
LABORATORY SOLUTION

Milling & Grinding Equipments

분쇄 및 파쇄용 장비

Main Products

FRITSCH made in Germany
The Expert of Milling to Nano-scale





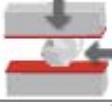


www.mjr.co.kr | www.mj-research.co.kr



CONTENT

3	Sample Preparation
4	Principle of High-Energy Ball Mill
5	Line-up of High-Energy Ball Mill
6	High-Energy Ball Mill
10	Vibratory Ball Mill
12	Rotor Mill
13	Cutting Mill
16	Jaw Crusher
17	Disk Mill
18	Cup Mill
19	Hand Mortar Grinder
20	Cross Beater Mill
21	Knife Mill
22	Sieve Shaker
24	Particle Size Analyzer
25	Image Sizer
26	Sample Divider / Feeder
27	Laboratory for Sample Test

HOW to Choose the right type of comminution

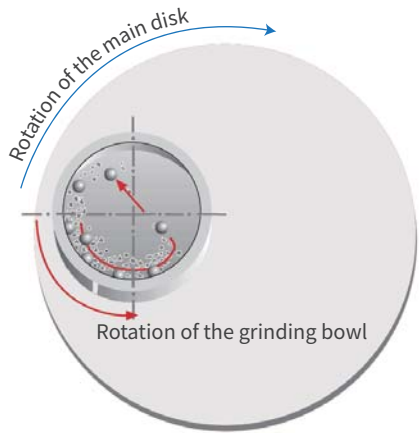
Comminution principle	Type of comminution	Mill equipments
	Pressure Moving surfaces apply pressure to the sample in between.	Jaw crusher
	Impact The sample is accelerated against a surface at an extremely high speed.	Planetary ball mill, Ball mill Cup mill Rotor mill
	Friction With friction-based comminution, the sample is ground between two surfaces due to the vertical pressure of one surfaces relative to the other during simultaneous movements.	Mortar grinder, Disk mill
	Shearing Here, comminution takes place due to the shearing effect between at least on fixed surfaces and one moving surface that both move against one another.	Disk mill Rotor mill
	Cutting Rotating knives cut the sample between blades or fixed knives.	Cutting mill Knife mill

Abrasive	Planetary mill, Ball mill, P9
Alloy	Planetary mill, Ball mill, P1
Analytic	Planetary mill, Ball mill, P11, P14
Animal food	Cutting mill, Ball mill
Biology	Cutting mill, Planetary mill, Ball mill, P11
Bones	Cutting mill, P0
Building material	Planetary mill, Ball mill, P1, P13, P9
Catalytic converter	Planetary mill, Ball mill, P1
Cement clinker	Planetary mill, Ball mill, P1, P13, P9
Ceramics	Planetary mill, Ball mill, P1, P13, P9
Coal	Planetary mill, Ball mill, P1, P13
Coating powder	Planetary mill, Ball mill, P14
Compound material	Cutting mill, P14
Drug	Cutting mill, Planetary mill, Ball mill
Electronic scrap	Cutting mill, P0, P14
Environment	Cutting mill, P11, Ball mill
Feed (pellet)	Cutting mill, P11, P14
Fertilisers	Planetary mill, Ball mill, P14
Fibres	Planetary mill, Ball mill, P1, P13, P9
Foils	Cutting mill
Food	Cutting mill, Planetary mill, Ball mill, P11
Glass	Planetary mill, Ball mill, P1, P13, P9
Grains	Cutting mill, P14
Household waste	Cutting mill
Leather	Cutting mill

Lime	Planetary mill, Ball mill
Material research	Planetary mill, P7 premium, P5 premium
Mechanical alloying/activation	Planetary mill
Metallurgy	Planetary mill, P1, P9
Minerals	Planetary mill, Ball mill, P1, P13, P9
Mining	Planetary mill, Ball mill, P1, P13, P9
Ores	Planetary mill, Ball mill, P1, P13, P9
Pharmaceutical	P14
Pigments	Planetary mill, Ball mill
Plants	Cutting mill, P11, P14
Plastics	Cutting mill, P14
Refractory material	Planetary mill, Ball mill, P1, P13, P9
Rocks	Planetary mill, Ball mill, P1, P13, P9
RoHS	Cuttingm mill, P0, P9, P14
Rubber	Cutting mill, P14
Sediments	Planetary mill, Ball mill, P9
Slags	Planetary mill, P1, P9
Soil research	Planetary mill, Ball mill, P1, P13
Spectroscopy	Planetary mill, Ball mill, P14
Spices	Cutting mill, P14
Tablets	Planetary mill, Ball mill
Textiles	Cutting mill
Wood	Cutting mill, P14

* Planetary Mill: High-energy Ball Mill. Ball Mill: Vibratory Ball Mill.
** P0: Vibratory Ball Mill. P1: Jaw Crusher. P9: Cup Mill. P11: Knife Mill. P13: Disk Mill. P14: Rotor Mill.

