MODOT
BINDER IGNITION OVEN TRAINING/CERTIFICATION COURSE

Missouri University of Science & Technology

Department of Civil, Architectural, and Environmental Engineering

1-21-11

4-14-11 Revision

4-27-12 Revision

12-18-13 Revision

4-22-15 Revision

BINDER IGNITION OVEN
CERTIFICATION COURSE
2014-2015

Time	Module	Location	Topic	Instructor
8:00-8:15	Intro	Lecture	Intro/welcome	Richardson
8:15-9:30		Lecture	Binder Ignition Oven	Richardson
9:30-10:30		Lecture	Homework	Richardson
10:30-10:50		Lab	Binder Ignition test demo Hands-on practice	Lusher Staff
10:50-11:00		Lecture	Course Review	Richardson
2 hours		Lecture	Written Exam	Richardson
?-Until all have finished		Lab	Proficiency Exam	Staff

AASHTO T308

Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Oven Method

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AASHTO T308

Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Oven Method

SCOPE

- ***Background***
- Binder Content Role in QC/QA
- Sampling
- Test procedure
- Field verification

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BINDER CONTENT- WHY TEST?

- Excessive binder can cause instability e.g. rutting, shoving, corrugations, bleeding

- Binder content is an important part of the dust-to-binder ratio which affects compactibility and cohesion

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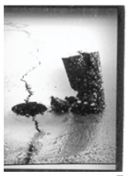
BINDER CONTENT- WHY TEST?

- Insufficient binder can lead to lack of adhesion, raveling, stripping, and cracking



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AASHTO TEST METHODS & SPECIFICATIONS

- ***T168 Sampling Hot Mix***
- ***R 47 HMA Sample Splitting***
- ***T329 Moisture Content of Hot Mix***
- ***T 308 Binder Content Ignition Oven***
- ***T30 Sieve Analysis of Residue***

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Equipment

- Ignition Furnace
- Basket assembly
- Oven (110 ± 5 C)
- Balance
- Safety Equipment: face shield, gloves, long-sleeved jacket, protective basket cage

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BINDER CONTENT TEST METHODS

- Solvent extraction T 164
- Nuclear gage: T 287, TM 54
  - Low radiation
  - Regular radiation
- Ignition oven: T 308
  - Method A
    - Convection oven
    - Infrared oven
  - Method B

- Method A: internal scale
- Method B: no internal scale

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SOLVENT EXTRACTION T 164

- Solvent health issues
- Solvent disposal issues
- Thus, expensive



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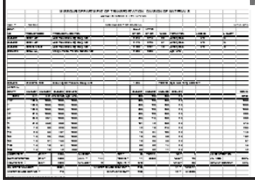
NUCLEAR GAGE T 287, TM 54

- Health issues
- Interferences
- Calibration issues



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IGNITION OVEN T 308

Method A:

- more convenient, higher lab production rates

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METHOD "A"

- Convection oven (NCAT)
- Infrared oven:
  - First generation
  - Second generation (NTO)

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HEAT TRANSFER

- ***Convection:*** heat warms the air, which warms the sample
- ***Infrared:*** electromagn etic energy waves directly heat the sample

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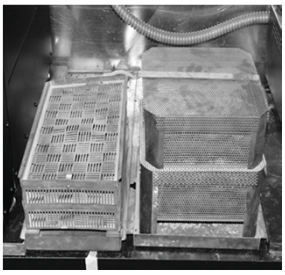
BASKETS



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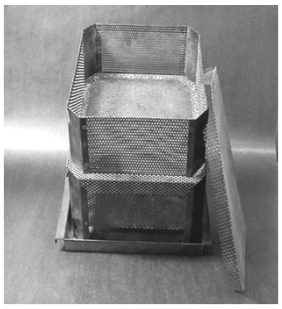
CONVECTION OVEN BASKET



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INFRARED OVEN

Default - Normal

Option 1 - Less

Option 2 - More

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SECOND GENERATION INFRARED

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IGNITION OVEN

Method B: no internal scale

- lower oven cost; less operational problems

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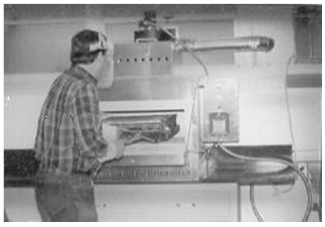
METHOD "B"

- Note the special heat resistant shirt



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TYPES OF METHODS In Missouri

- NCAT oven - vast majority
- Nuclear – a few
- Low radiation nuclear - 1
- First generation infrared ignition oven – 1
- Second generation infrared ignition oven – 1

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REPORTED USAGE

- Dolomite:
  - Nuclear
  - Low radiation nuclear
- All other: convection or infrared ignition ovens

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SCOPE

- Background
- ***Binder Content Role in QC/QA***
- Sampling
- Test procedure
- Field verification

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Binder Content Role

- ***Mix design & acceptance***
- Field Verification of mix

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Mix Design & Mix Acceptance

- Contractor designs mix & submits target binder content to MoDOT
- MoDOT approves and sets JMF target binder %

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Binder Content Role

- Mix design & acceptance
- ***Field verification of mix***

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CONTENT

- ***Binder content of mix***
- Binder content of RAP
- Aggregate gradation

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% BINDER

- Design (target) binder content is determined during mix design and verified/approved by MoDOT
- May have to be adjusted in the field resulting in a new target binder content

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Binder Role

- Binder content is a pay factor in 403 projects

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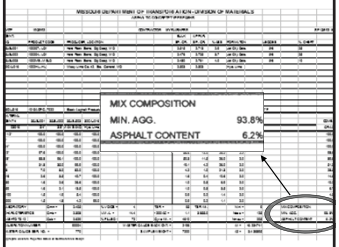
Location of Target Binder Content on JMF



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SCOPE

- Background
- Binder Content Role in QC/QA
- ***Sampling***
- Test procedure
- Field verification

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Binder Content Samples

- 401: plant
- 403: roadway

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Location of Target Binder Content on JMF

MISSOURI DEPARTMENT OF TRANSPORTATION - DIVISION OF MATERIALS

ASPHALTIC CONCRETE TYPE SP125HB

DATE = **10/29/03** **CONTRACTOR = MY BUSINESS** **SP125 03-16**

IDENT. NO.	PRODUCT CODE	/ PRODUCER, LOCATION	BULK SP. GR.	APPAR. SP. GR.	%ABS	FORMATION	LEDGES	% CHERT
35JSJ001	100207..LD1	/ Hard Rock Stone, Dig Deep, MO	2.515	2.713	2.9	Jet City Dolo.	5-8	25
35JSJ002	100204..LD1	/ Hard Rock Stone, Dig Deep, MO	2.476	2.725	3.7	Jet City Dolo.	5-8	25
35JSJ003	1002MS..MSLD	/ Hard Rock Stone, Dig Deep, MO	2.480	2.761	4.0	Jet City Dolo.	5-8	10
30CAJ016	1002HL..HL	/ Missy Lime Co. #2, Ste. General, MO	2.303	2.303		Hyd. Lime		
36DLJ016	1015ACPG..7022	/ Black Asphalt Product					0°F	

