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# **8515 ENCLOSED SHATTERBOX<sup>®</sup>**

# **OPERATING MANUAL**

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## **1.0 INTRODUCTION**

Since its introduction three decades ago, the SPEX CertiPrep Shatterbox has become the most popular “swing mill” in America. Now as then, it remains the most efficient way to pulverize up to 100 ml in volume (or 100 g in weight) of brittle material to analytical fineness. The 8515 has many advanced features, including an electronic timer, a cam-action clamp, a safety-interlocking lid with pneumatic cylinders, and lockable casters.

The Shatterbox swings a dish-shaped grinding container, with a puck and (often) a ring inside, in a tight high-speed circle; the sample is quickly crushed between the wall and floor of the container and the moving puck/ring grinding elements. Smaller grinding containers and those made with ceramics have a puck-shaped grinding element; larger containers add a ring. Most grinding containers are fitted with a gasket to prevent sample loss during grinding.

Since grinding containers are chosen for specific tasks, there is no “standard” Shatterbox grinding container. In general, grinding times average two-to-five minutes, with resultant particle size well below 200 mesh, and in some cases 10 microns. Typical samples include cements, soils, ceramics, slag, rocks, and ores, but the Shatterbox has also ground sulfur pellets, dried marsh-grass, pharmaceuticals, and many other materials. To maximize grinding capability and minimize contamination, grinding containers are available in hardened steel, tungsten carbide, alumina ceramic, and zirconia ceramic. The full range of Shatterbox grinding containers is described in detail in the SPEX Handbook of Sample Preparation and Handling.

The Shatterbox’s advanced design, features:

1. A cam action clamp lever assembly that engages the end of the clamp bar, and holds it down firmly as the lever is pushed into place.
2. A timer with a constant numerical display indicating the programmed time, up to 10 minutes. Push buttons are used to advance the timer or pause the mill.
3. Safety features including a safety lid interlock and gas cylinders for the lid, as well as a sound-insulated steel cabinet and lockable casters with which the mill can be fixed in place.

### **8515-115 Enclosed Shatterbox with Digital Timer & Safety Interlock**

For 115 V/60 Hz operation. Includes cam-activated clamp and electronic timer with digital display, sound attenuating cabinet with lockable casters, and a lid with safety interlock. The unit accepts all Shatterbox grinding containers (not included with mill).

### **8515-230 Enclosed Shatterbox with Digital Timer & Safety Interlock**

For 230 V/50 Hz operation. Same as 8515-115 but with 230 V/50 Hz circuitry and continental European CEE 7/7 two prong plug.

## **2.0 SPECIFICATIONS**

**Type of mill:** grinding mill

**Grinding mechanism:** grinding containers

**Weight** (empty, without vial): 225 lbs. (102 Kg)

**Dimensions:** 19 in (48 cm) x 19 in (48 cm) x 40 in. (102 cm)

**Grinding Vials Available** (see page 17 for more information):

- 8501 Hardened Steel Grinding Container
- 8504 Tungsten Carbide Grinding Container
- 8505 Alumina Ceramic Grinding Container
- 8506 Zirconia Grinding Container
- 8507 Small Hardened Steel Grinding Container
- 8508 Small Tungsten Carbide Grinding Container
- 8521 Large Hardened Steel Grinding Container

*Note: in practice, the sample capacity of any particular vial depends on the properties of the sample, particle-size requirements, and other considerations.*

**Electrical:** available in 115 60Hz (10 amp fuse) or 230V 50Hz (5 amp fuse).

***NOTE: OUR ELECTRONIC CIRCUIT BOARDS ARE NOT USER SERVICEABLE. REPAIRS SHOULD ONLY BE CARRIED OUT BY TRAINED PERSONNEL.***

**Cord:** 115V 60HZ version, 3-prong grounded cord supplied.  
230V 50HZ version, with European CEE 7/7 two-prong plug supplied.

***NOTE: Operator is responsible for supplying alternate line cord/plug if required.***

**Fuses:** 115V 60HZ version, 10-amp slow-blow fuse in inlet module,  
230V 50HZ version, 5-amp slow-blow fuse in inlet module

**Important:** these fuses are "slow-blow" fuses, meant to withstand a temporary voltage peak in excess of the fuse's current rating. (Electric motors of the type used in the Shatterbox draw more amperage than normal while getting up to speed.) Whenever you replace a fuse, remember to unplug the Shatterbox first, and always use a "slow-blow" type fuse.

**Motor:** a 1/3 horsepower dual-winding 825-RPM motor powers The 8515 Shatterbox. The low horsepower rating of the motor is based on its low fixed speed, but the motor has high torque (especially when starting up) and is more powerful than its HP power rating implies.

**Safety Features:** Lid Interlock prevents mill from running if lid is not closed.

### **3.0 UNPACKING**

The 8515 Shatterbox mechanism and its cabinet are shipped assembled, and carefully packed to avoid damage during shipping. Any visible damage to the shipping container should immediately be reported to the carrier. If there is no visible damage, remove all packing documents from the exterior of the box, and after completion of your inspection, file in your records.

Before unpacking the 8515 Shatterbox, place the shipping carton upright and as close as possible to the mills intended location. Open the top of the shipping box. Remove the top and body of the carton. Note that if the tape holding the carton's bottom piece together is slit on one side, that flap can be folded down and the Shatterbox rolled off after unlocking the casters.

A plug-in line cord, an extra set of 51793 drive belts, an extra set of fuses, and a 31688 Friction Disc are included with your new Shatterbox. One Friction Disc (a circle of thin rubber matting) should always be kept in the recess off the capsule container, to cushion the grinding container, reduce the noise of the grinding, and prevent unnecessary and rapid wear of the clamp and capsule retainer.

Move the mill to the location where it is likely to stay, lock the casters, and open the lid. Please note that the Shatterbox should always be installed and operated on a level surface. Check the power switch, which is on the back of the cabinet, next to the electrical inlet (Diagram C Item 50); this switch should be in the off position (the 0 should be pushed in) when the power cord is first attached. Look for any hidden damage that may have occurred during shipping.

Your 8515 Shatterbox comes fully assembled. However, before plugging the Shatterbox in and using the controls for the very first time you should also inspect the drive mechanism to make sure it is properly linked and aligned. Your Shatterbox capsule was tested before shipment, but as there is a flexible coupling between the motor and the capsule retainer there is a chance they were jarred out of alignment during shipping. If you try to run the Shatterbox with the drive mechanism uncoupled or misaligned, you can damage the coupling arms.