Planetary Ball Mill Technology



Scheme of planetary ball mill

Planetary Ball Mill 의 원리

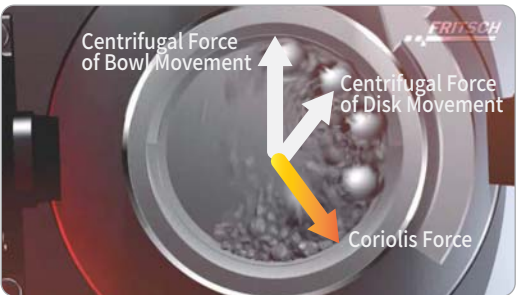
Grinding ball 과 Sample 간의 강력한 impact 발생
원심력에 의한 원심가속도를 이용

바깥쪽의 Main-disk가 공전 (Revolution)을 할 때,
Grinding bowl이 반대방향으로 자전 (Rotation) 함으로서,
강력한 impact energy 발생

이때 발생한 최대 95G 의 강력한 중력가속도는
①Grinding ball 과 Grinding bowl wall 간의 강력한 impact
②Grinding ball 간의 강력한 impact
발생하여 Sample을 나노수준까지 분쇄가 가능하도록 함

다양한 재질의 Grinding bowl과
다양한 사이즈의 Grinding ball를 이용하여 분쇄정도 조절

Process of the Planetary Ball Mill



Line up of High-Energy Ball Mill

	Planetary Ball Mill PULVERISETTE 5 Classic line	Planetary Mono Mill PULVERISETTE 6 Classic line	Planetary Micro Mill PULVERISETTE 7 Classic line	Vario-Planetary Mill PULVERISETTE 4 Classic line	Planetary Ball Mill PULVERISETTE 5P Premium line	Planetary Micro Mill PULVERISETTE 7P Premium line
Working principle	Impact force	Impact force	Impact force	Impact force	Impact force	Impact force
Number of working stations	4	1	2	2	2	2
Grinding bowl size	80, 250, 500 ml	80, 250, 500 ml	12, 45 ml	12, 45, 80, 250, 500 ml	125, 150, 250, 420, 500 ml	20, 45, 80 ml
Grinding ball diameter	0.1 ~ 40 mm	0.1 ~ 40 mm	0.1 ~ 15 mm	0.1 ~ 40 mm	0.1 ~ 40 mm	0.1 ~ 15 mm
Max. feed size	10 mm	10 mm	5 mm	10 mm	10 mm	5 mm
Min. sample quantity	10 ml	10 ml	0.5 ml	0.5 ml	15 ml	2 ml
Max. sample quantity	900 ml	225 ml	40 ml	450 ml	450 ml	70 ml
Final fineness	< 1 um	< 1 um	< 1 um	< 1 um	< 0.1 um	< 0.1 um
Grinding process	Dry / wet	Dry / wet	Dry / wet	Dry / wet	Dry / wet	Dry / wet
Grinding in inert gas	Yes	Yes	Yes	Yes	Yes	Yes
Gas press. & temp. measurement	Yes	Yes	No	Yes	Yes	Yes
Rotation speed of main disk	50 ~ 400 rpm	100 ~ 650 rpm	100 ~ 800 rpm	0 ~ 400 rpm	100 ~ 800 rpm	100 ~ 1,100 rpm
Transmission ratio Planetary disk / grinding bowl	$i_{relative} = 1 : -2.19$	$i_{relative} = 1 : -1.82$	$i_{relative} = 1 : -2$	Variable	$i_{relative} = 1 : -2$	$i_{relative} = 1 : -2$
Effective diameter of main disk	~ 250 mm	121.6 mm	140 mm	~ 250 mm	180 mm	140 mm
Centrifugal acceleration	22 g	29 g	50 g	22 g	64 g	95 g
Interface	Yes	Yes	Yes	Yes	Yes	Yes
Electrical details	200~240V, 1730 watt	200~240V, 1000 watt	200~240V, 740 watt	200~480V, 6000 watt	200~240V, 2800 watt	200~240V, 1200 watt
Weight	120 kg	63 kg	35 kg	320 kg	110 kg	44 kg
Dimension w x d x h	580 x 670 x 570 mm	370 x 530 x 500 mm	370 x 530 x 500 mm	600 x 800 x 110 mm	820 x 520 x 480 mm	400 x 580 x 360 mm

High-Energy Ball Mill

유성형 볼 밀

Feature

- 나노수준 분쇄시 최적화
- 건식 및 습식 모두 가능
- 건식: 최소 5um 이내
- 습식: 나노 수준까지 분쇄
- 다양한 재질의 Grinding bowl를 이용한 분쇄
- Inert (in N₂, Ar) 환경하에서 실험 가능

Application

- 세라믹재료 : Porcelain, sintered ceramics, clay, etc.
- 금속재료 : Coating powder, metal, sinter, ores, etc.
- 화학 : Organic, inorganic materials, pigment, glass, etc.
- 광물 및 암석 : Rock, gravel, sand, mineral, etc.
- 제약원료 : Drug, tablet, extract, etc
- 분석시료 : XRF, Spectroscopy, XRD, etc.
- 바이오 : Plant, freeze-dried sampls, etc.
- Mechanical alloying

국내 국가기관연구소, 기업연구소, 학교실험실에 1,000여 대 이상 납품된 장비로서, 제품의 성능 및 내구성이 검증된 제품

Grinding bowl & Grinding ball

Agate	SiO ₂
Sintered corundum	Al ₂ O ₃
Silicon nitride	Si ₃ N ₄
Zirconium oxide	ZrO ₂
Hardened stainless steel	Fr - Cr
Hardmetal tungsten carbide	WC



Planetary Mono Mill Classic line

PULVERISETTE 6

High performance in minimum

Working station	1 ea
Rotation speed	100 ~ 650 rpm
Max. G force	29 g
Grinding bowl	80, 250, 500 ml
Max. sample volume	225 ml
Min. sample volume	10 ml
Max. feed size	10 mm
Final fineness	5 um (dry), < 1um (wet)
Inert gas	possible (optional)
Dimensions (w x d x h)	370 x 530 x 500 mm
Weight	63 kg