MIX COMPOSITION

MIN. AGG. 93.8%

ASPHALT CONTENT 6.2%

MATERIAL IDENT #	35JSJ001	35JSJ002	35JSJ003	30CAJ016								COMB.
03016	3/4"	3/8"	MAN SAND	Hyd. Lime								GRAD
1 1/2"	100.0	100.0	100.0	100.0								100.0
1"	100.0	100.0	100.0	100.0								100.0
3/4"	100.0	100.0	100.0	100.0								100.0
1/2"	97.6	100.0	100.0	100.0	58.6	12.0	26.0	2.0				98.6
3/8"	83.8	96.1	100.0	100.0	50.3	11.5	26.0	2.0				89.8
#4	31.8	35.0	99.9	100.0	19.1	4.2	26.0	2.0				51.3
#8	7.0	8.0	82.0	100.0	4.2	1.0	21.3	2.0				28.5
#16	2.6	3.5	40.7	100.0	1.6	0.4	10.6	2.0				14.6
#30	1.6	2.6	26.6	100.0	1.0	0.3	6.9	2.0				10.2
#50	1.6	2.1	13.5	100.0	1.0	0.3	3.5	2.0				6.7
#100	1.5	1.9	5.4	100.0	0.9	0.2	1.4	2.0				4.5
#200	1.5	1.8	4.2	99.0	0.9	0.2	1.1	2.0				4.1

LABORATORY	Gmm =	2.405	% VOIDS =	4	TSR =	95	TSR Wt.		Nini =	9	MIX COMPOSITION	
CHARACTERISTICS	Gmb =	2.308	V.M.A. =	14.4	-200/AC =	1.1	3855.0		Ndes =	125	MIN. AGG.	93.8%
AASHTO T312	Gsb =	2.629	% FILLED =	72	Gyro Wt. =	4610			Nmax =	205	ASPHALT CONTENT	6.2%
CALIBRATION NUMBER		90004		MASTER GAUGE BACK CNT. =		2196			A1 =	-5.234741		
MASTER GAUGE SER. NO. =		770			SAMPLE WEIGHT =	7200			A2 =	3.436895		

Aggregate & Mixture Properties Based on Contractors Mix Design

Binder Content Field Verification

- 401: JMF ± 0.3%
- 403: JMF ± 0.3%

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LOOSE MIX: 403

Volumetric/%Binder Sample

- Sampling Frequency:
  - QC: one per ***sublot***
  - QA: one per ***lot****-
    "independent sample"
  - QA: once per ***day****test QC "retained sample". This may be omitted on days when independent QA sample is taken, if confident and "favorable comparison" exists between QA and QC*

* *Per EPG and Task Force*

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Loose Mix: 401

- QC: 1000 tons or a minimum of once per day when production exceeds 1000 tons per day. If less than 1000 tons per day, test at least once; RE may waive testing if less than 200 tons per day
- QA: one independent sample per day when production exceeds 500 tons per day
- QA: Retained QC sample split: once per 5 days

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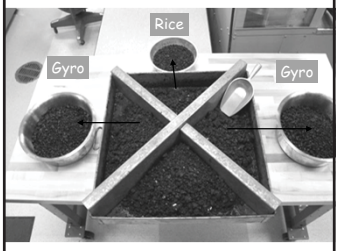
403: SAMPLE

- 50 lb. sample –get 2 portions for the 2 volumetric pucks plus Rice



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403
REMIX, QUARTER AGAIN
Ignition Oven & Moisture

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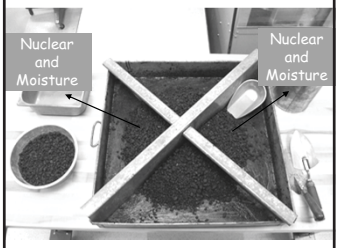
Or
REMIX, QUARTER AGAIN
Nuclear & Moisture



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IGNITION OVEN SPECIMEN SIZE

Mix	NMS in.	Specimen Size g
SP048 & BP-3	#4	1200-1700
SP095	3/8	1200-1700
SP125 & BP-1 & BP-2	1/2	1500-2000
SP190 & Bit Base	3/4	2000-2500
SP 250	1	3000-3500

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IGNITION OVEN SPECIMEN SIZE

- Large specimens of fine mixes tend to result in incomplete ignition

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SCOPE

- Background
- Binder Content Role in QC/QA
- Sampling
- ***Test procedure***
- Field verification

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TEST PROCEDURE

- Corrections
- Binder content test procedure

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IGNITION OVEN BASICS

- % Binder: loss in mass of specimen
- Problem: other materials also burn off
  - moisture
  - aggregate

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TEST PROCEDURE

- ***Corrections***
- Binder content test procedure

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BINDER CONTENT CORRECTIONS

- ***Moisture***
- Aggregate burn loss
- Temperature effects on weighing

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MOISTURE CORRECTION

- Moisture in mix will burn off, too.
- This will count as binder unless corrected
- Correction:
  - Dry mix to a constant mass at 110 ± 5 C prior to testing
  - "Aging"—must still verify that constant mass has been achieved

  Or
  - Determine moisture content of mix (AASHTO T 329), subtract it from the apparent binder content

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AASHTO T 329-13

- MoDOT is now following AASHTO T 329
- Temperature now is at 325 ±25 F
- Initial drying time is 90 minutes
- Moisture is now calculated based on *wet* weight of HMA

$$MC = \left[\frac{M_{i(wet)} - M_{i(dry)}}{M_{i(wet)}} \right] X100$$

MC = % moisture

$M_{i(wet)}$ = initial mass of mix, wet

$M_{i(dry)}$ = initial mass of mix, dry

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MOISTURE DATA SHEET

MOISTURE CONTENT OF HOT MIX ASPHALT (HMA) by OVEN METHOD
AASHTO T 329-13
(for ignition oven correction purposes)

Project No.	Job No.	Route	County
Technician	Date	Sublot No.	Mix No.
Oven Temp.	Time in	Time out	Interval
		Sample:	Sample:
Pan wt. (g)		340	
Mix + pan wt., moist (g) = (W_{wet})		1840	
Mix + pan wt., dry (g) [Trial 1]		1839	
Mix + pan wt., dry (g) [Trial 2]		1838	
Mix + pan wt., dry (g) [Trial 3] = (W_{dry})		1838	
$\%\ Moisture = \frac{W_{wet} - W_{dry}}{W_{wet} - pan} \times 100$			

NOTE: All weights to nearest 0.1 gram and % moisture to nearest 0.01%

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MOISTURE TESTING FREQUENCY: Several per Day

