Rocky Mountain Asphalt Education Center

Laboratory for the Certification of Asphalt Technicians (LabCAT)

Level A - Laydown

2024 Presentation Manual

In cooperation with the Colorado Asphalt Pavement Association, the Colorado Department of Transportation, and the Federal Highway Administration

Rocky Mountain Asphalt Education Center

Welcome to the LABORATORY for the CERTIFICATION of ASPHALT TECHNICIANS (LabCAT)

2024

1

Asphalt Technicians Certification Program, Levels A, B, C and C minus Design

This is a certification class not a training class

2

Introductions

- Introduction of CAPA & RMAEC Staff
  - LabCAT Board of Directors
  - LabCAT Technical Committee
- Program Description
- Safety
- General Information

3

Colorado Asphalt Pavement Association (CAPA)
Rocky Mountain Asphalt Education Center (RMAEC)

• Tom Peterson, P.E.	CAPA, Executive Director
• Tom Clayton, SET and	CAPA/RMAEC, Director of Training Member Services
• Mike Skinner, P.E.	CAPA, Director of Engineering
• Diane Hammond	RMAEC, Training Coordinator
• Cindy Rutkoski	RMAEC, Instructor

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LabCAT Board of Directors

Ken Coulson	Coulson Excavating
Ed Wells	Connell Resources
Craig Wieden	CDOT Staff Materials
Jody Pieper	RME - CDOT R-2
Brian Dobling	Colorado Division Office-FHWA
Craig Vaughn	CMT Technical Services
Tim Webb	RME CDOT R-5
Justin Cupich	Kumar and Associates
Tom Peterson	CAPA

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LabCAT Technical Committee

Vincent Battista	CDOT, Asphalt Pavement Services Manager
Patrick Kowing	FHWA – Central Federal Lands Division
Johnny Lam	CDOT, Asphalt Pavement Program
Cindy Rutkoski	RMAEC, Instructor
Ethan Wiechert	Earth Engineering
Tom Clayton	RMAEC, (Co-Chair)
Tammy Buck	
Eric Biggers	Martin Marietta
David Fife	United Companies, a CRH Company
David Chelgren	Martin Marietta
Mike Gallegos	CDOT, R-1 Lab Manager
Lisa Wisner	CDOT, R-5 Materials
Jeff Cuypers	Brannan Sand and Gravel

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Asphalt Technician Certification Program

- Certification A – Laydown
- Certification B - Plant Materials Control
- Certification C – Volumetrics, Gyratory, Stability & Lottmans
- Certification C minus Design – Volumetrics and Gyratory Compaction
- Certification E - Aggregates
- Certification I – Asphalt Inspector

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Certification Schedule Tuesday

8:00 am

Certification Level A

PC/OA Program	Technician Responsibilities
Random Sampling Plans	CP 75
Sampling Aggregate	CP 30
Sampling Asphalt Mix	CP 41,
Bulk SP G for Roadway Cores	CP 44, Method B
Compaction Test Section	CP 82, Field Cores
In-Place Density by Nuclear Method	CP 81

Certification: Written Exam on Level A, Procedures – 60 Minutes

Following the written exam, laboratory proficiency testing will occur.

8

Certification Schedule - Wednesday

Certification Level B

Verification of Lab Equipment	CP 76
Reducing Asphalt Mixture	CP 55
Bulk SpG for Lab compacted Specimens	CP 44
Maximum Specific Gravity	CP 51
Asphalt Content by Ignition Method	CP-L 5120
Asphalt Content by Nuclear Oven	CP 85
Splitting Aggregate	CP 32
-200 Wash & Sieve Analysis	CP 31, AASHTO T11/T27

Certification: Written exam on Level B Procedures - 75 minutes

Following the written exam, laboratory proficiency testing will occur.

9

Certification Schedule Wednesday

Laboratory –Certification Level B

Reducing Asphalt Mixture	CP 55
Bulk SpG of Lab Compacted Specimens	CP 44
Maximum Specific Gravity	CP 51
Ignition Oven	CP-L 5120
Determination of Moisture in HMA	CP 43
Asphalt Nuclear Content Gauge	CP 85
Splitting Aggregate	CP 32
-200 & Sieve Analysis	AASHTO T11/T27, CP 31

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Certification Schedule - Thursday

Classroom -Certification Level C

Mixture Volumetric Properties	
Superpave Gyratory Compactor	**CP-L 5115**
Hveem Stability	**CP-L 5106**
Resistance to Moisture Induced Damage	**CP-L 5109**

Certification: Written Exam on: Level C Procedures – 60 minutes

Following the written exam, laboratory proficiency testing will occur.

11

RMAEC Requirements

- **Relax**
- **Please, don't be late from breaks**
- **Questions/Comments are welcome and encouraged during presentations**
- **CEU's are available (See Diane)**
- **Please Silence Cell Phones**

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What are the Safety Issues?

- Materials
  - Heated Mixture samples (Level C only)
  - Compacted Specimens (Level B and C)
- Equipment
  - Nuclear Gauges (Source less)
  - Forced Draft Ovens (Level C only)
  - Compression Testing Machine (Level C only)
  - Gyratory Compactors (Level C only)

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General Information

- Coffee & Refreshments, Counter in lobby Area
- Pop Machine
- Lunch ~ provided
- Breaks ~ As needed
- Restrooms, Main building hallway on the left.

14

Handouts Provided

- LabCAT Presentation Manual (slide presentations)
- Evaluations (First page in the presentation manual). Please complete the critique form and return it prior to leaving our facility.
- CDOT Manuals
  - Field Materials Manual-Levels A & B (Are available but not supplied, only the required sections are provided during the written test)
  - Laboratory Manual of Test Procedures-Level C (Are available but not supplied, only the required sections are provided during the written test)

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LabCAT Program Policies

Written Test:

- Written exams are closed book. No personal notes are allowed during testing. Written tests are timed, times are stated at top of exams & will be adhered to.
- Before beginning the written exam, the instructor will distribute copies of the CDOT procedures per level. These handouts are for quick reference. Please be prepared, as all written exams are timed.
- Handouts will be collected at the completion of the written exams.