Planetary Ball Mill Classic line

PULVERISETTE 5

Fast and fine

Working station	4 ea
Rotation speed	100 ~ 400 rpm
Max. G force	22 g
Grinding bowl	80, 250, 500 ml
Max. sample volume	900 ml
Min. sample volume	10 ml
Max. feed size	10 mm
Final fineness	5 um (dry), < 1um (wet)
Inert gas	possible (optional)
Dimensions (w x d x h)	580 x 670 x 570 mm
Weight	120 kg



Planetary Micro Mill Classic line

PULVERISETTE 7

Ideal for the smallest quantity

Working station	2 ea
Rotation speed	100 ~ 800 rpm
Max. G force	50 g
Grinding bowl	12, 45 ml
Max. sample volume	40 ml
Min. sample volume	0.5 ml
Max. feed size	5 mm
Final fineness	5 um (dry), < 1um (wet)
Inert gas	possible (optional)
Dimensions (w x d x h)	370 x 530 x 500 mm
Weight	35 kg



More safety operation

Premium line advantage



Easy insertion



ServoLOCK



Clamping release



Automatic closing

High-performance grinding down into **Nano range**



Snapping bowl lids



Easy bowl positioning



SelfLOCK



Automatic closing

Premium line만이 갖는 강점

- 최대 중력가속도 95 g 달하는 높은 에너지
- Classic line 제품 대비 최대 약 3배 높은 중력가속도 에너지
- 최대 1,100 rpm 까지 회전
- 나노 수준 분쇄 시 가장 적합하고 효율적인 모델
- 최소 0.05 mm ball 까지 사용 가능하여 분쇄효율 극대화
- 건식 및 습식 모두 가능
- Inert (in N₂, Ar) 환경하에서 안정적인 실험 가능
- 안전한 bowl 장착 및 탈착, Automatic check

Application

- 세라믹재료 : Porcelain, sintered ceramics, clay, etc.
- 금속재료 : Coating powder, metal, sinter, ores, etc.
- 화학 : Organic, inorganic materials, pigment, glass, etc.
- 광물 및 암석 : Rock, gravel, sand, mineral, etc.
- 제약원료 : Drug, tablet, extract, etc
- 분석시료 : XRF, Spectroscopy, XRD, etc.
- 바이오 : Plant, freeze-dried sampls, etc.
- Mechanical alloying



Ferrovanadium



Glass



Soil



Granite



Planetary Mill Premium line

PULVERISETTE 5 Premium

Ideal for large quantities

Working station	2 ea
Rotation speed	100 ~ 800 rpm
Max. G force	64 g
Grinding bowl	125, 150, 250, 420, 500 ml
Max. sample volume	450 ml
Min. sample volume	40 ml
Max. feed size	10 mm
Final fineness	5 um (dry), < 0.1 um (wet)
Inert gas	possible (optional)
Dimensions (w x d x h)	820 x 520 x 480 mm
Weight	110 kg



Planetary Micro Mill Premium line

PULVERISETTE 7 Premium

Ideal for the smallest quantity

Working station	2 ea
Rotation speed	100 ~ 1,100 rpm
Max. G force	95 g
Grinding bowl	20, 45, 80 ml
Max. sample volume	70 ml
Min. sample volume	2 ml
Max. feed size	5 mm
Final fineness	5 um (dry), < 0.1 um (wet)
Inert gas	possible (optional)
Dimensions (w x d x h)	400 x 580 x 360 mm
Weight	44 kg



Vibratory Ball Mill

진동 볼 밀

Feature

- 상하 진동을 이용한 분쇄
- 3 ml 이하의 소량 샘플 분쇄시 최적
- 건식 및 습식 모두 가능
- 건식: 최소 5um 이내
- 다양한 재질의 Grinding bowl의 이용한 분쇄
- Liquid nitrogen을 이용한 동결분쇄 - PTFE bowl

상하 진동을 이용한 분쇄



동결분쇄를 위한 PTFE bowl



Cryogenic milling of Pulverisette 0



Grinding and sieving in one unit



Application

- 세라믹재료 : Porcelain, sintered ceramics, clay, etc.
- 금속재료 : Coating powder, metal, sinter, ores, etc.
- 화학 : Organic, inorganic materials, pigment, glass, etc.
- 광물 및 암석 : Soil, sand, mineral, etc.
- 제약원료 : Drug, tablet, extract, etc
- 분석시료 : XRF, Spectroscopy, XRD, etc.
- 바이오 : Hair, freeze-dried sampls, bone, Teeth, etc.
- RoHS : M.P board, camera, keypad, LCD glass panel, etc



Hair



Keypad



T-shirt



Bone

Grinding bowl & Grinding ball

Agate	SiO ₂
Sintered corundum	Al ₂ O ₃
Silicon nitride	Si ₃ N ₄
Zirconium oxide	ZrO ₂
Hardened stainless steel	Fr - Cr
Hardmetal tungsten carbide	WC
PTFE	C _x -F _{2x}



Vibratory Mini Mill

PULVERISETTE 23

3 ml 이하의 소량 샘플 분쇄 및 혼합에 적합

Grinding principle	Impact force
Grinding bowl	5, 10, 15 ml
Max. sample volume	5 ml
Min. sample volume	1 ml
Max. feed size	5 mm
Final fineness	5 um
Cryogenic grinding	Liq. nitrogen in PTFE bowl
Oscillation per minute	900 ~ 3,000, 9 mm Amp.
Dimensions (w x d x h)	200 x 300 x 300 mm
Weight	7 kg



