Nuclear Gauges and Cores

HOW CAN WE GET THE BEST CONSISTENCY AND CORRELATION PERTAINING TO DENSITY?

Introduction

- Nuclear Gauge Performance can be associated with the operator, equipment's functionality, and the programmed targets (Theoretical or Bulk Densities).

- Let's address the Gauge first…

Major Categories that Impact Readings

1. Time vs. Precision @ 140 pcf

	Fast	Norm	Slow
Time	15 sec (3400) 30 sec (4640)	1 min	4 min
Range (pcf)	138.5 – 141.5	139.0 – 141.0	139.5 – 140.5
	+/- 3	+/- 2	+/- 1

Major Categories that Impact Readings

2. Standard Counts

Why do we *really* take them?

To Calibrate the Gauge?

- Yes and No
- Depends on your definition.

Most believe that if the detector tube counts measure within limits, compared to the baseline average of the last 4 standard counts, usually everything is okay (assuming the operator hasn't had a drink before hand).

Standard Counts are really taken to Compensate for Radioactive Source Decay

$$\frac{DC}{DS} = \frac{2000 \text{ cts}}{4000 \text{ cts}} = .5 = 164 \text{ pcf (Granite)}$$

1 Year Later

$$\frac{DC}{DS} = \frac{1500 \text{ cts}}{3000 \text{ cts}} = .5 = 164 \text{ pcf (Granite)}$$

Can you utilize this procedure to help Consistency?

Absolutely, especially during compaction testing.

Major Categories that Impact Readings

3. Temperature

- We all know how temperature affects the compaction process, but what about the gauges?
- At 170°F and higher, this element can impact gauge electronics, which obviously may contribute to predetermined gauge/core correlation offsets.
- Taking numerous Standard Counts during the day will offset any temperature effects on the gauge readings.

Major Categories that Impact Readings

4. Physical Condition of the Gauge

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Impact of Asphalt Stuck on the Tip of the Probe

Programmed Targets

Your targets are determined by 3 different methods:

1. Control Strip Test – measure the density of the strip, and use that value as the target density for the project.
2. Compacting samples in the laboratory during mix design and during the lay-down procedure.
3. The Theoretical Maximum Density (TMD) – ASTM D2041

Which is better?

That's a conversation for another day.

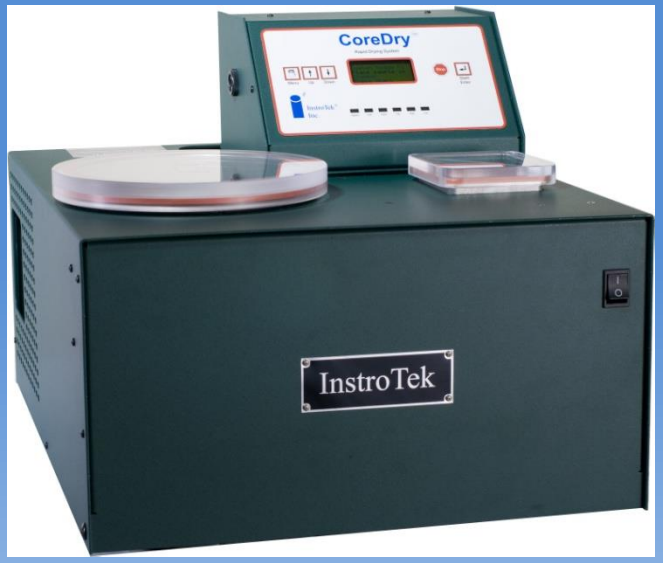
NJ utilizes the third – Density specified as percent of TMD.

Programmed Targets (cont'd)

- This type of compaction specification requires the TMD be measured routinely **during** construction. The TMD measured during design should not be used as a reference target for the mix being produced.
- This difference can be attributed to the materials changing when heated and mixed at the plant. TMD must be measured on plant produced samples.

Core Densities

- Failure to allow the core to dry before obtaining the dry weight can cause many issues. It should be allowed to air-dry or dry using the Core Dry method – AASHTO PP-75, ASTM 7227.



Core Densities

- Contractors and the State can quickly dry cores and determine bulk density results in hours, not days, after core is cut (AASHTO T166 > 12 hours).
- In-place densities and gauge correlations determined at far greater speeds.
- Cores are thoroughly dried by vacuum rather than evaporating water with heat – far more efficient drying process.

Core Densities

- This method will allow consistency between State DOT and Contractor density readings.
- Heating the cores in the oven at an elevated temperature is not the path to follow.
- If not completely dry, this factor will lead to higher density values.
- Cores should be saw-cut, especially with SMA mixes – failure to do so can lead to possible erratic density calculations.

Full Depth Reclamation

- Can we obtain a legitimate Proctor Value on this type of application?
- Engineers have a tendency to use Dry Density calculations. This requires accurate moisture measurements from the gauges.
- It is prudent to use the Wet Density readings from the gauge instead of the Dry Density readings.

Food for Thought…

- Bituminous production and paving involve extensive procedures and testing. We wonder if the cards are stacked against us, i.e. avoiding the dreaded “penalty”. Re-evaluation of designs, production and placement practices are necessary, but the fine line is balancing theory/research with practicality in the field.

Conclusion

Density is only one aspect, but hopefully procedures, especially concerning operators and testing equipment, are consistent regardless of who is “behind the wheel”.

The information presented today may be a refresher for some, but if it keeps the attorneys at bay, “You’re welcome! I’m still learning…”!