Application Note — QN-100 Moisture Measurement in Corrugated Board

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1. Purpose

This application note describes how the QN-100 near-infrared (NIR) moisture sensor is used to control warp in corrugated board, and outlines the process variables, control limits, and measurement principles relevant to installation and use on a corrugator line.

2. Background

The moisture content of the paper used for linerboard and corrugating medium affects many aspects of corrugated board quality, including board warp, glue adhesion, and printability. Controlling the moisture in both faces of the board can yield significant improvements in final board quality.

The QN-100 is suited to on-line moisture measurement in corrugated board production, providing reliable, accurate readings to within 0.2% moisture on-line.

3. Why Corrugated Defects Matter

Corrugated board defects are more than cosmetic issues: they directly affect box performance, print quality, converting efficiency, and customer satisfaction.

- A warped sheet that will not feed through a printer-slotter can stop a converting line.
- Wash-boarding that spoils printed graphics leads to customer rejections.
- Delamination weakens the board and can cause boxes to fail in transit.

4. Warp: The Most Common Corrugated Defect

Warp — the curving or twisting of corrugated board so that it does not lie flat — is the single most common quality problem in corrugated manufacturing. Warped board causes feeding problems on converting equipment, creates print misregistration, and produces boxes with poor appearance and inconsistent dimensions.

5. Root Causes of Warp

Nearly all warp results from differential moisture content between the components of the corrugated board. Paper is hygroscopic: it absorbs and releases moisture from the surrounding air. When the moisture content of the two liners, or of the liner and medium, differs, the components expand or contract at different rates, causing the sheet to curve.

5.1 Roll Moisture Variation

If linerboard or medium rolls arrive at the corrugator with different moisture levels, the resulting board will have a built-in moisture imbalance. Moisture variation across the web width should be kept within ±0.5–1.0% to prevent side warp.

5.2 Adhesive Over-Application

Excess starch adhesive introduces extra moisture to the board at the glue line. If the double-backer section does not provide enough heat to drive out this excess moisture, the board exits the corrugator with elevated moisture in the flute region, causing warp.

6. Warp Control Using the QN-100

Installing a QN-100 NIR moisture sensor allows accurate, real-time moisture measurement for balance-roll conditioning, and can be used together with a re-moisturiser where fitted. The typical application measures the relative moisture between the upper and lower surfaces of the corrugated board; this reading is used to control the amount of wrap taken by the wrap arms and the double-backer, maintaining a consistent moisture level to reduce warp and improve production consistency.

As an option, the QN-100 can simultaneously measure moisture and temperature.

Recommended actions to control warp:

- **Adjust pre-heater wrap.** Increase pre-heater wrap on the component with higher moisture content to drive out excess moisture before bonding; decrease wrap on the drier component to prevent over-drying. Adjust wrap angles gradually — sudden changes overcorrect and mask the underlying cause.
- **Control glue nip temperature.** Keep liner and medium temperatures within 5°C of each other at the glue nip.
- **Maintain double-backer condition.** Ensure the double-backer hot plates are at the correct temperature and make consistent contact across the full web width — uneven hot-plate contact is a common cause of cross-machine warp. The double-backer is where warp becomes "locked in," so uniform pressure across the width is essential, and the bottom liner should not be over-dried.

7. Key Control Limits

Parameter	Target	Action Limit
Liner moisture	6 – 8%	> 8.5% or < 5.5%
Medium moisture	6.5 – 8.5%	> 9% or < 6%
Cross-direction (CD) moisture variation	≤ 1.0%	> 1.0%
Liner vs. medium difference	≤ 1.0%	> 1.0%

- No moisture gradients → no side warp
- No wet medium → no up-warp
- No dry liner → no down-warp

> *Stable paper = stable board.*

8. Moisture Control Process

Paper web path: unwind stand → re-moisturiser (if fitted) → preheater drum → single facer → double-backer. The web wraps partly around the heated preheater drum, which is typically operated at a surface temperature of 90–120°C, transferring heat to the paper to reduce its moisture content.

8.1 Wrap Arm Assembly

A pivoting wrap-arm roller adjusts how much of the web contacts the drum. A high wrap angle (approximately 270°) increases heat exposure and lowers moisture; a low wrap angle (approximately 90°) reduces heat exposure and results in higher moisture.