Vibratory Micro Mill

PULVERISETTE 0

10 ml 이하의 소량 샘플 분쇄시 적합

Grinding principle	Impact force
Grinding bowl	-
Max. sample volume	10 ml
Min. sample volume	1 ml
Max. feed size	5 mm
Final fineness	10 um
Cryogenic grinding	Yes
Oscillation per minute	3,000 ~ 3,600, 3 mm Amp
Dimensions (w x d x h)	370 x 400 x 200 mm
Weight	21 kg



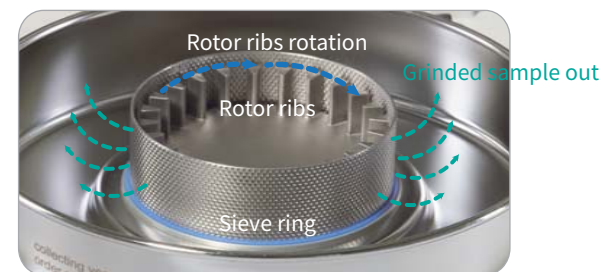
Rotor Mill

로터 밀

Feature

- Rotor ribs의 고속회전에 의한 분쇄 및 해쇄
- 5 ~ 100 ml 실험 시 최적
- 건식: 40 ~ 1,000 um 사이 분쇄 시 최적
- 0.08 ~ 6 mm 의 다양한 Sieve ring 을 이용한 입도 조절
- Liquid nitrogen을 이용한 동결분쇄
- 열에 의해서 변형되는 샘플 분쇄시 최적
- 여러 종류의 ribs 선택 (8, 12, 24 ribs)
- Easy cleaning and assembly

Rotor ribs의 고속회전에 의한 분쇄



Application

- 열에 민감한 샘플: PVC, PP, PE, films, plastic, etc.
- Polymer, rubber, resins, chemicals, filler, etc.
- 식품: Rice, Dried food, coffee, seed, grain, peat, etc.
- 제약: Tablet, granuals, 제약원료, etc.
- 바이오: Plants, root, leaves, etc.
- RoHS: Electronic parts, glass, etc.

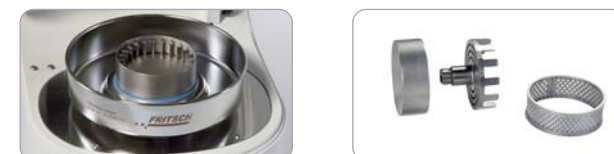


Rotor Mill

PULVERISETTE 14

Liquid nitrogen을 이용한 동결분쇄

Grinding principle	Impact force
Variable speed	6,000 ~ 20,000 rpm
Max. throughput	5 L / h
Ideal sample quantity	5 ~ 10 ml
Max. feed size	10 mm
Final fineness	40 um
Dimensions (w x d x h)	310 x 480 x 470 mm
Weight	23 kg



Cutting Mill

컷팅 밀

Feature

- Rotor의 고속회전에 의한 분쇄
- Speed range: 300 ~ 3,000 rpm (Pulverisette 19)
- 3 종류의 Rotor를 통한 다양한 샘플 분쇄
- 건식: 200 ~ 6,000 um 사이 분쇄 시 최적
- 최대 Feeding size: 70 x 80 mm
- 0.2 ~ 12 mm의 다양한 Sieve cassette을 이용한 입도조절
- Liquid nitrogen을 이용한 동결분쇄
- Easy cleaning and assembly, disassembly

Rotor의 고속회전에 의한 분쇄



간단한 분리 및 결합, 세척



Application

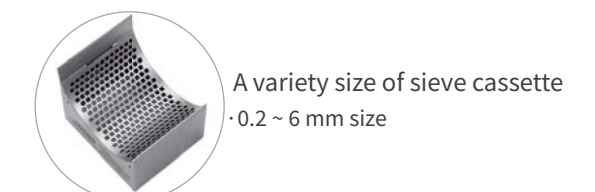
- Plastics & textiles: PVC, PP, PE, plastic, rubber, fabric, etc.
- Agriculture: Wood, leaves, roots, grain, corn, peat, etc.
- 환경: Paper, metal-free waste, household waste, etc.
- 제약: Tablet, granuals, 제약원료, etc.
- 바이오: Bone, plant, etc.
- 식품: Maize, malt, pasta, herbs, spices, dried meat, etc.
- RoHS: Electronic parts, glass, etc.



3-Type Rotor



Sieve cassette





Mini Cutting Mill
PULVERISETTE 29

Table-top Cutting mill

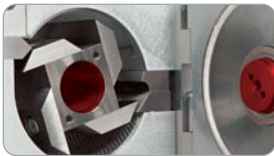
Grinding principle	Cutting
Max. feed size	up to 13 mm dia.
Sieve inserts	0.25 ~ 6 mm
Max. throughput	up to 100 ml
Feeding	Batch / continuous
Material of cutting tool	Hardened stainless steel
Rotor speed	500 ~ 6,000 rpm
Dimensions (w x d x h)	370 x 300 x 300 mm
Weight	15 kg