- High RAP/RAS mixtures especially prone to moisture
- Rainy weather
- "Warm mix"
- New aggregate
- If plant operator reports burning more fuel to maintain temperature
- Fluctuating volumetrics or binder contents

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MOISTURE TESTING FREQUENCY: Less Often

- Dry weather
- Same stockpiles
- No moisture when tested

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MOISTURE DATA SHEET

MOISTURE CONTENT OF HOT MIX ASPHALT (HMA) by OVEN METHOD AASHTO T 329-13 (for ignition oven correction purposes)			
Project No.	Job No.	Route	County
Technician	Date	Sublot No.	Mix No.
Oven Temp.	Time in	Time out	Interval
		Sample:	Sample:
Pan wt. (g)		340	
Mix + pan wt., moist (g) = (W_{wet})		1840	
Mix + pan wt., dry (g) [Trial 1]		1839	
Mix + pan wt., dry (g) [Trial 2]		1838	
Mix + pan wt., dry (g) [Trial 3] = (W_{dry})		1838	
$\%\ Moisture = \frac{W_{wet} - W_{dry}}{W_{wet} - pan} \times 100$			

NOTE: All weights to nearest 0.1 gram and % moisture to nearest 0.01%

BINDER CONTENT CORRECTIONS

- **Moisture**
- ***Aggregate burn loss***
- Temperature effects on weighing

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Asphalt Binder Correction Factor (Aggregate Correction Factor)

- To correct for loss of mass during the mix ignition due to aggregate burn-off
- Determined during mix design and then verified by mix designer (usually QC)
- Re-determined if mix design changes (e.g. >5% change in stockpiled aggregate proportions)

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Asphalt Binder Correction Factor (Aggregate Correction Factor), cont'd.

- C_F Procedure:
  - Mix specimen in lab with dry aggregate at a known (***actual***) % binder
  - Input "zero" for the C_F
  - Burn, obtain ***measured (apparent)***% binder
  - The difference between the ***measured*** and the ***actual*** % binder is the Asphalt Binder Correction Factor (C_F)
  - If the C_F is > 1.0%, re-determine at a lower temperature

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Asphalt Binder Correction Factor (Aggregate Correction Factor), cont'd.

- Lab-produced sample (dry)

$$C_f = Measured - Actual$$

- Math:

$$C_f = \left[\frac{M_{t(dry)} - M_f}{M_{t(dry)}}\right] - \left[\frac{M_{t(dry)} - M_{t(agg)}}{M_{t(dry)}}\right]$$

- The difference is the aggregate mass loss
- The Measured content can be from the oven ticket
- If the C_F is > 1.0%, re-determine at a lower temperature

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CONVECTION OVEN TEMPERATURES

- AASHTO:
  - Normal: 538 C
  - High C_F's (>1.0%): 482 C
- MoDOT:
  - Normal: 538 C
  - High C_F's: if >1.0% try 482 C
  - Very high C_F's: if >1.0% at 482 C, use 427 C

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Asphalt Binder Correction Factor (Aggregate Correction Factor) Data Sheet

ASPHALT CONTENT IGNITION METHOD
(AASHTO T 308-10)
METHOD A

Aggregate Correction Factor
[Asphalt Binder Correction Factor] Determination

Sample_____Lab No._____Date_____Initials_____

Replicate	1	2	3	4
Test Temperature	538	538		
Tare (basket, etc.) Mass (g)	3000	3000		
Total Dry Mass (g)	5000	5005		
Initial Dry Specimen Mass (g)	2000	2005		
Loss in Weight (g)	125	126		
%AC, measured = M	6.25	6.28		
%AC, actual = A	6.00	6.01		
%AC$_{diff}$ (M$_1$ – M$_2$)	0.03	> 0.15%? If so, 2 more replicates		
Cr = M – A	0.25	0.27		
Cr, average	0.26			

Asphalt Binder Correction Factor (Aggregate Correction Factor) Data Sheet

ASPHALT CONTENT IGNITION METHOD
(AASHTO T 308-10)
METHOD A

Aggregate Correction Factor
[Asphalt Binder Correction Factor] Determination

Sample_____Lab No._____Date_____Initials_____

Replicate	1	2	3	4
Test Temperature	538	538		
Tare (basket, etc.) Mass (g)	3000	3000		
Total Dry Mass (g)	5000	5005		
Initial Dry Specimen Mass (g)	2000	2005		
Loss in Weight (g)	125	126		
%AC, measured = M	6.25	6.28		
%AC, actual = A	6.00	6.01		
$\%AC_{diff}$ ($M_1 - M_2$)	0.03	> 0.15%? If so, 2 more replicates		
$C_F = M - A$	0.25	0.27		
C_F, average	0.26			

INFRARED BURN PROFILES

- "Default"- most mixes
- "Option 1" (Less)- for C_f > 1.0% eg. RAP containing dolomite
- "Option 2" (More) – hard to burn mixes

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Asphalt Binder (Aggregate) Correction Factors

- Anecdotal: Infrared runs ~0.05% higher than convection oven
- AMRL Proficiency samples are comparable

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RAP Aggregate Correction Factor (Asphalt Binder Correction Factor)

- Follow TM-77:
  - Assumes aggregate C_F for RAP is same as C_F for virgin aggregate
  - Follow the standard procedure as if there was no RAP, i.e., use only the virgin aggregate, and only the binder content associated with the virgin aggregate portion when fabricating the specimen

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BINDER CONTENT CORRECTIONS

- Moisture
- Aggregate burn loss
- ***Temperature effects on weighing***

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CONVECTION OVEN: TEMPERATURE COMPENSATION FACTOR

- Material "weighs" differently at elevated temperatures
- Mass loss shown on the oven printout must be corrected
- Oven calculates and prints the "Temperature Correction Factor (TCF)" for the particular test run
- ***TCF = apparent loss in weight due to heating***

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USE OF TEMPERATURE CORRECTION FACTOR

- When determining the Aggregate Correction Factor, if the oven printout is used for determination of the Measured Asphalt Content, include the Temperature Correction Factor (TCF)
- If all weighing is performed outside of the oven, do not use the TCF

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Second Generation Infrared oven

- No Temperature Correction Factor
- Scale is better insulated from the chamber

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TEST PROCEDURE

- Corrections
- ***Binder content test procedure***

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REHEATING

EPG 403.1.5

- If a retained sample must be reheated:
  - Warm the sample until workable
  - Spread it in a large pan and reheat—this will minimize the damage caused by reheating

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CONVECTION OVEN
TEST PROCEDURE:
Method A

- 1. Dry specimen at 110 ± 5 °C or determine moisture content (T 329-13):
- 2. Enter the ***chamber set point*** (desired oven temperature).
- 3. Enter the ***asphalt correction factor (C_F)***

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CONVECTION OVEN
TEST PROCEDURE:
Method A

- 4. Weigh the test specimen.