8.2 Control Mechanism

Wrap angle is controlled manually or automatically via moisture sensors and PLC feedback. Moisture sensors are positioned before and after the preheater to measure web moisture and temperature and guide wrap-arm adjustments. The operator HMI displays target moisture, actual readings, and wrap-angle position.

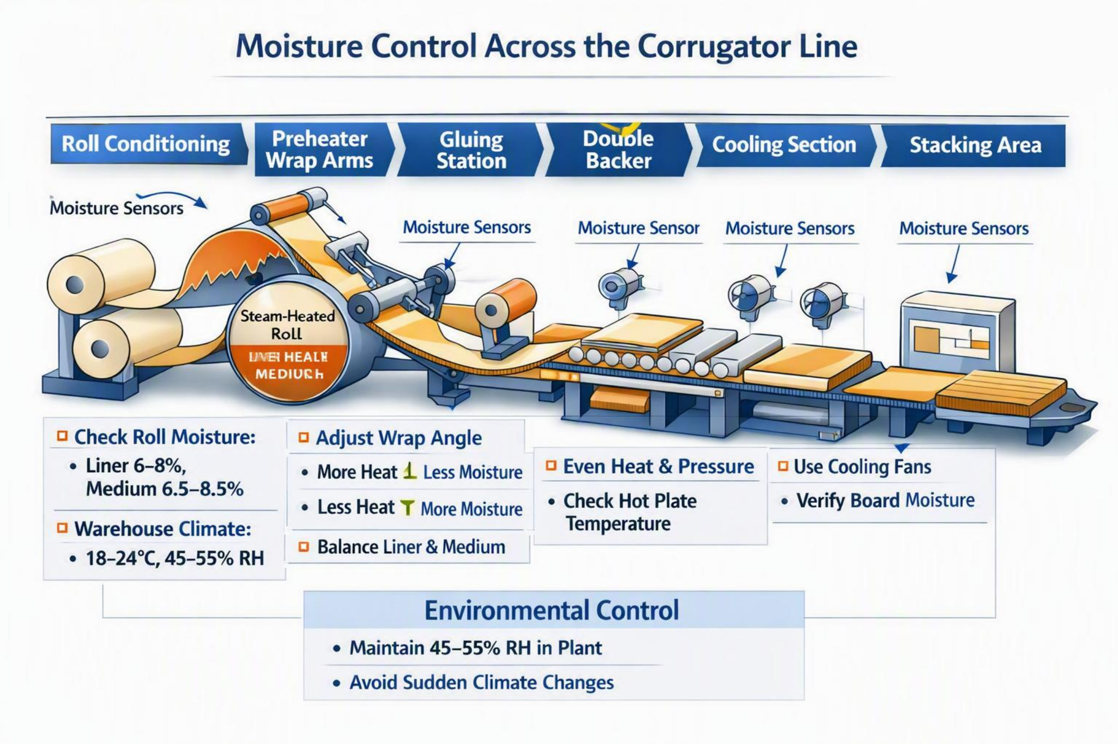

Figure 1: Corrugator line moisture control — preheater and wrap arm assembly

9. Measurement Technology

The QN-100's NIR architecture applies filter sets selected for the specific material being measured, so filter selection is grounded in real operating conditions: variable particle size, changing moisture range, and surface variation.

Every QN-100 sensor measures using Interpolated Baseline Correction (IBC), Absorption Systems' algorithm for separating the true moisture signal from background noise caused by particle size, surface texture, and product-to-product variation. Rather than applying one fixed correction factor across a whole product range, IBC continuously recalculates the baseline from live reference readings, so it adapts to the product instead of assuming it stays constant. This gives:

- **More accurate readings across a wider moisture range.** Fixed-coefficient methods are typically tuned around one operating point and lose accuracy at the extremes; IBC holds up better as conditions move away from that point.
- **Fewer false readings from scatter effects.** Particle size, surface roughness, and packing density are a leading cause of baseline drift, and IBC is designed to track and correct for it.
- **Less time spent recalibrating.** Because the baseline adapts automatically, day-to-day and batch-to-batch variation is less likely to push readings out of tolerance.
- **Proven across applications.** Refined against real production conditions across a wide range of applications.

Revision History

Rev	Date	Description	Author
1.0	Jul 2026	Reissued in current Application Note format; content reviewed and restructured for clarity and technical accuracy	Applications Engineering

10. Approval

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