



High Shear Colloid Mill Installation, Operation and Maintenance Manual

Model:

Large Scale In-Line/Vertical Colloid Mill

Unit Serial Number:

Sales Representative's General Sample Manual

Customer:

Purchase Order:

For Service and Information Contact:

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We at Chemineer, Inc would like to take this opportunity to thank you for choosing us for your processing equipment needs.

Whether you are one of our many repeat customers or a brand new customer, our goal is to supply you with a piece of equipment that is superior in both design and ease of operation. By following the instructions in this manual and performing regular maintenance, we trust you will receive years of trouble – free operation from this machine.

If you have any questions at all, or require additional information, do not hesitate to contact your local Chemineer representative or our Customer Service Department.

CAUTION

THIS MACHINE SHOULD ONLY BE OPERATED BY QUALIFIED PERSONNEL WHO HAVE READ THIS MANUAL & UNDERSTAND HOW THE MACHINE OPERATES.

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EQUIPMENT DESCRIPTION

You have just purchased a Greerco[®] Colloid Mill. The Greerco[®] Colloid Mill is a high speed, high shear mixer capable of batch or in-line processing. Although a “colloid mill” is commonly considered a particle destruction unit, it is actually a *dispersion* piece of equipment. The machine will blend, emulsify, de-agglomerate and produce a thorough wetting of dispersed substances resulting in a completely homogeneous product. However, the colloid mill will NOT dry grind.

For example, assuming that the basic particle size in an agglomerated slurry is 1 to 3 microns, a colloid mill set with the proper gap clearance is capable of destroying all the larger agglomerates of those particles to produce a distribution of that basic particle size. The proper gap setting, which refers to the opening between the tapered plane faces of the rotor and stator, can only be determined by pilot plant or production test runs.

PRINCIPLE OF OPERATION

Like most high shear devices, the Greerco[®] Colloid Mill employs a high-speed rotor running in close proximity to a fixed stator to perform its shearing operation. In this colloid mill, the gap between the rotor and stator is adjustable. Product is processed as it passes through the shear zone, where intense hydraulic and shear forces result in a product that has been broken down into its primary particle size and/or the dispersion of the dispersed phase throughout the carrier phase.

The Greerco[®] Colloid Mill consists of a high-speed, hardened rotor turning inside a matching, fixed, hardened stator, which is surrounded by a jacket. As the rotor turns, the upper blades force the material into the first shearing zone of sharp teeth milled into the stator. The material then passes through the second shearing zone where fine serrations in the rotor channel the fluid, with increasing velocity, towards the adjustable gap between the ultra-smooth, lapped, hardened surfaces of the rotor and stator. Finally, centrifugal force impinges the fluid against the stator-housing wall for further refinement.

ADJUSTABLE GAP SETTING

On this colloid mill, the rotor-stator clearance is continuously adjustable and may be done “on-the-fly”. Gap adjustment may be made by turning the *handwheel* on the unit. This wheel acts as a gap setting micrometer. Three precision-machined gears regulate shaft movement that results in the gap setting adjustment. On the gear case of the hand wheel, you will find indicator markings providing the appropriate turning direction for gap adjustment. Clock wise rotation will close the gap while counter-clockwise rotation will open the gap.

The colloid mill also comes complete with an index wheel. A Plexiglas[®] window allows the operator to view the index wheel. The markings on this wheel are unit-less. They are a nominal number scale that may be correlated to gap setting of the unit.

NOTE:

The “ZERO” designation is a nominal value.

**When your machine left the factory, *zero* was a 0.003-0.005” gap setting.
Your machine is configured to prevent against metal-to-metal contact.**

MOUNTING CONFIGURATION

A Greerco[®] Colloid Mill is available in one of two configurations, horizontal or vertical. There is no difference in the milling head or mixing processes in these configurations, merely the machine’s orientation.

Horizontal Configuration – “H” Model Designation

If you have purchase a W_____H model colloid mill, you will be receiving a horizontal colloid mill. Intended as an in-line piece of processing equipment, this configuration will allow for “hard plumb”, directly to the mill as with other system component. The mill is equipped with standard Tri-Clamp Ferrules for quick disconnect and sanitary services.