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LabCAT Program Policies (continued)

- **Each level of the written exams is divided into sections. A score of 70% or higher must be achieved per section, with an overall score of 80% or higher to pass the written exam portion of certification.**
- **If any section of the written exam score is less than 70%, the technician will be advised.**
- **Re-testing of the failed section is allowed if the total number of failed sections per level does not exceed the maximum. The maximum number of failed sections per level is as follows: Level A – 2 sections, Level B – 2 sections and Level C, 1 section, C minus Design no sections.**

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LabCAT Program Policies (continued)

- **The technician will be allowed to briefly review the failed section of the first exam (Test 1). The instructor will not coach the technician regarding the failed questions. The Re-test (Test 2), will be immediately administered.**
- **15 minutes will be allowed for re-test of one section, 30 minutes will be allowed for two or more re-test sections.**
- **If the technician fails (Test 2), as in an overall score of less than 80%", the technician will not be allowed to continue the certification process or proceed to the Laboratory portion of certification. The technician must re-register for certification. Please note: If the technician fails (Test 2) and is not allowed to continue, the entire registration fee will still be invoiced.**

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LabCAT Program Policies (continued)

- **Written exam re-test fees are $25 per level.**
- **A letter will be sent to the appropriate company advising them of the failure and what is required for the technician to successfully complete the certification program.**
- **These new policies are being applied to encourage technicians to come prepared for certification testing and for the companies to provide necessary training.**

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2024 LabCAT Program Policies (Continued)

- **Laboratory Procedures are graded Pass or Fail.**
- **Laboratory Procedure Proficiency Testing is closed book. Technicians will be required to independently demonstrate proficiency in each Laboratory Procedure per level. Additional training or coaching by the laboratory exam proctor will not be allowed.**
- **If the technician does not Pass the first attempt (Trial 1) a second attempt (Trial 2) is allowed. The second attempt (Trial 2) will be immediately administered. However, the maximum number of Failed Procedures is limited per level.**

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2024 LabCAT Program Policies (continued)

▶Laboratory Proficiency Testing

If the maximum number of Failed Procedures is exceeded, the technician will not be allowed to continue the certification process.

Maximum number of failed proficiencies allowed:

1 - Level A
2 - Level B
1 - Level C
0 - Level C minus Design

▶Laboratory Procedure Re-Testing Fees

▶Laboratory Procedure re-test fees are $150 per level.

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Failure/Retest Policy (Continued)

- **Lab Proficiencies**

  If at or below the number allowed to be eligible to re-test, you will be required to perform an additional proficiency from the same level to ensure competency at that level.

- ***No Refund or consideration*** will be given to a Technician who begins a session and chooses not to complete the session on the scheduled day. A Technician who chooses to leave a session will be considered as failing and will need to retest as described in the ***"Retest Policy".***

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Supplemental Examiners (Proctors)

- **Where our proctors come from:**
  - **CDOT**
  - **Local Agency**
  - **Contractors**
  - **Consultants**
- **Time needed for proficiency testing is based on the number of proctors available during the certification session.**
- **How do I become a proctor?**

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Presentation Information

- **Information presented during LabCAT Certification is based on CDOT Procedures where indicated by type in Blue, Bold and Underlined are specific to CDOT and vary from AASHTO.**
- **All other information presented is based on AASHTO procedures.**
- **In any situation where the CDOT procedure is present, it will supersede the AASHTO procedure and the technician will be tested on the CDOT Procedure.**

24

Who you are is important too!
Self Introductions

- Name
- Organization
- General responsibilities
- Years in the construction field

25

Questions ?

Let's Get Started!

26

WHAT IS A PROCESS CONTROL PROGRAM?

Why is accurate materials sampling, splitting and testing so important on Highway Construction Projects?

1

WHAT IS THE CONTRACTOR'S PC PROGRAM

The contractor shall develop a PC Program for each element listed in table 106-1 of the project special provisions:

- Frequency of test or measurement
- Test result chart
- Quality Level chart

2

WHAT IS INCLUDED IN THE CDOT QA PROGRAM

The QA Program will provide for:

- An Acceptance Program
- Frequency Guide Schedule, Identification of specific sampling location
- Project verification sampling and testing
- Independent Assurance Program
- Project Materials Certification
- Retention of sampling and testing records

3

WHAT IS THE TESTER'S RESPONSIBILITY IN THE ACCEPTANCE PROGRAM

- To conduct the sampling, splitting and testing of asphalt according to proper procedures (CDOT or AASHTO).
- Input asphalt test results into Lims (Laboratory Information Management System) and must have current LabCAT certification in order to do so. CDOT conducts the training for using Lims.
- Communication–CDOT and the Contractor

4

WHY ARE YOUR TEST RESULTS SO IMPORTANT?

- The sampling, splitting and overall handling techniques affect test results.
- Test results must be accurate when input into the CDOT acceptance programs for proper incentive or disincentive to be applied.
- Test results must be accurate to determine the quality of pavement, which affects both the short term and long term, life of the roadway.

5

Item 403S Cost/ton: $35.00

% Max Density

Upper Test Limit: 96.0 V Factor: 1.10
Lower Test Limit: 92.0 W Factor: 0.40

Test No.	Date	Quant Repr.	Total Quant.	Density	MQL
1	06/11/00	500	500	94.20	
2	06/12/00	500	1000	92.40	
3	06/12/00	500	1500	93.60	100
4	06/12/00	500	2000	93.30	100
5	06/13/00	500	2500	94.20	100
6	06/13/00	500	3000	92.90	100
7	06/14/00	500	3500	94.20	100
8	06/14/00	500	4000	93.90	100
9	06/15/00	500	4500	93.90	100
10	06/15/00	500	5000	93.90	100
11	06/18/00	500	5500	94.40	100
12	06/18/00	500	6000	94.30	100
13	06/19/00	500	6500	93.90	100
14	06/19/00	500	7000	94.30	100
15	06/20/00	500	7500	94.70	100
16	06/20/00	500	8000	92.70	100
17	06/20/00	500	8500	93.60	100
18	06/21/00	500	9000	92.70	100
19	06/21/00	500	9500	94.10	100
20	06/22/00	500	10000	94.20	100
21	07/06/00	500	10500	93.20	100
22	07/06/00	500	11000	94.50	100
23	07/10/00	500	11500	93.60	100
24	07/10/00	500	12000	92.70	100
25	07/10/00	500	12500	93.70	100
26	07/10/00	500	13000	93.00	100
27	07/11/00	500	13500	93.40	100
28	07/11/00	500	14000	94.80	100
29	07/12/00	500	14500	94.50	100
30	07/12/00	500	15000	95.00	100
31	07/12/00	500	15500	92.20	99
32	07/13/00	500	16000	93.00	96

