Anton Paar

MCR Rheometer Setups for Powder

Powder Flow Cell | Powder Shear Cell

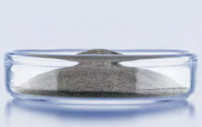
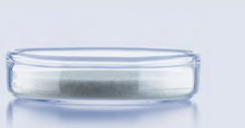
The Only High-Precision System for Powder Characterization

Working with powder and granular media can be challenging, particularly when it comes to processing and storage. A wide range of factors influence powders, e.g., particle shape, particle size and size distribution, chemical structure, humidity, and temperature.

To ensure efficient quality control and smooth powder processing, powder behavior can be characterized under real conditions, simulating the manufacturing process using true powder rheology with the MCR rheometer.

An MCR rheometer combined with the powder shear cell and the powder flow cell gives you all the possibilities you need for comprehensive powder characterization. This unique system guarantees the determination of powder behavior with the highest sensitivity and delivers the best results.

With the intuitive user interface of the RheoCompass software, you can run fully automated measurements with only a few clicks while maintaining complete autonomy over all measurement parameters. It supports modern laboratories with multiple clients and features a central database as well as ERP connectivity.

General area of application			
Very cohesive →	**Cohesive →**	**Easy-flowing →**	**Free-flowing**
			
Ideal: Powder shear cell		Ideal: Powder flow cell	
	Possible: Powder flow cell	Possible: Powder shear cell	

Find out more

True powder rheology methods			
High load	**Low load**	**Aerated**	**Fluidized**
● Shear testing	● Wall friction | caking*		
● Flowability | bulk density | compressibility			
	● Envelope density	● Cohesion strength	
		● Permeability	
		● Tensile strength	
		● Basic flowability energy**	● Pressure drop
		● Specific energy**	● Air retention
			● Fluidized bed viscosity
			● Segregation

● **Powder shear cell**
● **Powder shear and flow cell**
● **Powder flow cell 20 and 30**
● **Powder flow cell 30**

* Time consolidation weights required
** Powder flow cell 10 also possible

Powder Flow Cell Features

From powder to solid – true powder rheology and envelope density with just one measuring cell
True powder rheology helps you characterize and understand your powders. A wide range of dedicated powder measurement methods are available using the capabilities of rheometers, e.g., rotational and oscillating measurements, or even shear-rate- and airflow-dependent tests.

Patented dust protection system
Clean and safe handling of your samples is ensured with the patented (EP 3067684) dust protection hood. It safeguards you and the instrument from fine and potentially hazardous powder, even when it is fully fluidized. The system relies on a fourfold shaft sealing concept combining an air seal with geometric barriers, making the powder flow cell 100 % dustproof while retaining the MCR rheometer's extraordinary accuracy and resolution down to 10 nNm and below.

Reliable results with powder preparation modes
Anton Paar combines the extremely high sensitivity of the air-bearing rheometers with automated sample preparation modes for unrivaled reproducibility of up to ±0.5 %. The sensitivity helps you differentiate very similar powders and detect even small changes within your samples.