Vertical Configuration – “V” Model Designation

If you have purchase a W_____V model colloid mill, you will be receiving a vertical colloid mill. Intended as a batch-processing device, vertical models come complete with stainless steel hoppers and recirculation piping. A three-way valve on the recirculation tube allows for fluid discharge at the conclusion of the processing cycle.

COLLOID MILL SET-UP

All colloid mills are shipped completely assembled and ready to connect and operate. Prior to operation ensure the following

- Check that the rotor turns freely and that no foreign objects have lodged in the mixing head during transport or storage.
- **Do not** couple the motor and mill until proper rotation is established.
- Since the gap setting is achieved through axial movement of the shaft, be certain there is a 1/8" separation between the coupling halves *when the gap-setting indicator is at zero.*

WIRING

Unless otherwise specified by you, the customer, at the time of quote/order, your mill has been supplied with a 230/ 460V/3 ϕ /60Hz explosion-proof motor with a nominal speed of 3600rpm.



ALL WIRING SHOULD BE COMPLETED BY A QUALIFIED ELECTRICIAN FAMILIAR WITH THIS MOTOR, ITS ENVIRONMENT AND ITS INTENDED FUNCTION

Consult motor nameplate to confirm actual specifications of the motor on your mill. Motor wiring diagram is located within the motor conduit box or on the motor nameplate.

See the next section for concerns regarding motor rotation.

W250V-B/H-B models are supplied in a belt driven configuration. The mill was shipped to you with the transmission belt loose. Motor height/ belt tension should be adjusted via the motor mounting bolts provided. Personnel familiar with the tensioning of transmission belts should perform the installation of this component of the mill. Errors in belt tensioning may lead to premature failure of moving parts.

DIRECTION OF ROTATION

Proper rotational direction is **vital** to continued operation of the machine. The colloid mill rotor is threaded onto its shaft. Improper direction of rotation will result in catastrophic escalating damage to the mixing head components and possibly the entire mill depending on the duration of improper operation.



OPERATING DIRECTION IS COUNTERCLOCKWISE WHEN FACING THE INLET PORT OF THE MILL (MOTOR IS AWAY FROM YOU).

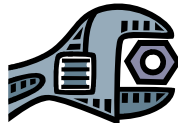
The proper shaft rotation required by your colloid mill is indicated by the red arrow affixed to the mill head support just forward of the motor coupling.

SHAFT SEALING

A Greerco[®] Colloid Mill is available with a number of shaft seal configuration options. Consult the assembly drawing at the back of this manual for confirmation of the scope of your machine.

Double Lip Seal – All Greerco[®] Colloid Mills are stocked at the factory in a double lip seal configuration. The lip seals used are multiple layer radial shaft seals consisting of a Teflon[®] anti-friction element and a fluoroelastomer sealing element bonded to a metal shell.

Single Mechanical Seal – A standard factory option, your colloid mill may have been purchased with a *John Crane Type 21* single mechanical seal. Factory standard faces are Carbon vs. Silicon Carbide. Alternate faces are available however they must be requested at the time of quote.



Reconfiguration of a colloid mill with lip seals to allow for the use of a mechanical seal (or vice versa) is an easy field retrofit. This requires the purchase of the new style seal(s) and a new seal plate. Consult your local Chemineer representative for a quote on the appropriate parts and field retrofit procedure.

Double Mechanical Seal – *This configuration is not a field retrofit.* It requires special parts and assembly that must be specified at the time of quotation. Contact your local sales representative if you wish to consider a factory retrofit.

COLLOID MILL ELASTOMERS (SEALS & O-RINGS)

All Greerco colloid mills utilize commonly accepted elastomeric materials for the seals and o-rings. The common construction materials are listed below. Should the products you are processing require alternate materials, we would be happy to source these components for you.

Shaft Seals

See above section detailing shaft sealing options.

Should your seal leak, you will see process material discharge from the weep hole located in the underside of the mill housing.



Seals should be replaced at the *first* sign of leakage or more costly failures may result.

O-Rings

Your colloid mill is equipped with five (5) o-ring gaskets. All o-rings supplied by the factory are Viton[®], unless alternate materials were requested at the time of quote. There are three (3) wetted o-rings; seal plate, stator OD and stator face. The o-rings that are not wetted are the duplex bearing o-ring and radial bearing o-ring.

