ANGLE OF REPOSE

TAPPED DENSITY

FLOW RATE

SIEVE SIZE

FLOWABILITY EVALUATION

# PowderPro X1

## 18-in-1 Automated Powder Testing Platform

Bettersize

BETTER PARTICLE SIZE SOLUTIONS

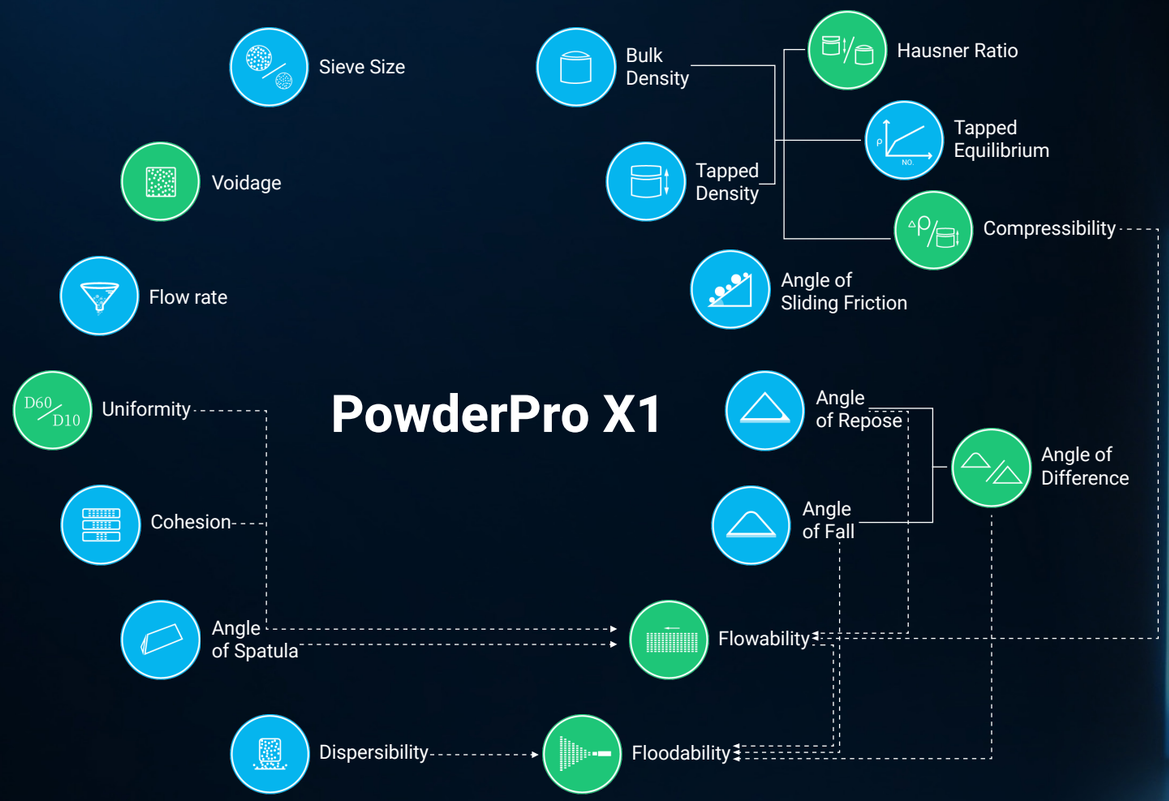
# PowderPro X1

## The Next Generation of Powder Characterization

| 18-in-1 | SOP | 360° | 20+ | 21 CFR |
|---|---|---|---|---|
| Automated Testing | Based Workflow | Image Analysis | Standards Compliance | Part 11 Support |

PowderPro X1 is a next-generation powder characterization system independently developed by Bettersize. Combining 18 critical powder parameters with automated testing on an integrated platform, it enables comprehensive evaluation of key powder properties, including angle of repose, bulk and tapped density, dispersibility, and flow rate. Based on the Carr Index Method and aligned with more than 20 international and industry standards, including the Chinese Pharmacopoeia, USP, Ph. Eur., ISO, and ASTM standards, PowderPro X1 supports applications ranging from R&D and quality control to method validation and regulatory compliance.