- 5. Enter the ***specimen weight***.
- 6. Place the sample in the oven and compare the weight indicated by the oven scale to that of the external scale the sample was first weighed on (this helps detect if basket is contacting the furnace wall)

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CONVECTION OVEN
TEST PROCEDURE:
Method A

- 7. Burn
- 8. Oven will stop when burn is complete and will calculate % binder based on the:
  - Original specimen weight entered
  - Total loss
  - Asphalt correction factor (C_F) that you entered.
  - "Temperature Compensation" factor that the oven calculates = apparent loss in weight due to heating.
- 9. ***You*** must then correct (subtract) for ***moisture*** if started with a wet sample

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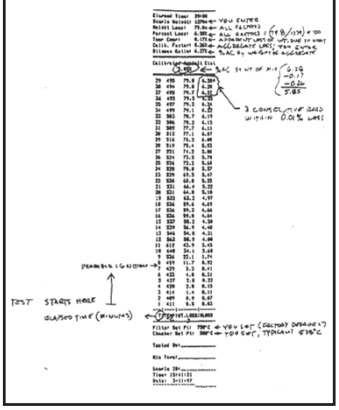
Test Results Printout



ASPHALT CONTENT IGNITION METHOD
(AASHTO T 308-10)
METHOD A

Reproducing Oven Ticket Values

Project No.	Job No.	Route	County
Technician	Date	Sublot No.	Mix No.

Empty Basket Assembly Weight (g), [T_a]	3000
Basket Assembly + Wet Sample Weight (g), [T_t]	4270
Wet Sample Weight (g), [$W_i = (T_t - T_a)$]	1270
Loss in Weight (g), [L] (from tape)	79.8
Total % Loss, [$P_L = (L / W_i) \times 100$]	6.28
Temperature Compensation (%), [C_{tc}] (from tape)	-0.17
% AC, uncorrected, [$P_{ac} = P_L - C_{tc}$]	6.11
Aggregate Correction (Calibration) Factor (%), [C_a] (from tape)	-0.26
Calibrated %AC (from ignition oven tape), [$P_{cal} = P_{ac} - C_a$]	5.85
% Moisture Content, [MC] (previous test)	-0.10
% AC, corrected (by weight of mix), [$P_b = P_{cal} - MC$]	5.75

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Asphalt Binder Correction Factor (Aggregate Correction Factor) Calculation

If final weighing is performed on bench top scale, calculation:

$$P_b = \left[\frac{M_{i(wet)} - M_f}{M_{i(wet)}} \times 100 \right] - C_f - MC$$

Where:

$M_{i(wet)}$ = initial mass of mix, wet

M_f = final mass of mix

MC = % moisture

C_f = Asphalt Binder Correction Factor (old Aggregate Correction Factor)

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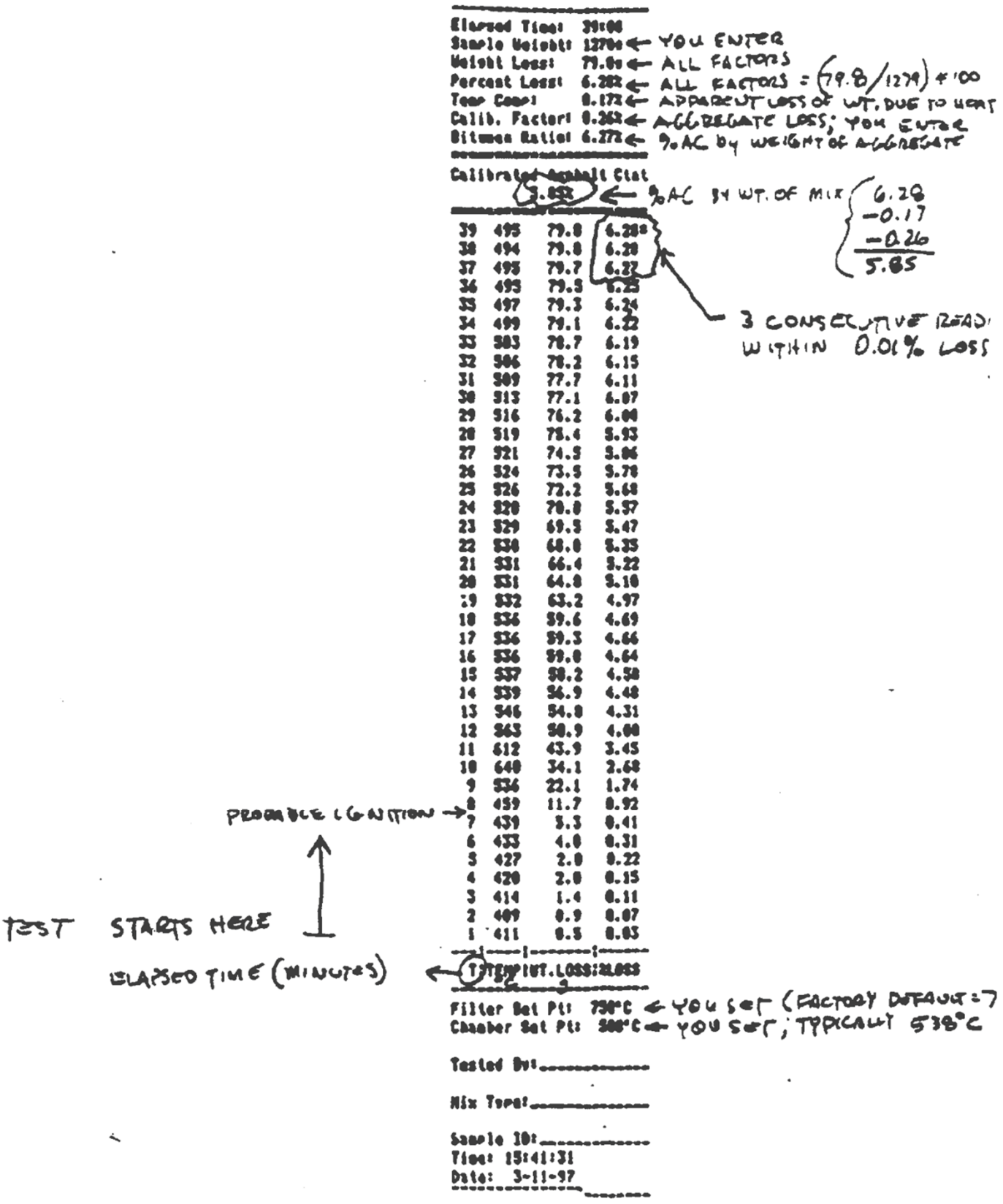
Test Results Printout



