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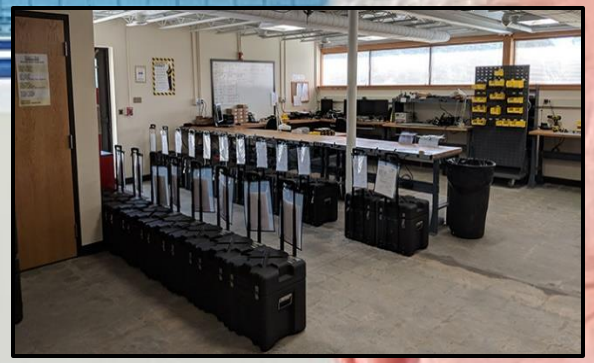
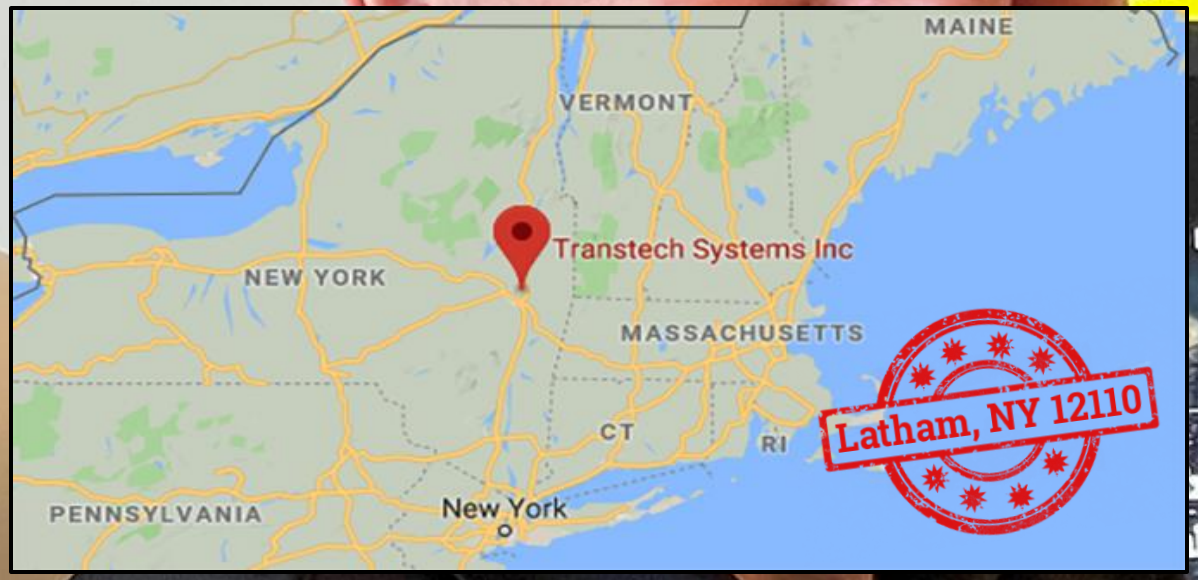
Minnesota Asphalt Pavement Association

Benefits of In-Place Density Measurement of Asphalt using Non-Nuclear Density Gauge

John Lamond
Sales Manager





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Why consider changing your current QC procedures?