Cutting Mill
PULVERISETTE 15

General cutting mill

Grinding principle	Cutting
Max. feed size	40 x 70 mm
Sieve inserts	0.25 ~ 6 mm
Max. throughput	50 l / h
Feeding	Batch / continuous
Material of cutting tool	Tool steel, chromium-free
Rotor speed	2,800 , 3,400 rpm
Rotor peripheral speed	14.92 m/s, 17.9 m/s
Dimensions (w x d x h)	420 x 480 x 690 mm
Weight	42 kg



Universal Cutting Mill
PULVERISETTE 19

Fast effective comminution

Grinding principle	Cutting
Max. feed size	40 x 80 mm
Sieve inserts	0.2 ~ 6 mm
Max. throughput	60 l / h
Feeding	Batch / continuous
Material of cutting tool	Steel, T.C., chromium-free
Rotor speed	300 ~ 3,000 rpm
Rotor peripheral speed	1.57 ~ 15.7 m/s
Dimensions (w x d x h)	400 x 790 x 560 mm
Weight	60 kg



Power Cutting Mill
PULVERISETTE 19 L

Powerful pre-crushing for large sample

Grinding principle	Cutting
Max. feed size	120 x 85 mm
Sieve inserts	1 ~ 10 mm
Max. throughput	85 l / h
Feeding	Batch / continuous
Material of cutting tool	Steel, T.C., chromium-free
Rotor speed	300 ~ 3,000 rpm
Rotor peripheral speed	1.57 ~ 15.7 m/s
Dimensions (w x d x h)	450 x 650 x 630 mm
Weight	88 kg



Jaw Crusher

조크러서

Feature

- 2개의 Jaw 의 pressure를 이용한 분쇄
- 2개의 Jaw: Fixed Jaw, Movable Jaw 로 구성
- Jaw 사이의 Gap를 조절하여 샘플 입도조절
- 주먹만한 크기를 콩알크기 수준으로 분쇄 (1~15 mm)
- Max. feeding size: 95 mm
Tempered steel, Stainless steel, Cr-free steel, Manganese steel, Tungsten carbide, Zirconium oxide
- 다양한 재질의 Jaw 선택 가능
- Disk mill 과 연결하여 연속 공정 가능
- Easy cleaning and assembly

2개 Jaw의 Pressure를 이용한 분쇄



Application

- 암석 및 토양: Clinker, quartz, concrete, etc.
- 광업: Slag, coke, coal, vanadium, ores, etc.
- Geology: Granite, silicate, other rocks, etc.
- Ceramic: Sintered ceramic, Dental ceramic, glass, etc.



Jaw Crusher

PULVERISETTE 1

주먹크기의 샘플을 콩알크기로 분쇄하는 조분쇄용

Grinding principle	Pressure
Max. feed size	95 mm
Final fineness	1 ~ 15 mm
Jaw size (w x d)	100 x 260 mm
Min. sample quantity	20 ml
Max. throughput	200 kg/h
Feeding	Batch / continuous
Grinding parts	Fixed & movable jaws
Eccentric oscillations	308 movements / min
Dimensions (w x d x h)	400 x 800 x 800 mm
Weight	205 kg



Disk Mill

디스크 밀

Feature

- 2개의 Disk 사이에서 발생하는 shearing 이용한 분쇄
- 2개의 Disk: Fixed disk, Movable disk 로 구성
- Disk 사이의 Gap를 조절하여 샘플 입도조절
- 콩알크기를 설탕크기 수준으로 분쇄 (0.1 ~ 1 mm)
- Max. feed size: 20 mm
Hardened cast steel, Manganese steel, Tungsten carbide, Zirconium oxide
- Jaw crusher와 연결하여 연속 공정 가능
- Easy cleaning and assembly

2개 Disk 사이에 발생하는 shearing 이용한 분쇄



Disk Mill

PULVERISETTE 13

콩알크기의 샘플을 설탕크기 수준으로 분쇄

Grinding principle	Shearing
Max. feed size	20 mm
Final fineness	0.1 ~ 12 mm
Disk diameter	200 mm
Min. sample quantity	20 ~ 30 ml
Max. throughput	150 kg/h
Feeding	Batch / continuous
Grinding parts	Fixed & movable disks
Rotating speed of disk	440 rpm
Dimensions (w x d x h)	440 x 870 x 400 mm
Weight	140 kg



Application

- 암석 및 토양: Clinker, quartz, concrete, etc.
- 광업: Slag, coke, coal, vanadium, ores, etc.
- Geology: Granite, silicate, other rocks, etc.
- Ceramic: Sintered ceramic, Dental ceramic, glass, etc.



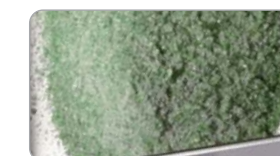
Stone 분쇄 전



Stone 분쇄 후



Glass bottle 분쇄 전



Glass bottle 분쇄 후



Cup Mill [Disk mill, Shutter, Ring mill]

컵 밀

Feature

- Grinding element (링, 펌)을 이용한 분쇄
- 링과 펌의 원형 수평진동에 의한 impact, 마찰력, 압력을 이용
- 12 mm 이내의 샘플을 20 um 이하로 분쇄
- 50 ml, 100 ml, 250 ml 처리
- Max. feeding size: 12 mm
- 다양한 재질의 Grinding element 선택 가능
Tempered steel, Tungsten carbide, Agate, Zirconium oxide
- Easy cleaning and assembly

링과 펌의 원형 수평진동에 의한 분쇄



Cup Mill

PULVERISETTE 9

12 mm 크기의 샘플을 20 um 이하로 분쇄할 수 있는 장비

Grinding principle	Impact
Max. feed size	12 mm
Final fineness	10 ~ 20 um
Min. sample quantity	10 ~ 20 ml
Max. sample quantity	250 ml
Feeding	Batch
Grinding parts	Grinding puck with ring
Motor speed	1,100 rpm, 1,300 rpm
Useful capacity	50, 100, 250 ml
Dimensions (w x d x h)	720 x 660 x 1,200 mm
Weight	250 kg



Application

- Mining: Coal, ores, minerals, etc.
- Metallurgy: Slag, cast iron sample, etc.
- Agriculture & environment: Soil, sludge, etc.
- Analysis: XRF, etc.