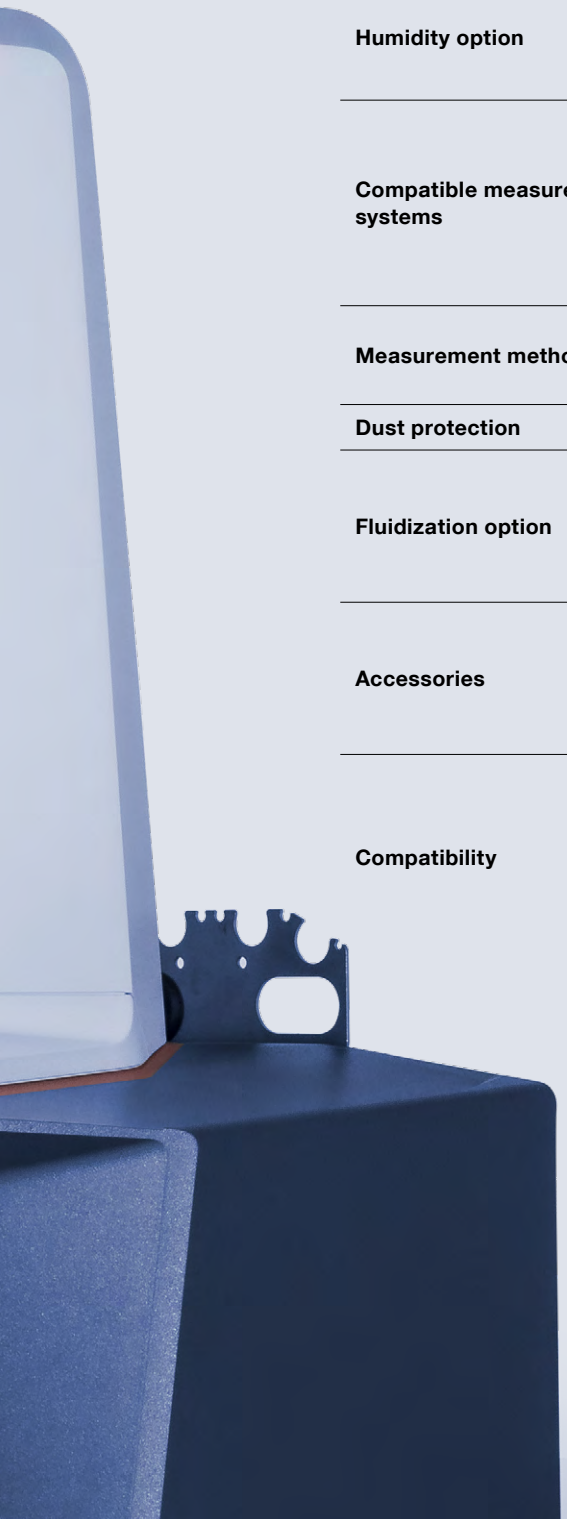
More than just powder rheology
Save costs by understanding your powders:

→ Get an Anton Paar MCR rheometer and unlock countless applications such as classical rheology, DMA, tribology, and mechanical testing

→ Use the powder flow cell to measure envelope density

Available as a measurement method: Envelope density and basic flowability energy

	Powder flow cell		
	PFC 30	**PFC 20**	**PFC 10**
Sample volume	60 mL to 120 mL		21 mL
Torque range	0.2 nNm to 300 mNm		
Normal stress	22 kPa		-
Temperature option	-15 °C to +80 °C	-15 °C to +80 °C (possible with upgrade kit)	-170 °C to +600 °C
Humidity option	Customizable on request		5 % rH to 95 % rH from 5 °C to 120 °C with CTD 180 and humidity option
Compatible measurement systems	- Two-blade stirrer - Helical two-blade stirrer - Warren Spring geometry - Powder Preparation Set with exchangeable disks (stainless steel, air-permeable, PTFE, further materials on request) - Cylinder and profiled cylinder		- Helical two-blade stirrer for PFC 10 (further stirrers on request); not compatible with PFC 20 and PFC 30 stirrers
Measurement method	For fluidized, aerated, and low-load conditions	For non-fluidized, aerated, and low-load conditions	For non-fluidized, aerated conditions (BFE and SE)
Dust protection	Included	Upgrade kit available	-
Fluidization option	Choice of three mass flow controllers for volumetric flow from 0.05 L/min up to 80 L/min		-
Accessories	- ø 50 mm PFC with uncoated glass tube - Optional: FTO-coated glass/steel tube		- ø 24 mm PFC made of stainless steel - Optional: Measuring cup made of Inconel or disposable cup
Compatibility	- MCR 102, MCR 302, MCR 502, MCR 702 - MCR Evolution series - MCR 303, MCR 503, MCR 703	- MCR 101, MCR 301, MCR 501 - MCR 102, MCR 302, MCR 502, MCR 702 - MCR Evolution series - MCR 303, MCR 503, MCR 703	- MCR 102, MCR 302, MCR 502, MCR 702 - MCR Evolution series - MCR 303, MCR 503, MCR 703



Highly Versatile

The highly versatile powder flow cell can be used for in-depth powder characterization or as a quality control tool. Use it to control the quality of your products with quick tests while benefiting from the precision of Anton Paar's MCR rheometers. Characterize powder during processing, handling, and storage, as well as in the final product.