- TECHNICAL BENEFITS
- OPERATIONAL BENEFITS
- SAFETY & HEALTH BENEFITS
- FINANCIAL BENEFITS

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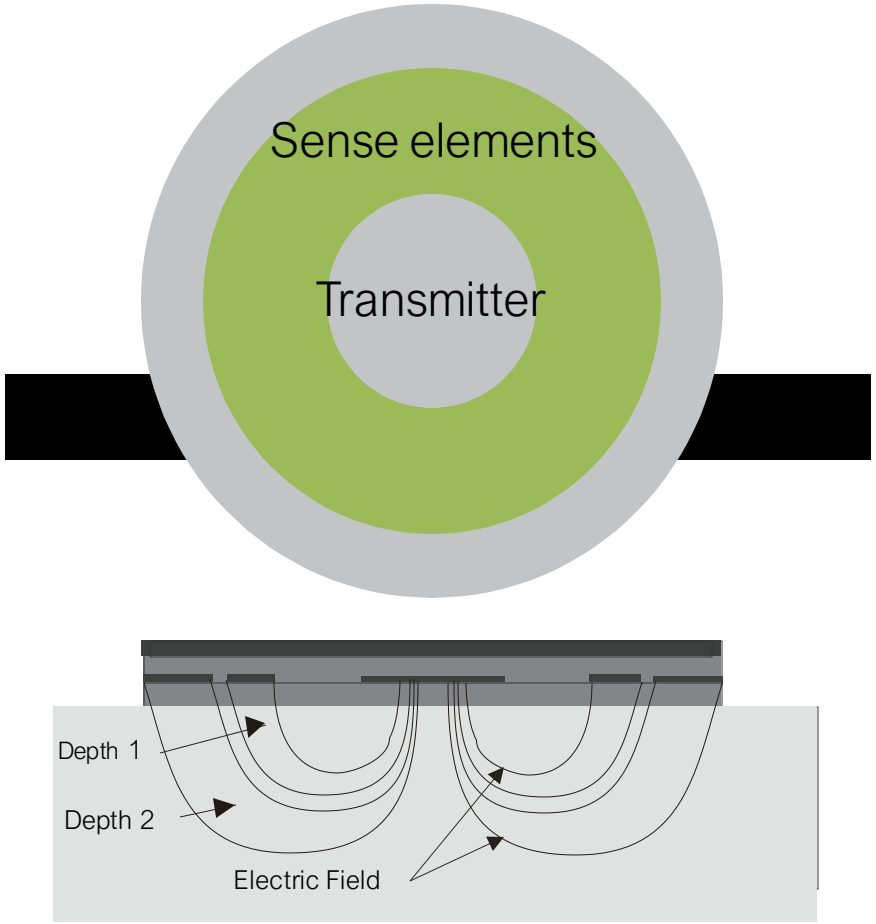
BY DATE
DUE
OFF
ON
Do Not Touch
PQI During Rounding
GPS
Pavement Quality Indicator
Control Menu

nc.

Theory of Operation

Electrical Impedance Technology for Asphalt Density Measurement



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Theory of Operation

Dielectric Constant:

The ability of a material to store electrostatic energy per unit volume.

Impedance:

The “resistance” to AC electricity flow (varies with frequency).

DC formula:
V=IR (R=Resistance)

AC formula:
V=IZ (Z=Impedance)

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Theory of Operation

In asphalt:

- Dielectric constant of air -1 range
- Dielectric constant of aggregate and binder -5 to 6 range

High density (compaction) yields less % of air, a higher overall dielectric constant and a lower impedance (resistance to AC electricity flow)

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Theory of Operation

- High density, well compacted asphalt contains less % air.

- Less air results in a higher overall dielectric constant.

We can measure this since it results in less resistance to the flow of alternating electrical current

