STANDARD OPERATING PROCEDURE

Mill, Ultra-Centrifugal

Model: ZM-1
Manufacturer: Retsch GmbH & Co. KG
Location: Dry Processing Pilot Plant, 1851 Food Sciences Building
Publication Date: 08/29/2014
Description and Uses

The Retsch/Brinkmann Centrifugal Grinding Mill (Model ZM-1) is a very versatile grinder available for laboratory use. The mill is ideal for small batches of material (from 3 grams up to 100 grams). It quickly grinds almost any dry sample to a final particle size of 40 microns. Key features include a powerful, dual-speed motor with a speed-selector switch that allows the operator to adjust the speed at either 10,000 or 15,000 rpm, a 60-minute timer, and an amperage meter. It has an easy access for sample recovery and cleaning, as well as a wide selection of rotors and ring sieves. It also has a micro-switch that prevents operation while the lid is open. Materials which can be ground include animal feeds, chemicals, coal, cocoa beans, coffee, corn, cotton seeds, fertilizers, food, pharmaceuticals, plant stems, polyester, polypropylene, soybeans, spices, and many other materials. Temperature-sensitive products or very wet samples are not a problem. If the product cannot be ground due to melting from frictional heat, or is simply too wet or malleable, it can be ground cryogenically after freeze-drying or treatment with dry ice or liquid nitrogen. Larger sample volumes can be ground using the optional vibratory feeder and “cyclone” collection chamber accessories.

Power Specifications

<table>
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<th>Mill</th>
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<tbody>
<tr>
<td>Motor: Model ZM-1, AC</td>
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<tr>
<td>Power: 400W @ 10,000 rpm; 600W @ 15,000 rpm</td>
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<tr>
<td>Voltage/Frequency: 110V/50-60 Hz</td>
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<td>Speed Selection: By switch, 10,000 or 15,000 rpm</td>
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<tr>
<th>Vibratory Feeder</th>
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<td>Model: Model DR15/40</td>
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<tr>
<td>Power: 12W with alternating electromagnetic power</td>
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<tr>
<td>Voltage/Frequency: 110V/60 Hz (Single-Phase)</td>
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<td>Oscillation: Adjustable intensity from 0-100 by potentiometer</td>
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<td>Timer: 0 to 60 min, or continuous operation</td>
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Potential Hazards and Safety Precautions

Standard Voltage/Possible Electric Shock (110-V)
• Make certain to use the correct outlet that is specifically designed to fit the electrical cord plug.
• Make sure the area around the outlet, floor and your hands are completely dry when plugging or unplugging the electrical cord to/from the outlet.

Sharp, Rotating Cutting Blades/Abrasions, Cuts, or Severed Body Parts
• Do not insert hands, fingers or other body parts into the hopper (funnel) or the feed inlet while the mill is in operation.
• The blades are sharp! Use extra caution when cleaning the interior of the mill or changing/adjusting cutting blades.

Mechanical Pinch Points/Possible Entanglement of Extremities, Hair, Jewelry or Clothing
• Do not use any tool to assist product flow through the hopper, as serious injury may result.
• Make sure to secure long hair and any loose clothing or jewelry before operating the mill.
• Nothing, except the material for which the mill is intended to cut, should ever be placed into the hopper or feed inlet while the mill is running.

Flying Debris/Potential Eye Damage
• Do not operate the mill without wearing all required personal protective equipment, including safety goggles.

Required Personal Protective Equipment
Lab Coat
Dust Mask
Safety Goggles
Hair Net (Tie Back Long Hair)
Protective Boots
No Open-toed or Open-heeled Shoes
Long Pants and Sleeves
No Loose Fitting Clothing
Training

**Required Training (*denotes courses offered online)*

- Fire Safety & Extinguisher Training*
- Laboratory Safety: Core Concepts*
- Machine & Site Specific Training

**Recommended Training for Frequent Users (*denotes courses offered online)*

- Electrical Safety & Lockout/Tagout
- Shop Safety Fundamentals: Basic Procedures & Policies*

Operation

**Operation: Mill Preparation**

1. Be sure to wear all Personal Protective Equipment.

2. Do not operate the mill without appropriate training. Be sure to completely familiarize yourself with the *Ultra-Centrifugal Mill Operating Manual* on file in the pilot plant office, 1955 Food Sciences Building. Refer to this manual during operation.

