

SECTION 09 05 61.16 CONCRETE SLAB MOISTURE TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. In-situ relative humidity (RH) testing of concrete floor slabs in accordance with ASTM F2170.
2. Concrete surface moisture evaluation.
3. Ambient temperature and relative humidity monitoring at test locations.
4. Documentation and reporting of all moisture test results.

B. Related Sections:

1. Section 03 30 00 - Cast-in-Place Concrete: Concrete slab construction, curing, and protection.
2. Section 09 05 61.13 - Moisture Vapor Emission Control: Moisture mitigation systems.
3. Section 09 60 00 - Flooring: Floor covering installation requirements.
4. Section 09 65 00 - Resilient Flooring.
5. Section 09 68 00 - Carpeting.
6. Section 07 26 00 - Vapor Retarders: Below-slab vapor retarder systems.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes.
2. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
3. ASTM E1907 - Standard Practices for Determining Moisture-Related Acceptability of Concrete Floors to Receive Moisture-Sensitive Finishes.
4. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
5. ASTM F2659 - Standard Guide for Preliminary Evaluation of Comparative Moisture Condition of Concrete, Gypsum Cement and Other Floor Slabs and Screeds Using a Non-Destructive Electronic Moisture Meter.

1.3 DEFINITIONS

- A. Relative Humidity (RH): The ratio of the partial pressure of water vapor present in the air to the saturating vapor pressure of water at the same temperature, expressed as a percentage.
- B. In Situ Probe: A sensor placed inside a drilled hole in the concrete slab to measure the internal relative humidity at a specified depth.
- C. Equilibration Period: The minimum time required for the in situ probe to reach moisture equilibrium with the surrounding concrete before recording a valid measurement.
- D. NIST: National Institute of Standards and Technology.

- E. Slab Depth: The total thickness of the concrete slab, measured from the finished surface to the bottom of the slab.

1.4 SUBMITTALS

A. Product Data:

- 1. Manufacturer product data sheets for all RH testing equipment, including in situ probes, readers, and accessories.
- 2. NIST-traceable factory calibration certificates for each sensor/probe.
- 3. Manufacturer instructions for sensor installation, equilibration, and data recording.

B. Test Reports:

- 1. Submit written test reports for each test area in accordance with ASTM F2170, Section 11, including:
 - a. Project identification and location
 - b. Test hole locations shown on a floor plan
 - c. Date and time of sensor installation
 - d. Date and time of each RH reading
 - e. Recorded RH value (%) at each test location
 - f. Recorded temperature at each test location
 - g. Ambient temperature and RH at time of reading
 - h. Slab thickness and test depth
 - i. Identification of equipment used, including serial numbers
 - j. Name and qualifications of testing personnel
 - k. Any conditions that may have affected readings
- 2. Submit electronic copies of test reports generated through the manufacturer-provided reporting software or application.

C. Qualification Data:

- 1. Documentation of testing personnel qualifications and experience with ASTM F2170 test procedures.

1.5 QUALITY ASSURANCE

A. Testing Personnel Qualifications:

- 1. Testing shall be performed by personnel experienced in performing ASTM F2170 concrete moisture testing.
- 2. Personnel shall be trained in the use of the specified testing equipment per the manufacturer instructions.

B. Calibration Requirements:

- 1. All RH sensors shall be factory calibrated with NIST-traceable calibration certificates. No ongoing field recalibration shall be required.
- 2. Calibration certificates shall be available for review at the project site.

C. Pre-Testing Conference:

- 1. Conduct a pre-testing conference with the owner, architect, general contractor, flooring installer, and testing contractor to review:
 - a. Testing schedule and sequence
 - b. Acceptable RH threshold values for specified floor coverings
 - c. Remedial measures, if test results exceed acceptable thresholds
 - d. Responsibilities for environmental conditioning prior to and during testing

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver testing materials in original, unopened, manufacturer-sealed packaging with identification labels intact.
- B. Store testing materials in a clean, dry, temperature-controlled environment per manufacturer recommendations.
- C. Protect sensors and probes from physical damage, contamination, and exposure to extreme temperatures.