Through intuitive outputs such as angle-of-repose images, flow rate curves, sieve size reports, and flowability and floodability indices, PowderPro X1 transforms complex powder behavior into clear, quantifiable, and comparable results, supporting process optimization, product development, quality improvement, and scientific research.




**Solid line**: Direct calculation or test-derived relationship
**Dashed line**: Parameter used in Carr Index evaluation

## Features

- **18-in-1** automated powder characterization platform
- Integrated design for comprehensive powder flowability evaluation
- SOP-based workflows aligned with **20+** international standards
- Patented **360°** angle-of-repose imaging technology
- Integrated environmental monitoring and dust control
- Combined dispersibility and flow rate testing on a common base

## Benefits

- Unlock comprehensive insight into powder flow and handling behavior
- Adapt testing capabilities to changing application needs
- Strengthen quality assurance through standardized, traceable workflows
- Improve angle measurement reliability for complex powder pile geometries
- Reduce cleanup time and improve laboratory efficiency
- Predict process performance from laboratory-scale measurements with greater confidence

### PP-D1 Dispersibility Test Unit

A three-stage testing system with integrated precision weighing technology enables comprehensive evaluation of powder dispersibility.

### PP-F1 Flow Rate Test Unit

Using funnels compliant with pharmacopoeial requirements, the system automatically measures flow rate, discharged powder mass, and flow time for fast, repeatable flow analysis.

# **Redefining Angle** Measurement

Camera Rotation Range:
**0-180°**

Azimuthal Analysis Range (AoR directions)
**0°-360°**

Angle of Repose Measurement Range:
**0-90°**

Number of Image Capture Positions:
**180**

x2 Number of Angle Measurements per Position:
**2 (left and right)**

Total Angle Measurements per Test:
up to **360**

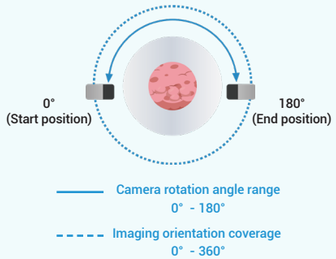
## 360° Multi-Angle Imaging and Analysis System

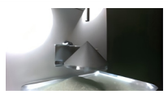
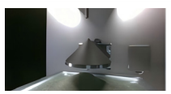
In practical testing, powder piles often exhibit asymmetrical shapes and surface irregularities. Measurements taken from a single viewing angle may overlook local slopes and other critical features, leading to incomplete characterization and reduced measurement reliability.

PowderPro X1 features a patented 360° multi-angle imaging and analysis system that captures powder pile morphology from different perspectives. By systematically analyzing the pile across the full azimuthal range, the system minimizes the bias associated with single-view measurements and delivers a more representative assessment of irregular or complex powder pile structures.

### Relationship Between Camera Rotation and Azimuthal Range

The camera rotates through 0–180°, while simultaneous measurements from both sides provide complete coverage of the 0–360° azimuthal range.




| Camera Angle | No.1 | No.2 | No.3 | No.4 | No.5 | Ave. |
|---|---|---|---|---|---|---|
| 45° Standard | | |  |  | | |
| Results | 44.33° | 44.11° | 44.85° | 44.93° | 45.02° | 44.67° |
| 2μm Calcium carbonate | | | | | | |
| Results | 27.09° | 31.91° | 36.17° | 41.69° | 39.65° | 35.30° |

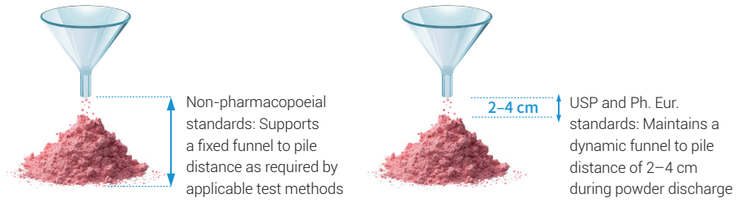
Validation with a 45° standard angle block yielded an average measured angle of repose of 44.67°, corresponding to a relative error of less than 1% from the reference value and demonstrating excellent measurement accuracy.

