Application Note — Using a Moisture Balance to Calibrate the QN-100

Document ref.	AS-MK-AN-008	**Revision**	1.0
Date of issue	July 2026	**Status**	Approved
Document owner	Applications Engineering	**Classification**	Public / Customer-facing

1. Purpose

This application note explains how to use a laboratory moisture balance (loss-on-drying) as the reference method when calibrating or verifying a QN-100 near-infrared (NIR) moisture sensor. It covers sample size, weighing sensitivity, expected agreement between balances, and practical sampling guidance for reliable reference data.

2. Background

An on-line NIR sensor is designed for real-time process monitoring and control. It delivers continuous measurements that support automated process optimisation rather than stand-alone laboratory analysis — but an NIR calibration is only as good as the reference technique used to build and check it. Moisture balances are widely used for this purpose and do a practical job on the shop floor; they are not, however, infallible. Understanding their limits is essential if the QN-100 is to be calibrated against them with confidence.

3. Why the Reference Method Matters

If the reference moisture is noisy or biased, the NIR calibration inherits that error. The consequences show up as sensor drift complaints, unnecessary recalibration, and process adjustments made against the wrong target.

- **Calibration quality. A moisture balance often claims 0.001 g readability, but a 0.002 g drift is easy to introduce through airflow, vibration, temperature change, or sample movement — and on a 5 g sample that already equals 0.04% moisture noise.**
- **False process corrections. When reference noise is large relative to the product tolerance (for example 6.0% ±0.2%), operators may chase the balance rather than the process, wasting time and product.**
- **Inter-instrument disagreement. Two identical moisture balances, side by side, same sample, same time, will typically still differ. That is a property of loss-on-drying physics, not necessarily a fault of either instrument.**
- **Traceability. Without controlled sample mass, loading practice, and end-point settings, calibration records become hard to defend and hard to repeat.**

4. How a Moisture Balance Works

A moisture balance determines moisture by loss-on-drying (LOD): a weighed sample is heated under a defined programme until an end-point criterion is met, and the mass loss is expressed as % moisture. The result depends on sample mass, how the sample is loaded, heater profile, end-point detection, and the laboratory environment — not only on the true water content of the product.

4.1 Sample Mass and Water Lost

At a given moisture level, the absolute mass of water driven off scales directly with sample weight. Small samples make the balance more sensitive to tiny weighing fluctuations; larger samples improve robustness but take longer and may dry less uniformly if the bed is too deep. Table 1 shows water lost at typical moistures for 2 g, 5 g, and 10 g samples.

4.2 Weighing Noise Versus Moisture Error

Moisture error from a weight fluctuation is approximately (weight fluctuation / sample weight) x 100. On a 5 g sample, a barely visible 0.002 g drift already contributes about 0.04% moisture. Table 2 quantifies this relationship for common weighing fluctuations at a 5 g sample mass.

5. Recommended Measurement Locations

Moisture %	Water lost @ 2 g	Water lost @ 5 g	Water lost @ 10 g
1%	0.02 g	0.05 g	0.10 g
5%	0.10 g	0.25 g	0.50 g
6%	0.12 g	0.30 g	0.60 g
10%	0.20 g	0.50 g	1.00 g

Table 2 - Moisture error from weighing fluctuation at 5 g sample mass

Fluctuation @ 5 g	Moisture error
0.001 g	0.02%
0.002 g	0.04%
0.005 g	0.10%
0.010 g	0.20%
0.020 g	0.40%

6. Expected Agreement Between Moisture Balances

Even two identical moisture balances, operated side by side on the same sample at the same time, will typically differ. Shop-floor expectation: +/-0.1-0.3% moisture is excellent agreement; +/-0.3-0.6% is typical; around +/-1.0% or worse usually points to sample geometry, heater differences, or inconsistent loading. Drivers of disagreement include micro-differences in sample loading, temperature profile differences, balance readability versus real-world noise, environmental micro-differences (airflow, vibration, ambient temperature), sample chemistry (volatiles other than water), calibration drift of the balance, end-point detection differences, and operator influence.

7. Practical Guidance for QN-100 Calibration

When sampling for QN-100 calibration or verification against a moisture balance, treat the balance result as a reference with a known uncertainty - not as an absolute truth. Prefer a consistent sample mass (commonly around 5-10 g where the product allows), load samples the same way every time, and keep the balance away from draughts, vibration, and rapid temperature changes.

Take the calibration sample from the same product stream and condition that the sensor sees, as promptly as practical, and record sample mass, balance identity, drying programme, and end-point setting with every reference point. If two balances disagree beyond the typical band above, resolve the reference method before adjusting the NIR calibration. Key practices:

- **Use one nominated moisture balance (or a verified pair) for a given calibration campaign.**
- **Standardise sample mass so weighing noise stays small relative to the product tolerance.**
- **Match drying programme and end-point settings to the product; do not mix programmes within one calibration set.**
- **Reject or repeat reference points taken during obvious draught, vibration, or interrupted drying cycles.**

Revision History

Rev	Date	Description	Author
1.0	July 2026	Initial issue	Applications Engineering

8. Approval

Role	Name / Signature	Date
Prepared by	Applications Engineering	July 2026
Approved by	Applications Engineering	July 2026