



DP Pulveriser[®]
since 1962

DP PULVERISERS

THE COMPLETE GUIDE TO
JET MILLING & ULTRAFINE
PARTICLE ENGINEERING

THE SCIENCE OF JET MILLING

Jet milling is a fluid energy-based size reduction technology that utilizes high-velocity compressed gas (air or steam) to induce inter-particle collisions, resulting in particle fracture and size reduction.

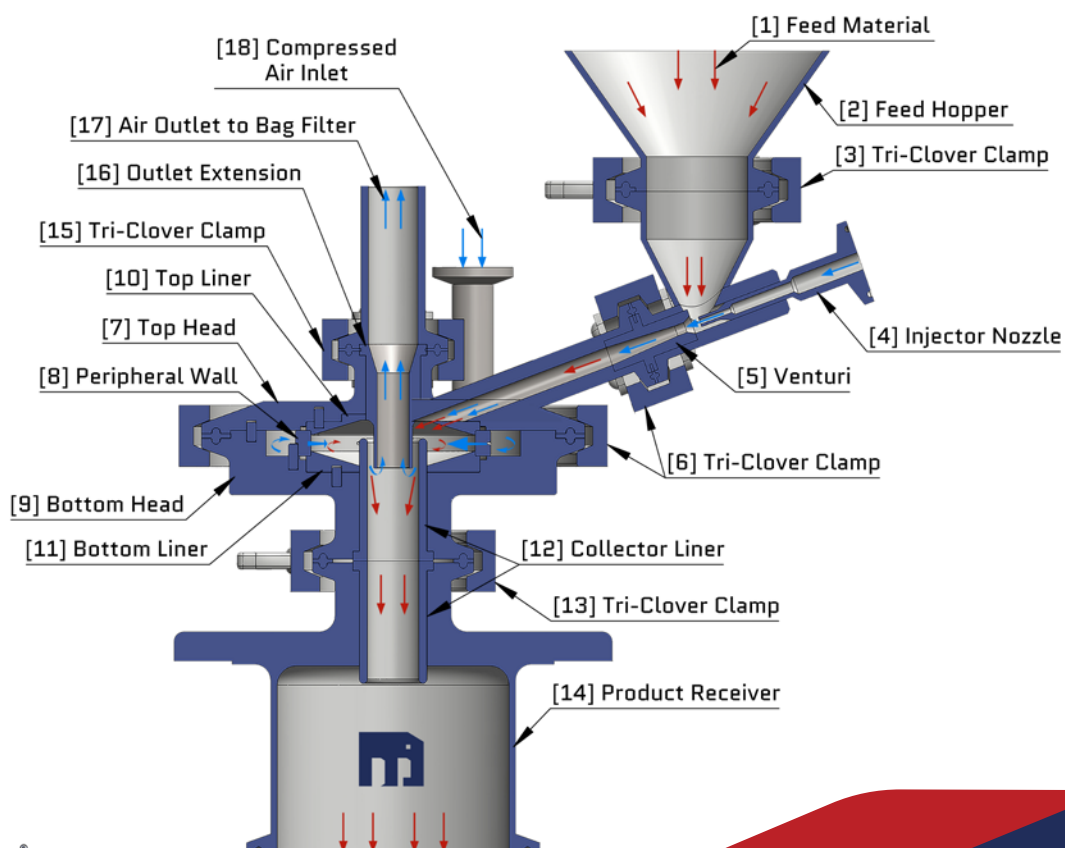
Unlike mechanical milling systems that rely on impact tools, grinding media, or rotating elements, jet milling operates using pure kinetic energy transfer.

Core Principle: Particle-on-Particle Collision

Particles are accelerated through nozzles at velocities approaching sonic or supersonic speeds. Within the grinding chamber, these particles collide with one another, fracturing along natural stress points.

Key Result:

- No mechanical contact surfaces
- No heat generation from friction
- No contamination from wear components



FLUID DYNAMICS & PARTICLE BREAKAGE MECHANISMS

Jet milling performance is governed by three primary physical mechanisms:

1

Inter-Particle Impact

- Dominant mechanism in spiral jet mills
- Particles collide at high velocity → brittle fracture occurs

2

Attrition & Shear

- Secondary mechanism
- Particles experience surface erosion due to turbulent flow

3

Turbulent Vortex Classification

- Internal circulation creates a centrifugal classification zone
- Fine particles exit
- Coarse particles remain

THERMODYNAMIC ADVANTAGE

One of the most critical advantages of jet milling is its near-isothermal grinding environment.