For challenging materials such as ultrafine calcium carbonate, 360° multi-angle analysis effectively captures pile asymmetry and generates a more representative angle-of-repose result for a realistic evaluation of powder flow behavior.

## Funnel Following Module

The funnel following module automatically maintains the distance between the funnel outlet and the top of the powder pile within the 2–4 cm range recommended by the USP and Ph. Eur. throughout testing. This reduces particle scattering, pile collapse, and variability caused by manual adjustment.

By promoting the formation of a stable and symmetrical powder pile, the module improves the accuracy, repeatability, and pharmacopoeial compliance of angle of repose measurements.



## Angle of Sliding Friction Module

The angle of sliding friction module measures the critical angle at which a powder bed begins to slide on an inclined plane. During testing, the platform gradually tilts while an integrated camera continuously monitors powder movement and automatically records the angle of sliding friction.

| Sample | No.1 | No.2 | No.3 | Average |
|---|---|---|---|---|
| Aluminum block | 21.94° | 22.38° | 21.78° | 22.03° |
| Calcium carbonate | 47.7° | 45.6° | 48.9° | 47.4° |
| Silicon carbide | 38.22° | 37.71° | 37.56° | 37.83° |

A larger angle of sliding friction indicates stronger friction between the powder and the contact surface, and therefore a lower tendency to slide.

This parameter quantitatively assesses powder handling behavior and its interaction with equipment surfaces.

# Intelligent **Flow Behavior Testing**

The PP-F1 Flow Rate Test Unit and PP-D1 Dispersibility Test Unit share a common base platform and can be quickly interchanged according to testing requirements. This integrated design enables both flowability and dispersibility evaluation within a single system, reducing the instrument footprint while improving testing efficiency. Its compact configuration simplifies installation, cleaning, and maintenance, supporting a streamlined process across multiple test applications.

## PP-F1 Flow Rate Test Unit

The flow rate test unit evaluates powder flow behavior by measuring either the time required for a fixed mass of powder to pass through a standard funnel or the mass discharged within a specified period.

**Multiple Test Modes**
Supports both flow time and flow mass methods to meet different testing needs.

**Automatic Curve Recording**
Records mass changes over time and automatically generates a flow rate curve.

## Shared Base Platform

**Integrated Test Configuration**
PP-F1 and PP-D1 can be quickly switched on a common platform, saving space and improving laboratory efficiency.

**Built-in Weighing System**
Integrated precision weighing technology records mass changes in real time, eliminating the need for an external balance while improving measurement stability.

**PP-F1**
Flow Rate Test Unit

Shared Base Platform

**PP-D1**
Dispersibility Test Unit

## PP-D1 Dispersibility Test Unit

The dispersibility test unit evaluates how readily a powder disperses by allowing it to fall from a fixed height and measuring the mass collected in the receiving tray. The test helps assess dusting tendencies during conveying, feeding, mixing, and other powder handling operations.

**Three-Section Modular Design**
Allows quick assembly, disassembly, cleaning, and maintenance.

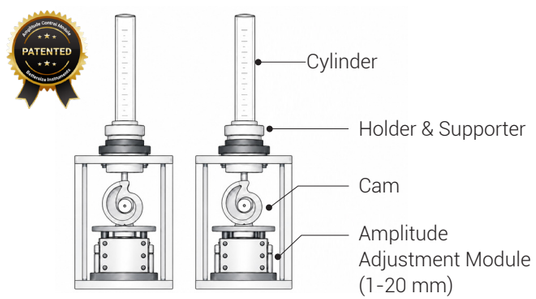
**One-Click Testing**
Testing is initiated directly through the software, with data acquisition and calculation completed automatically.