ASPHALT CONTENT IGNITION METHOD
(AASHTO T 308-10)
METHOD A

Reproducing Oven Ticket Values

Project No.	Job No.	Route	County
Technician	Date	Sublot No.	Mix No.
Empty Basket Assembly Weight (g), [T_e]			3000
Basket Assembly + Wet Sample Weight (g), [T_i]			4270
Wet Sample Weight (g), [$W_i = (T_i - T_e)$]			1270
Loss in Weight (g), [L] (from tape)			79.8
Total % Loss, [$P_L = (L / W_i) \times 100$]			6.28
Temperature Compensation (%), [C_{tc}] (from tape)			-0.17
% AC, uncorrected, [$P_{bu} = P_L - C_{tc}$]			6.11
Aggregate Correction (Calibration) Factor (%), [C_f] (from tape)			-0.26
Calibrated %AC (from ignition oven tape), [$P_{bcal} = P_{bu} - C_f$]			5.85
% Moisture Content, [MC] (previous test)			-0.10
% AC, corrected (by weight of mix), [$P_b = P_{bcal} - MC$]			5.75

Example
Manual Method

- Moisture = 0.05%
- C_f = 0.22%
- Initial wet mass = 5400 g
- Final burned mass = 5256 g

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ASPHALT CONTENT IGNITION METHOD
(AASHTO T 308-10)
METHOD A
Manual Weighing Method

Project No.	Job No.	Route	County
Technician	Date	Sublot No.	Mix No.
Empty Basket Assembly Weight (g), [T_a]			3000
Initial Basket Assembly + Wet Sample Weight (g), [T_i]			5400
Initial Wet Sample Weight (g), [$W_i = (T_i - T_a)$]			2400
Final Basket Assembly + Sample Weight (g), [T_f]			5256
Loss in Weight (g), [$L = T_i - T_f$]			144
% Loss, [$P_L = (L / W_i) \times 100$]			6.00
Aggregate Correction (Calibration) Factor (%), [C_f]			-0.22
Calibrated %AC, [$P_{bcal} = P_L - C_f$]			5.78
% Moisture Content, [MC]			-0.05
% AC, corrected (by weight of mix), [$P_b = P_{bcal} - MC$]			5.73

TEST PROCEDURE
Method B

- 1. Weigh out specimen.
- 2. Burn for about 45 minutes.
- 3. Remove, cool, weigh.
- 4. Burn for another 15 minutes.
- 5. Remove, cool, weigh.
- 6. Keep repeating until 2 consecutive mass weighings do not change by > 0.05%.
- 7. Subtract moisture %.

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ASPHALT CONTENT IGNITION METHOD (AASHTO T 308-10) METHOD A Manual Weighing Method

Project No.	Job No.	Route	County
Technician	Date	Sublot No.	Mix No.
Empty Basket Assembly Weight (g), [T_e]			3000
Initial Basket Assembly + Wet Sample Weight (g), [T_i]			5400
Initial Wet Sample Weight (g), [$W_i = (T_i - T_e)$]			2400
Final Basket Assembly + Sample Weight (g), [T_f]			5256
Loss in Weight (g), [$L = T_i - T_f$]			144
% Loss, [$P_L = (L / W_i) \times 100$]			6.00
Aggregate Correction (Calibration) Factor (%), [C_f]			-0.22
Calibrated %AC, [$P_{bcal} = P_L - C_f$]			5.78
% Moisture Content, [MC]			-0.05
% AC, corrected (by weight of mix), [$P_b = P_{bcal} - MC$]			5.73

OVEN VERIFICATION

- The oven must be "verified' after a move—the balance needs to be checked

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Common Testing Errors/Source of Non-Comparison/Early Shut-off

- Starting test when oven is cold: incomplete burn; can affect TCF
- Neglecting to push "Start" (binder burns but is not recorded)
- Not cleaning oven & vents often enough
- Using vent pipe less than 4 in, diameter (NTO clogs more quickly)

77

Common Testing Errors/Source of Non-Comparison/Early Shut-off

- Asphalt correction factor (C_F) not used
- Not cleaning baskets
- Allowing scale plate or support tubes to rub
- Not spreading specimen out
- Not tearing off ticket before opening oven door
- Allowing door to not latch correctly
- Not correcting for moisture (e.g. when plant speed increases, etc)

78

Common Testing Errors/Source of Non-Comparison/Early Shut-off

- Using an oversize specimen
- Not using the same size specimen for asphalt correction factor (C_F) determination and all production tests
- Using a plant-made specimen instead of a lab-made specimen for (C_F) determination
- Not double-checking specimen weight on oven scale against exterior scale weight

79

Common Testing Errors/Source of Non-Comparison/Early Shut-off

- Materials used for (C_F) determination not the same as project materials
- Inaccurate asphalt contents used for (C_F) determination
- QA & QC starting with different temperature specimens
- Door left open too long between loadings

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Common Testing Errors/Source of Non-Comparison/Early Shut-off

- QA & QC starting with different temperature specimens
- Wrong chamber set point
- Wrong burn profile

81

OPERATIONAL PROBLEMS

- Oven won't shut itself off—it's OK to manually shut off as long as 3 consecutive readings show less than 0.01% loss and the sample appears to be completely burned (EPG 403.1.5)

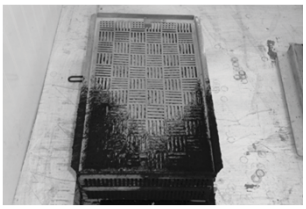
82

Premature Burn Stop

- Vibrations
- Basket or strap up against wall or top of chamber
- Clogged port
- Used U.S. date, not European date (1998-2000 NCAT models)

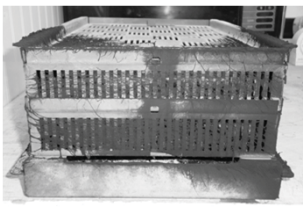
83

NTO Incomplete Burn Pattern: Shingle Mix



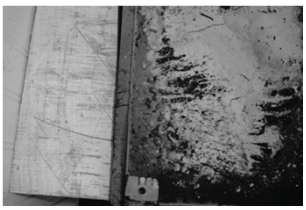
84

Soot



85

Coke



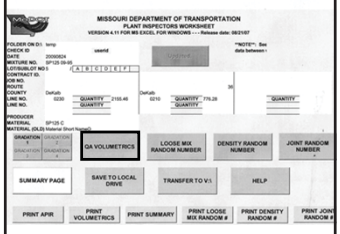
86

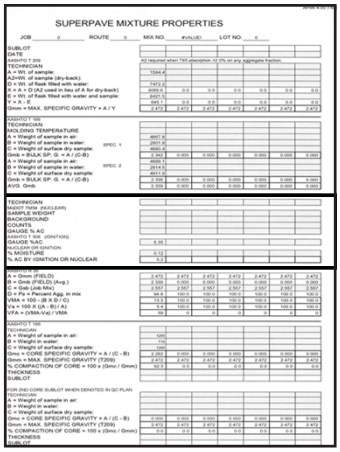
SCOPE

- Background
- Binder Content Role in QC/QA
- Sampling
- Test procedure
- ***Field verification***