Remove the access panel on the back of the case. (Note that in general this panel should not be removed without unplugging the power cord.) Before it was shipped, your Shatterbox was tested and found to be operating properly, but the drive mechanism should still be inspected after shipment. Although the odds are overwhelmingly in favor of the drive mechanism still being properly hooked up and aligned, you should check to be sure. If the Shatterbox is started with the drive linkage disconnected or misaligned, damage can result. Check the arm and belt linkage between the motor and the funnel. The coupling arm is attached to the top of the motor shaft. The eccentric arm is attached to the bottom of the rotating funnel. The two arms should be parallel and unbent, connected by four belts (O-rings) in a diamond pattern that overlaps at the corners (Diagram B, item 28).

**3.0 UNPACKING**

(Cont'd)

If either arm has become bent, straighten it; the arms are made of a soft alloy which can be bent without harming it. Spin the coupling arm by hand; the eccentric arm and the funnel should rotate together freely. The hubs of the coupling arm and the eccentric arm should be between 1/16" and 1/8" apart; if they are not, the coupling arm may have ridden up or down the motor shaft. Correct this by loosening the setscrews holding the coupling arm, and adjusting its position on the motor shaft. When the drive belts are aligned and the hubs of the two arms properly separated, tighten the setscrews (use a 1/8" Allen wrench).

As you re-install the access panel, note the electrical inlet, on/off switch, and the fuse holder on the left side of the access panel opening. The 115V 60HZ Shatterbox takes two 10 amp "slow blow" fuses; the 230V 50 HZ unit takes two 5 amp "Slow Blow" fuses.

Plug the cabinet power cord into an approved electrical outlet: in North America, a 3 prong grounded 115V outlet on a circuit fused at 20 amps. The 230V/50HZ Shatterbox is equipped with a standard European 2 prong plug that in some countries may have to be replaced to suit local electrical codes. The 230V power cord conforms to European wiring color codes.

If everything seems to be okay, proceed to the next section "SETTING UP."



**8515D Shatterbox**

(Figure 2)

#### **4.0 SETTING UP**

After the initial unpacking and setup of the Shatterbox, you are ready to prepare the unit for actual use. The Shatterbox consists of our world-renowned Model #8500 Shatterbox unit and the Model #8511 Sound Attenuating Cabinet.

As you begin to setup the Shatterbox for grinding your samples, decide which Grinding Container will be the one that you will need to use. The sample is placed in a container with a puck (and sometimes a ring); the container is swung in a tight circle while the puck (and ring) crush the sample against the bottom and wall of the container. Most of the Shatterbox containers have an O-ring or gasket that prevents leakage during grinding. Grinding containers are available in several sizes and in a range of materials to minimize objectionable contamination: hardened steel (Cat. Nos. 8501, 8507, and 8521), tungsten carbide (Cat Nos. 8504, 8508), alumina ceramic (Cat. No. 8505), and zirconia ceramic (Cat No. 8506). See page 17 for more information

Before actually operating your new 8515 Shatterbox, it is important that you become familiar with its special features. This section explains in detail how each part of the Shatterbox works. Directions for operation (minus these detailed descriptions) are given in “Operations.” There are two important conditions of operation, which bear repeating:

- 1. ALWAYS UNPLUG THE MILL BEFORE OPENING THE ACCESS PANEL ON THE BACK OF THE CABINET***
- 2. ALWAYS HAVE A CONTAINER CLAMPED IN PLACE WHEN RUNNING THE SHATTERBOX.***

While familiarizing yourself with the operation of the Shatterbox you may wish to clamp in place a grinding container without its puck/ring.

#### ***4.1 Locking Casters***

The front two casters swivel, and can be locked and unlocked with the foot. Each front caster has a downward sloping pedal with a small tab projecting up. To lock the casters, press the pedal down. To unlock the casters, push the tab on the caster pedal back. To move the 8515 Shatterbox easily, unlock the casters; to keep it in place, lock them. Always lock the casters before operating the Shatterbox.

#### ***4.2 Pneumatic Cylinders***

There is one on either side of the lid, to hold it firmly in the open or closed positions. Open and close the lid several times to get the “feel” of lowering the lid gently. Keep fingers and objects off the rim of the Shatterbox cabinet when lowering the lid, as the pneumatic cylinders will not slow its descent during the last few inches.

## **4.0 SETTING UP**

(Cont'd)

### ***4.3 Safety Interlock***

The 8515 Shatterbox is designed so the lid cannot be lifted while the capsule retainer is moving. When the start button is pushed, it does not immediately turn on the motor, but activates a solenoid that locks down the lid. The operation of this solenoid can be heard as a click. Not until the lid locks down will the Shatterbox motor start.

If the safety interlock cannot engage, the mill will not start, and the word "Lid" will blink on and off in the timer display. When the problem has been corrected and the Interlock can engage, the word "Lid" will continue to flash until the pause/stop button is pushed. Only when the timer setting reappears in the display can the Shatterbox be started.

The only exposed part of the Safety Interlock is a U-shaped metal latch which projects from the inside lip of the lid and can be seen only when the lid is lifted. Please do not treat this as a hook, and bend it or hangs things on it. If this part of the interlock is damaged and cannot close properly, the Shatterbox will not start.

***NOTE: Never try to force open the lid before the Time-Delay Latch unlocks.***

### ***4.4 Cam-Action Clamp***

The cam-action of the clamp makes it possible to hold any SPEX Shatterbox grinding container firmly in place without applying excessive pressure to the lever. The clamp can also be adjusted easily for containers of different heights, or to compensate for wear. The different parts of the clamp are illustrated in Diagram A.

To use the clamp, first swing the clamp arm to the left side of the cabinet and the clamp lever to the right. Then place a grinding container squarely in the recess of the capsule retainer. (If the container is not firmly seated, it can work itself loose during grinding.) The use of a 31688 Friction Disc in the capsule retainer recess, under the grinding container, is recommended at all times; it lessens noise, aids the gripping action of the clamp, and prevents rapid wear of the capsule retainer.

When the grinding container is in place, swing the clamp arm to the right, so the guide fits over the boss (raised protuberance) in the center of the container lid. Then bring up the clamp lever so that the open gate at its base fits over the end clamp arm; the roller in the clamp lever assembly should rest in the curved recess of the clamp arm. Swing the clamp lever over to the left.

