

# Moisture & Degree of Roast: Coffee



Measurement & Control



Applications Note: 10200-01-2018

## Rapid Quality Assurance

It's common practice for Coffee roasters to measure the moisture and "color" (which ranges from light to dark) of roasted coffee beans to monitor the quality of the roasting process, and ensure the product is within target specification prior to further processing. The color value, often referred to as degree of roast (DOR), is normally measured in the ground state as the beans are generally not uniform in color.

To date, these measurements require the use of multiple analytical technologies (instruments) with different sample handling and operating requirements.

The trustworthy InfraLab Top-Loader (TL) at-line moisture analyzer provides a **simultaneous** measurement of Moisture and also Degree of Roast in five seconds. See Figure 1. With no special skill required to operate, the InfraLab TL provides process vision far beyond that of conventional testing. This provides unprecedented feedback to the process controller for improved control of Moisture and DOR which offers financial benefits such as:

- Performing both measurements in a single instrument for reduced maintenance
- Improving batch-to-batch consistency through rapid feedback of moisture and DOR, enabling roasters to confirm and refine processing operations
- Improving operating efficiency

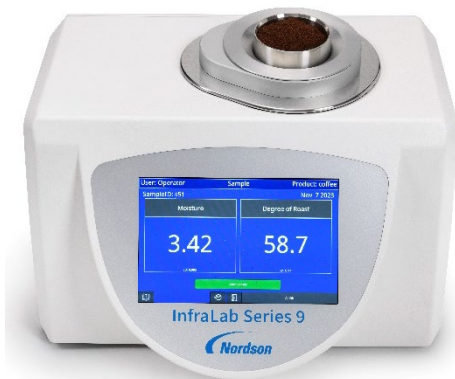


Figure 1. InfraLab Top Loader At-line moisture with DOR



Figure 2. Series 9 On-line moisture with DOR

On-Line measurements of Moisture and DOR with the Series 9 Color gauge (figure 2.) are also possible, provided there is no surface moisture after quenching on the beans. Measurements can be on whole beans or ground coffee.

## Applications and Measurement Performance

The InfraLab TL analyzer incorporates a patented opto-electronic design that not only enables it to withstand the processing environmental conditions but also provide robust, linear and consistent measurements over long periods of operation without requiring constant re-adjustment after commissioning.

Achieving this capability has required significant applications engineering to deliver off-the-shelf, linear measurement algorithms that are fit-for-purpose and do not drift over time.

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## Moisture:

Table 1 includes a list of developed moisture measurements and the charts in Figure 2 demonstrate the InfraLab's performance against an oven primary measurement method.

Product	Measurement	Range	Accuracy ( $\pm 2\sigma$ )
Coffee (Agglomerated)	Moisture	1 - 6%	0.1
Coffee (Freeze dried)	Moisture	1 - 6%	0.1
Coffee (Ground Roast)	Moisture	1 - 10%	0.1
Coffee (Roast beans)	Moisture	5 - 10%	0.3
Coffee (Spray dried)	Moisture	1 - 6%	0.1