JACKETED STATOR HOUSING

Considerable heat build-up may occur through operation of the mill, particularly at close gap settings and especially with thicker fluids. Because of this, water-cooling jackets are standard equipment on all Greerco[®] Colloid Mills. Should your process require it, these jackets may be used to heat or insulate your product as well.

- Stainless steel hose barb connections are provided on the jacket.
- Not all applications require use of the jacket and use of the jacket is not mandatory for proper mill operation. Water jacket provided around the stator need only be used as required by your process.

PRODUCT PROCESSING GUIDELINES

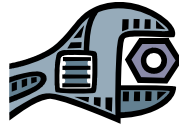
- Insure that foreign materials are not introduced into the mixing head of your colloid mill. Tramp metal or rigid solids may severely damage the mixing head and its components.
- When determining the appropriate gap setting, the mill should be started at a fairly open gap setting, approximately 30 on the indicator dial. The gap should then be gradually decreased until a suitable sample is obtained.
- Some applications will require the product to be recycled to achieve the desired refinement; others may be processed after a single pass. The nature of the fluid, rate of throughput and mill gap setting will all play a part in determining the amount of processing required.
- Processing through a colloid mill requires prior preparation of a suitable pre-mix to prevent non-lubricated solids from settling into the small clearances between the rotor and stator. A colloid mill will not dry grind. Be sure that product carrier phase is present to appropriately lubricate the seals and wearing faces in the unit at all times.



- Do not consider this Colloid Mill a “pump”. While there is an inherent pumping capability, the function of the mill is to produce shear. A positive pump feed to the mill is recommended for most systems and required by systems with fluids exceeding 5,000cPs.

When using a pump, it is necessary to limit the inlet pressure seen by the mill to avoid overloading the bearings. Nameplate limits are as follows.

W250	100psig Max Inlet Pressure
W500	90psig Max Inlet Pressure
W750	45psig Max Inlet Pressure



DAILY MAINTENANCE & CLEANING

To prevent damage to seals, it is essential that the mill cavity be cleaned before the mill is allowed to stand idle for a prolonged period of time.

Aqueous dispersions and emulsions will only require a hot water rinse. With the mill operating, the gap should be opened and closed several times to dislodge any material buildup around the seals.

More severe materials such as oils, waxes and greases may require a detergent and hot water rinse. Materials such as oil paints, inks and pigment dispersions may require a solvent rinse. If solvents are used it is essential that you confirm chemical compatibility or effect of solvent on the Teflon[®] and Viton[®] Lip Seal elements or your mechanical seal faces/components.



The outside surface of the mill may be periodically cleaned with soapy water or washing with a suitable solvent. (The mill housing is cast aluminum and standard bases are epoxy coated carbon steel.)

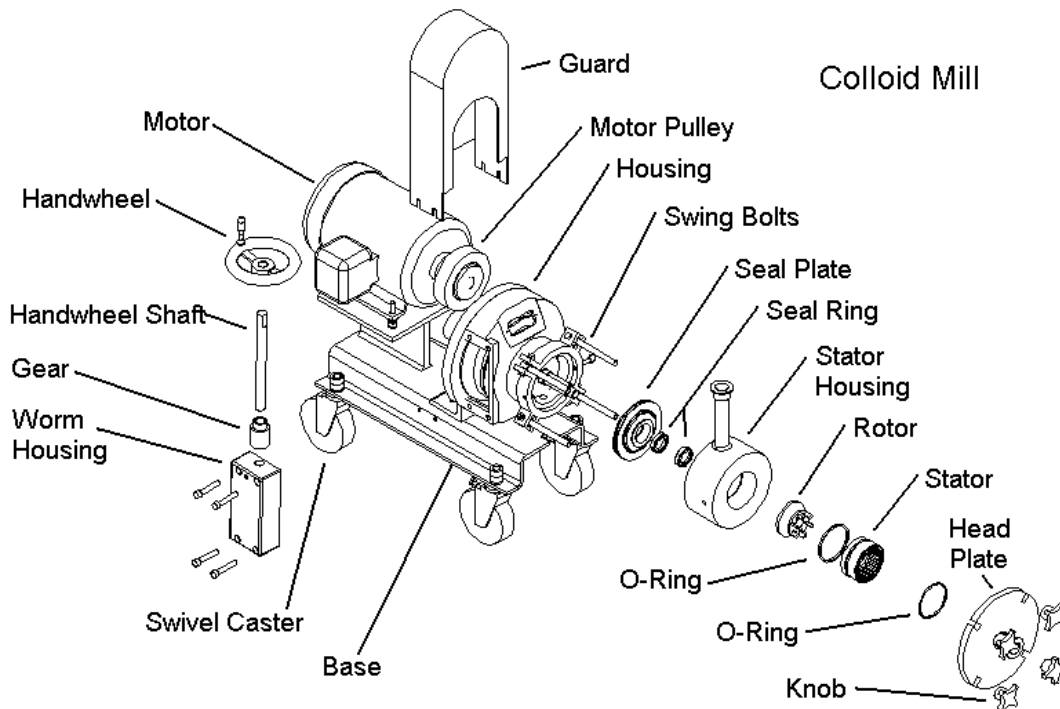
Should your application require that the milling components (wetted parts) be disassembled for cleaning, refer to the first four steps found in the disassembly procedure section that follows.