## **4.0 SETTING UP**

(Cont'd)

If the lever is perfectly adjusted, it will meet moderate resistance as it is pushed through the top of its arc, then close easily. With the clamp lever pushed all the way to the left, the clamp should hold the grinding container firmly.

If the guide is set too loose, the lever will meet little or no resistance, and the grinding container can be rotated in place; disengage the lever and tighten the guide. If the guide is set too tight, the lever will meet strong resistance as it approaches the vertical; do not force the lever, but disengage it and loosen the guide.

The guide may be tightened or loosened by screwing it away from, or toward the clamp arm. First disengage the locking pin by pushing its flange toward the spring. Then screw the guide away from the clamp arm to tighten it, or toward the clamp to loosen it. Test the fit by closing the clamp. When the clamp is adjusted, make sure the locking pin is engaged.

## **4.5 Control Panel**

### **4.5.1 The Main Power Switch** (Diagram C, Item 49)

This is the rocker switch on the back of the cabinet, next to the electrical inlet. It controls the flow of current to the controls and motor. When you press this switch to the on position (I) the timer display will light up. The timer can now be programmed. Pressing this switch to the off position (0) will switch off power to the mill.

### **4.5.2 The Emergency Stop Switch** (Diagram C, Item 46)

This is the rocker switch on the right hand side of the front of the lid. It is a “Kill Switch” which if turned off (0) will stop the mill quickly in an emergency, but otherwise should be left on. It must be in the on position (I) for electrical current to reach the motor.

***NOTE: If the Emergency-Stop Switch is in the off position (0 pressed in) the timer will function and count down, but the motor will not start. If the timer is running and the Shatterbox is not, check this switch!***

**4.5.3 The Electronic Timer** - The timer includes a minutes: seconds numerical display, a start button, a stop/pause button, and two buttons to change the timer setting. The display indicates the set grinding time when the mill is not running, and counts down the time remaining when the mill is running. The time is displayed in minutes and seconds, e.g., 1:30 = one minute and thirty seconds. The faceplate of the timer may be covered with a transparent sheet of plastic to protect it during shipping; if so, peel it off.

***NOTE: Before setting the timer and operating the 8515 Shatterbox, clamp a grinding container firmly in place. Also, while learning how to operate the Shatterbox you may want to use a grinding container with its puck/ring grinding elements removed.***

## **4.0 SETTING UP**

(Cont'd)

### **4.5.3.1 Setting the Timer**

When power is switched on, the timer will first display 88 : 88 (a "display test" lasting several seconds) and then its default setting of 1:00 (one minute). Set the grinding time using the two buttons beneath the timer display; the right-hand button is pushed to advance the seconds, and the left-hand button is pushed to advance the minutes. If a button is pushed and immediately released, it will advance its respective setting by one unit. If a button is held down, the setting will advance rapidly. The maximum setting for the timer is nine minutes and fifty-nine seconds (9:59). At this setting, pushing the minutes button once will reset the timer to 0:59; pushing the seconds button once will reset the timer to 9:00.

### **4.5.4 Starting and Running the Shatterbox**

Push the start button to begin a grinding cycle. There will be a short pause while the lid interlock engages, and then the Shatterbox motor will start. While the mill runs, the timer display will count down the minutes and seconds left in the grinding cycle. When the timer reaches zero and the motor shuts off, the lid will remain locked for several seconds while the capsule retainer mechanism slows down and stops. When the interlock releases the lid (with an audible click), the timer display will return to its current full setting.

***NOTE: Do not try to open the lid before the interlock releases.***

### **4.5.5 Using the Stop/Pause Button**

To interrupt/pause a grinding cycle, push the stop/pause button once. This will stop the mechanism and halt the timer. The lid will stay locked for 10 seconds to allow the capsule retainer to stop moving. During this pause the timer will display (in flashing mode) the time remaining in the grinding cycle.

When the stop/pause button is pushed, there is a 10-second delay before the motor can be re-started. If you push the start button during this 10-second delay, motor operation will begin again at the end of the 10-second delay period. During this 10-second delay the lid will remain locked. During a pause, the time remaining in the grinding cycle will be displayed in blinking mode. To override the pause and complete the grinding cycle, push the start button. To abort a grinding cycle after pausing, push the stop/pause button again; the lid will unlock and the most recently entered timer setting will be displayed.

### **4.5.6 Timer/Lid Interlock**

The timer is connected to the safety interlock. If the Shatterbox lid cannot be locked down when the start button is pushed, the motor will not start and the word LID will appear, blinking on and off, in the timer display. If this happens, correct the interlock fault, then press the stop button to clear LID from the timer display. Only when the timer setting is restored can the Shatterbox be started again.

## **5.0 OPERATION**

The following sequence is typical (it supposes familiarity with the chief features of the Shatterbox, as described in “**Setup**”):

### **NOTE**

- a. NEVER OPERATE THE SHATTERBOX WITHOUT A GRINDING CONTAINER AND FRICTION DISC CLAMPED FIRMLY IN PLACE.**

*(If you need to run the Shatterbox without grinding a sample, remove the grinding element(s) from the container).*

- b. NEVER REMOVE THE ACCESS PANEL IN THE BACK OF THE CABINET UNLESS THE MILL IS FIRST UNPLUGGED.**

1. Switch the power on. The timer display will light up. Initially it will read 88:88 as a "display test," but this will shortly change to the default setting of 1:00.

2. Program the timer, using the buttons immediately below the numerical display. The left-hand button controls the minutes, and the right-hand button controls the seconds.

3. Load the grinding container with sample. If you want to run the Shatterbox without grinding anything, remove the grinding element(s) from the container. Clamp the container into the capsule retainer. Make sure that the Friction Disc is properly placed and the grinding container is firmly seated. If the clamp is properly adjusted, the clamp lever should work smoothly with some resistance at the top of its arc, but you should not be able to rotate the container in place once the clamp lever is down. If the clamp is too tight or too loose, adjust it.