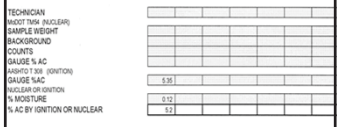
87

MoDOT SPREADSHEET



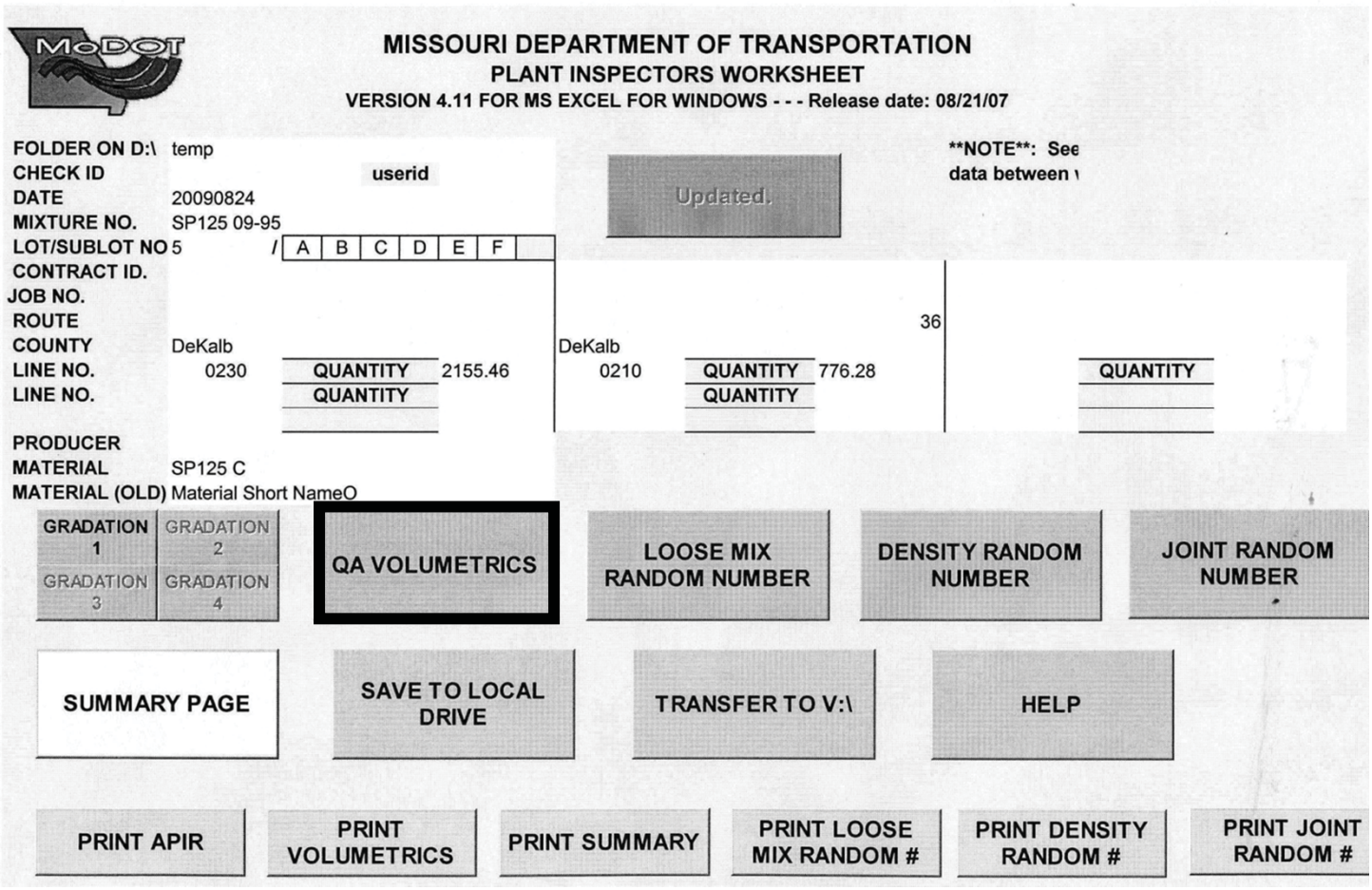


Binder Portion



MoDOT SPREADSHEET

APIW 4.11 12/17/200



MISSOURI DEPARTMENT OF TRANSPORTATION
PLANT INSPECTORS WORKSHEET
VERSION 4.11 FOR MS EXCEL FOR WINDOWS - - - Release date: 08/21/07

FOLDER ON D:\ temp
CHECK ID userid
DATE 20090824
MIXTURE NO. SP125 09-95
LOT/SUBLOT NO 5 / A B C D E F
CONTRACT ID.
JOB NO.
ROUTE
COUNTY DeKalb
LINE NO. 0230 QUANTITY 2155.46
LINE NO. QUANTITY
PRODUCER
MATERIAL SP125 C
MATERIAL (OLD) Material Short NameO

Updated.

NOTE: See data between

DeKalb
0210 QUANTITY 776.28
QUANTITY

36
QUANTITY

GRADATION 1 | GRADATION 2 | GRADATION 3 | GRADATION 4
QA VOLUMETRICS
LOOSE MIX RANDOM NUMBER
DENSITY RANDOM NUMBER
JOINT RANDOM NUMBER
SUMMARY PAGE
SAVE TO LOCAL DRIVE
TRANSFER TO V:\
HELP
PRINT APIR
PRINT VOLUMETRICS
PRINT SUMMARY
PRINT LOOSE MIX RANDOM #
PRINT DENSITY RANDOM #
PRINT JOINT RANDOM #

SUPERPAVE MIXTURE PROPERTIES

JOB 0 ROUTE 0 MIX NO. #VALUE! LOT NO. 0

SUBLOT							
DATE							
AASHTO T 209	A2 required when T85 absorption >2.0% on any aggregate fraction.						
TECHNICIAN							
A = Wt. of sample:	1594.4						
A2=Wt. of sample (dry-back):							
D = Wt. of flask filled with water:	7472.2						
X = A + D (A2 used in lieu of A for dry-back)	9066.6	0.0	0.0	0.0	0.0	0.0	0.0
E = Wt. of flask filled with water and sample:	8421.5						
Y = X - E	645.1	0.0	0.0	0.0	0.0	0.0	0.0
Gmm = MAX. SPECIFIC GRAVITY = A / Y	2.472	2.472	2.472	2.472	2.472	2.472	2.472