# Accurate **Tapping Conditions**

## Amplitude Control Module

PowderPro X1 features a high-precision adjustable tapping module that allows the tapping height to be set from 1 to 20 mm by precisely controlling the vertical distance between the cam and the support base.

This flexible design accommodates the different tapping heights required by ASTM, USP, ISO, and other international standards without the need to replace components of different heights. This makes testing more convenient, stable, and reproducible.

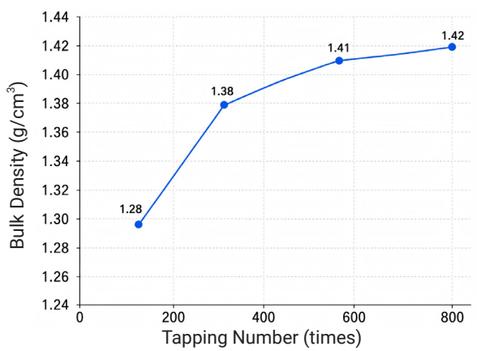



## Automatic Tapped Equilibrium Determination

Tapped equilibrium is reached when the powder volume or tapped density shows no significant change after repeated tapping.

PowderPro X1 automatically monitors volume changes during tapping and stops the test when the preset equilibrium criterion is met, improving testing efficiency and result repeatability.

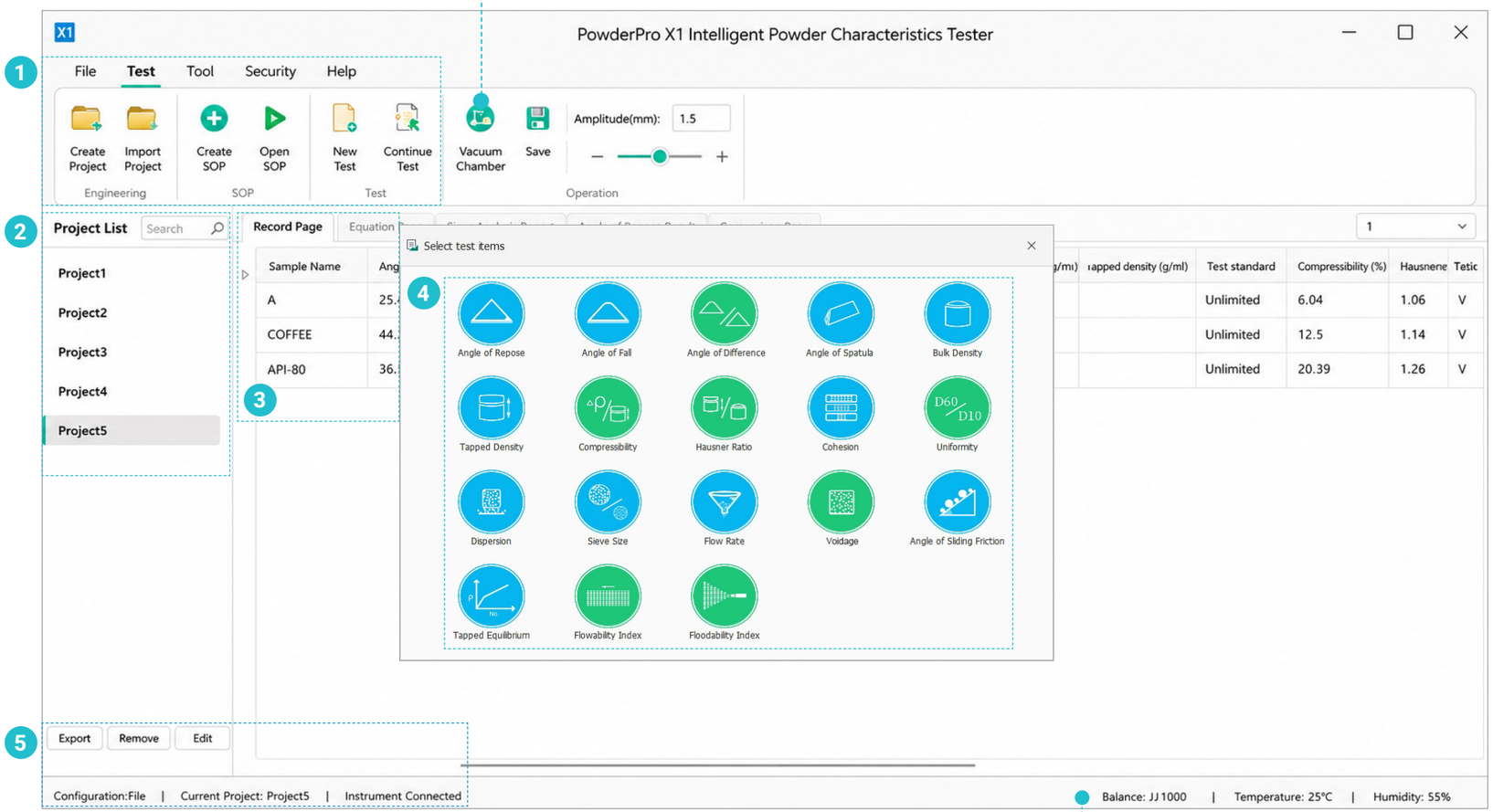
| Tapped Equilibrium | | |
|---|---|---|
| Tapping setting | Drop height = 18 mm | Speed = 150 taps/min |
| | Stop condition = 3 % | Volume = 100 $cm^3$ |