Grinding element fixing



- 정확한 위치에 장착될 수 있도록 설계
- 슬라이딩 구조라서 입구에 vessel을 놓고 밀어서 중심까지 이동



- 신속하고 안전한 Clamping이 될 수 있는 구조



- 정확한 장착이 되었는지 자동으로 인지
- 실험자가 안전하게 실험할 수 있도록 설계



Hand Mortar Grinder

절구

Feature

- 주먹크기의 샘플을 설탕크기 수준으로 조분쇄
- Ball mill 장비의 전처리 조분쇄용 분쇄장비로 사용
- 소량 샘플 처리시 용이
- 분석용 샘플 분쇄시 용이
- Jaw crusher, Disk mill 대용으로 사용가능
- 다양한 재질 구성
Tungsten carbide, Zirconium oxide, Steel
- 완전분리형 구조라서 세척 용이



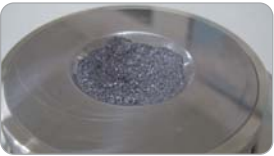
Silica 분쇄 전



Silica 분쇄 후



Metal silicon 분쇄 전



Metal silicon 분쇄 후

	Mortar	Mold-I	Mold-II
Outer diameter	170 mm	140 mm	190 mm
Inner diameter	120 mm	50 mm	120 mm
Height	170 mm	135 mm	190 mm
Depth	50 mm	8 mm	50 mm
Max. feed size	100 mm	30 mm	100 mm
Final size	1 ~ 5 mm	1 ~ 5 mm	1 ~ 5 mm
Pestle size	300 mm, 1.6 kg	200 mm, 1.4 kg	300 mm, 1.6 kg
Type	일체형	분리형	분리형
Weight	20 kg	8.5 kg	23 kg
Use with	P9	P23	P9

Cross Beater Mill

비터 밀

Feature

- Chamber 내부에서 고속회전하는 Beater와 샘플간의 impact에 의한 milling
- Cross beater와 Grinding insert 사이에서 샘플 milling
- Grinding insert 재질: Cast iron, Stainless steel
- 하부에 있는 Bottom sieve에 의해서 샘플 입도 조절
최소 100 um 수준까지 분쇄 가능
- Mohs hardness 6 정도의 샘플까지 분쇄 가능
- Max. feeding size: 20 mm
- 연속 처리 가능: 최대 80 L / h
- 다양한 크기의 Sieve insert를 통한 입도 조절
0.12 mm, 0.2 mm, 0.25 mm, 0.5 mm, 1 mm, 1.5 mm
2 mm, 3 mm, 4 mm, 5 mm, 6 mm, 8 mm, 10 mm

Application

- Agriculture and forestry: Grain, peat, seeds, dried plants
- Geology: Salts, gypsum, potash, stons, soil, limestone, etc
- Mining: Coal, coke, ores, minerals, slate, slag, etc.
- Plastics and textiles: Resins, cellulose, etc.
- Ceramics: Oxide ceramics



Stones



Soil

Grinding insert & Impact plate

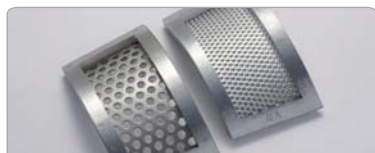


Cross Beater Mill

PULVERISETTE 16

Coal, coke, lime, slate 등의 샘플에 최적인 Beater mill

Grinding principle	Impact
Max. feed size	20 mm
Min. sample quantity	30 ~ 40 ml
Max. throughput	80 L / h
Sieve insert	0.12 ~ 10 mm
Feeding	Batchwise / continuous
Grinding part	Cross beater
Materials of grinding parts	Cast iron, Stainless steel
Motor speed	2,850 rpm
Dimensions (w x d x h)	420 x 450 x 560 mm
Weight	38 kg



Knife Mill

나이프 밀

Feature

- 128 mm knife를 이용한 고속 분쇄
- 건식 및 습식 모두 가능
- Grinding vessel: PC vessel, Stainless steel 316L
- Vario-Lid system을 이용한 volume 조절
- 살균 및 멸균 가능: Autoclavable
- Liquid nitrogen을 이용한 동결분쇄
- 열에 의해서 변형되는 샘플 분쇄시 최적

Vario-Lid System



Sample volume control

Knife Mill

PULVERISETTE 11

Ideal for the smallest quantity

Grinding principle	Cutting
Variable speed	2,000 ~ 10,000 rpm
Max. sample volume	1,400 ml
Max. feed size	40 mm
Final fineness	300 um
Knife diameter	128 mm
Cryogenic milling	Liquid nitrogen
Dimensions (w x d x h)	320 x 430 x 480 mm
Weight	17.6 kg



Application

- 식품: Fish, meat, ham, vegetable, potato, cheese, grain seed, nut, chocolate, bread, etc.
- Animal food: Feed pellet, dog food, etc.
- 제약: Tablet, granuals, 제약원료, etc.
- 바이오: Plant, leaves, freeze-dried samples, etc