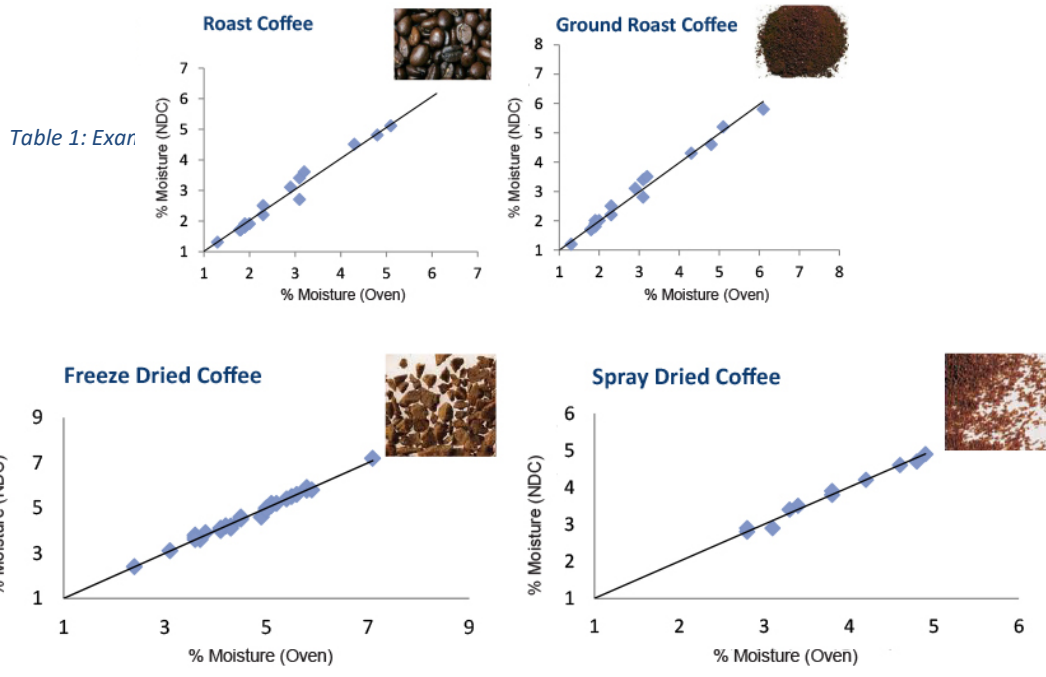


Figure 2: InfraLab Moisture measurement performance against primary reference methods

## Degree of Roast:

Historically, to differentiate between different degrees of roast, a narrow band of visible light wavelengths reflected from a ground sample of the roasted bean is measured. The InfraLab TL and Series 9 gauge incorporates this capability to provide a simultaneous measurement of Moisture (using NIR light) and DOR from a single sample of coffee.

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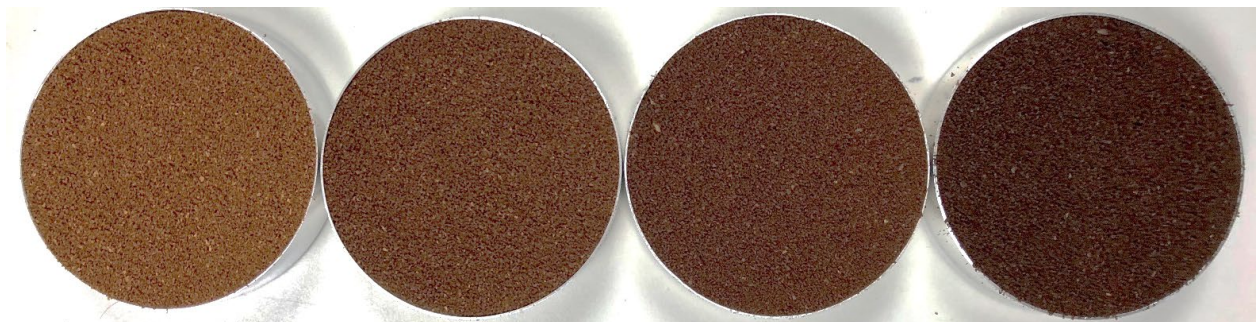


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For consistency, samples should be analyzed close to room temperature and as DOR is an absolute reflectivity measurement, the sample bowl filled to form a flat surface that is level with the edge of the dish. To simplify this

for ground and soluble coffee, a sample levelling device is provided. The operator simply overfills the sample dish which is then pushed under the leveling bar to create a flat surface as shown in Figure 3.

Figure 4 shows Moisture and DOR values obtained from 4 different samples of ground coffee ranging from light to dark roast.



<b>DOR:</b>	81	59	46	25
<b>Moisture:</b>	3.1	2.5	2.5	2.0

Figure 4: DOR and Moisture results from a range of ground coffee samples

Table shows DOR readings from three equilibrated samples of ground coffee measured over a period of several months. Six individual measurements were made from each pot of sample and the DOR readings averaged.

	1		2		3	
Date	DOR-Avg	SD	DOR-Avg	SD	DOR-Avg	SD
26/01/2022	77	0.4	53	0.4	44	0.2
10/05/2022	78	0.5	53	0.2	44	0.2
07/09/2022	78	0.6	53	0.3	45	0.3

Table 2: DOR readings from equilibrated ground coffee samples

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## Summary

Nordson's MCS applications-engineered measurement solutions bring measurable process benefits to the coffee processor:

- Improved product consistency and quality
- DOR measurement can be used out of the box to provide a roast value from a ground coffee sample of the roasted beans on a scale similar to the visual coffee roast standards created by SCAA – (Specialty Coffee Association America). If required, the DOR scale can be adjusted to agree with your current instrumentation and roast scale.
- Linear measurement algorithms engineered for the product, parameter and operation range
- Robust, state-of-the-art optics and electronics design
- Long-lasting stability: no need for re-calibration
- Highly dependable operation: unaffected by ambient conditions
- Best performance: accuracy, precision, speed and signal-to-noise
- Fastest ROI and lowest cost of ownership
- Lifetime partnership philosophy with customers to cooperatively develop solutions and improve competitiveness
- Peace of mind knowing that you are working with a stable, reliable organization for the long term

For questions or support go to: <https://ndc.custhelp.com/>

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