Why This Matters:

- No temperature rise from friction
- Suitable for heat-sensitive materials
- Prevents:
 - Melting
 - Degradation
 - Chemical transformation

Applications that depend on this:

- Pharmaceuticals (API stability)
- Polymers
- Nutraceutical actives
- Battery materials with thermal sensitivity



PARTICLE SIZE DISTRIBUTION (PSD) CONTROL

Jet mills are capable of producing extremely tight and predictable PSD due to:

- Controlled gas velocity
- Adjustable feed rate
- Internal classification dynamics

Typical Capabilities:

- D50: 1–10 microns
- D90: 3–25 microns
- Narrow distribution curve (low variance)

Why PSD Matters:

- Bioavailability (pharma)
- Reactivity (chemicals)
- Flowability (powders)
- Energy density (battery materials)



MATERIAL BEHAVIOR IN JET MILLING

Ideal Materials:

- Brittle materials
- Crystalline structures
- Low elasticity

Challenging Materials:

- Fibrous materials
- Highly elastic polymers
- Sticky or hygroscopic powders

Solutions:

- Pre-conditioning (drying, cooling)
- Cryogenic jet milling (if required)
- Feed system optimization



CONTAMINATION CONTROL & PURITY ENGINEERING

Jet milling is widely used in industries requiring ultra-high purity.

Why DP Jet Mills Excel:

- No moving parts in grinding zone
- Optional ceramic liners (Alumina, Silicon Carbide)
- Stainless steel construction (304 / 316)
- No lubrication inside product zone

Result:

Virtually zero contamination risk

WEAR, LINERS & MATERIAL COMPATIBILITY

DP Pulverizers offers a wide range of liner materials to match application needs:

- **Alumina** → ultra-high purity applications
- **Silicon Carbide** → extreme abrasion resistance
- **Polyurethane / PTFE** → soft or reactive materials
- **Alloy steel** → general industrial applications

Engineering Philosophy:

Match the mill to the material—
not the other way around.



PROCESS VARIABLES THAT CONTROL PERFORMANCE

Jet milling is widely used in industries requiring ultra-high purity.

Critical Parameters:

- Gas pressure & flow rate
- Feed rate
- Nozzle configuration
- Classifier dynamics
- Chamber geometry

DP Advantage:

We engineer these variables together to achieve:

- Target micron size
- Throughput optimization
- Energy efficiency

SCALABILITY: FROM LAB TO PRODUCTION

One of the biggest challenges in micronization is scale-up consistency.

DP solves this through:

- Geometrically scalable designs
- Proven data across multiple sizes (1" to 42")
- Process replication from lab trials

Result:

Predictable performance from R&D to full production



JET MILLING APPLICATIONS PLAYBOOK

BATTERY MATERIALS

[LITHIUM / GRAPHITE /
CATHODE POWDERS]

Challenge:

- Tight PSD required for energy density
- Avoid contamination
- Maintain material integrity

DP Solution:

- Ceramic-lined jet mills
- Ultra-tight classification
- Contamination-free grinding

Result:

- Improved battery efficiency
- Consistent electrode performance
- Reduced defect rates

PHARMACEUTICAL [API MICRONIZATION]

Challenge:

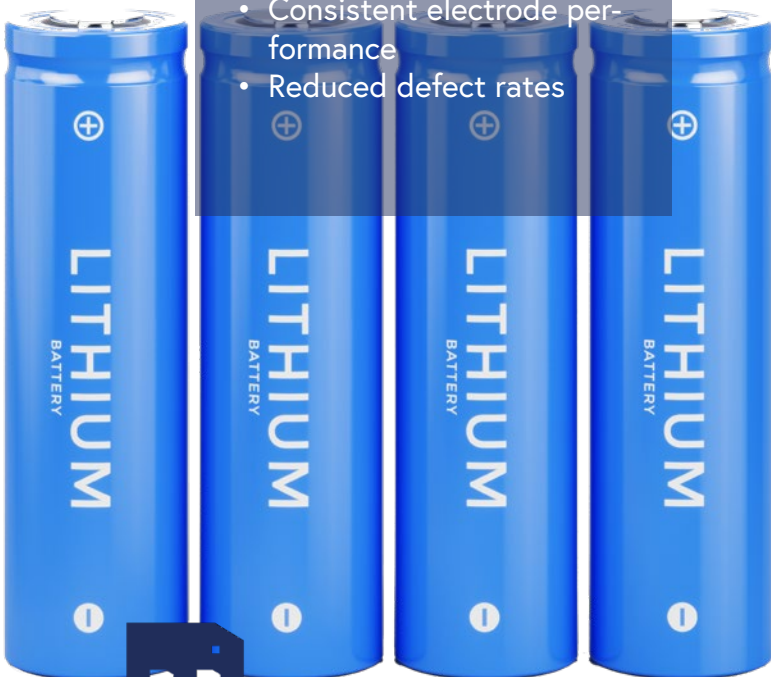
- Precise particle size for bioavailability
- Strict contamination control
- GMP compliance

DP Solution:

- Stainless steel sanitary design
- No heat generation
- IQ/OQ documentation

Result:

- Improved drug absorption
- Consistent dosing
- Regulatory compliance



PIGMENTS & COATINGS

Challenge:

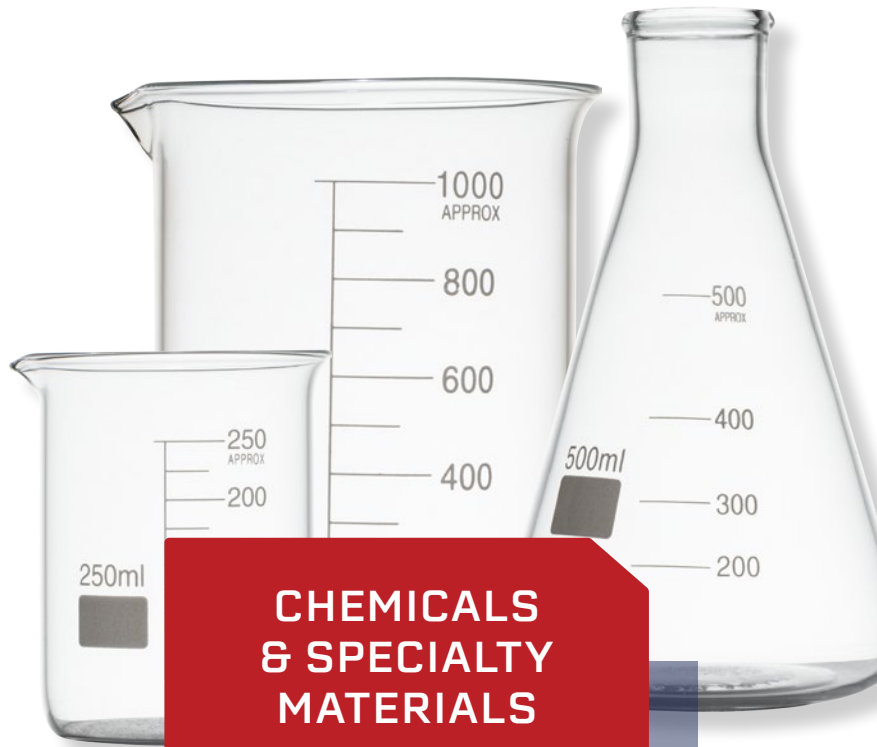
- Uniform color distribution
- Agglomeration control
- Fine particle dispersion

DP Solution:

- High-energy particle collision
- Narrow PSD
- Consistent micronization

Result:

- Brighter colors
- Better dispersion
- Improved coating performance



CHEMICALS & SPECIALTY MATERIALS

Challenge:

- Abrasive materials
- Tight reaction control
- Fine particle requirements

DP Solution:

- Wear-resistant liners
- High-energy grinding
- Controlled PSD

Result:

- Increased reactivity
- Improved product consistency
- Reduced downstream processing