Cookies



Tablet

3-Type of Knife



Sieve Shaker

체 진동기

Feature

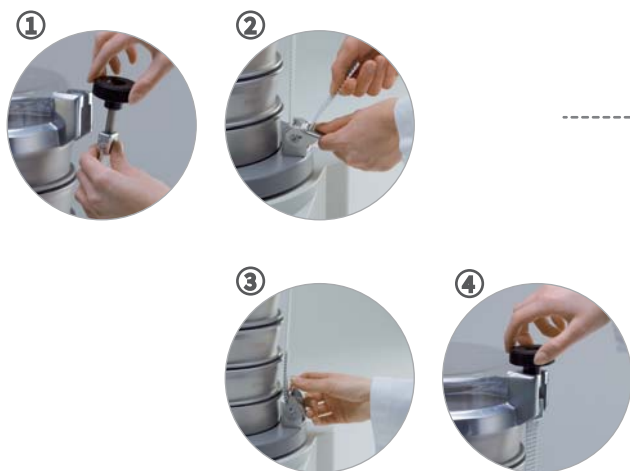
- 상하 진동에 의한 Sieveing
- 전자석 방식을 이용한 진동으로 안정적.
- 건식, 습식 모두 가능 (Analysette3 PRO)
- 다양한 크기의 Sieve 장착
 - 75 mm, 100 mm, 203 mm (Analysette3 PRO)
 - 200 mm ~ 450 mm (Analysette18)
- 국산 Sieve 장착 가능 : 75 mm, 203 mm
- 최대 10개 까지 Sieve 장착 가능 (Analysette3 PRO)
- 장비 자체를 분쇄기로 사용 가능 (Analysette3 PRO)
- Pulse 기능: pause 시간을 설정하여 가벼운 샘플처리시 용이
- Micro sieve 장착: 20 um 이하 sieve (5, 10, 15, 20 um, · ·)
- ISO 9001 Quality management

Analysette 3 PRO 의 분쇄기능

- 액세서리 구성을 추가하여 분쇄기로 사용
- Vibratory Micro Mill (Pulverisette 0) 모델로 전환
- 최대 10 ml 분쇄 가능
- 다양한 재질의 Grinding bowl 선택가능



간단한 Sieve 장착 및 안전한 Stacking



주요 기능



- 프로그램 저장 기능: 실험조건을 9개 까지 저장
- Pulse 기능: pause 기능으로 가벼운 샘플 처리 시 용이
- 시간조절
- Amplitude 조절: 0.1 ~ 3 mm 사이로 조절
- Micro sieving 기능: 20 um 이하 sieve 사용시 적용



Vibratory Sieve Shaker

ANALYSETTE 3 PRO

Precise sieving with automatic amplitude control

Sieving principle	Vibrating
Dry sieving	20 um ~ 63 mm
Wet sieving	20 um ~ 10 mm
Micro-sieving	5 um ~ 100 um
Max. weight of sieve stack	3 kg
Amplitude	0.1 ~ 3 mm
Amplitude control	automatic
Sieve diameter	75 mm, 100 mm, 203 mm
Max. number of sieve	10 (50 mm ht.), 16 (25 mm ht.)
Dimensions (w x d x h)	370 x 400 x 200 mm
Weight	21 kg



Heavy Duty Analytical Sieve Shaker

ANALYSETTE 18

Effective sieving of large quantity

Sieving principle	Vibrating
Dry sieving	20 um ~ 125 mm
Max.weight of sieve stack	42 kg
Amplitude	0.1 ~ 2 mm
Amplitude control	Automatic
Sieve diameter	200, 250, 300, 315, 350, 400, 450 mm
Max. number of sieve	12 (65 mm height)
Max. height of sieve stack	845 mm
Dimensions (w x d x h)	580 x 590 x 1,300 mm
Weight	135 kg



Particle Size Analyzer

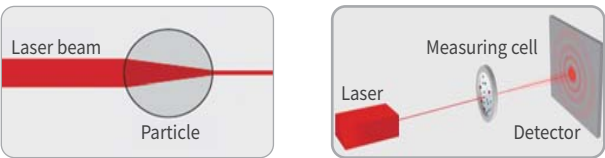
입도분석기

Feature

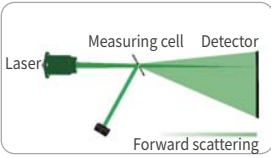
- 레이저회절법을 이용한 입도측정
- 입도측정범위: Micro 0.5 ~ 1,500 um
Nano 0.01 ~ 3,800 um
- Fraunhofer diffraction or Mie scattering
- Green laser를 이용하여 입도분석
- Wider scattering angle range
- Wet: Sample vol. 150~500 ml
Ultrasonic suspension 50 wat
- Automatic dispersion, measurement
Analysis, rinsing, reporting
- 구성: Measuring unit, Wet dispersion unit,
Ultrasonic box
- All method SOP control

Principle

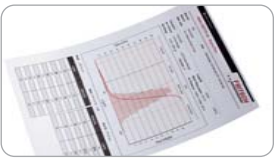
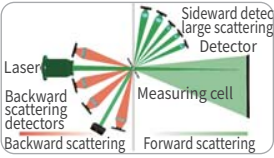
Laser diffraction method (레이저회절법)