# Compliant & **Traceable Workflow**

## Dust Collection Control

Compatible with external dust collector systems, PowderPro X1 integrates built-in vacuum control for software-based dust collection and automated cleaning for a more efficient workflow.




1 Function Menu

2 Project List

3 Test Records

4 Test Items

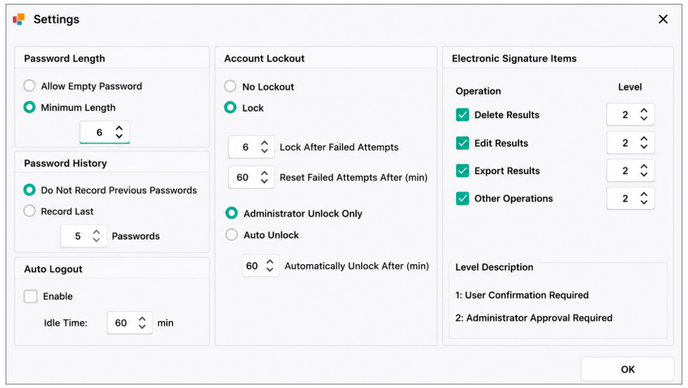
5 Instrument Status

## Test Environment Logging

Integrated temperature and humidity sensors continuously monitor environmental conditions during testing. The recorded values are automatically stored with the test results, improving data traceability and comparability under different test conditions.

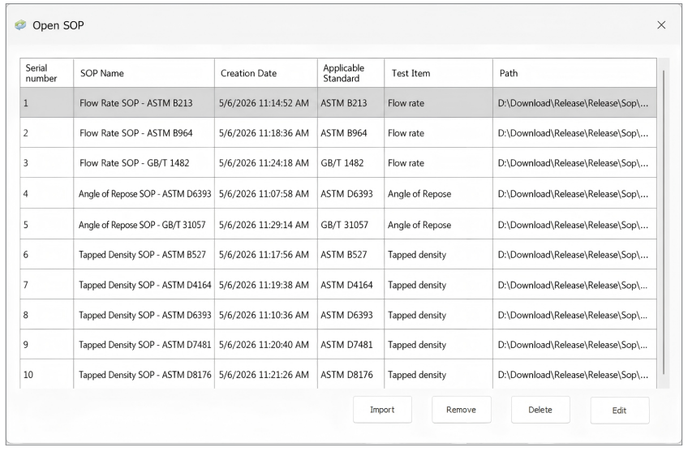
## Audit Trail Function

The software supports FDA 21 CFR Part 11 requirements through features such as user access control, electronic signatures, and operation logs. These capabilities help maintain data integrity and support compliance in regulated laboratory environments.