1.7 PROJECT CONDITIONS

A. Environmental Conditions:

- 1. HVAC systems shall be operational and the building enclosed and maintained at service conditions for a minimum of 48 hours prior to commencement of moisture testing.
- 2. Ambient temperature at test locations shall be maintained between 65 degrees F (18 degrees C) and 85 degrees F (29 degrees C) during testing.
- 3. Ambient relative humidity at test locations shall be maintained between 40% and 60% during testing.

B. Concrete Slab Conditions:

- 1. Concrete slab shall have been placed and cured for a minimum of 28 days prior to initial testing.
- 2. Concrete slab surface shall be free of standing water, curing compounds, coatings, adhesive residues, or other surface treatments at test locations that could affect RH readings.
- 3. Below-slab vapor retarder, when specified, shall be in place per Section 07 26 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design:

1. Wagner Meters, Rogue River, Oregon. www.wagnermeters.com. Phone: (800) 634-9961
2. Product: Rapid RH L6 Complete Starter Kit and Rapid RH L6 Smart Sensors

B. Substitutions:

1. Substitution requests shall be submitted in accordance with Section 01 60 00 and shall include documentation demonstrating equivalence in accuracy, compliance, features, and reporting capability.

2.2 IN SITU RELATIVE HUMIDITY TEST SYSTEM

A. General Requirements:

1. System shall comply with all requirements of ASTM F2170 for in situ relative humidity testing of concrete floor slabs.
2. System shall be a single-use, fully disposable smart sensor design that remains in the test hole for continuous monitoring capability without the need for reusable probe insertion and removal.
3. System shall not require ongoing field calibration by the user. Each sensor shall include a NIST-traceable factory calibration certificate with individual serial number.

B. Smart Sensor Performance Requirements:

1. RH Measurement Range: 0% to 100% RH.
2. RH Accuracy: +/- 2% RH over the range of 10% to 90% RH at 77 degrees F (25 degrees C).
3. Temperature Measurement: Integral temperature sensor with accuracy of +/- 1 degree F (+/- 0.5 degree C).
4. Equilibration Time: Sensor shall provide a documentable reading in accordance with ASTM F2170 within 24 hours of installation.
5. Data Storage: Each sensor shall include integrated on-board data storage capable of recording and retaining RH, temperature, date, and time stamp data.
6. Drift Verification: System shall record readings at intervals to verify less than 1% RH drift over 5 minutes, as required by ASTM F2170.

C. Reader/Data Collection Device:

1. Reusable reader device capable of communicating with installed smart sensors via Bluetooth wireless technology.
2. Reader shall be capable of obtaining sensor readings through a mobile device application compatible with both iOS and Android platforms.
3. Reader shall display real-time RH and temperature values.

D. Reporting and Data Management:

1. System shall include a companion mobile application and/or web-based platform for wireless recording, storage, and reporting of RH test data.
2. Reporting platform shall generate reports compliant with ASTM F2170 Section 11 reporting requirements.
3. System shall support optional True Remote Monitoring capability, allowing authorized users to obtain sensor readings from a distance without requiring physical presence at the test location.
4. All test data shall be exportable to PDF format for project documentation.

2.3 ACCESSORIES

- A. Hole Liners: Manufacturer-supplied sleeves designed to fit the test holes and protect the sensor from debris and direct water contact.
- B. Caps/Plugs: Manufacturer-supplied caps for sealing test holes between readings to maintain equilibrium conditions.
- C. Drill Bits: Manufacturer-recommended drill bit size and type for preparing test holes to the proper diameter and depth.
- D. Vacuum/Cleaning Tools: Appropriate tools for removing drilling dust and debris from test holes prior to sensor installation.

2.4 CONCRETE SURFACE MOISTURE METER

A. Basis of Design:

- 1. Wagner Meters C555 Concrete Moisture Meter

B. Performance Requirements:

- 1. Non-destructive, hand-held meter for rapid evaluation of relative moisture conditions at the surface of concrete slabs.
- 2. Meter shall be used for comparative screening to identify areas of elevated moisture prior to in situ RH testing, and shall not be used as a substitute for ASTM F2170 testing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that HVAC systems are operational and the building is enclosed and maintained at service conditions, in accordance with Article 1.7.
- B. Verify that the concrete slab has cured for the minimum period specified in Article 1.7.
- C. Inspect the concrete slab surface at proposed test locations. Notify the Architect and General Contractor of conditions that may affect test results, including:
 - 1. Presence of curing compounds, sealers, coatings, or adhesive residues
 - 2. Standing water, visible dampness, or efflorescence
 - 3. Cracks, joints, or surface defects at test locations
 - 4. Ambient conditions outside the specified range
- D. Do not proceed with testing until unsatisfactory conditions have been corrected and accepted by the architect.