Measurement design
ANALYSETTE 22 NeXT Micro



Measurement design
ANALYSETTE 22 NeXT Nano



Particle Size Analyser

ANALYSETTE 22 NeXT Micro and Nano

레이저 회절법을 이용한 입도분석

Measuring range	Micro: 0.5 ~ 1500 um, Nano: 0.01 ~ 3800 um
Method of analysis	Laser light scattering
Theory	Fraunhofer, Mie
Standard	ISO 13320
Laser	Green (532nm)
Detector	Semi-conductor
Large angle detector	Micro: No Nano: Yes
Backward scattering	Micro: No Nano: Yes
Dimensions (w x d x h)	666 x 319 x 294 mm
Weight	25 kg
System	Window10, 4GB RAM



Image Sizer

이미지입도분석기

Feature

- 고해상도 렌즈를 이용한 파우더의 모양 및 입도 분석
- 입도측정범위: Dry 20 um ~ 20 mm
Wet 5 um ~ 3 mm
- 5 megapixel CMOS 카메라 이용
: 2,448 x 2,050 pixel resolution
- High-performance camera with telecentric lenses
- Powder, solid, suspension, emulsion 모두 측정
- 측정시간: 5 분 이내
- 이미지를 최대 75 images/ s 찍을 수 있음
- Automatic analysis
: ImageSizing-Software ISS, SOP control

Principle

Telecentric lenses 로 구성된 고해상도 카메라



Image Analysis of Particle shape and size

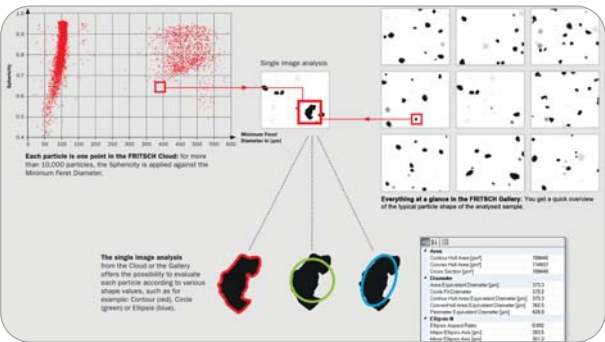


Image Sizer

ANALYSETTE 28

고해상도 렌즈를 이용한 파우더의 모양 및 입도분석

Measuring range	Dry : 20 um ~ 20 mm, Wet : 5 um ~ 3 mm
Method of analysis	Dynamic image analysis
Type of analysis	Dry : powder, solid Wet : suspension, emulsion
Measurement values	Particle shape and size
Standard	ISO 13322-2
Camera	5 megapixel CMOS camera 2,448 x 2,050 pixel resolution
Sample quantity	Dry: 10 ~ 100 g, Wet: 0.1 ~ 1 g
Measuring speed	Max. 75 images / s
Dimensions (w x d x h)	900 x 300 x 550 mm
Weight	Dry: 36.8 kg, Wet: 58.8 kg
System	Window10, 16GB RAM





Sample Divider

LABORETTE 27

Rotary cone sample divider

- Rotation speed를 이용하여 샘플을 일정한 양으로 분주
- 99.9% 의 분주 정확성
- Rotation speed: 100 rpm
- 8, 10, 30 channel 선택 가능
- 최소 25 ml bottle 부터 500 ml bottle 까지 장착가능
- 몇 ml 부터 최대 4,000 ml 까지 가능
- Head 재질: POM plastic or aluminium

			
Division ratio	1 : 8	1 : 10	1 : 30
Number	8	10	30
Max. feed size	10 mm	10 mm	2.5 mm
Max. quantity	4,000 ml	2,500 ml	300 ml
Useful bottle	25, 250, 500ml	25, 250ml	15, 20, 30ml
Division	Dry/wet	Dry/wet	Dry/wet

Vibratory Sample Feeder

LABORETTE 24

Reliable automatic feeding

- Vibration을 이용한 파우더 샘플 feeding
- Stainless steel 재질의 funnel
- V-shaped feeder channel
1 g ~ 1,500 g / min feeding
- U-shaped feeder channel
5 g ~ 2,500 g / min feeding
- 결합, 분리, 세척이 용이한 구조
- Compact한 구조
- Stand를 이용한 장비 높이 조절



Laboratory for Sample Test

샘플 테스트 실험실 운영

- 샘플 분쇄, 파쇄를 위한 테스트 실험실 운영
- Ball mill, Cutting mill, Disk mill 등 다양한 분쇄 장비 보유
- 분쇄완료된 샘플에 대한 입도분석
- **샘플 분쇄부터 입도분석까지 One-Step 서비스**
- 샘플 테스트 통해서 최적의 분쇄장비 선정에 도움을 드립니다.



High-energy ball mill



Pulverisette5P

Vibratory ball mill



Pulverisette23

Rotor mill



Pulverisette14

Jaw crusher



Pulverisette1



Pulverisette7P



Pulverisette0



Pulverisette11



Pulverisette13



Pulverisette5



Pulverisette19



Pulverisette9



Analysette22 NeXT



Pulverisette6



Pulverisette29



Analysette3 pro



Analysette28

About FRITSCH



1920

Company founded as a technical precious stones dealer

Since **100 years**

Specialist for Milling & Grinding



주식회사 엠제이리서치

MJ Research Co., Ltd.

Tel. 032-818-5368

Fax. 032-818-5369

E-mail. mjr@mj-research.co.kr

Homepage. www.mjr.co.kr | www.mj-research.co.kr

Address. 인천광역시 연수구 송도과학로56 송도테크노파크 BT센터 1108호



홈페이지 바로가기