

## Whitepaper FDM

# **Carbonation Testing: Complete Procedures A Technical Whitepaper for Plant and Agricultural Research**

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## Executive Summary

Carbonation testing is a pivotal process in evaluating the impact of CO<sub>2</sub> on biological and structural materials, particularly within plant science and agricultural research. By simulating elevated CO<sub>2</sub> environments, researchers can investigate phenomena such as **concrete carbonation**, **plant vernalization**, and **crop response under altered atmospheric conditions**. This whitepaper provides a detailed overview of the procedures, parameters, and compliance frameworks essential for effective carbonation testing using FDM's advanced **climatic chambers**. With increasing focus on CO<sub>2</sub> behavior in controlled ecosystems, our goal is to support research institutions in achieving scientific excellence and regulatory compliance.

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## Technical Parameters or Operational Setup

Effective carbonation testing demands precise environmental control. FDM chambers are engineered to regulate:

- **Temperature:** from -20°C to +60°C, with ±0.2°C stability
- **Relative Humidity (RH):** from 20% to 95%, with ±1.5% accuracy
- **CO<sub>2</sub> Concentration:** programmable up to **5,000 ppm**
- **Light Cycles:** adjustable for day/night simulation
- **Thermal Shock & Cyclic Transitions:** customizable for stress response analysis

These parameters are managed through integrated control systems ensuring **consistent, repeatable testing conditions** tailored to scientific protocols.

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## Normative, Procedures or Software Programming

FDM supports full compliance with international standards such as **ISO 12504**, **ICH Q1A**, and **IEC 60068**. Chambers are validated through **IQ (Installation Qualification)**, **OQ (Operational Qualification)**, and **PQ (Performance Qualification)**. Proprietary software ensures precise protocol execution, risk mitigation, and automatic logging. FDM's systems are designed to integrate seamlessly with **LIMS** platforms for streamlined data management and traceability.

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## Monitoring, Data Analysis or Maintenance

Environmental parameters are continuously monitored with multi-sensor arrays and stored via secure digital logging. FDM offers the **FDM Care** program, combining predictive maintenance, calibration services, and 24/7 technical support to minimize downtime and extend equipment lifespan—critical for uninterrupted experimental cycles.

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## Case Study

A botanical institute required simulation of **progressive concrete carbonation** for plant–substrate interaction studies. Using an FDM climatic chamber, they implemented a protocol with **28°C temperature**, **85% RH**, and **3,500 ppm CO<sub>2</sub>**, over a 14-day cycle. Results allowed for validation against **ISO 1920-12**, confirming material reactivity and plant resilience under semi-industrial conditions. The study reinforced the necessity of **precise CO<sub>2</sub> and humidity regulation**, achieved effortlessly via FDM's adaptive control systems.

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## Conclusion

FDM climatic chambers offer unparalleled advantages for carbonation testing:

- **Precision** in environmental control
- **Flexibility** for diverse research applications
- **Tailored configurations** for specific protocols
- **FDM Care** for predictive maintenance
- **"100 Test" quality check** before shipment
- Aligned with our mission: *"We offer tailored climatic solutions for R&D"*
- In pursuit of our vision: *"To be a trusted partner to the scientific community"*
- Embodying FDM's core values: **innovation, experimentation, creativity, precision, reliability, expertise**

**FDM** is committed to advancing carbonation testing through dependable, customizable, and research-focused climatic solutions.

**CONTACT Us FOR EXPERT CONSULTATION**

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