% Max Density Process Summary

Process 1 Tests 1-32 Quantity 16000 tons PF= 1.05500 I/DP=$12,320.00
Mean: 93.719 Std.Dev: 0.736 QL = 99.213

6

Item 403S Cost/ton: $35.00

% Max Density

Upper Test Limit: 96.0 V Factor: 1.10
Lower Test Limit: 92.0 W Factor: 0.40

Test No.	Date	Quant Repr.	Total Quant.	Density	MQL
1	06/11/00	500	500	94.20	
2	06/12/00	500	1000	92.40	
3	06/12/00	500	1500	93.60	100
4	06/12/00	500	2000	93.30	100
5	06/13/00	500	2500	94.20	100
6	06/13/00	500	3000	92.90	100
7	06/14/00	500	3500	94.20	100
8	06/14/00	500	4000	93.90	100
9	06/15/00	500	4500	93.90	100
10	06/15/00	500	5000	93.90	100
11	06/18/00	500	5500	94.40	100
12	06/18/00	500	6000	94.30	100
13	06/19/00	500	6500	93.90	100
14	06/19/00	500	7000	94.30	100
15	06/20/00	500	7500	94.70	100
16	06/20/00	500	8000	92.70	100
17	06/20/00	500	8500	93.60	100
18	06/21/00	500	9000	92.70	100
19	06/21/00	500	9500	94.10	100
20	06/22/00	500	10000	94.20	100
21	07/06/00	500	10500	93.20	100
22	07/06/00	500	11000	94.50	100
23	07/10/00	500	11500	93.60	100
24	07/10/00	500	12000	92.70	100
25	07/10/00	500	12500	93.70	100
26	07/10/00	500	13000	93.00	100
27	07/11/00	500	13500	93.40	100
28	07/11/00	500	14000	94.80	100
29	07/12/00	500	14500	94.50	100
30	07/12/00	500	15000	95.00	100
31	07/12/00	500	15500	92.20	99
32	07/13/00	500	16000	93.00	96
33	07/13/00	500	16500	90.60	70

% Max Density Process Summary

Process 1 Tests 1-33 Quantity 16500 tons PF= 1.05201 I/DP=$12,014.13
Mean: 93.624 Std.Dev: 0.905 QL = 96.341

7

Item 403S Cost/ton: $35.00

% Max Density

Upper Test Limit: 96.0 V Factor: 1.10
Lower Test Limit: 92.0 W Factor: 0.40

Test No.	Date	Quant Repr.	Total Quant.	Density	MQL
1	06/11/00	500	500	94.20	
2	06/12/00	500	1000	92.40	
3	06/12/00	500	1500	93.60	100
4	06/12/00	500	2000	93.30	100
5	06/13/00	500	2500	94.20	100
6	06/13/00	500	3000	92.90	100
7	06/14/00	500	3500	94.20	100
8	06/14/00	500	4000	93.90	100
9	06/15/00	500	4500	93.90	100
10	06/15/00	500	5000	93.90	100
11	06/18/00	500	5500	94.40	100
12	06/18/00	500	6000	94.30	100
13	06/19/00	500	6500	93.90	100
14	06/19/00	500	7000	94.30	100
15	06/20/00	500	7500	94.70	100
16	06/20/00	500	8000	92.70	100
17	06/20/00	500	8500	93.60	100
18	06/21/00	500	9000	92.70	100
19	06/21/00	500	9500	94.10	100
20	06/22/00	500	10000	94.20	100
21	07/06/00	500	10500	93.20	100
22	07/06/00	500	11000	94.50	100
23	07/10/00	500	11500	93.60	100
24	07/10/00	500	12000	92.70	100
25	07/10/00	500	12500	93.70	100
26	07/10/00	500	13000	93.00	100
27	07/11/00	500	13500	93.40	100
28	07/11/00	500	14000	94.80	100
29	07/12/00	500	14500	91.90	92
30	07/12/00	500	15000	91.80	77
31	07/12/00	500	15500	92.00	71
32	07/13/00	500	16000	91.90	63

% Max Density Process Summary

Process 1 Tests 1-32 Quantity 16000 tons PF= 1.04963 I/DP=$11,117.83
Mean: 93.497 Std.Dev: 0.869 QL = 95.919

8

WHY ARE THE RESPONSIBILITIES OF A TECHNICIAN PERFORMING ACCURATE SAMPLING, SPLITTING AND TESTING SO IMPORTANT ON A PROJECT?

The test results obtained are the basis for the contractor's incentive or disincentive payment and to help determine the overall pavement quality.

9

QUESTIONS?

10

RANDOM SAMPLING OF MATERIALS PROCEDURE
CDOT CP 75

1

This covers the random selection of materials to be sampled and tested.

The sampling and testing procedures to be followed are specified in the procedures of the tests required.

Sampling is one of the most critical steps in materials testing.

2

RANDOM SAMPLING

Most CDOT specifications call for using the *Stratified Random Sampling Process.*

This ensures that any portion of the material on a project has an equal chance of being selected.

Bias is introduced when judgment is used.

3

IMPORTANCE OF STRATIFIED RANDOM SAMPLING OF MATERIALS

- If not chosen randomly, the tests may not reflect the true characteristics of the material being evaluated.
- Stratified random sampling requires that one random sample is selected from each sub lot.
- Ensures that samples are selected uniformly throughout the entire production process.