4. Shut the lid, and press the start button. There will be a brief pause while the lid locks down, and then the Shatterbox motor will start. If the Shatterbox does not start when the start button is pressed, check the timer display. If the timer is counting down normally but the Shatterbox is not running, the Emergency Stop Switch is in the off position. Press the Pause/Stop button twice to reset the timer, and then turn the stop switch on. If the word LID appears instead of numerals, the interlock has not properly engaged. Correct this situation and clear the timer by pressing the stop button. Again after the lid is properly closed, push the start button. As it runs, the timer display will count down the minutes and seconds remaining. When the Shatterbox reaches the end of its timed grinding period, the motor will shut off and the mechanism will continue to oscillate for a few seconds. During this brief period the lid will remain locked. Open the lid after it unlocks; do not try to force it open prematurely. Unclamp the grinding container and remove it for emptying and cleaning.

## **5.1 GRINDING CONTAINERS**

(Selection and Use)

There are at present ten different Shatterbox grinding containers in five different materials and four sizes; while each of the ten has a puck-shaped grinding element or a puck and ring, each has different requirements for sample size and/or grinding time. Consequently the following instructions are general in nature.

### ***5.1.1 Choice of Grinding-Container Material***

Every grinding-container material has its benefits and drawbacks. Some will contaminate a sample fairly heavily, others lightly; some will grind a sample more rapidly than others, while some are more prone to breakage; and there are cost considerations. Detailed advice on choosing the proper grinding container can be found in the Handbook of Sample Preparation and Handling.

Often the prime consideration in choosing the container material is whether it will contaminate the sample with elements being looked for in the analysis. Thus steel mills looking for iron in slag will choose tungsten carbide over steel, while a geochemist doing trace-element determinations in igneous rocks might avoid both zirconia ceramic for its major Zr and Hf, and tungsten carbide for the small amounts of Ti, Ta, and Nb present.

Performance is also important: the denser the grinding-container material, the more rapid the grinding. Tungsten carbide is the densest, followed by steel, zirconia ceramic, and alumina ceramic. Of these, steel is the most prone to wear if the samples are hard; however, it is the only material of the four warranted against breakage. The following summary of properties may be helpful:

***Steel:*** is extraordinarily durable and relatively inexpensive, but subject to unusual wear when used to grind hard materials (quartz and feldspar, glasses and slag). Grinds rapidly but tends to contaminate. Major element: Fe. Minor elements: Cr, C, Mn, and Si.

***Tungsten Carbide:*** grinds very rapidly and wears well, but is subject to occasional breakage. It is harder than most samples other than the hardest refractories, but contaminates moderately. Major elements: W, C, Co. Minor elements: Ta, Ti, and Nb.

***Zirconia Ceramic:*** is harder than steel and most slag and mineral samples, but is neither as heavy nor as hard as tungsten carbide. Grinds fairly rapidly with low contamination levels, and almost never breaks. Major elements: Zr. Minor elements: Hf, Mg.

***Alumina Ceramic:*** is harder than tungsten carbide, but is comparatively lightweight. It grinds fairly slowly with low contamination levels and is subject to fracture. Major elements: Al. Minor elements: Si, Mg, and Ca.

## **5.1 GRINDING CONTAINERS**

(Selection and Use)

### ***5.1.2 Choice of Grinding-Container Size***

There are four sizes of Shatterbox grinding container: small, medium, large, and extra large. To pick the correct size it is necessary to know the minimum amount of sample you have to grind, its approximate density, and the fineness of grind desired, as each may affect your final choice. The typical sample capacities of each container type are given below in grams, assuming a sample of the density of quartz sand, rock, etc. (approx. 2 to 3-1/2) and the requirement to pulverize the sample to around 325 mesh (44 microns). The sample capacity volume RANGE, which is much broader, is given in ml. If you are unsure which Shatterbox grinding container to select, consult our product specialists. You can also send your samples in for evaluation and test grinding.

***Small:*** 8507 Small Hardened Steel and 8508 Small Tungsten Carbide grinding containers. Each has a puck-shaped grinding element. Typical sample capacity 8-12 grams, sample volume range 5 - 15 ml. Requires 8507R Rack to operate one 8507/8508 or three simultaneously.

***Medium:*** 8505 Alumina Ceramic and 8506 Zirconia Ceramic grinding containers. Each has a puck-shaped grinding element. Typical sample capacity 20-30 grams, sample volume range 15 - 40 ml.

***Large:*** 8501 Hardened Steel and 8504 Tungsten Carbide grinding containers. Each has a puck and ring. Typical sample capacity 40-60 grams, sample volume range 20 - 70 ml.

***Extra Large:*** 8521 Large Hardened Steel grinding container, with puck and ring. Typical sample capacity 60-100 grams, sample volume range 30 - 120 ml.

The sample volume ranges given above are estimates, not absolute limits. The upward limit on the weight/volume of a given sample for a given grinding container is really determined by the point where the mill stops grinding the sample satisfactorily. This limit can vary with the type of the sample and its particle size. The lower limit on the size of the sample is usually reached when the sample becomes highly contaminated and is hard to recover. (If very little sample is ground there is a lot of direct contact between the grinding element or elements and the container, and under these conditions the tungsten carbide and ceramic grinding containers are more likely to become chipped.) Avoid grinding large chunks of sample, as these can either jam the grinding container or damage it; even if they grind satisfactorily they will probably not grind consistently. We recommend reducing the feed size to at least 1/4" for the tungsten carbide and steel grinding containers, and to 1/8" for the alumina and zirconia ceramic grinding containers.

When developing a procedure for your combination of Shatterbox and grinding container, try a sample size near the middle of the given range(s). Grind for two minutes in steel or tungsten carbide, or four minutes in alumina or zirconia. If grinding is not satisfactory but the sample is not caking, try increasing the grinding time or decreasing the sample size, or both. If caking occurs, consult the Handbook of Sample Preparation and Handling for information about grinding aids.

## **5.1 GRINDING CONTAINERS**

(Selection and Use)

### ***5.1.3 Loading a Shatterbox Grinding Container***

Before using a Shatterbox grinding container, check to make sure that it is clean and that the gasket or O-ring is in good condition. Before it is loaded into the container, the sample should be crushed to proper feed size as discussed previously: approx. 1/4" for the steel and tungsten carbide containers, and 1/8" for the alumina and zirconia ceramic containers.

Place the sample in the grinding container AFTER the ring or ring-and-puck is in place. Do not overload the grinding container (see "***Choice of Grinding-Container Size***" above for recommended loads). If loading a steel or tungsten carbide grinding container with a ring as well as a puck, place the sample more or less evenly on both sides of the ring.

