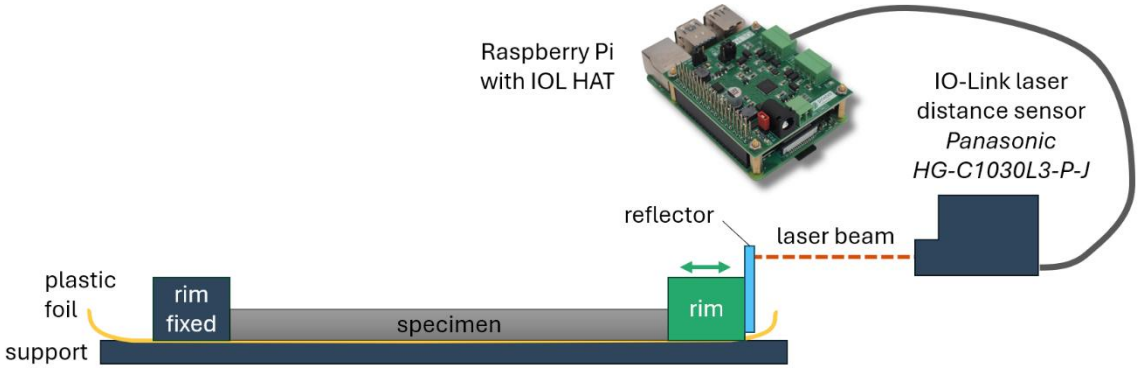
USE CASE

Continuous, Automated Length-Change Measurement of Cementitious Materials by Uzin Utz North America

Digital shrinkage and expansion monitoring complementary to ASTM C490, using IO-Link laser sensors and the Pinetek IOL HAT

Shrinkage and early expansion are primary drivers of cracking and debonding in self-leveling compounds, screeds, and concrete. ASTM C490 defines a reference method and apparatus for length-change measurement of cementitious specimens, but the classical length comparator only reads hardened specimens through periodic, manual readings. In a laboratory application, Uzin Utz North America demonstrated a digital alternative: IO-Link laser distance sensors continuously stream measurement data to the IOL HAT on a Raspberry Pi.



Schematic test setup: a specimen measured with a sensor over IO-Link

THE CHALLENGE

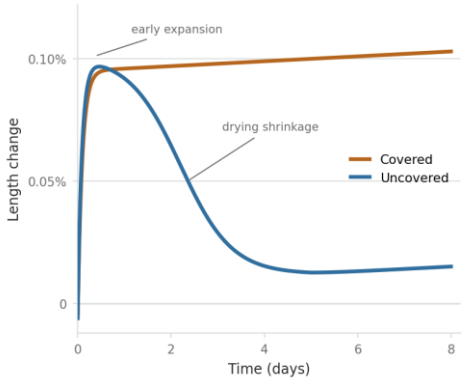
The comparator-based ASTM C490 method begins after demolding, when the specimen is already hardened, and readings are taken by hand at discrete ages. Two consequences follow: the plastic and early-hydration phase, where the largest movements occur, is never recorded, and short-lived peak values fall between reading intervals. Specimen handling adds further scatter.

THE SOLUTION

The IOL HAT turns any Raspberry Pi into an IO-Link master. Because IO-Link is a vendor-independent standard (IEC 61131-9), the user is free to choose any compatible sensor for the range and resolution a given test demands. In this study a Panasonic HG-C1030L3-P-J laser triangulation sensor (±5 mm measuring range, 10 µm repeatability, ±0.1 % F.S. linearity) tracked the distance to the reflector on the specimen and streamed digital length values. Logging starts in the fresh state and runs unattended at a freely configurable cycle time, with reduced signal-chain drift, no analog wiring, and no operator presence during the run.

APPLICATION EXAMPLE

Two 1 × 1 × 10 inch specimens of a self-leveling floor compound were measured. One was sealed against moisture loss; the other was open on all sides. The recorded curves show a clear, reproducible difference between the sealed and the drying condition, resolved from the fresh state through to final length. Peak expansion and the full shrinkage trajectory were captured without manual measurements.



The test results for two test runs (schematic)

KEY ADVANTAGES

- **Flexibility and fast implementation:** the Raspberry Pi is a fully open, general-purpose computer, not a closed, single-purpose instrument, so the user keeps complete control over data acquisition and processing, with no vendor-imposed limits. Provided examples and documentation get a measurement running quickly, and with today's AI-assisted coding tools, adapting or extending the Python application is faster and more approachable than ever, letting users focus on the measurement task itself.
- **Measurement from the fresh state:** logging begins while the material is still fluid, not only once hardened.
- **No missed peaks:** continuous logging captures early expansion and rapid movements that periodic manual readings may miss.
- **Autonomous:** the Raspberry Pi runs headless and unattended for days.
- **Digital and traceable:** IO-Link delivers digital, time-stamped values ready for analysis, avoiding analog signal drift.
- **Accurate, repeatable results:** with the 10 µm-repeatable sensor used here, the setup resolves differences between even very similar formulations. If required, a finer or coarser sensor can be fitted to match the specimen and test setup.

SCALES WITH THE TEST

A single IOL HAT offers two IO-Link ports, leaving space for extensions like temperature and humidity logging. Recording these alongside the length signal on a common time base lets the user correlate environmental conditions with dimensional change and account for the temperature coefficient of the measurement itself (for the sensor used here, 0.03 % F.S./K, roughly 3 µm/K). Further IOL HATs can be stacked to extend to parallel measurements.

SETUP

- **Platform**
  Raspberry Pi + Pinetek Networks IOL HAT
- **Sensor**
  Any IO-Link IODD 1.1 sensor (in this application: Panasonic HG-C1030L3-P-J)
- **Cycle time**
  User-configurable
- **Software**
  Open source software stack by Pinetek Networks, user Python application with CSV logging

The IOL HAT Pro with a Raspberry Pi

About Uzin Utz North America

Uzin Utz North America, Inc. is a manufacturer of flooring installation systems since 1911, supplying the UZIN, PALLMANN, and WOLFF brands across subfloor preparation, self-leveling and patching compounds, adhesives, and tools. The Waco, Texas site houses the company's North American manufacturing and R&D laboratory, where this length-change study was carried out.

About Pinetek Networks

Pinetek Networks develops IO-Link compatible masters, edge gateways, and condition-monitoring solutions for industrial and laboratory use. The IOL HAT brings standardized IO-Link connectivity to the Raspberry Pi platform, with an open master application and Python examples for rapid integration.
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