3-WAY VALVE MAINTENANCE & CLEANING (FOR "V" MODELS ONLY)

The three-way valve on your recirculation piping should be periodically disassembled for thorough cleaning and inspection. The tapered body and plug of the valve are precision ground and extreme care should be taken to insure that these surfaces are not damaged. Nicks on the surface of the plug must be removed with a fine file or stone to prevent scoring the body and eventual leakage. Valve bodies and plugs are mated during manufacture and must not be interchanged with parts of other valves. Each body and matching plug is identified with identical numbers.

COLLOID MILL LUBRICATION

Motor	Follow motor manufacturer's guidelines for proper motor maintenance.
Bearings	All mill bearings are of the shielded type and are packed in high temperature grease for long life in high-speed operation. No lubrication required.
Grease	<i>Dow Corning 44 High Temp Bearing Grease Medium Consistency</i> or similar
Valve	Valve supplied requires no lubrication.



COLLOID MILL DISASSEMBLY

1. *If your mill is horizontal skip to step 2. If your mill is in the vertical configuration, disconnect the clamps at the junction between the mill outlet pipe and the three-way valve. Remove the recirculation piping from the outlet port on the mill. Disconnect the clamp at the mill inlet and remove the hopper.*
2. Loosen the four (4) swing-bolt knobs that secure the mill cover plate to the mill head, retract the swing bolts and remove the cover plate.

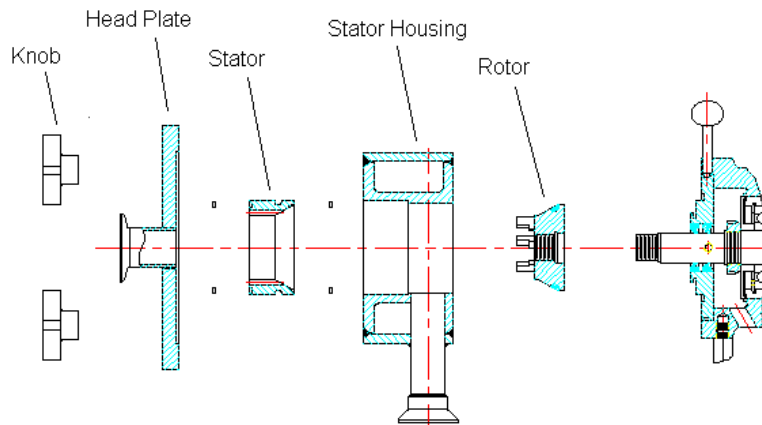
NOTE: Stator housing is now loose. If you are working on a horizontal unit, do not allow stator housing to fall.

Lay the mill head plate on flat surface to prevent damage to the OD of the plate.

3. The stator housing assembly can now be lifted out of the mill.

Complete disassembly of the stator housing and stator assembly is not necessary for most routine maintenance.

Inspect the condition of the stator milling surfaces. There should be no burrs, gouges or scuffing on its face. Should oring or stator need replacement, stator may be slipped from stator housing with an arbor press.