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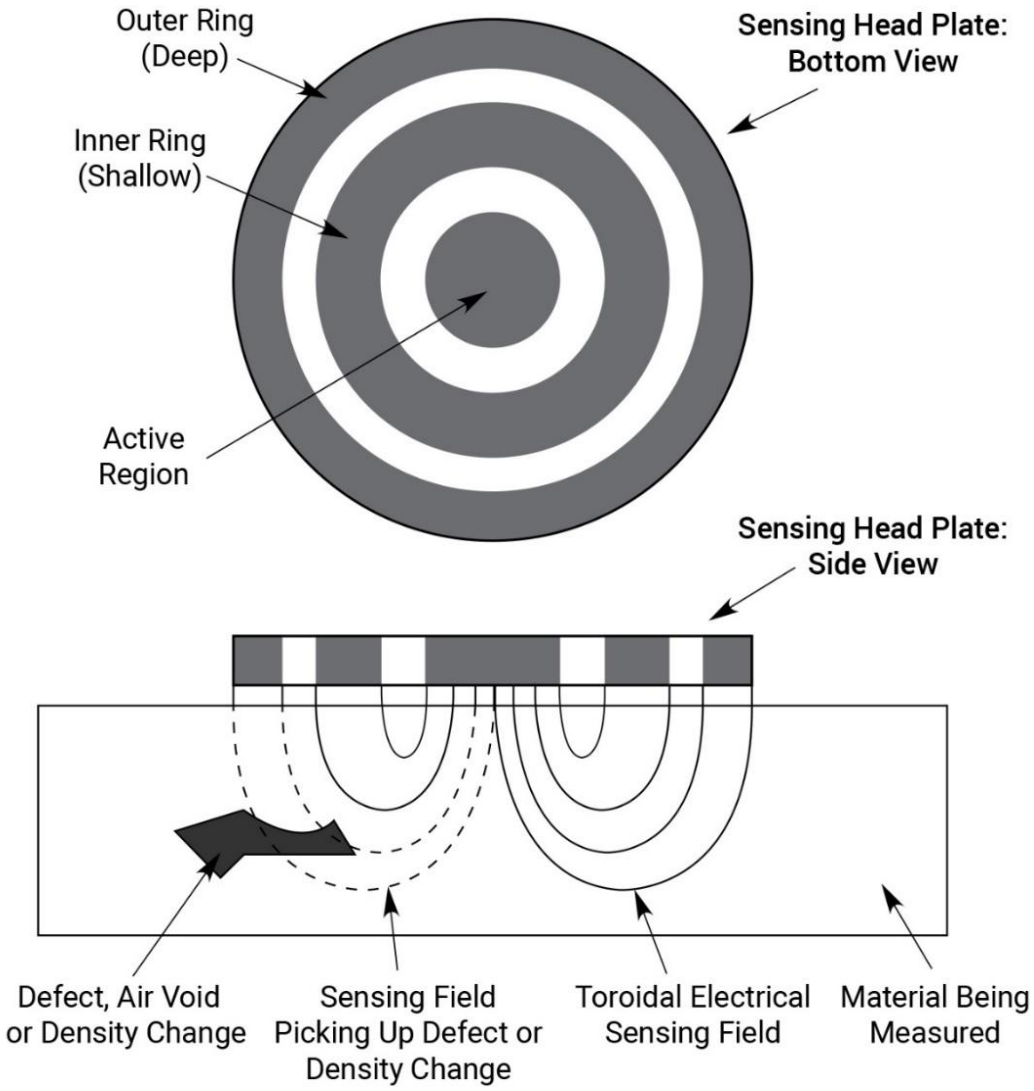
Theory of Operation

The importance of this innovation is that relative density measurements can now be taken instantly, allowing for necessary changes to the rolling pattern to be made immediately, as well as making it possible to take many more readings per hour on the job site, both of which help ensure the best possible pavement quality.



Uses of Impedance Technology

Widely used in many measurement applications since the 1960s

- Aircraft Maintenance
- Food Processing Industry
- Agriculture Industry
- Pulp Paper Production

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Research Started in 1996

With the following goals…

- Non-Nuclear Based Asphalt Density Measurement
- Small, Lightweight Device
- Precise and Repeatable
- Instantaneous / Fast Reading

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First Prototypes Completed in 1997

Due to existing knowledge of impedance engineering, rapid prototyping was achieved.

The first prototype was introduced within one year of development launch.

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7.9 V

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nc.

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Technical Benefits

Compaction Data

as the material is being laid behind the roller.

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Technical Benefits

Large amount of data points (more than any other test method)

3 seconds a reading OR continuous readings.