## Standard Method Library

A built-in library of pharmacopoeial, ISO, ASTM, and other standardized methods enables rapid test setup and execution. Method parameters can also be customized to meet specific application requirements.




| Serial number | SOP Name | Creation Date | Applicable Standard | Test Item | Path |
|---|---|---|---|---|---|
| 1 | Flow Rate SOP - ASTM B213 | 5/6/2026 11:14:52 AM | ASTM B213 | Flow rate | D:\Download\Release\Release\Sop\... |
| 2 | Flow Rate SOP - ASTM B964 | 5/6/2026 11:18:36 AM | ASTM B964 | Flow rate | D:\Download\Release\Release\Sop\... |
| 3 | Flow Rate SOP - GB/T 1482 | 5/6/2026 11:24:18 AM | GB/T 1482 | Flow rate | D:\Download\Release\Release\Sop\... |
| 4 | Angle of Repose SOP - ASTM D6393 | 5/6/2026 11:07:58 AM | ASTM D6393 | Angle of Repose | D:\Download\Release\Release\Sop\... |
| 5 | Angle of Repose SOP - GB/T 31057 | 5/6/2026 11:29:14 AM | GB/T 31057 | Angle of Repose | D:\Download\Release\Release\Sop\... |
| 6 | Tapped Density SOP - ASTM B527 | 5/6/2026 11:17:56 AM | ASTM B527 | Tapped density | D:\Download\Release\Release\Sop\... |
| 7 | Tapped Density SOP - ASTM D4164 | 5/6/2026 11:19:38 AM | ASTM D4164 | Tapped density | D:\Download\Release\Release\Sop\... |
| 8 | Tapped Density SOP - ASTM D6393 | 5/6/2026 11:10:36 AM | ASTM D6393 | Tapped density | D:\Download\Release\Release\Sop\... |
| 9 | Tapped Density SOP - ASTM D7481 | 5/6/2026 11:20:40 AM | ASTM D7481 | Tapped density | D:\Download\Release\Release\Sop\... |
| 10 | Tapped Density SOP - ASTM D8176 | 5/6/2026 11:21:26 AM | ASTM D8176 | Tapped density | D:\Download\Release\Release\Sop\... |

# **Powder Performance** Evaluation

## Application Case 1: Flowability Evaluation of Pharmaceutical Excipients under Different Temperature and Humidity Conditions

### Evaluation Logic

**Measure key parameters** → Angle of repose, compressibility, angle of spatula, cohesion or uniformity

**Convert to index scores** → Use the chart to convert test values into corresponding index scores

**Calculate Flowability Index** → Use the total score to classify powder flowability

PowderPro X1 continuously records environmental conditions during testing and correlates them with key flowability parameters. This enables users to evaluate powder behavior under different storage and processing conditions, supporting material selection, storage optimization, process development, and quality control.

| Samples / Test items | 25°C 30%RH | | 25°C 50%RH | |
|---|---|---|---|---|
| | Test Value | Index | Test Value | Index |
| Angle of repose (°) | 36.82 | 18 | 47.25 | 12 |
| Angle of spatula (°) | 44.53 | 17.5 | 56.67 | 16 |
| Tapped density (g/cm$^3$) | 0.66 | / | 0.70 | / |
| Bulk density (g/cm$^3$) | 0.52 | / | 0.49 | / |
| Compressibility (%) | 21.21 | 17 | 30.0 | 12 |
| Uniformity | 1.98 | 23 | 2.51 | 23 |
| **Evaluation of Flowability** | | | | |
| **Flowability Index** | **75.5** | | **63** | |
| **Evaluation** | **Good** | | **Normal** | |

## Application Case 2: Hall Flow Rate Evaluation of Metal Powders

In additive manufacturing, powder metallurgy, and metal injection molding, powder flowability directly affects powder spreading, die filling, and batch consistency. Using a Hall funnel, the PP-F1 Flow Rate Test Unit measures powder flow characteristics in accordance with ISO 4490 and ASTM B213.