Before putting the cover on the grinding container, check the position of the O-ring, and make sure no sample is on the rim of the container, or underneath or on top of the ring and puck. A good way to tell whether the cover is firmly seated is to rotate it slightly, or slide it from side to side; if sample particles are preventing the cover from closing tightly, this will be apparent.

If the cover of the grinding container is not firmly seated when the container is clamped into place, it is likely that the clamp will loosen during grinding. At best the grinding container will leak. At worst, the container can leave the clamp, causing damage to both the mill and container.

### ***5.1.4 Emptying and Cleaning the Grinding Container***

The grinding container is usually emptied by brushing out the ground sample. Typically a technician will start by brushing sample off the underside of the cover into the container, and brushing off the tops of the puck and ring. Then the ring is lifted partway out of the container and brushed off, followed by the puck. Finally the container is tilted and the entire sample brushed out. Some technicians recommend coarse-bristled brushes (for example, inexpensive Nylon paintbrushes) because they are easy to clean.

***WARNING: finely pulverized sample always presents a respiratory hazard, so a dust mask or other protection should be worn when working with it.***

Grinding containers should be cleaned after use. Methods have included wiping with a damp paper towel, blowing out with an air hose, rinsing with water or alcohol, etc. Most of these methods are not very effective, and blowing the dust out of a container with an air hose certainly causes a respiratory hazard. We recommend a two-minute period of grinding with a mixture of clean quartz sand, hot water, and soap or laboratory detergent. The residue is easily and safely washed out of the container, which then may be dried.

## **5.1 GRINDING CONTAINERS**

(Selection and Use)

Technicians who are particularly concerned about cross-sample contamination may adopt the "grind and discard" technique. After sample A has been ground and the grinding container nominally cleaned, a portion of sample B is ground and discarded, and the container cleaned again. Now it should be possible to grind a portion of sample B without contaminating it with sample A.

A cleaned grinding container, which will not be used for some time, should be stored in a plastic bag. Hardened steel grinding containers should always be dried and stored carefully, as they are prone to surface rusting.

### ***5.1.5 Grinding Hints***

It is risky to give exact formulas for sample grinding because there are so many variables. Few types of sample have the same grinding characteristics. Grinding containers are made of different materials, all of which grind differently; furthermore, a worn grinding container will be less efficient than a new one. While there are many analytical techniques that require finely ground samples, the necessary particle size for proper analytical results may vary from instrument to instrument and from sample to sample. Consequently these guidelines are general.

For any grinding container, the smaller the overall sample size, the finer it can be ground in a given time. Unless a sample cakes during grinding, the longer it is ground, the finer it will get. Particle size can almost always be lowered further by reducing the sample size or lengthening the grinding time, or both.

Dry grinding is relatively efficient for most brittle materials, but at small particle sizes (below 50 microns) there is a tendency for particles to stick back together, or "cake." There are many grinding aids to prevent caking. Water, alcohol, solvents, and other liquids can be added to create slurries whose mean particle size after grinding can be well below 10 microns, but for most analytical techniques the liquid must be removed before analysis. Dry grinding aids include soap powders, detergents, stearates, and aspirin, all added to comprise 1% to 10% of the total sample weight. SPEX recommends a technique pioneered by Howard Kanare of Construction Technology Laboratory: ethylene glycol or propylene glycol is added to the sample in the amount of one drop for every five to ten grams of sample.

In most analytical work it is important to reproduce particle size from sample to sample. Like other laboratory mills, the Shatterbox requires a fixed routine to accomplish this: a uniform sample weight, grinding aid, grinding time, container, etc. You are welcome to telephone SPEX CertiPrep at 1-800 522-7739 or 732-549-7144 to discuss your particular application.

## **6.0 MAINTENANCE**

### ***6.1 Shatterbox Part Numbers***

Following these written instructions are a parts list and diagrams (pages 22-24) of the Shatterbox mechanism and cabinet. Note that all SPEX parts have 5-digit inventory numbers that must be used to order them. However, most of these parts also have 1-digit or 2-digit numbers that correspond to the part's position in an engineering drawing. Example: the screws, which hold the columns in place, are part no. 26 in Diagram A, but must be ordered as SPEX Part No. 50619.

### ***6.2 Cleaning the Shatterbox***

Depending on how dusty the working environment is it may be necessary to clean the Shatterbox regularly. The clamp and capsule retainer should be vacuumed or wiped off. Any spilled powders or liquids should be wiped up immediately with a slightly damp cotton cloth after every use. This should minimize the buildup of any powders, mold/mildew, or unsightly gunk over the life of the unit. To clean the Shatterbox mechanism, remove the access panel on the back of the cabinet (after unplugging the mill) and vacuum the exposed surfaces.

For a properly functioning Cam-Action Clamp, it is absolutely necessary that the lever assembly roller rotate smoothly (Diagram A Item 13). Clean off any excess dust or dirt from the outer segments of the clamp, with special attention being placed on the hinge sections and on the roller. It may be necessary to oil the hinge and the roller from time to time. If the roller locks up, the clamp can be easily damaged.

***NOTE: unplugging the unit from its power source should, FIRST precede any cleanup or maintenance work that is to be performed on the mill.***

### ***6.3 Replacing Drive Belts***

Special compound O-rings are used as drive belts (item 22 Diagram B). These should be replaced if worn and can be reached after the dust cover is lifted up. It is highly recommended that when replacing belts, all four be replaced at a time. When installing drive belts, check the clearance between the coupling arm and eccentric arm. There should be at least 1/16" up to 1/8" clearance between them.

## **6.0 MAINTENANCE**

(Cont'd)

### ***6.4 Removing the Upper Section of the Shatterbox Mechanism***

If it is necessary to remove the top section of the Shatterbox, lift the black rubber skirt (item 2 Diagram A) and remove the drive belts and screws. The top section will then lift off.