- Check the uniformity of compaction
- Identify potential problem areas
  (while effective decision can still be made to rectify)
- Full coverage across the mat

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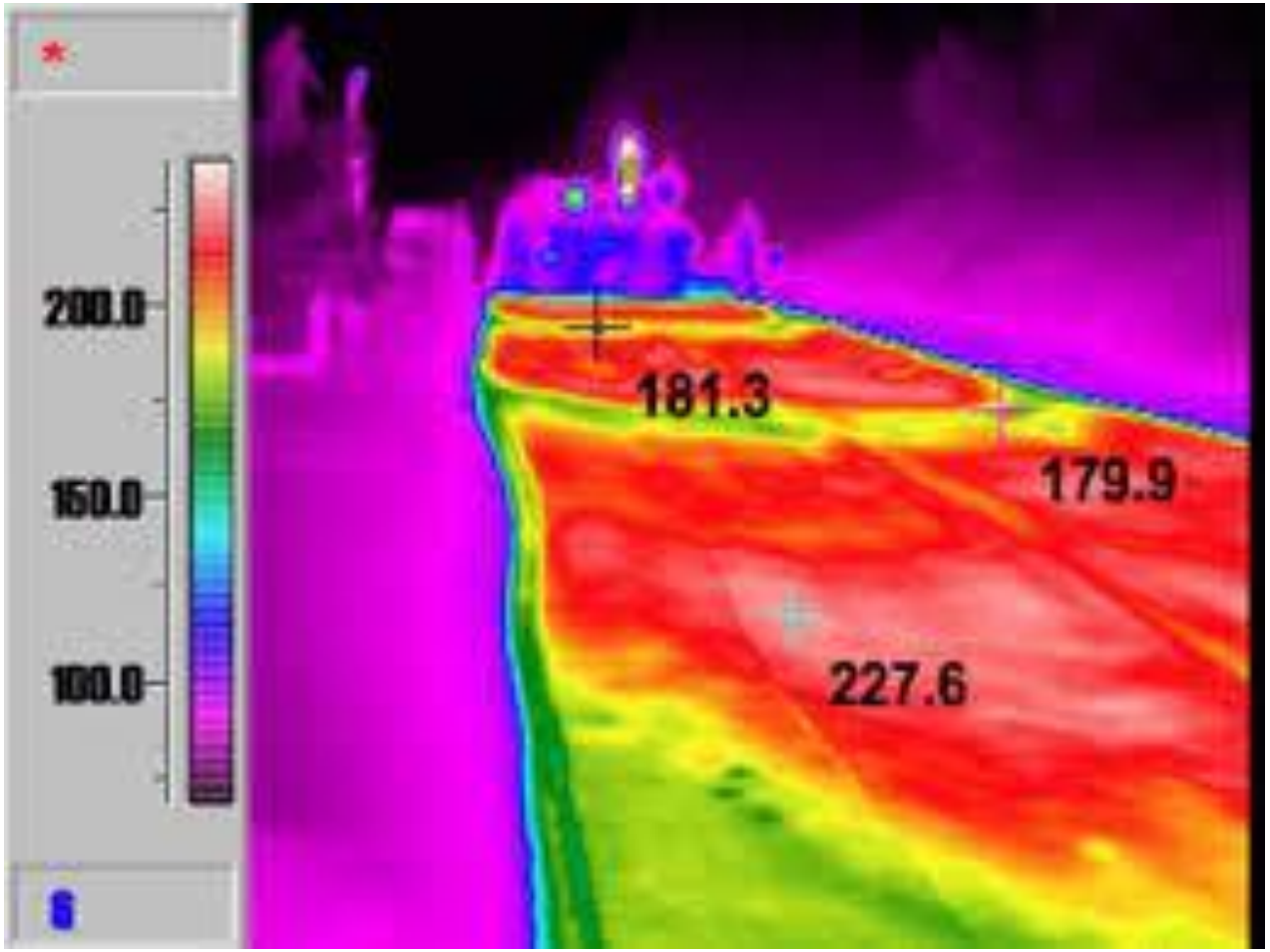
Technical Benefits



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Technical Benefits

Ability to make on site adjustments to the rolling pattern.