4

IMPORTANCE OF STRATIFIED RANDOM SAMPLING OF MATERIALS
(CONTINUED)

- No material is excluded from the chance of being selected unless it is specified in the specifications.
- It is the nature of random sampling that some samples will represent below average or above average material.
- The random number schedule should be predetermined and not shared with the supplier or contractor before sample is taken.

5

RANDOM NUMBER SCHEDULES

- It is the responsibility of the tester to ensure that the minimum sampling frequency is met.
- CP 75 contains complete instructions on accessing and using the programs.

6

RANDOM NUMBER SCHEDULES (CONTINUED)

As stated before, random sampling times and locations should not be shared with the contractors prior to the time samples are obtained or density tests are to be performed

however, it is acceptable and encouraged for contractors to take split samples or perform density testing that coincides with the OA testing schedule.

7

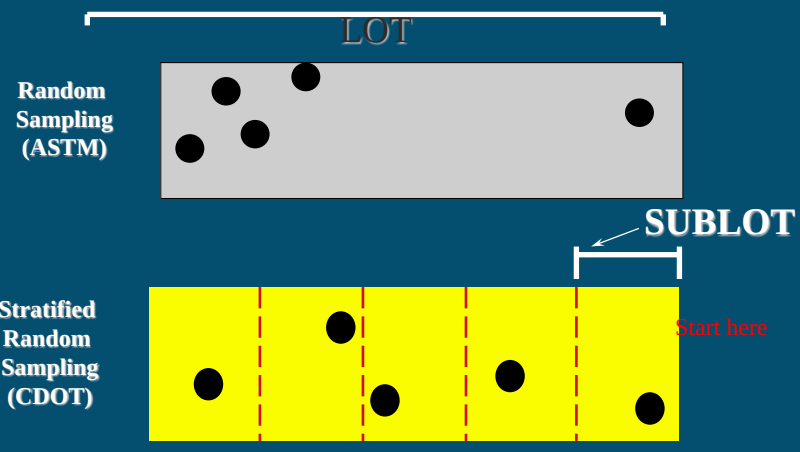
RANDOM NUMBER SCHEDULES (CONTINUED)

- Sampling should take place as close as possible to the values represented on the sampling schedule. Fill in the "Taken At" column of random schedule as samples are taken.

- Major deviations from the sampling schedules should be noted and explained on the form.

8

LOTS AND SUBLOTS



Stratified Random Sampling methods will be used on ALL CDOT Projects!

9

QUESTIONS?

10

Standard Method for Sampling of Aggregates

CDOT CP 30

AASHTO T 2
ASTM D-75

1

Sampling Locations

1. Flowing Aggregate Stream - Belt Discharge using hand tools, automatic belt samplers or power equipment.
2. Stopped conveyor belt.
3. Stockpiles – with power equipment & without power equipment.
4. Roadway – Bases & Subbases
5. Processed Windrows
6. Cover Coat Material Spreader

2

Securing Samples

- Aggregates used in asphalt shall be sampled by the contractor and witnessed by an authorized state representative
- Samples for preliminary approval or production control may be submitted by the producer, read and consider CP 52 Contractor Asphalt Mix Design Approval Procedures.

3

CP 30

These methods are intended to apply to the sampling of aggregates used in acceptance and quality control from the points of acceptance as designated for construction materials including aggregate base course and aggregates for asphalt mixtures.

4

Summary of the procedure

- Sampling is equally as important as the testing of the aggregate material
- Samples must be taken accurately to represent the characteristics of the material
- Always avoid segregation
- Samples must be selected from all the material being produced via CP-75 (Random Sampling)

5

Belt Discharge using Hand Tools

- If safe and practical to stand within 2’ of belt discharge
- Obtain one or more equal increments
- Combine to form field sample that equals or exceeds the minimum recommended in Table 30-1 Size of Field Samples
- Several quick passes from entire cross section of flow
- Container shall be at least 12” diameter with sufficient capacity to hold entire sample

6

Automatic Belt Sampler

- Must cut the full charge of the belt without any loss of any portion
- Take one or more field samples that combined equals or exceeds the minimum recommended in Table 30-1 Size of Field Samples

7

Belt Discharge using Power Equipment

- Front-end loader bucket positioned under belt discharge
- Material placed in separate small sampling stockpile using the following procedure

8

Sampling with Power Equipment should always follow this procedure

- Combine and mix the material in a separate small pile

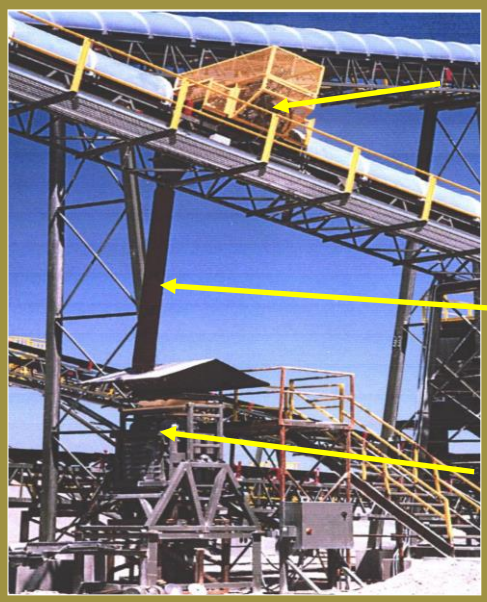
- Flatten the pile not thicker than approx. 1 ft.