Customizable for your application and needs

Measuring systems designed for your specific applications and measurements

PFC 10 for basic flowability energy measurements at elevated temperatures

Envelope density

Simple and safe measurement method for characterizing the envelope density of solids with a sample size ranging from 0.3 cm^3 to 25 cm^3, by using a reusable, free-flowing displacement powder. Precise volume measurement with a repeatability of up to 1 % is ensured with a sample quantity of at least 25 % of the total filling volume.

In combination with gas pycnometry measurements, the absolute density, porosity, and specific pore volume of solid materials can be determined.

Applications

- → Filling and dosing – discharge processes
- → Tableting, packaging, and compacting
- → Spray drying, wet granulation, and coating
- → Mixing and blending
- → Conveying
- → Fluidized bed reactors
- → Attrition investigations
- → Raking, doctor blading
- → Impact of flow additives
- → Influence of humidity
- → Envelope density determination of solids

Typical industries

- → Chemicals, polymers
- → Food
- → Paints and coatings
- → Additive manufacturing

Standards

- → DIN-EN-ISO 8130-15:2024-01 (Powder Coatings)

Specifications MCR rheometer	
Bearing	Air
EC motor	✓
Rotation mode	✓
Oscillation mode	✓
Toolmaster	✓
QuickConnect for measuring system	✓
Virtually gradient-free (horizontal, vertical) temperature control	✓
T-Ready	○
TruRate	○
TruStrain	○

RheoCompass software	
Test designer	✓
Report designer	○
Managed lab, multiple clients, and server	✓
Temperature calibration	✓

✓ Included ○ Depending on rheometer

Powder Shear Cell Features

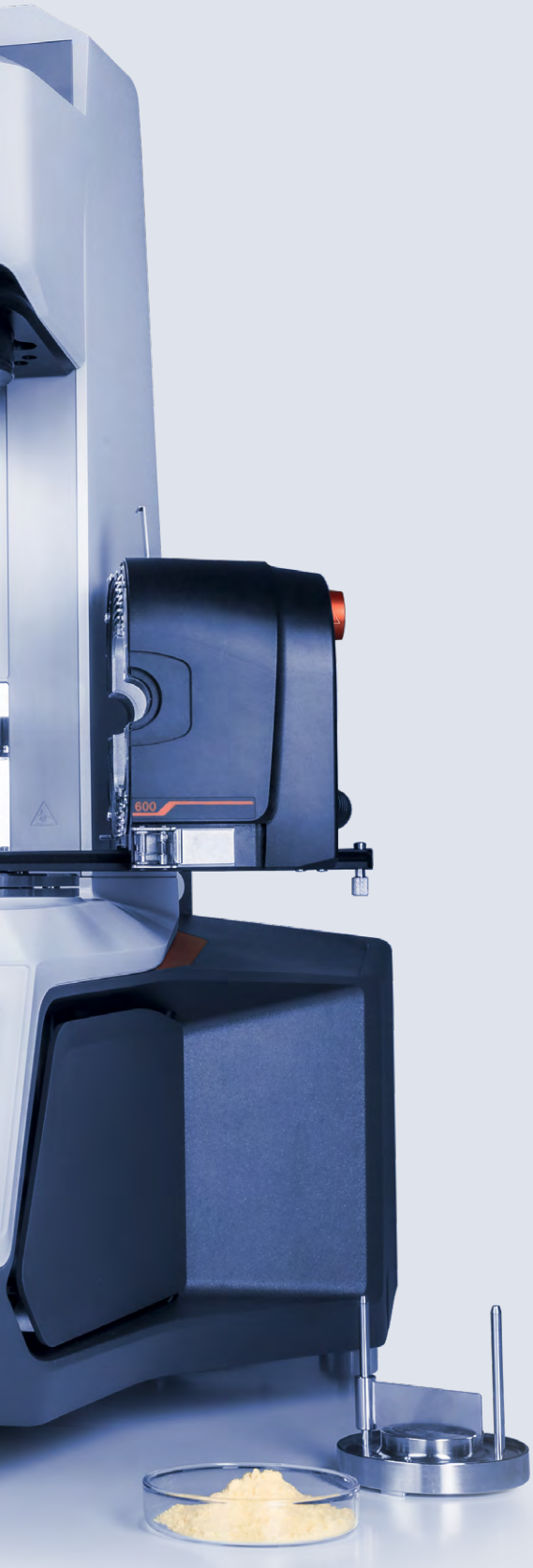
The only system with temperature and humidity control
The powder shear cell is designed to be combined with a temperature device that can be connected to a humidity generator so you can find out how temperature (-170 °C to +980 °C) and humidity (5 % rH to 95 % rH) impact your powders during storage, handling, and processing. The ring shear cell design allows for high precision with uniform shear conditions.