3.2 PREPARATION

A. Test Hole Layout:

- 1. Determine test hole locations in accordance with ASTM F2170. Provide a minimum of 3 test locations for the first 1,000 square feet (93 square meters) of floor area, plus 1 additional test location for each additional 1,000 square feet (93 square meters).
- 2. Locate test holes a minimum of 3 feet (1 meter) from any wall, column, or expansion/isolation joint.
- 3. When surface moisture screening is performed per Article 2.4, concentrate in situ test locations in areas identified with elevated surface moisture readings.
- 4. Mark all proposed test locations on the floor plan and submit to the architect for approval prior to drilling.

B. Test Hole Drilling:

- 1. Drill test holes to a depth of 40% of the slab thickness for slabs drying from one side only, or 20% of the slab thickness for slabs drying from two sides, in accordance with ASTM F2170.
- 2. Use a rotary hammer drill with the manufacturer-recommended drill bit diameter.
- 3. Verify slab thickness and confirm test hole depth prior to sensor installation.
- 4. Thoroughly remove all drilling dust and debris from each test hole using a vacuum and/or brush. A clean hole is critical for accurate readings.

C. Sensor Installation:

- 1. Install one smart sensor per test hole in accordance with the manufacturer instructions and ASTM F2170.
- 2. Insert the manufacturer-supplied hole liner (if applicable) and seat the sensor at the proper depth.
- 3. Seal the test hole with the manufacturer-supplied cap immediately after sensor installation.
- 4. Record the date, time, sensor serial number, and location for each installed sensor.

3.3 TESTING PROCEDURES

A. Equilibration:

- 1. Allow each installed sensor to equilibrate for a minimum of 24 hours before recording the initial documentable reading, in accordance with ASTM F2170.

B. Recording Readings:

1. After the equilibration period, connect the reader device to each sensor and record the RH value, temperature, date, and time.
2. Verify that the RH reading does not drift more than 1% over a 5-minute period. If drift exceeds 1%, allow additional equilibration time and retest.
3. Record ambient temperature and RH in the immediate vicinity of each test location at the time of reading.
4. Subsequent readings may be taken at any time, as the sensors remain installed and in equilibrium.

C. Acceptance Criteria:

1. Concrete slab shall be considered acceptable for the installation of floor coverings when in situ RH readings at all test locations do not exceed the threshold specified by the floor covering manufacturer.
2. If any test location exceeds the acceptable RH threshold, do not proceed with floor covering installation in that area. Notify the architect and implement one of the following:
 - a. Allow additional drying time and retest.
 - b. Install a moisture mitigation system in accordance with Section 09 05 61.13.
 - c. Select an alternate floor covering system with a higher RH tolerance.

3.4 RETESTING

- A. When initial test results exceed the acceptable RH threshold, retest after additional drying time or after installation of a moisture mitigation system.
- B. Retesting shall follow the same procedures specified in Article 3.3. Because the smart sensors remain in the slab, no new equilibration period is required for retest readings on existing sensors.
- C. Submit retest reports in the same format as initial test reports.

3.5 POST-TESTING

- A. Sensors installed in the concrete slab are single-use and shall remain in the test holes. Do not remove sensors.
- B. After final acceptable readings are documented and approved, cap all test holes flush with the slab surface to prevent interference with floor covering installation.
- C. Protect test locations from damage, contamination, or moisture intrusion between final testing and floor covering installation.

3.6 DOCUMENTATION

- A. Compile a complete moisture testing report package including:
 1. Floor plan showing all test hole locations with corresponding sensor serial numbers
 2. All individual test reports per Article 1.4.B
 3. Calibration certificates for all sensors used
 4. Ambient condition logs for each testing date
 5. Summary of results with pass/fail determination against specified RH thresholds
- B. Submit the complete report package to the architect and owner prior to commencement of floor covering installation.
- C. Retain copies of all test documentation for a minimum of 5 years, or as required by the owner.

END OF SECTION 09 05 61.16