9

Sampling with Power Equipment (continued)

- Sample from at least 3 locations through full depth of the pile created using a flat, square end shovel.
- Combine all portions

10

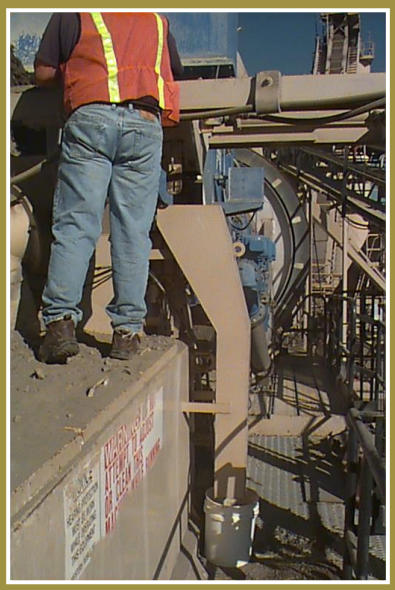


Automatic Belt Sampling Device

Tube Transfer Device

Automatic Gradation Unit

11



13

Storage Bin Discharge

- Bin discharge – is not for acceptance testing

14

Stopped Conveyor Belt

- Obtain at least 3 [one or more CDOT] increments selected at random
- Stop the conveyor belt
- Insert two templates contoured to fit the belt

16

Stopped Conveyor Belt

- Distance between templates to yield an increment of the required weight
- Remove all material between the templates

17

Stopped Conveyor Belt

- Include all of the finer aggregates
- Use a brush and dustpan
- Combine all portions

18

Stockpiles

- Stockpile sampling should be avoided if possible (MSHA/OSHA)
- Sampling should only be done by or under the direction of experienced personnel
- Mechanical equipment should be used if stockpiles are to be sampled

19

Power Equipment

- Remove segregated material from the stockpile sides.
- Expose a representative face.
- Channel the face from bottom to top

20

Power Equipment

- Combine and mix to form a small sampling pile

21

Power Equipment

- Flatten the pile to a depth not thicker than approximately 1ft
- Sample from at least three (3) locations, to full depth of pile if possible
- Combine all portions

22

Stockpiles (Manually)

- Obtain portions of the sample from the top third, mid-point and bottom third of the stockpile
- Take two sets of three samples 180° apart

23

Stockpiles – Coarse & Mixed Size Aggregate

- Place shelf up slope from the sampling point
- Remove top six (6) inches outer layer of material
- Use a flat square end shovel or a scoop with sides
- Sample to full depth of shovel
- If possible, use front end loader or backhoe

24

25

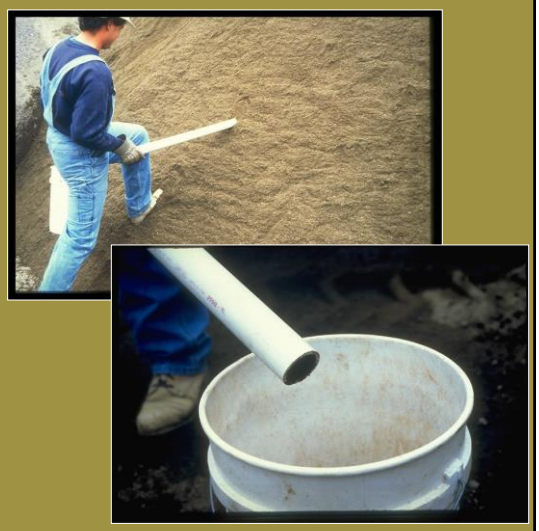
Stockpiles – Fine Aggregate (- 3/ 8 in.)

- Same as coarse and mixed sized aggregate
  or
- Sampling tube

26

Stockpiles – Fine Aggregate (- 3/ 8 in.) using a sampling tube

- Sampling tube approximately 1.25 in. minimum diameter by 6 ft. long inserted horizontally at a minimum of 5 locations to form the sample



27

Roadway

- Sample from random location
- Minimum of 3 approximately equal increments
- Use flat square end shovel or scoop

28

Roadway

- Sample full depth of lift

29

Roadway

- Take care to exclude any underlying material
- Combine all portions

30

Processed Windrows

- Material should contain sufficient moisture to maintain a near vertical face
- Remove material from one side toward the center to the full depth until a representative face is exposed
- Channel the exposed face from bottom to top and obtain a sample of required weight

31

Processed Windrows

- Sample from at least three equally spaced locations on the exposed face
  - Use a flat, square end shovel
- Do not lose particles off the shovel

32

Cover Coat Material Spreader

- Last possible location prior to placement on the pavement
- Spreader must be stopped
- Samples will be taken from minimum of three individual gates as it is falling from the spreader
- Combine all samples to equal or exceed minimum requirement

33

Cover Coat Material Spreader

- If there is a belt transfer device, samples may be taken from the stopped belt as per the Sampling from the Stopped Conveyor Belt method.

- Under the engineer's approval, material may be sampled from the stockpile as per 4.3.3

34

Definition: (Aggregate for Item 403)

- Nominal Maximum Particle Size is one sieve size larger than the first sieve that retains more than 10% of the aggregate sample (SHRP/Superpave)

35

Example

Sieve Size mm (in.)	Aggregate – % Passing		
	A	B	C
19 (3/4)	*100*	100	100
12 (1/2)	88	*93*	*90*
9.5 (3/8)	78	88	79

36

Sample Size Requirements are based on the

Nominal Maximum Particle Size and can be found in Table 30-1 Size of Field Samples

37

Questions???

38

TABLE 30-1: SIZE OF FIELD SAMPLES

Nominal Maximum Size of Aggregates	Approximate Minimum Mass of Field Samples

Fine Aggregate	lbs	kg
No. 8 (2.36 mm)	10	5
No. 4 (4.75 mm)	10	5

Coarse Aggregate	lbs	kg
3/8 inch (9.5 mm)	15	7
½ inch (12.5 mm)	20	10
¾ inch (19.0 mm)	25	12
1 inch (25.0 mm)	30	15
1 ½ inch (37.5 mm)	40	20
2 inch (50.0 mm)	45	22
2 ½ inch (63.0 mm)	50	25
3 inch (75.0 mm)	55	27
3 ½ inch (90.0 mm)	60	30

Standard Method of Test for Sampling Asphalt Paving Mixtures

AASHTO T – 168

CDOT CP 41

1

Significance and use:

- **Sampling is equally as important than the testing of Asphalt pavement materials.**
- **Samples must be taken to accurately represent the characteristics of the material.**

2

Securing Samples

- Samples for acceptance or assurance testing shall be sampled by the contractor and witnessed by an authorized representative of CDOT.

3

Sampling Asphalt Mixtures

- Method A: Tube Sampler (sample can)
- Method B: Point of Delivery
  - Windrow prior to Laydown
  - Paving Machine Augers
  - Roadway prior to Compaction
- Method C: Roadway after Compaction

4

Tube Sampler Apparatus (Plant Swing Arm)

- Tube sampler holder with metal collar to hold sample with 3 foot handle or two tube arrangement with handle length dependent on discharge set-up.