To remove the funnel (item 31 Diagram B), loosen the setscrew and unscrew the screw, remove it along with the eccentric arm assembly, and loosen the funnel setscrew. The funnel can then be removed from the shaft. To replace the rubber support columns placed into position on the base assembly, remove and save the screws holding the columns in place. Pull columns out. Install new columns, drill holes through top and bottom, and re-insert screws

### ***6.5 Tightening or Replacing the Yokes***

All but a few of the early Shatterboxes have a long yoke (Diagram A, item 19) and swing short yoke (Diagram A, item 12) that are fastened to the capsule retainers by Allen bolts inserted from above. If these bolts loosen, they can be tightened with an Allen wrench after removing the pin holding the clamp arm or lever. To do this, remove one of the C-clips (Diagram A, item 18) holding the pin (Diagram A, item 17) in place, and push the pin out from that end. In the unlikely event that the bolts shear and cannot be removed from above, or if you have one of those early Shatterboxes with the bolts inserted from below, it will be necessary to remove the funnel to gain access to the underside of the capsule retainer. After detaching the upper section of the mechanism (Diagram A, item 18 from item 22), invert it and remove the eccentric arm (Diagram B, item 35) by first taking out the small setscrew from the large slotted setscrew (Diagram B, item 27) and removing it. Then pull the funnel straight off the shaft. When installing either yoke, first clean the yoke and its mounting bolts to remove all traces of oil, and treat each bolt with a locking agent to prevent loosening after assembly. When replacing the funnel and eccentric arm make sure that the long side of the eccentric arm and the funnel counterweight (Diagram A, item 9) are on the same side of the funnel, otherwise the gyrating motion of the Shatterbox will be unbalanced.

### ***6.6 Replacing the Rubber Columns***

To replace the rubber columns (Diagram A, item 7) first remove the older columns by removing the retaining screws (Diagram A, item 26) that hold them, and pulling the old columns from their sockets. Then place the new columns in those sockets and check and adjust the clearance between the eccentric and coupling arms as mentioned above. Once the correct clearance is established, drill holes through the new columns to allow insertion of the retaining pins.

***PLEASE NOTE:*** *If you have any questions about the operation and maintenance of your 8000M Mixer/Mill, please contact our specialists by phone at 1-800 LAB-SPEX (522-7739) or 732-549-7144, or by e-mail at [sampleprep@spexcsp.com](mailto:sampleprep@spexcsp.com)*

**7.0 Accessories: Grinding/Mixing Vials**

*(If not included in your Order, they are Available for Purchase at Additional Cost)*

**8501 Hardened Steel Grinding Container**

Outer Dimensions (dia. x height): 17.5 x 7.5cm,  
Weight: 8kg Recommended Load: 20-50ml  
Complete with: Dish, Lid, Ring, Puck, & Gasket



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**8504 Tungsten Carbide Grinding Container <sup>1</sup>**

Outer Dimensions (dia. x height): 17.5 x 8cm  
Weight: 12.5kg Recommended Load: 20-60ml  
Complete with: Dish, Lid, Ring, Puck, & Gasket



**8505 Alumina Ceramic Grinding Container <sup>1</sup>**

Outer Dimensions (dia. x height): 15.2 x 8cm  
Weight: 5kg Recommended Load: 15-40ml  
Complete with: Dish, Lid, Puck, & Gasket



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**8506 Zirconia Grinding Container <sup>1</sup>**

Outer Dimensions (dia. x height): 15.2 x 8cm  
Weight: 6kg Recommended Load: 15-40ml  
Complete with: Dish, Lid, Puck, & Gasket



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**8521 Large Hardened Steel Grinding Container**

Outer Dimensions (dia. x height): 20.3 x 8.2cm  
Weight: 13kg Recommended Load: 30-100ml  
Complete with: Dish, Lid, Ring, Puck, & Gasket



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<sup>1</sup>Tungsten carbide, zirconia ceramic and alumina ceramic are brittle as well as extremely hard, and cannot be guaranteed against chipping or breaking. If handling instructions are followed, these containers will provide years of useful service.

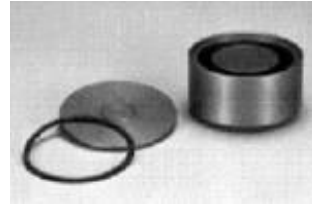
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**7.0 Accessories: Grinding/Mixing Vials**

*(If not included in your Order, they are Available for Purchase at Additional Cost)*

**8507 Small Hardened Steel Grinding Container**

Outer Dimensions (dia. x height): 9 x 5.4cm  
Weight: 1.9kg Recommended Load: 5-20ml  
Complete with: Dish, Lid, Puck, & Gasket



**8508 Small Tungsten Carbide Grinding Container <sup>1</sup>**

Outer Dimensions (dia. x height): 9.2 x 5.9cm  
Weight: 3.5kg Recommended Load: 5-20ml  
Complete with: Dish, Lid, Puck, & Gasket



**8507R Rack <sup>2</sup>**

Holds one or three 8507 or 8508 grinding containers.  
Rack base assembly and lid included; rack with three grinding containers lifts easily in and out of Shatterbox.  
Please note that 8507 and 8508 containers cannot be mixed during the same run.



**31688 Shatterbox Friction Disc**

Durable rubber pad reduces operating noise and wear when placed under grinding container.

**51793 Shatterbox Drive Belt**

Special elastomer O-ring. **Note:** Drive belts should always be replaced as a set to ensure proper operation, 4 required. For models 8500 and 8515 only.

▼  
▼  
To Order any of these, or the above accessories, call Customer Service at 800-522-7739 or 732-549-7144