DP Pulveriser®
since 1962

www.dppulveriser.com
www.dpmills.com

FOOD & NUTRACEUTICALS

Challenge:

- Heat-sensitive ingredients
- Flavor integrity
- Fine powder blending

DP Solution:

- No heat generation
- Gentle particle reduction
- Sanitary construction

Result:

- Preserved nutritional value
- Enhanced solubility
- Consistent product quality

MINERALS & CERAMICS

Challenge:

- High hardness materials
- Wear on equipment
- Fine particle requirements

DP Solution:

- Silicon carbide / ceramic liners
- High-energy jet streams
- Robust construction

Result:

- Silicon carbide / ceramic liners
- High-energy jet streams
- Robust construction



DP Pulveriser®
since 1962

 www.dppulveriser.com

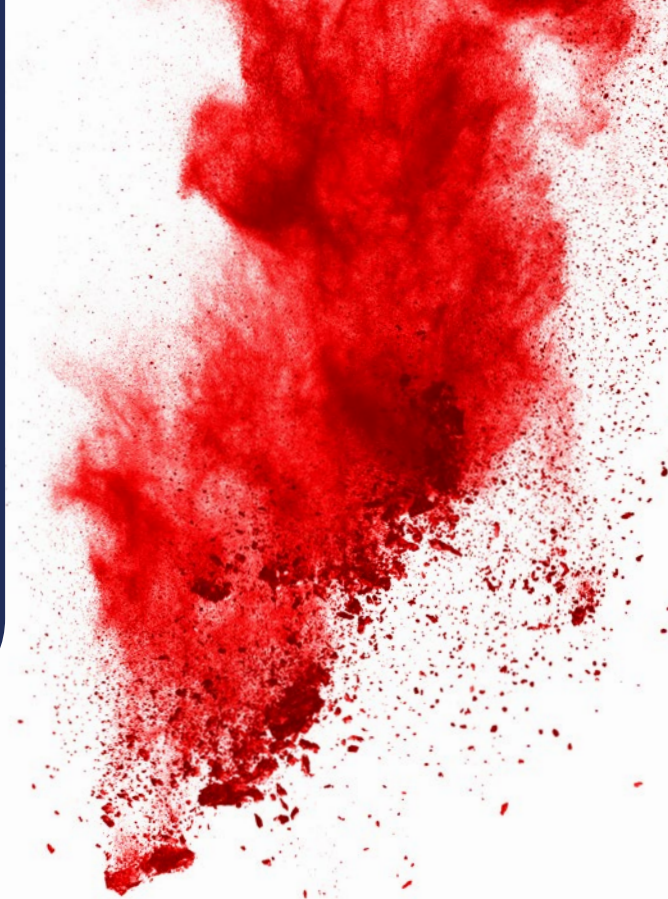
www.dpmills.com

Jet milling is not just about reducing particle size—it is about engineering performance at the microscopic level.

At DP Pulverizers, we combine:

- Advanced fluid dynamics
- Precision engineering
- Decades of application experience

To deliver systems that don't just meet specifications—they redefine them.



**Bring us your material.
We'll engineer your result.**

- Lab testing available
- Process optimization included
- Scalable from grams to tons

**DP Pulverizers —
The Science Behind
Every Micron**



www.dppulveriser.com
www.dpmills.com

Our Global Footprint

Australia	Bahrain	Bangladesh	Bhutan	Canada	China	Estonia
Bremen	Ghana	Hongkong	Iran	Indonesia	Kenya	Mauritius
Mexico	Malaysia	Newzealand	Nepal	Nigeria	Oman	Philippines
	Saudi Arabia	South Africa	Singapore	Sri Lanka	Tanzania	
	Qatar	U.A.E	Guatemala	Zambia	Uruguay	



Contact Us

North America (Factory)

Chicago, Illinois, 60601, USA

Contact: John Paul

Tel: +1 312-883-7432

Email: john.paul@permixtec.com

www.permixmixers.com

UK

Scotland, Great Britain

Contact: Laura Griffin

Email: laura.griffin@permixtec.com

www.permixmixers.co.uk



www.dppulveriser.com

www.dpmills.com