Two methods:

- Swing arm with tube through discharge fast enough to obtain a representative sample filling the tube.
- Prior to discharge center tube directly under discharge flow, after return of tube to storage position, strike off material above top of rim.

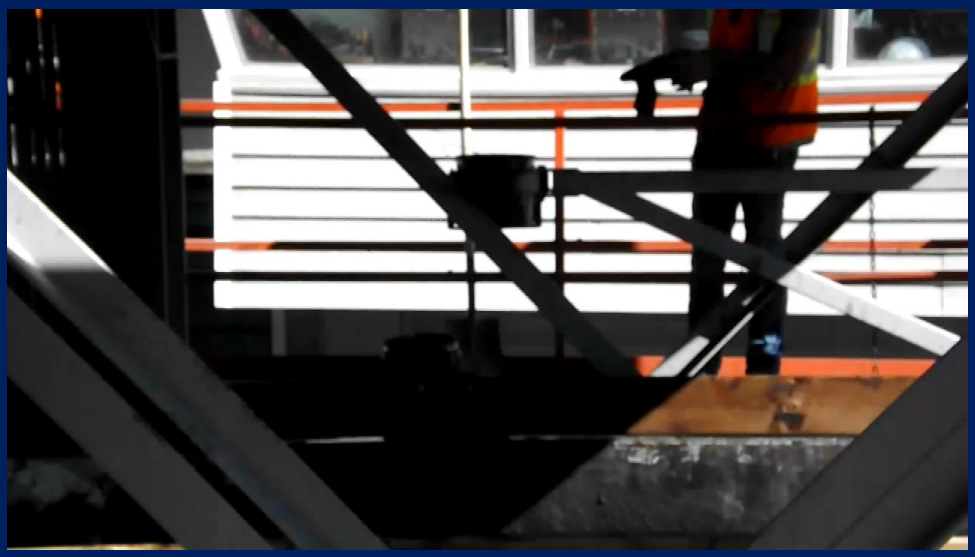
5

The sampler is required to pass completely through the discharge

6




7



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The CDOT specs for the sample cans when samples are to be submitted to any CDOT lab are as follows:

A container with 3 to 4 gallon capacity made of at least 30 gauge non galvanized metal, having a “bail” type handle and a tight fitting lid.

9

Sampling Asphalt Mixtures Point of Delivery

- **Locations**
  - **Windrow**
  - **Paving machine spreading screws (auger chamber)**
  - **Mat behind paver**

10

Sampling Asphalt Mixtures Windrow

- Select 3 or more random locations based on CP 75.
- Remove material from one side of windrow full depth towards the center to expose a representative face.
- Trench the exposed face from bottom to top avoiding segregation.
- Deposit sample into container.

11

12

Sampling Asphalt Mixtures- Spreading Screws (Auger Chamber)

- Observe auger rotation.
- Augers should be operating at least 80 % or more of the time.
- Auger area should be at least 2/3 (1/2 the auger) covered with mixture.

13

14

Sampling Asphalt Mixtures Behind Paver (AASHTO & CDOT)

- Apparatus
  - small flat scoop with sides or sampling device.
  - container, with tight fitting lid, of suitable capacity

17

Sampling Asphalt Mixtures Behind Paver

- Use a random method to determine sampling locations.
- Obtain at least 3 approximately equal size increments immediately behind paving machine.
- Increments shall be the full depth of lift.
- Templates which are placed before mixture is spread can be helpful.

18

19

Sampling from Roadway After Compaction

- Select the units to be sampled by a random method.
- Obtain at least 3 approximate equal samples for the full depth of material, taking care to exclude any underlying material.
- Each increment shall be obtained by coring, sawing or other methods in such a manner to ensure a minimum disturbance of the material.

20

Questions?

21

Standard Method of Test for Bulk Specific Gravity and Percent Compaction of Compacted Bituminous Mixtures Using SSD Specimens

CDOT CP 44

AASHTO T - 166

1

Purpose

- This procedure provides methods for determining bulk specific gravity to calculate the percent relative compaction of HMA and air void analysis.
- The Bulk Sp G is also used in determining the correlation factor for nuclear density gauges.

2

Test Specimens

- Method B (Rapid Test for Pavement Cores)
- Method C (COREDRY Test)
- Size of Specimens.

  Diameter should be at least 4 times the maximum size of the aggregate.

  Thickness at least 1.5 times the maximum size of the aggregate.

3

Specimen Preparation

- Avoid distortion, bending or cracking during and after removal from pavement.
- Stored in safe, cool place.
- Separating specimen layers should be done by sawing or suitable means.
- Specimens shall be free from foreign materials such as seal coat, tack coat, foundation material, etc.

4

Testing Apparatus required

- Balance, with suspension apparatus.
- Wire of the smallest practical size at the penetration point of the water surface.
- Water bath with overflow outlet.
- Flannel or terry cloth towel.

5

Procedure for Method B Roadway Cores using the Rapid Test Method

- Check water level.
- Check water temperature 77 ± 1.8°F (25 ± 1.0°C).
- Immerse specimen in water 4 ± 1 minutes.
- Record immersed mass.
- Remove specimen from water, blot with freshly wrung out, damp towel and record SSD mass.

6

Method B Drying Cores to Constant Mass Rapid Test

- Tare pan, record mass of specimen and place pan and specimen into a forced draft oven at 230 ± 9 °F (110 ± 5C).
- Leave 5 ½ inch (140 mm) or larger, or porous or wet cores in oven until they can be separated into pieces no larger than 2 inches (50 mm).
- Dry the specimens for 3 hours and determine the mass.
- Determine the mass at 2 hour intervals until constant mass (no change of more 0.00)%) has been attained or 24 hour maximum.
- Cool specimen to room temperature and determine the dry mass.