3. The mill must be mounted on a clean and level surface. For grinding batches larger than the capacity of the collection pan, place the mill near the edge of the table, cart or workbench so that the “cyclone” can be affixed along the side of the mill (see Section 7 of the *Ultra-Centrifugal Mill Operating Manual*, on file in the pilot plant office, for the assembly and connection of accessories).

4. The standard stainless-steel rotor with 24 teeth is suitable for most applications. For grinding long-fibered products, use a 6 or 12-toothed rotor so that the fibers will not easily coil around the teeth. All rotor changes must be done with a special box wrench and under the supervision of the pilot plant manager (see Section 6 of the *Ultra-Centrifugal Mill Operating Manual*, on file in the pilot plant office, for the selection and mounting of grinding tools).

5. Install the desired ring sieve (screen) as per your application.

6. Once the selected rotor and ring sieve are installed, secure the lid onto the mill using the two fastening knobs attached to the lid.

**Operation: Preparation of Optional Vibratory Feeder**

1. For a consistent feed rate when grinding larger sample volumes, it is recommended that the optional vibratory feeder be properly assembled and used with the mill.

2. Do not operate the feeder without appropriate training. Be sure to completely familiarize yourself with the *Vibratory Feeders Operating Manual* on file in the pilot plant Office, 1955 Food Sciences Building. Refer to this manual during operation.
3. The apparatus must stand on a level surface; holes are provided in the base plate for securing the instrument to a bench or cart when necessary. When carrying the apparatus, be sure not to lift it by its channel, as this may alter the gap between the fixed and moving magnet poles.

4. Under the supervision of the pilot plant manager, assemble the feeder as shown in Figure 1.

5. Once properly assembled and positioned above the mill’s feed inlet atop the lid, make sure that the electrical requirements of the feeder as shown on the small metal plate on the instrument agree with the available power supply. Then, carefully plug the vibratory feeder into an appropriate outlet that fits the electrical plug. **Note:** Make sure the area around the outlet, floor and your hands are completely dry when plugging or unplugging the electrical cord to/from the outlet.

Figure 1
**Operation: Milling**

1. Make sure that the electrical requirements of the mill as shown on the back plate of the mill agree with the available power supply. Then, safely and carefully plug the mill into an appropriate outlet that fits the electrical plug.

2. The front plate of the mill has the following controls:
   a. Master power switch with a thermic-overload circuit breaker.
   b. Two-stage switch (1 and 2) to adjust the speed of the cutting ring (10,000 or 15,000 rpm, respectively).
   c. Timer dial for continuous operation “I” or for a selected time range from 0 to 60 minutes.
   d. Ammeter to supervise the rated motor current.

3. The GREEN master power switch serves to connect or disconnect the unit from the main power supply. To begin, flip the switch to the ON position. Then, select the cutting speed (10,000 or 15,000 rpm) using the two-stage switch.

4. The timer dial is used to start or stop the mill during grinding. When the timer cuts out the drive motor, an electronic brake will cause the rotor to stop after about 5 seconds. To begin grinding, set the timer to either the continuous “I” position, or for a specified grinding time on the dial. This automatically starts the drive motor.

5. With the motor running, the ammeter shows the mill power input which, in continuous or timed operation, must not exceed the RED ammeter mark.

6. Optimal grinding of materials usually requires a very high relative speed between the mill cutters. Watery products, such as potatoes, tomatoes, cucumbers, etc. can also be ground, but make sure that no water enters the motor shaft bearings.