AASHTO T 166							
TECHNICIAN							
MOLDING TEMPERATURE							
A = Weight of sample in air:	4867.8						
B = Weight of sample in water: SPEC. 1	2801.9						
C = Weight of surface dry sample:	4880.4						
Gmb = BULK SP. G. = A / (C-B)	2.342	0.000	0.000	0.000	0.000	0.000	0.000
A = Weight of sample in air:	4899.1						
B = Weight of sample in water: SPEC. 2	2814.5						
C = Weight of surface dry sample:	4911.9						
Gmb = BULK SP. G. = A / (C-B)	2.336	0.000	0.000	0.000	0.000	0.000	0.000
AVG. Gmb	2.339	0.000	0.000	0.000	0.000	0.000	0.000

TECHNICIAN							
MoDOT TM54 (NUCLEAR)							
SAMPLE WEIGHT							
BACKGROUND							
COUNTS							
GAUGE % AC							
AASHTO T 308 (IGNITION)							
GAUGE %AC	5.35						
NUCLEAR OR IGNITION							
% MOISTURE	0.12						
% AC BY IGNITION OR NUCLEAR	5.2						

AASHTO R 35							
A = Gmm (FIELD)	2.472	2.472	2.472	2.472	2.472	2.472	2.472
B = Gmb (FIELD) (Avg.)	2.339	0.000	0.000	0.000	0.000	0.000	0.000
C = Gsb (Job Mix)	2.557	2.557	2.557	2.557	2.557	2.557	2.557
D = Ps = Percent Agg. in mix	94.8	100.0	100.0	100.0	100.0	100.0	100.0
VMA = 100 - (B X D / C)	13.3	100.0	100.0	100.0	100.0	100.0	100.0
Va = 100 X ((A - B) / A)	5.4	100.0	100.0	100.0	100.0	100.0	100.0
VFA = (VMA-Va) / VMA	59	0	0	0	0	0	0

AASHTO T 166							
TECHNICIAN							
A = Weight of sample in air:	1255						
B = Weight in water:	710						
C = Weight of surface dry sample:	1260						
Gmc = CORE SPECIFIC GRAVITY = A / (C - B)	2.282	0.000	0.000	0.000	0.000	0.000	0.000
Gmm = MAX. SPECIFIC GRAVITY (T209)	2.472	2.472	2.472	2.472	2.472	2.472	2.472
% COMPACTION OF CORE = 100 x (Gmc / Gmm)	92.3	0.0	0.0	0.0	0.0	0.0	0.0
THICKNESS							
SUBLOT							

FOR 2ND CORE SUBLOT WHEN DENOTED IN QC PLAN							
TECHNICIAN							
A = Weight of sample in air:							
B = Weight in water:							
C = Weight of surface dry sample:							
Gmc = CORE SPECIFIC GRAVITY = A / (C - B)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gmm = MAX. SPECIFIC GRAVITY (T209)	2.472	2.472	2.472	2.472	2.472	2.472	2.472
% COMPACTION OF CORE = 100 x (Gmc / Gmm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THICKNESS							
SUBLOT							

Binder Portion

TECHNICIAN							
MoDOT TM54 (NUCLEAR)							
SAMPLE WEIGHT							
BACKGROUND							
COUNTS							
GAUGE % AC							
AASHTO T 308 (IGNITION)							
GAUGE %AC	5.35						
NUCLEAR OR IGNITION							
% MOISTURE	0.12						
% AC BY IGNITION OR NUCLEAR	5.2						

MODULE CONTENT

- Binder content of mix
- ***Binder content of RAP***
- Aggregate gradation

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RAP Binder Content

- Per Spec 403.2.6, RAP binder content must be determined
- QC: 1 per lot
- QA: 1 per project
- T164 (solvent extraction)
- Can use T308 (ignition) if a correction factor is determined which is the difference between T164 & T308 (best to use your own oven when T164 is determined by another lab)

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RAP & RAS

- Some contractors stockpile RAP & RAS, prepare (grind) it, and sample it.
- Send sample to a commercial lab to have extractions run (T164), obtain binder content & gradation
- This is what is submitted to MoDOT during mix design
- During production, RAP is sampled and ignition oven used to get binder content & gradation

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MODULE CONTENT

- Binder content of mix
- Binder content of RAP
- ***Aggregate gradation***

94

GRADATION SAMPLES

- MoDOT allows gradation sample testing to be satisfied by using the residue from the HMA ignition oven sample.
- An aggregate (gradation) correction factor (AGCF) may be necessary to account for the breakdown in rock.
- RAP gradation in the field is determined with ignition oven

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RAS Gradation

- Not recommended to use T308 on RAS (too dangerous)
- Fan will suck fines out
- Use extraction to get gradation or use the standard gradation

96

GRADATION SAMPLES

- When determining the aggregate (gradation) correction factor (AGCF), prepare a aggregate blank (no binder) specimen.
- Do a washed gradation analysis (T 30)
- Do a washed gradation analysis of the burned HMA specimen (T 30)

97

GRADATION SAMPLES
Plus #200 Portion

- Determine a difference for each sieve. Calculate the average difference.
- If the difference on ***any*** sieve exceeds the allowable, then each sieve must have the AGCF applied.
- Allowable differences:
- ≥ #8: ± 5.0%
- ≥ #200 to < #8: ± 3.0%

98

GRADATION SAMPLES
Minus #200 Portion

- Calculate the difference between the burned %-#200 and the blank (unburned) % -#200:
- $(\%\text{-}\#200)_{burned} - (\%\text{-}\#200)_{blank}$
- If difference is >0.5%, use the difference as the AGCF for the minus #200 material.

99

Conventional vs. Infrared

Conventional (NCAT)	Infrared (NTO)
Chamber temperature	Burn profile
240 v	120 or 240 v
Ceramic filter or afterburner	none
Reports burn time to the nearest minute	Reports burn time to the nearest second (thus is not an indication of operator interference)
Asterisk at end of machine stop	No asterisk

100

Conventional vs. Infrared

Conventional (NCAT)	Infrared (NTO)
Fan starts when "Start" is pressed	Fan does not start when "Start" is pressed: good for RAP/RAS- won't suck out fines; Bad: odors
	Reduced emissions, but still requires venting
	Requires cleaning more often
	No Temperature Compensation Factor

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SUMMARY

- 1. Sample loose mix every sublot (QC) or every day (QA).
- 2. Obtain specimen from quartered sample.
- 3. Specimen size is tied to NMS of gradation.
- 4. Burn
- 5. Loss of mass is the total of burned off binder, water, & aggregate.
- 6. Subtract the loss of aggregate & moisture.
- 7. Remains of the HMA burned specimen may be used for checking gradation.
- RAP binder content required

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ASPHALT CONTENT IGNITION METHOD
(AASHTO T 308-10) METHOD A
Asphalt Binder Correction Factor (C_F) Determination
(a.k.a. aggregate correction factor)

1. Run a butter mix through the mixing equipment.

2. For a given mix, prepare two asphalt binder correction factor (C_F) specimens at the design asphalt content using oven dry aggregate. It is recommended that the C_F and field verification specimen sizes be the same.