7

Method C (CoreDry Test)

- May be used for pavement cores in place of Method B, and for cores that can then be saved.
- May be used on cores containing moisture.
- Tested the same day – quick results.
- Allowing cores to warm to room temperature, towel blot any free standing moisture on cores.
- Place core on side on wire mesh in vacuum chamber.
- Follow procedure in 11.4 of Method C for use of CoreDry apparatus to obtain dry weight.
- Determine the weight in water and SSD weights as in Method B.

8

CoreDry Procedure (11.4)

- Turn the CoreDry to ON position.
- Allow to warm up & go through preparation cycles until "Systems Ready" prompt appears.
- Allow cores to warm to room temperature & towel dry samples of free standing moisture.
- Place core on its side on wire mesh in the vacuum chamber.
- Make sure that moisture trap is cleaned out.
- Place lids on vacuum chamber & moisture trap.
- Press START.
- CoreDry will cycle until drying is complete. If moisture is visible on core surface, clean moisture trap and run again.
- Record dry weight & use as dry mass in equation.

9

Bulk Specific Gravity Calculation

$$G_{mb} = \frac{A}{(B - C)}$$

where:

A = mass (in grams) of dry sample in air
B = mass (in grams) of SSD sample, in air
C = mass (in grams) of sample in water

10

Percent Relative Compaction

$$\text{Percent Relative Compaction} = \frac{\text{Bulk Specific Gravity}}{\text{Maximum Specific Gravity}} \times 100$$

11

Air Voids (Va) Calculation

- Air Voids = 100 - % Compaction

12

Convert Specific Gravity (Gs) to pounds per cubic ft (pcf)

CDOT uses:

- **Specific gravity x 62.4= pcf**
- **Pcf / 62.4 = specific gravity**

13

Questions ??

14

COMPACTION TEST SECTIONS

1

Compaction Test Section

- Information about the Compaction Test Section is found in the Standard Specifications for Road & Bridge Construction under 401.17
- Calculations for the Correction Factor and the procedure are found in CP 82 of the CDOT Field Materials Manual.
- Calculations for the determination of Density & Percent Compaction of HMA Pavement by Nuclear Method is found in CP 81 of the CDOT Field Materials Manual.

2

What is a Compaction Test Section?

- A section of road is constructed to determine the number and type of rollers and most effective rolling pattern to achieve the specified density.
- On CDOT Projects – The test strip ***should*** be constructed using the First 500 tons of production.
  - *First 300 tons placed to determine the process.*
  - *Last 200 tons placed to test for density correction.*

3

Procedure

- The contractor determines the methods and procedures to be used for the test section and all subsequent placement of asphalt mixtures for the project.
- These processes are used uniformly over the final 200 tons placed in the test section.
- Data which should be recorded, includes but not limited to:
  - Type, size, amplitude, frequency, and speed of roller.
  - Tire pressure for rubber tire rollers.
  - Passes using vibratory type rollers, vibratory or static.
  - Surface temperature of mix behind laydown machine.
  - Subsequent temperatures and densities after each roller pass.
  - Sequence and distance from laydown machine for each roller.
  - Number of passes of each roller to obtain specified density.

4

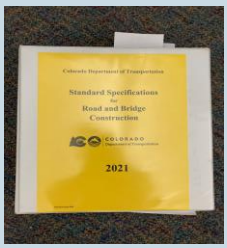
Nuclear/Core Corrections as per CP 82

- *Perform 7 random Nuclear density tests on final 200 tons of material placed for the test section.*
- *Obtain duplicate cores from footprint location of each test Nuclear test performed.*
  - Contractor cuts 2 cores from each location, one set to CDOT.
  - Contractor tests the other set.
  - CDOT observes coring and testing by contractor.
- *Correlate Nuclear Tests to Cores*
  - Average core bulk specific gravities of all 7 cores.
  - Average specific gravities or wet densities from the 7 nuclear test.
  - Calculate and record correction factor for each gauge. Determine acceptability of the test section.

5

Acceptability of Test Section

- As per Section 401.17 of the Spec Book, a new CTS shall be constructed when a change in the compaction process is implemented.
- A new CTS may be required for different layers of pavement.
- Core locations should be distributed across the mat



6

CP 82

- **Provides for the development of a correction factor that should be valid until the ingredients in the bituminous pavement change (new mix design),or the underlying material changes.**
- **May also be used whenever variations in conditions bring the Moisture/Density Gauge readings into question.**

8

COLORADO DEPARTMENT OF TRANSPORTATION
NUCLEAR ASPHALT - DENSITY CORRECTION

Project code (SA#)	Project No.	Item	Mix design #
11925	IM 0253 - 151	403	142011
Date	Proj. location	Job Mix - % A.C.	Lab SpG
	I25, SH 7 TO WCR 16	5.9	2.441

Region	Paving Contractor	Grading	Course
4	Keiwit Western	S(75)	Top 1.5"

Gauge #1 - Owner	Gauge #1 - ID# & SN	Gauge #2 - Owner	Gauge #2 - ID# & SN
Geocal	G -1	Keiwit	K -2

Core #	Station	Transverse location	CP 44 (or CP-L 5103) (A) Oven dry wt.	CP 44 (or CP-L 5103) (B) Sat surf dry wt.	CP 44 (or CP-L 5103) (C) Immersed wt.	CP 44 (or CP-L 5103) A/(B-C) Bulk SpG	Density Bulk SpG x 62.4 lb/ft³	Nuclear Gauge #1 Wet density	Nuclear Gauge #2 Wet density
1	2535+60	10' Rt	599.1	600.1	342.0	2.325	145.1	143.5	142.2
2	2536+60	7' Rt	689.7	690.6	393.8	2.324	145.0	144.0	141.8
3	2537+20	9' Rt	731.6	733.1	415.2	2.301	143.6	143.6	141.5
4	2537+20	4' Rt	519.5	520.2	294.4	2.301	143.6	143.2	141.0
5	2539+70	11' Rt	510.1	510.5	287.0	2.282	142.4	142.1	140.3
6	2539+71	3' Rt	698.7	699.2	394.3	2.292	143.0	143.0	141.7
7	2542+00	5' Rt	627.3	628.1	350.8	2.262	141.1	141.7	140.4
		Totals				16.087	1,003.80	1,001.100	988.900
		Average (Total/7)				2.298	143.400 (E)	143.014 (F1)	141.271 (F2)
		Correction Factor (E-F)						+0.4	+2.1

Comments
Top Mat 1.5"

Nuclear gauge #1	Nuclear gauge #2
Intended gauge use ☐ QA ☐ QC	Intended gauge use ☐ QA ☒ QC
Gauge operator	Gauge operator
☐ CDOT or company (name) Geocal	☐ CDOT or company (name) Keiwit
Lab tester for CP 44	
Supervisor	Supervisor

Previous editions are obsolete and may not be used CDOT Form #469 4/07

9

HANDLING OF CORES

10

Why is it important to handle cores with care?