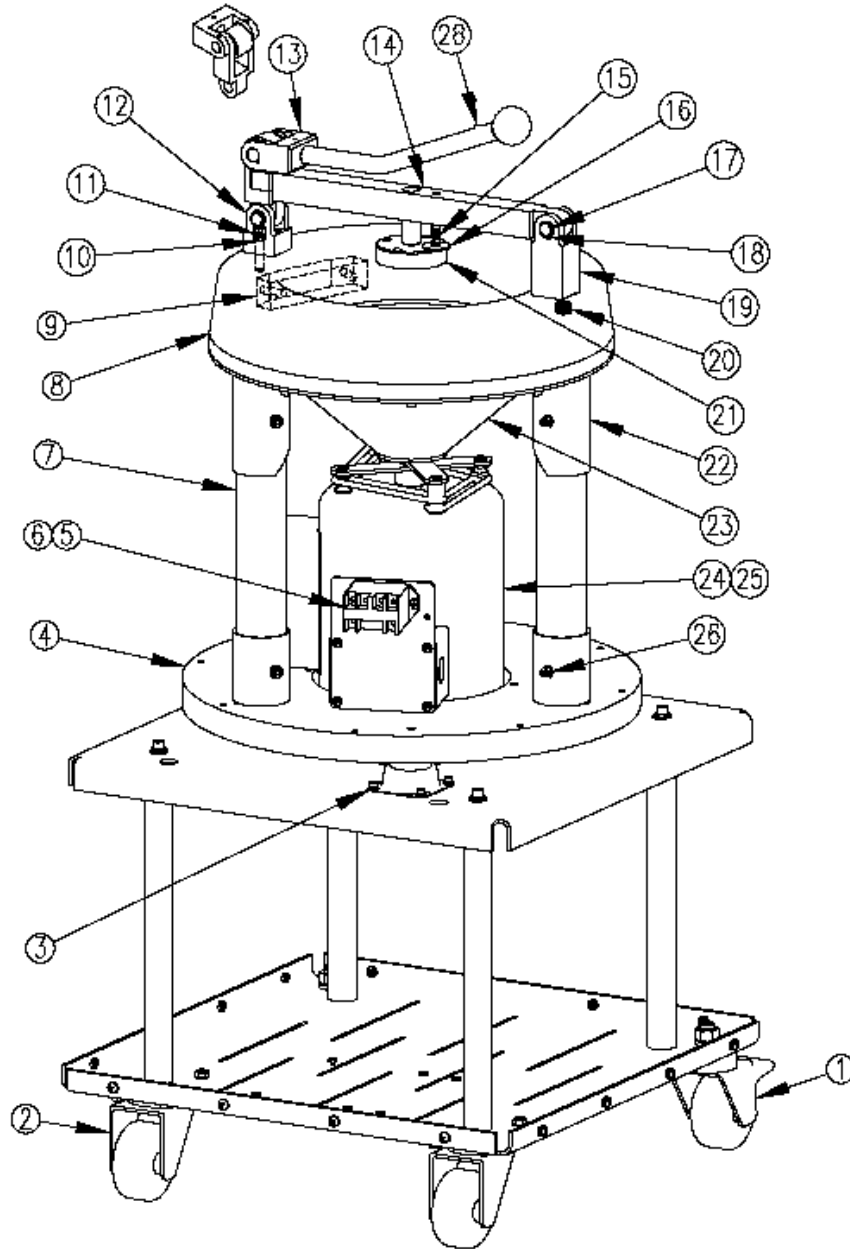
<sup>1</sup>Tungsten carbide, zirconia ceramic and alumina ceramic are brittle as well as extremely hard, and cannot be guaranteed against chipping or breaking. If handling instructions are followed, these containers will provide years of useful service.

<sup>2</sup>Smaller tungsten carbide (8508) and steel (8507) grinding containers require 8507R rack for proper use.

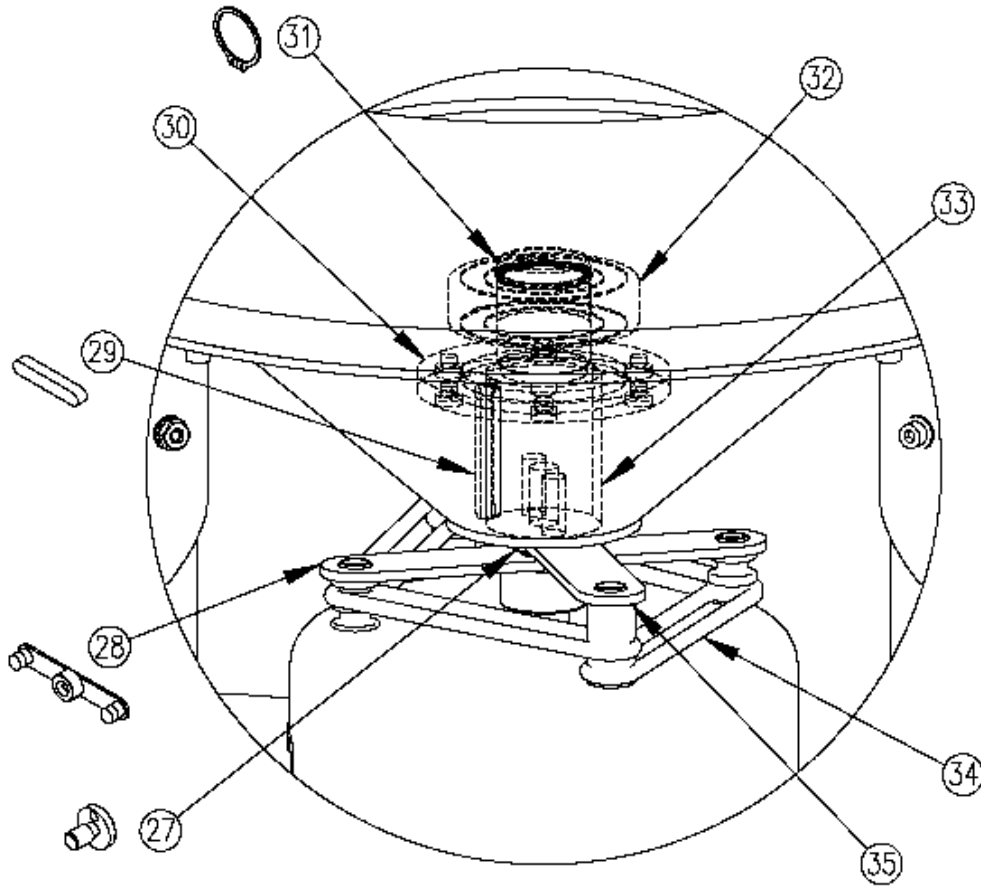
**8.0 PARTS LIST & ITEM LOCATOR***(See Diagram A, B & C)*