7. If you chose to use the vibratory feeder, which is recommended for more consistent feeding, begin pouring materials into the funnel (see Figure 1, #33). The timer dial (Figure 1, #4) works as an ON and OFF switch. Turn the dial clockwise into position “I” to make the chute operate continuously. Turn it further to the right and beyond this position to select an operation period between 0 and 60 min. If the timer is set for a specific time period, the chute will stop automatically when this period has elapsed.

8. Use the flow dial (see Figure 1, #3) to regulate the amplitude of the feeder’s electric magnet and thereby, the flow velocity in the chute. **Note:** The scale is graduated between 0 and 100. The higher the setting, the faster the flow rate into the mill.

9. Back off the clamp screw (see Figure 1, #12) to adjust the funnel vertically. This will vary the height of the layer and hence, the quantity of the material to be fed. **Note:** To ensure interruption-free operation of the feeder, the maximum particle size of the material being fed in should not exceed one-third of the diameter of the hopper (funnel) outlet being used. Also, note that the feed inlet funnel in the lid loosely carries an insert member that prevents vortex formation in the funnel and may simply be taken out for grinding coarser materials.

10. Immediately report any operational difficulties to the pilot plant manager.
11. After grinding is complete, turn the timer dials on the mill and vibratory feeder (if used) to the “O” position. This will turn OFF each machine.

12. On the mill’s front panel, flip OFF the GREEN master power switch to disconnect the mill from the main power supply.

13. Safely unplug both the mill and vibratory feeder (if used) from their respective electrical wall outlets. 
   **Note:** Make sure the area around the outlet, floor and your hands are completely dry when plugging or unplugging the electrical cord to/from the outlet.


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### Clean-up Procedures

Please note that these clean-up procedures are for non-transgenic grains or materials only. Transgenic material has a separate, more thorough clean-up procedure, as all transgenic material must be accounted for. For more information, see special standard operating procedures for the handling of transgenic material.

1. Under the guidance of the pilot plant manager, completely disassemble and separate any parts of the mill and vibratory feeder that came into contact with your product.

2. All parts which have been in contact with your product should be thoroughly cleaned with food-grade detergent and water in the wet processing pilot plant, 1091 Food Sciences Building. During cleaning, report any problems to the pilot plant manager.

3. Make sure that the space underneath the rotor is free from contamination. Therefore, removal of the rotor will be necessary to clean the space beneath it. **Note:** The stainless-steel plate underneath the rotor has two annular liquid pockets or traps that must be cleaned without fail after each operation. Do not attempt to remove the rotor or the plate without supervision by the pilot plant manager.

4. The grinding tools (rotors, ring sieves with big apertures) might be cleaned mechanically by means of a brush or cloth and an air hose. If a more thorough cleaning is necessary, use a brush with food-grade detergent and water.

5. Be sure to rinse all washed parts with hot tap water, followed by a distilled water rinse. Allow all parts to dry on a drying rack before reassembly.

6. Before replacing the rotor, lightly wipe the motor shaft with grease to prevent rusting. For safety reasons, the reassembly of all dry parts, including the rotor and stainless-steel plate, requires supervision by the pilot plant manager.

7. Clean the surrounding work area of any debris and discard the debris in an appropriate waste container.

8. Have the cleaned mill, vibratory feeder (if used), and surrounding work area inspected by the pilot plant manager.

Machine Care and Maintenance

• Inspect the machine after every use for any leakage or broken parts. Report any leakage or broken parts directly to the pilot plant manager, 1955 Food Science Building.
• All final inspections are performed by the pilot plant manager.
• Any routine maintenance, such as lubrication of parts, and/or repairs, should be performed by the pilot plant manager or a trained service technician.

Accessories

Accessories for this mill include a vibratory feeder with three different hopper (funnel) attachments, three toothed rotors (6, 12 and 24-toothed rotors), pin-type rotor (for oily products), a variety of ring sieves (each with different pore sizes depending on the application), a securable mill lid with a feed inlet funnel, a collection pan, a “cyclone” collection chamber (for the collection of large-batch products), a filter-bag holder, and a special box wrench that is designed specifically for this mill. For safety purposes, please contact the pilot plant manager to change out any mill parts and/or accessories.