- They are representative samples of the pavement.
  - *Correlating for Density Tests*
  - *Assisting in the determination of density*
- They can damage easily.
  - *Keep out of heat/cold.*
  - *Store/transport on longest side.*
  - *Never stack cores.*
  - *Wrap or support perimeter.*
  - *Transport in tight container.*
- Takes time and $$ to re-sample.

11

Thank You

12

Standard Method of Test for Density and Percent Relative Compaction of HMA Pavement by the Nuclear Method CDOT CP 81

1

Purpose

For the in-place determination of density of HMA for acceptance testing.

2

CP 15 Certification of Consultant Nuclear M/D or Thin Lift Gauges

- Refer to CP 15 for complete instructions for requirements for gauges to be used on CDOT projects.
- Equipment used shall pass requirements for stat & drift test in CP-L 5302 & CP-L 5304.
- CP-L 5302 M/D Nuclear Gauges-CDOT
- CP-L 5303 Calibration of CDOT Gauges
- CP-L 5304 Nuclear Thin Lift Gauges-CDOT
- CP-L 5306 Certification of Consultant Nuclear M/D & Thin Lift Gauge

3

Apparatus Required

- Gauge
- Portable reference standard

4

Procedure

- Standardization
  - At the start of each day, whenever a gauge is turned off and when a gauge readings are in question.
- Test
- Calculations

5

Standardization Requirements

- Turn gauge on and allow to warm up for 20 minutes, allow to stabilize according to the manufacturer's recommendations.
  - (CPN Gauge, take out of hibernation and allow to stabilize ~ 1 minute.
- Check gauge operation with portable standard block.
- Place gauge on reference standard correctly.
  - Handle on side opposite metal plate (Troxler, Instrotek).
  - On raised bumps (CPN).
- Take a four-minute base count.
- Record count on log sheet.
- If the reading is not within 1% of the average of the previous 4 standards, re-run standard.

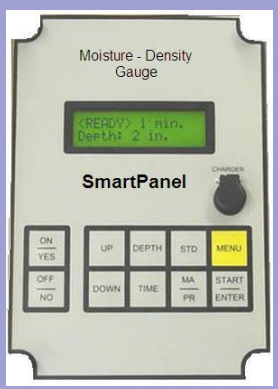
6

Measurement Requirements

- Standardization
  - 33 feet from other radio-active sources.
  - Clear of large masses of water or hydrogenous material.
  - Taken in the same environment as the actual measurement counts.
- Testing
  - 33 feet from other radio-active sources
  - 6 inches away from any vertical projection.
  - Long axis of test site shall be parallel to the direction of the paver.
  - Sites should be at least 1 foot away from longitudinal joints.

8

Instrotek Explorer Gauge



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Campbell Pacific Nuclear (CPN)

10

Troxler Electronic Laboratories

11

Performing a Test

For successful determination of density:

- Select a surface free of loose material and deformations.
  - The maximum void beneath the gauge shall not exceed 1/8 inch (3mm).
  - Optimum condition is total contact between the bottom of the gauge and the surface. Check that bottom of gauge is clean.
  - If necessary, use mineral filler or sand to fill voids. The depth of the filler should not exceed 1/8 inch (3mm) and the total area filled should not exceed 10% of the bottom area of the gauge.
  - Test location should be 1 foot or more away from confined or unconfined longitudinal joints.

12

Gauge Settings

- Set gauge to the "MA" or Backscatter mode (for testing asphalt) versus "PR" (soils) and sets gauge to perform the calculations on the wet density basis.
- Verify that the correct Maximum Mixture Density (that represents the mix being placed - Average Daily Rice converted) is input in the gauge or available for doing calculations.
- Verify correction factor for the gauge being used is accurate for the materials being placed.

14

Test Procedure

- Lower probe to backscatter position.
- Select Wet Density readings on gauge.
- Ensure that the rod is securely locked into the bottom of the notch of the depth slot.
- Set gauge flush on asphalt pavement test site.
- Perform two 1-minute readings, record direct wet density measurements.
- Mark gauge location.

15

Test Procedure

(continued)

- Turn gauge 180 degrees, taking care to place it within the marks of the original 2-one minute readings.
- Perform two more 1-minute readings, record direct wet density measurements on CDOT form No. 428 (CDOT), or appropriate form (Consultants/contractors).
- Test results may be affected by chemical composition, sample heterogeneity, and surface texture. Also, exhibit spatial bias in that the gauge is more sensitive to certain regions of the material under test.
- If total roadway thickness is less than 4 inches, underlying subgrade density variations can cause gauge test inconsistencies.

16

Calculations using wet density

- Average the four wet densities obtained.
- Add the known correction factor from the test section of the project (as per CP 82) to the average wet density to establish the adjusted wet density.
- Divide the adjusted wet density by the lab maximum mixture density (rice x 62.4) to determine the relative % density.

17

Convert Specific Gravity (Gs) to pounds per cubic ft

CDOT

- Specific gravity x 62.4= pcf
- Pcf / 62.4 = specific gravity

18

Calculations

- Average the four, one minute nuclear gauge readings.
- Calculate the adjusted wet density by adding the average field density to the correction factor (obtained from the 7 cores taken in 500 ton Compaction Test Section as per 401.17 in the standard Specifications for Road & Bridge Construction).
- Calculate the percent density by dividing the adjusted field density by the laboratory maximum mixture density (which is the maximum specific gravity, CP 51, multiplied by 62.4).

19

THE END

THANK YOU

21