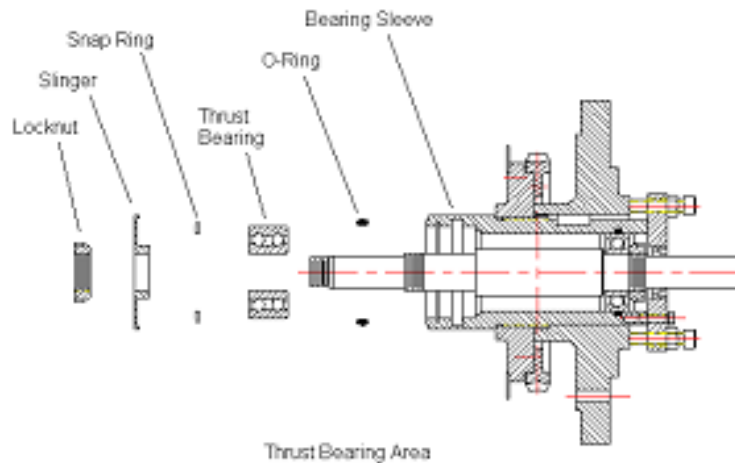


4. Secure the motor end of the shaft just above the coupling and unscrew the rotor in a counterclockwise direction. A strap wrench may be necessary to secure the shaft.
5. Inspect rotor for damage . [Burrs, gouges and scuffing should be noted.] Rotors with deep gouges or nicks should be replaced.
6. Loosen the three thumbs crews in the housing that retain the seal plate.
7. The seal plate may now be removed for seal replacement.
8. If the bearings and/or the shaft need replacement, follow the following procedure consulting the equipment drawing in the back of this manual for part identification.
 - a. Remove the mill from the base by loosening the lower nut on the front support stud under the base plate and removing the four nuts that secure the lower support to the housing support.
 - b. Remove the coupling half from the motor end of the shaft.

It is now possible to support the mill on wooden blocks for stability during the rebuild procedure as needed.

Spin mill shaft by hand to inspect bearings. Shaft should spin smoothly with no rumbling and very little play. Be sure to replace/ grease any bearings exhibiting evidence of wear.

- c. Disassemble the safety stop plate from the lower support by loosening the two large square head cap screws.
 - i. Check the condition of the lip seal. Lip seal should be flexible and dark in color.



- d. Remove the large, upper bearing locknut, slinger and retaining snap ring.
- e. The shaft with bearing intact may now be *gently* slipped from the upper end (mill side not motor side) of the bearing sleeve.

(A rubber mallet may be required.)

- f. Remove the lower locknut and press the upper and lower bearings from the shaft.

9. Further disassembly is not required for standard maintenance. Gear housing and adjustment gearing failures are not typical. Should you need to disassemble the shaft adjustment gearing, please consult the factory for guidance.

COLLOID MILL RE-ASSEMBLY

Reassembly may be completed by reversing the above procedure.

1. Shaft, Bearing and Bearing Housing Configuration
 - a. There are two o-rings located within the bearing housing, replace if necessary.
 - b. Lightly grease the shaft bearing seats.

- c. Press the radial bearing on the motor end of the shaft (end with keyway).
- d. Press the duplex bearing on the mill end of the shaft (end with threads).
- e. Thread the small locknut on the motor end of the shaft until it bottoms out.
- f. Fill the area between the two bearing assemblies with grease.

Dow Corning 44 Medium Consistency is factory standard.

- g. Slide the shaft-bearing assembly into the bearing housing. (Threads on bearing housing OD should be at motor end of shaft when assembled.)
- h. Replace the retaining ring, ensuring that the retaining ring is well seated in the groove provided.
- i. Replace the slinger on threaded end of shaft with flat side out and it sits against the bearing housing.
- j. Thread the large locknut onto the mill end of shaft until it bottoms out.

Once secure, the assembly is now a single component.

2. Replace the Gap Setting Adjustment Nut

- a. Adjustment Nut is the large bronze gear with a threaded ID and the red, numbered indicator wheel on one surface.
- b. Thread the adjustment nut onto the shaft assembly so that the teeth of the gear are toward the motor end of the mill and the numbered wheel faces the shaft end with threads.

Do NOT bottom out the adjustment nut. Leave approximately 1/4" of the thread exposed.