3. Obtain the tare weight of the baskets, pan, and lid.

4. Place the hot mix into the sample basket. If the mix has cooled, warm it at 110 ± 5°C prior to placing in the basket. Spread the mix in the basket, being careful to keep the mix away from the sides. Allow at least ¾" clearance.

5. Test (burn) the specimens as discussed in "Test Procedure."

6. If the difference between the measured binder contents of the two replicate specimens is more than 0.15%, test two more specimens. Discard the high and low values.

7. Calculate the C_F by determining the difference between the actual and measured asphalt binder contents [Actual %AC – Measured %AC] for each sample, and averaging the two differences. The "Actual %AC" is the amount weighed out in the batching process, expressed as a percent by weight of the mix.

8. If the C_F exceeds 1.0%, MoDOT Standard Specification Section 403.19.3.1.1 modifies AASHTO T 308-10 in the following manner:

   A. According to AASHTO T 308-10, if the C_F exceeds 1.0% at the typical chamber temperature of 538°C (1000°F), lower the chamber temperature to 482 ± 5°C (900 ± 8°F). If the C_F determined at this lower temperature is less than or equal to 1.0%, use that C_F for subsequent testing on that particular mix.

   B. However, according to MoDOT Standard Specification Section 403.19.3.1.1, if the C_F determined at 482 ± 5°C (900 ± 8°F) exceeds 1.0%, lower the chamber temperature to 427 ± 5°C (800 ± 8°F). Use the C_F obtained at 427°C even if it exceeds 1.0%.

ASPHALT CONTENT IGNITION METHOD
(AASHTO T 308-10)
METHOD A

Asphalt Binder Correction Factor (C_F) Determination

Sample_____Lab No._____Date_____Initials_____

Replicate	1	2	3	4
Test Temperature				
Tare (basket, etc.) Mass (g)				
Total Dry Mass (g)				
Initial Dry Specimen Mass (g)				
Loss in Weight (g)				
%AC, measured = M				
%AC, actual = A				
$\%AC_{diff}$ ($M_1 - M_2$)		> 0.15%? If so, 2 more replicates		
$C_F = M - A$				
C_F, average				

ASPHALT CONTENT IGNITION METHOD
(AASHTO T 308-10)
METHOD A

Specimen size: Use the following table. It is recommended that the field verification specimen size be the same as the correction factor specimen size.

NMS (mm)	Sieve Size	Minimum Specimen Size* (g)
4.75	#4	1200
9.5	3/8”	1200
12.5	1/2”	1500
19.0	3/4"	2000
25.0	1”	3000
37.5	1 ½”	4000

*Specimen sizes shall not be more than 500g greater than the minimum.

POSSIBLE SETTING CHANGES

1. To change the Stability Threshold:

   A. With oven off, press the “Calibration Factor” key while simultaneously pressing the Power Switch “on.”

   B. Enter new Stability Threshold value. Observe the Percent Loss window for the new value. Maximum allowable = 0.02.

   C. Press the Power Switch “off” then “on” to return oven to normal operation.

2. To change filter (afterburner) temperature (750°C typically):

   A. Press #5 key while simultaneously pressing the Power Switch “on.”

   B. Enter new temperature.

   C. Press “Enter.”

   D. New setpoint will be displayed.

MAINTENANCE

1. To check to see if the venting system is clogged, use the “Lift Test” procedure while the oven is at room temperature. With the power on, initiate a test (push “Start” button) without anything in the oven chamber. The blower fan will turn on. Watch the balance display. The display should read between -4 and -6 grams if the venting is adequate.

2. Burn accumulated soot out of the chamber by running the testing procedure at an elevated temperature without a sample.

TEST PROCEDURE

1. To change setpoint (furnace) temperature (538°C is typical):

   A. Press “Temp”

   B. Enter new setpoint

   C. Press “Enter”

   D. Press “Temp” again to verify new setpoint

2. To change the Asphalt Binder Correction Factor (C_F):

   A. Press “Calib. Factor”

   B. Enter new C_F

   C. Press “Enter”

   D. Press “Calib. Factor” again to verify

3. Preheat the oven to the setpoint, typically 538°C.

4. If the moisture content will not be determined, oven-dry the specimen at 110 ± 5°C to a constant mass.

5. Weigh the empty basket, etc. on an external scale to the nearest gram.

6. Place half the sample in the bottom basket and the other half in the top. Keep the specimen at least ¾” away from the basket sides. For larger samples, some operators make a hole in the middle of the mix.

7. Weigh the loaded assembly. Calculate the mass of the specimen.

8. Press the “Weight” key and enter the specimen mass. Press “Enter.”

9. Press the “Weight” key again to verify specimen mass entry.

10. Press the “0” (zero) key to tare the internal balance.

11. Don your clean gloves, safety face shield, and safety attire.

12. Carefully load the specimen into the oven by inserting the basket until the handle tines touch the back of the oven. Make sure the basket is centered and is not touching the walls. Shut the door.

13. Observe the internal scale reading. The displayed value should check with the external scale value of basket assembly + dry specimen within ± 5 grams.

14. Press the “Start/Stop” key to initiate the ignition procedure.

15. When weight loss stabilizes (the change in %AC readings will not exceed 0.01% for three consecutive minutes), the oven will automatically end the test and print out the results. Depending on the oven setup, an alarm may sound and one may have to press the “Start/Stop” key to unlock the door.

16. Remove the printed results before opening the door as the tape is heat-sensitive.

17. Again don the safety gear, open the door, and remove the basket and mount it on the cooling plate. Cover with the cooling cage.

18. Determine and record the final mass of the specimen, M_f.

19. From the total % loss, the oven will automatically subtract the C_F and the Temperature Compensation to give the %AC (by weight of mix). The %AC by weight of aggregate is the “Bitumen Ratio.”

20. Check for unburned asphalt (coke). If present, start with a new specimen.

    NOTE: Read the manufacturer’s manual for additional information on safety and more detailed instructions on maintenance and operation.

ASPHALT CONTENT IGNITION METHOD
(AASHTO T 308-10)
METHOD A
Manual Weighing Method

Project No.	Job No.	Route	County
Technician	Date	Sublot No.	Mix No.
Empty Basket Assembly Weight (g), [T_e]			
Initial Basket Assembly + Wet Sample Weight (g), [T_i]			
Final Basket Assembly + Sample Weight (g), [T_f]			
Loss in Weight (g), [$L = T_i - T_f$]			
% Loss, [$P_L = (L / W_i) \times 100$]			
Aggregate Correction (Calibration) Factor (%), [C_f]			
"Calibrated %AC", [$P_{bcal} = P_L - C_f$]			
% Moisture Content, [MC]			
% AC, corrected (by weight of mix), [$P_b = P_{bcal} - MC$]			

Ignition Ovens Forms.doc (11-24-06;12-28-06;12-12-08;3-9-10;12-14-10;4-14-11; 12-18-13; 4-22-15)