Temperature variation can influence compactive effort required.

(The PQI also gives you a surface temperature reading)

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Technical Benefits

Confidence that specified % compaction requirements have been achieved,

Before compliance testing is carried out.

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Technical Benefits

Precision Statements	ASTM D2950	ASTM D7113
Precision - density SD (lb/ft^3)	3.9	3.089
Single Operator Precision (lb/ft^3)	1.57	1.28
Acceptable range of 2 results (lb/ft^3)	4.4	3.6
Multi-laboratory Precision SD (lb/ft^3)	1.75	1.47
Acceptable range of 2 results (lb/ft^3)	4.9	4.1

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Operational Benefits

Any site operative can check density.

More effective use of resources.

No delays in getting compaction data.

A PQI can be on site every day.

Improves QC capability over the complete project duration.

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Operational Benefits

A PQI can be transported and stored anywhere.

No wasting time transporting gauges back to a "safe location".

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Operational Benefits

Test data can be downloaded and Passed to the QC manager / client the same day.

Increased real time QC visibility.

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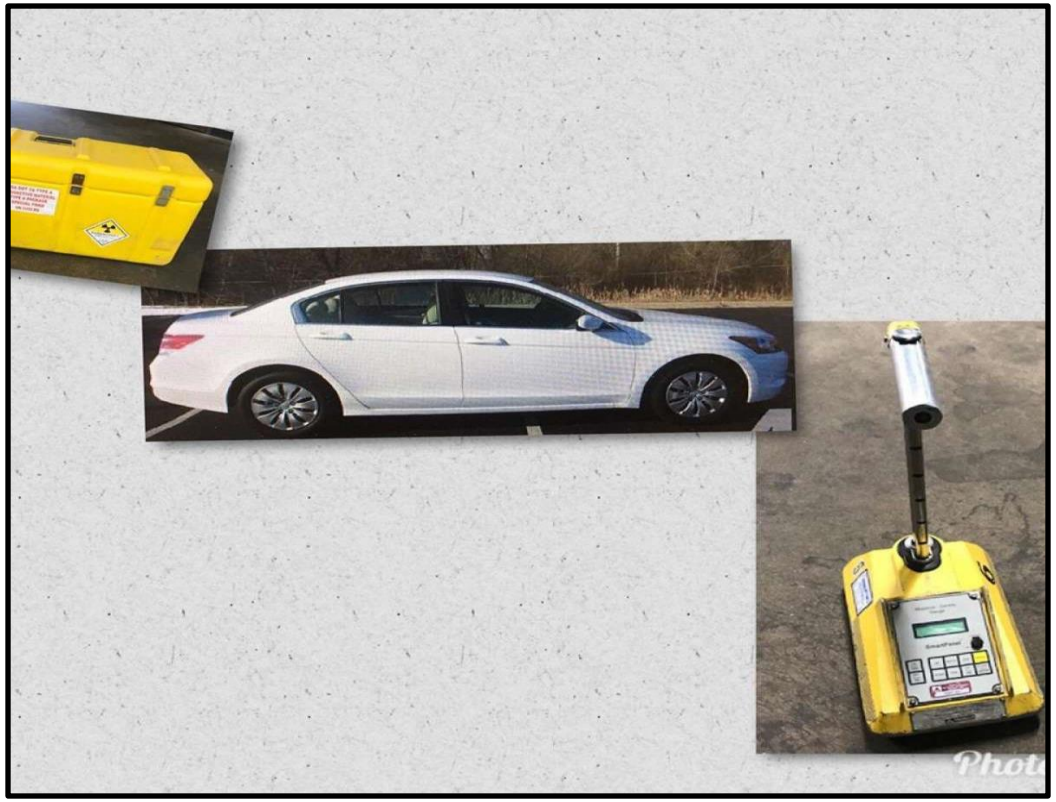
No More Nukes

Safety & Health Benefits

No risk of loss or damage to a non-nuclear device

“Connecticut State Police are hoping to locate a gauge used to hold sources of radioactive material — which was recently stolen along with the vehicle of a lab employee, who had the gauge in the vehicle’s trunk.”