| Sample type | Sample weight | Flow time | Flow rate |
|---|---|---|---|
| 316L Powder | 50 g | 18.6 s | 2.69 g/s |
| Copper powder | 50 g | 24.3 s | 2.06 g/s |
| Alloy powder | 50 g | 29.8 s | 1.68 g/s |



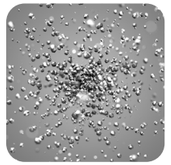
## Applications

PowderPro X1 is designed for comprehensive powder characterization across a wide range of industries, including pharmaceuticals, food and nutraceuticals, chemicals, metallurgy, additive manufacturing, etc. Based on the Carr Index Method, it quantitatively evaluates powder flowability while measuring a broad range of physical properties in accordance with international pharmacopoeial, ISO, ASTM, and industry standards.

Pharmaceuticals

Food & Nutraceuticals

Advanced Ceramics



Additive Manufacturing

Batteries

## Sales **Configuration**

### PowderPro X1-F

- Angle of Repose
- Angle of Spatula
- Compressibility & Hausner Ratio
- Tapped & Bulk Density (Fixed volumetric method)
- Cohesion & Uniformity
- Sieve Size
- Flowability
- Void Fraction

Main Unit

### PowderPro X1-S

**Includes all functions of the PowderPro X1-F configuration, plus:**

- Angle of Fall
- Angle of Difference
- Dispersibility
- Floodability

Main Unit

PP-D1

### PowderPro X1-U

**Includes all functions of the previous two configurations, plus:**

- Tapped & Bulk density (Fixed gravimetric method)
- Flow Rate
- Bulk Density (Scott Volumeter Method)
- Angle of Sliding Friction
- Tapped Equilibrium

Main Unit

PP-D1

PP-F1

(With one base platform)

| | | |
|---|---|---|
| **Parameters** | Quantity | 11 Measured Parameters: Sieve Size, Angle of Repose, Angle of Fall, Angle of Spatula, Bulk Density, Tapped Density, Cohesion, Dispersibility, Flow Rate, Angle of Sliding Friction, Tapped Equilibrium<br>7 Calculated Parameters: Angle of Difference, Voidage, Compressibility, Hausner Ratio, Uniformity, Flowability Index, Floodability Index |
| **Compliance** | ISO | ISO 3310, ISO 3923, ISO 3953, ISO 4490, ISO 8460 |
| | USP | USP <616>, USP <786>, USP <1174>, USP <1176> |
| | Ph. Eur. | Ph. Eur. 2.9.34, Ph. Eur. 2.9.36 |
| | ASTM | ASTM B212, ASTM B213, ASTM B329, ASTM B417, ASTM B527, ASTM C1770, ASTM D4164, ASTM D6393, ASTM D7481, ASTM D8176 |
| **Weight / Dimensions** | Main Unit | 42 kg / 352 × 517 × 558 mm |
| | Dispersibility Test Unit | 3.5 kg / 244 × 332 × 701 mm |
| | Flow Rate Test Unit | 5 kg / 244 × 321 × 332 mm |
| **Angle tests** | Test method | Depth camera |
| | Measurement range | 0° – 90° |
| **Depth camera** | Rotation angle range | 0° – 180° |
| | Imaging orientation coverage | 0° – 360° |
| **Tapped density** | Frequency | 1 – 300 taps/min |
| | Drop height range | 1 – 20 mm |
| | Settable number of taps | Max. 9999 |
| **Vibration sieve** | Amplitude range | 0.1 – 3 mm |
| **Control** | PC | Windows 10 system |
| **Repeatability** | | ≤3% |
| **Temperature (monitor)** | Range | -40 – 125 °C (±0.5 °C) |
| **Humidity (monitor)** | Range | 0% – 100% (±3% RH) |
| **Software** | Functions | SOP, 21 CFR Part 11 |
| | Connection | USB 3.0 |
| | Power supply | 90 ～ 250 V, 50/60 Hz |

Bettersize
BETTER PARTICLE SIZE SOLUTIONS

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Aug 2026