Colorado Asphalt Pavement Association

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DENSITY/MOISTURE GAUGE

InstroTek® Inc.

My Background

- 35 years in development of gauges
- Over 20 patents
- Inventor of the first ever and the only Thinlayer gauge in the market

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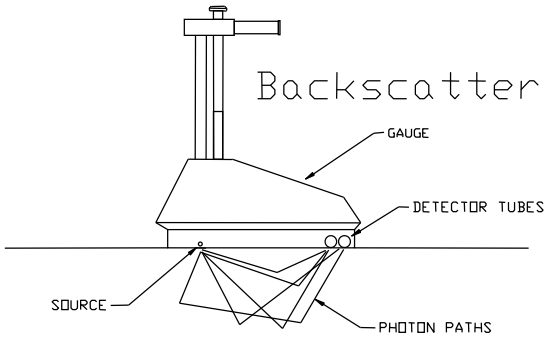
National Standards

- ASTM D6938 for soil- Direct Transmission (DT)
- ASTM D2950 for Asphalt – Backscatter (BS)
- AASHTO T310 for both BS
- ASTM D7013 and D7759 for calibration requirement of gauges

Advantages of Using a Nuclear Gauge

- Proven and established method, used for more than 40 years
- You can take multiple readings
- Cheaper than taking cores
- Does not turn Pavement into Swiss Cheese

Basic Gauge Theory



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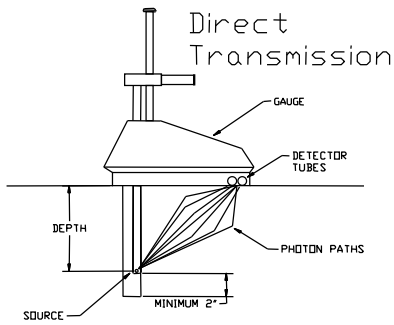
Direct Transmission



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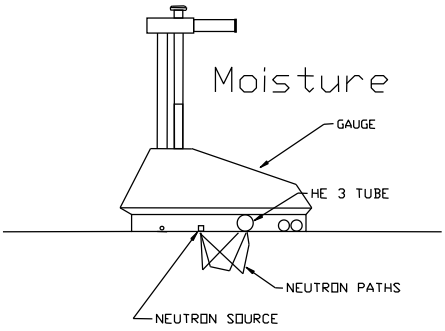
Moisture



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Avoidable Errors

- Standard Count
- Temperature
- Environment
- Placement

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Is My Standard Count Ok?

- The standard count needs to be within a specified range
- Range provided in a manufacturers sheet
- The range is specific to a particular gauge and standard block
- Note: some gauges provide an internal calculation and will display a pass or fail result

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Standard Count Range

Gauge Model: 3500
Serial Number: 32459
Calib. Date: 04/04/2016

Density Standard Count: 3096
Moisture Standard Count 718
Bay Number: 3

Date	From	To
Apr 16	3035	3096
May 16	3029	3090
Jun 16	3023	3084
•		
•		
•		
Nov 16	2926	2985

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Another Way to Check Std. count

- Compare todays standard count to the average of the last 4 standard counts
- Density within ± 1% and Moisture ± 2%

Importance of Standard Count

- Density Calculations based Count Ratio
- Count Ratio= Measurement Count/ Std. Count
- Lower than actual expected Std. Count make density appear low
- Higher than actual expected Std. Count make density appear high

What to do if Std. Count doesn't Pass??

- Temperature, is the current temperature very different from the temperature of the last standard counts
- Elapsed Time, how long since your last standard counts
- Environment, is there anything close to the gauge that would effect it
- Operator error

Temperature

- Going from inside to outside temperature
- Allow gauge to come to equilibrium with outside Temperature
- Take a standard count, if it fails take another
- If counts are not half the expected value, take 4 standard counts, store, fifth standard count should pass

Environment

- Is the gauge too close to a vehicle or an object, no closer than 3 ft
- Are there any gauges in the area, no closer than 30 ft
- Is the operator standing right next to the gauge as it measures

Important

- When taking measurements on hot pavement, don't leave the gauge on the surface
  - Take the reading
  - Remove the gauge

Inherent Gauge Errors

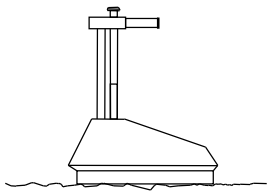
- Random or statistical - from nuclear source
- Surface roughness Error (SR)
- Composition Error (CE)

Random/Statistical Error

- Decay of radioactive sources produce gamma rays
- Gamma rays are produced in a random manner
- Counting over the same time interval at different times will result in different counts
- The density measurement will fluctuate slightly
- The longer the count time the smaller the relative fluctuation

Surface Roughness

- Backscatter is especially sensitive to surface roughness
- Spaces beneath the gauge will give the appearance of a low measured density
- Transmission not as sensitive but will have some error



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Reducing Surface Roughness Effect

- Prepare the surface, make sure gauge is level
- Water or Ottawa (fine) sand on the surface will help (usually 1 to 1.5 percent increase in density)
- Sand on the surface has to be level
- Take multiple readings and average

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Composition Error

- Gamma ray attenuation is effected mostly by density but also by composition of the material
- Heavy elements, calcium (Z=20) and iron (Z=26) absorb low energy gamma rays
- Limestone (CaCo3) and Iron make density read higher
- Granite (SiO_2) make readings lower

Different Ways to Correct for CE

- Comparing Results to Cores from a test strip
  - Correlate based on a model, Usually straight Line
  - Use relative offset, based on Average of Core and Gauge measurments

Reduce CE, Usual Method

- Take cores of measured locations
- Compare core densities to the densities obtained using the gauge
- From comparison determine correction
- Apply correction

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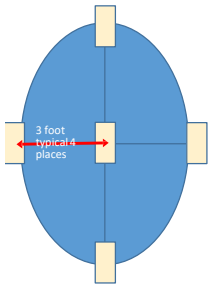
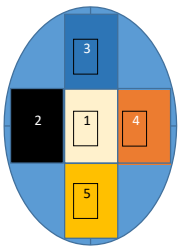
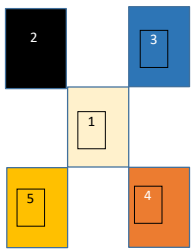
Proposed Methods to Reduce SR







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FIELD PRODUCTS

Questions?

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