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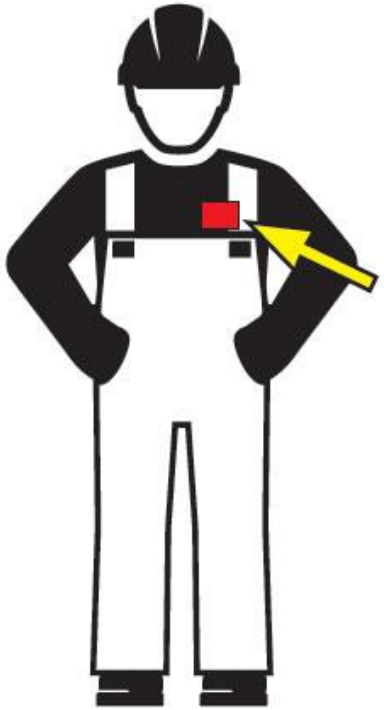
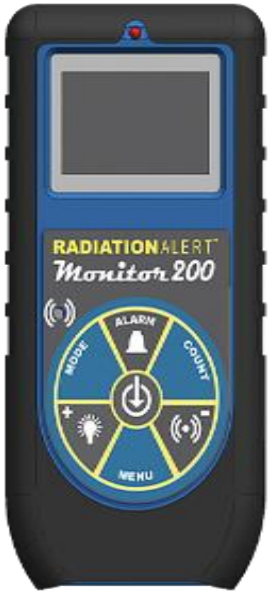
Safety & Health Benefits

No risk to health of operator from use of a non-nuclear device



Radiation Monitor



Radiation Survey Meter

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Financial Benefits

Average annual cost of nuclear density gauge ownership

Category	$
Licensing Fees	$2,000
Annual Regulatory Fee	$1,500
Safety Course	$125
Radiation Safety Officer	$295
Radiation Survey Meter	$500
TLD Badge monitoring	$140
Leak Test Kit	$150
Hazmat Shipping	$150
Reciprocity	$750
TOTAL Annual Cost	**$5,610**

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Financial Benefits

Average life time cost of ownership of a single nuclear density gauge

(assuming a 15 year source integrity)

15 Years x $5,610 = **$84,150**

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Financial Benefits

Greater confidence in achieving maximum pay factor bonus

Table 2360-22 Payment Schedule for Maximum Mat Density			
		Mat Density Pay Factor A	
4% Design Void Density	3% Design Void Density	Traffic Level 2 & 3	Traffic Level 4 & 5
≥ 93.6	≥ 94.6	1.03	1.05
93.1 – 93.5	94.1 – 94.5	1.02	1.04
92.0 – 93.0	93.0 – 94.0	1.00	1.00
91.0 – 91.9	92.0 – 92.9	0.98	0.98
90.5 – 90.9	91.5 – 91.9	0.95	0.95
90.0 – 90.4	91.0 – 91.4	0.91	0.91
89.5 – 89.9	90.5 – 90.9	0.85	0.85
89.0 – 89.4	90.0 – 90.4	0.70	0.70
< 89.0	< 90.0		

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Financial Benefits

How much are you leaving on the table?

Bonus available = $93 million

Paid out = $16 million

$77 million

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Why consider changing your current QC procedures to include the use of non-nuclear density gauges?

- Technical benefits ✓
- Operational benefits ✓
- Safety & Health benefits ✓
- Financial benefits ✓

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Final thought……

With environmental and sustainability issues becoming increasing relevant to our industry, the use of a clean, efficient, easy to use QC tool to determine the in-place density of asphalt, offering multiple benefits, should be considered a more serious option by everyone involved in asphalt paving.

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Thank You! Questions?