Absolute reproducibility – even for small sample volumes
An MCR rheometer, together with the powder shear cell, lets you run powder shear tests with impeccable precision and sensitivity, even if you measure small amounts down to 4.3 mL. The included sample preparation bench ensures that the samples are always identically prepared, greatly reducing operator influence and thereby increasing reproducibility. The sample preparation bench can also be used for time consolidation tests, so you know how powder behavior will change over time without blocking your device for other measurements.

Powerful software for incomparable control
With the intuitive user interface, you can run fully automated measurements with only two clicks while maintaining full autonomy over all measurement parameters. You can adapt all measurements to your needs. The software also features automatic analysis of all shear cell measurement parameters such as flow function (ffc) and angle of internal friction.

Designed to increase efficiency
Reduce costs and waste:

- → Increased efficiency by avoiding dosing and discharge issues
- → Ideal use of equipment with processing parameters optimized for your powder
- → Optimal quality control and maximized efficiency via powder characterization at regular intervals



	Powder shear cell
Sample volume	4.3 mL and 18.9 mL
Torque range	0.2 nNm to 300 mNm (device-dependent)
Normal stress range	- Shearing: up to 30 kPa - Compacting: up to 110 kPa - (sample- and cell-dependent)
Temperature option	- From -20 °C to +180 °C with CTD 180 - From -150 °C to +450 °C with CTD 450 - From -170 °C to +600 °C with CTD 600 - Customized up to 980 °C
Humidity option	- 5 % rH to 95 % rH - from 5 °C to 120 °C with CTD 180 and humidity option
Measurement systems	Included in the setup: - Small shear system (4.3 mL) - Large shear system (18.9 mL) - Wall friction system with exchangeable disks (stainless steel, aluminum, PTFE, further materials on request) Additional option for high-temperature applications: - Small shear system and lower shaft made of Inconel (shear geometry and compression geometry) - Compression/wall friction system
Accessories	Included in the setup: - Sample preparation / time consolidation bench - Weight base for small and large shear cell - Weights for small and large shear cell (up to 12 kPa in 1 kPa steps)
Compatibility	- MCR 102, MCR 302, MCR 502, MCR 702 - MCR Evolution series - MCR 303, MCR 503, MCR 703

A Complete Setup for All Your Shear Measurements

Large shear cell with a volume of 18.9 mL for larger particles

Small shear cell with a volume of 4.3 mL for small particles, valuable samples, and high normal loads up to 30 kPa

Wall friction measuring system with easily exchangeable disks

High-tech measuring shaft with integrated temperature sensor for the most accurate temperature control

Sample preparation bench for consistent sample preparation with reduced operator influence

Bench and weights for the small and large shear cell for time consolidation without blocking your device

With its focus on performance, precision, and measurement efficiency, this ring shear cell is the perfect tool for powder analysis. The ring shear design ensures consistent shearing conditions throughout the powder bed.

Anton Paar's MCR rheometers can be equipped with heating and humidity options. By precisely controlling the ambient conditions, you can find out for your specific application how temperature and humidity impact the behavior of your powder.

Applications

- → Silo design
- → Flow behavior (e.g., ffc)
- → Time consolidation behavior (caking)
- → Wall friction
- → Bulk density

Typical industries

- → Food
- → Batteries
- → Pharmaceuticals
- → Building materials

Standards

- → ASTM D6773
- → DIN 1055
- → USP 1174
- → Ph. Eur. 2.9.49

	PSC	PFC 10	PFC 20	PFC 30
Accessories to apply temperature and humidity for PSC and PFC				
CTD 1000 -150 °C to +980 °C	✓			
CTD 600 -170 °C to +600 °C	✓	✓		
CTD 450 -150 °C to +450 °C	✓	✓		
CTD 180 -20 °C to +180 °C	✓	✓		
LTD 80 -15 °C to +80 °C				✓

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