<u>Item</u>	<u>Part No.</u>	<u>Description</u>	<u>Item</u>	<u>Part No.</u>	<u>Description</u>
1	38366	Caster, Locking, Swivel	28	31772	Coupling Arm (Assembly)
2	38367	Rigid Caster	29	32823	Key
3	53077	Shock Mount	30	22468	Ring
4	31992	Base (Assembly)	31	50536	Retaining Ring
5	92941	Relay (115V)	32	50016	Bearing
6	92942	Relay (230V)	33	22467	Shaft
7	22464	Column for 8500 (3 Required)	34	51793	Drive Belt (4 required)
8	22460	Capsule Retainer	35	31771	Eccentric Arm (Ass'y)
9	22454	Block (Counterweight)	36	92677	Lever Switch
10	38407	Washer for Yokes	37	38819	Skid Pad
11	38396	Shoulder Bolt for Yokes	38	38874	Side Skid Pad
12	38282	Yoke for Clamp Lever	39	92679	Pushbutton Switch
13	38285	Roller Assembly for Clamp Lever	40	38372	Gas Spring
14	38284	Clamp Arm	41	38806	Latch
15	38373	Spring for Locking Pin	42	37483-P	Power Supply Board
16	38276	Locking Pin	43	37483-D	Display Board
17	22456	Pin, 1 1/2" for Yokes	44	38388	Polarized Display Window
18	50549	Retaining Ring for Pins	45	51206	Handle
19	38279	Yoke for Clamp Arm	46	92894	Kill Switch
20	38386	Threaded Insert for Capsule Retainer	47	92965	Solenoid (115V)
21	38278	Guide	48	92968	Solenoid (230V)
22	31991	Ring Assembly	49	92703	Power Switch
23	22459	Funnel	50	96004	Power Entry Module
24	96261	Motor 115/230-60Hz	51	96005	Individual Fuse Holder
25	96265	Motor 115/230-50Hz	52	93860	Fuse, 10 Amp (for 115V)
26	50619	Screw	53	93840	Fuse, 5 Amp (for 230V)
27	22469	Screw			
28	38285	Lever Arm			

**9.0 DIAGRAM "A"**

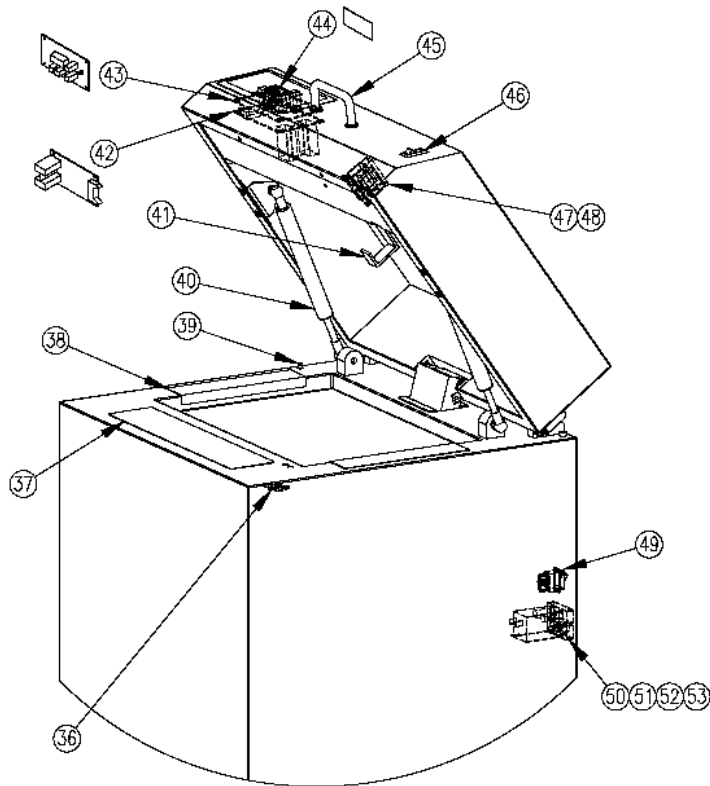


**9.1 DIAGRAM "B"**



<u>Item</u>	<u>Part No.</u>	<u>Description</u>
27	22469	Screw
28	31772	Coupling Arm (Assembly)
29	32823	Key
30	22468	Ring
31	50536	Retaining Ring
32	50016	Bearing
3	22467	Shaft
34	51793	Drive Belt (4 required)
35	31771	Eccentric Arm (Ass'y)

**9.2 DIAGRAM "C"**



<b><u>Item</u></b>	<b><u>Part No.</u></b>	<b><u>Description</u></b>
36	92677	Lever Switch
37	38819	Skid Pad
38	38874	Side Skid Pad
39	92679	Pushbutton Switch
40	38372	Gas Spring
41	38806	Latch
42	37483-P	Power Supply Board
43	37483-D	Display Board
44	38388	Polarized Display Window
45	51206	Handle
46	92894	Kill Switch
47	92965	Solenoid (115V)
48	92968	Solenoid (230V)
49	92703	Power Switch
50	96004	Power Entry Module
51	96005	Individual Fuse Holder
52	93860	Fuse, 10 Amp (for 115V)
53	93840	Fuse, 5 Amp (for 230V)

**10. TROUBLESHOOTING GUIDE**

<u>PROBLEM</u>	<u>CAUSE</u>	<u>SOLUTION</u>
1 The unit does not turn on	No current	Make sure power cord is plugged into outlet
2 The unit does not turn on	No current	Check outlet for power and correct as required
3 The unit does not turn on	Blown fuse	Replace fuses
4 The unit does not turn on	Power switch not turned on	Depress power switch
5 Unit does not run. Display indicates LID	Safety interlock switch	Close the lid and be sure that the latch is locked
6 Unit does not run	Disconnected harness	Re-connect wiring harness to motor
7 The Lid does not open	Unit may be paused	Depress start/stop button
8 The Lid does not open	Safety catch has not released	Depress start/stop button or turn off unit to open
9 The timer counts down but the unit doesn't run	Kill Switch is in Off position	Turn Kill Switch to on (I) position
10 Grinding puck doesn't move	Too much sample is in the vial or sample pieces are too large	Remove some sample from the vial and start again

## **11. WARRANTY**

SPEX CertiPrep Inc. guarantees its products and new equipment against defects in materials or workmanship for two years from the date of original shipment. Repairs, replacements, or parts are guaranteed for 30 days or for the remaining original warranty period (whichever is greater) for the item that was repaired or replaced. Items not produced by SPEX CertiPrep carry the manufacturer's warranty only.

### **11.1 Product Specifications**

Every effort has been made to provide complete and accurate product operation and information in this manual. However, since specifications are subject to change without notice, changes may be made from time to time to improve the performance of the product. Therefore slight changes that are not reflected in the current illustrations should be considered minor and inconsequential for the purposes of this operating manual.

### **11.2 To Arrange A Return Shipment**

We want you to be happy with whatever you purchase from SPEX CertiPrep. Please bring any problem to our attention, but please **DO NOT RETURN** any item before contacting us for a Return Authorization Number and instructions. Unauthorized returns will be refused. Cost for all return transportation is the responsibility of the customer. Credit for returned merchandise will be issued only after goods have been received and inspected. Returned goods are subject to a 25% restocking charge up to a maximum of \$200.00.

### **To Contact Us**

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