.9 LT	1308.2	739.8	1314.7	X	2.276		
2 B	2.50	.65	1,825	73+42	.18	11	2.0 LT	1530.2	860.2	1541.3	X	2.247		
3 A	2.13	.01	2,005	62+51	.82	11	9.0 LT	1312.5	739.0	1321.8	X	2.252		
3 B	2.25	.32	2,660	22+82	.69	11	7.6 LT	1386.8	780.6	1397.0	X	2.250		
4 A	2.38	.00	3,000	2+22	.26	11	2.9 LT	1504.5	851.9	1510.3	X	2.285		
4 B	1.75	.84	3,920	143+72	.90	11	9.9 RT	1197.8	679.8	1202.2	X	2.293		
5 A	2.38	.36	4,180	127+23	.10	11	1.1 RT	1441.7	802.7	1449.0	X	2.231		
5 B	2.25	.07	4,535	104+71	.59	11	6.5 RT	1463.7	832.4	1467.9	X	2.303		

Percent Density: _____