3. Install Shaft Assembly in Housing

- a. Grease exposed surfaces of the bearing housing

- b. Stand housing on mill end so that the end resembling a truncated circle with four bolt holes is facing up.

It may be useful to support housing on wooden blocks for ease of handling.

- c. Slide shaft assembly into the housing with threaded end down. Be sure to keep the bearing housing keyway in the center of the flat area in the housing before seating the bearing housing in the mill housing.

Tolerances between housing ID and bearing housing OD are very tight. You may have to ease the assembly into place. If force is used, be careful where that force is applied. Swing bolt mounting ears may be damaged by percussive forces.

4. Install lower support

- a. Place key in bearing housing keyway.
- b. Lower support is the cast iron component that resembles a flange and mates directly to the bottom of the housing.
- c. Grease the ID of the lower support
- d. Place a bead of silicon sealant around the edge of the housing and boltholes.
- e. Align lower support key way with key and Slide the lower support down over the shaft and bearing housing, insuring that all edges are aligned.

The lower support should sit completely flush against the housing. If lower support has been lowered into place and there is still a space between the two components, the adjustment nut was threaded onto the bearing housing too far and will need to be backed off in order to allow support to sit and seal properly.

- f. Secure lower support with four (4) ½ -13x1-1/4 socket head cap screws.
- g. Wipe away excess grease or sealant that may have seeped out during assembly.

5. Motor End Lip Seal

- a. Press motor end lip seal (black rubber ring without metal edge) into the safety stop plate (smooth disc with 2 large and 4 small holes).
- b. Seat the stop plate on the motor end of the housing (lip edge facing out) and secure with two (2) 3/8-16 x 1" long square head set screws and 3/8-16 jam nuts in the two large threaded holes provided.
- c. Position four (4) #10-32 x 1" Hex Head Cap Screws in the small stop plate holes.

6. Reattach Gear Housing Hand Wheel Assembly

It is unlikely that routine maintenance or a machine rebuild will require the disassembly of this component, so the assembly is treated as a single item. Should the gears need replacing, consult the factory for information on factory rebuild services or advice on how to proceed.

- a. Be sure that the hand wheel and gear assembly spins freely.
- b. Place a bead of silicon sealant around the edge of the square opening on the mill housing/lower support assembly where the adjustment nut gear is exposed.
- c. Align the gear housing hand wheel assembly with four (4) 5/16-18x1-3/4" square head cap screws.

This component also has a brass setscrew for the locking of the hand wheel position.

7. You may mount the mill head back on the base now or after attaching the rotor.

- a. Secure the mill housing to the base plate by fastening the four bolts that attach the housing to the housing support bracket.
- b. Tighten the jam nut that secures the head of the mill housing to the base.

8. Invert mill housing and wipe all exposed surfaces to remove any dust, particulate or grease that may have accumulated.

9. Install Seal Plate

a. Lip Seal Configuration

- i. Press two lip seals into the seal plate with the lips facing up until top lip is flush with the raised, wetted face of the seal plate.
- ii. Slide seal plate down over shaft (*It may be necessary to lubricate the sealing surface with mineral oil for ease of installation.*).
- iii. Replace seal plate o-ring around OD of plate in groove provided. Do not stretch the o-ring to fit the outer edge of the seal plate, merely lay it on the outer most section of the seal plate face.
- iv. Secure plate in place with the three locking screws provided.

b. Mechanical Seal Configuration

- i. Press the stationary seal face into the seal plate.
- ii. Slide seal plate down over shaft
- iii. Replace the seal plate o-ring around OD of plate in groove provided.
- iv. Secure in place with the three locking screws provided.
- v. Install the remaining mechanical seal components in accordance with standard protocol.

10. Install rotor by threading it onto the shaft.

11. Stator

- a. If stator or stator o-ring has been replaced, the stator must be pressed back into position within the stator housing.

- b. The angled stator face and o-ring groove should be *down* as you press the stator into the housing.

Take care not to pitch the o-ring during the pressing operation.

12. Reposition the stator housing over the rotor and position the outlet port in accordance with piping requirements.
13. Replace the stator face o-ring in the groove provided.
14. Replace the inlet cover and reposition the swing bolts to secure.
15. ***“Hand Tighten”*** swing bolts.



DO NOT USE A WRENCH. Over tightening and torquing the swing bolts will flatten o-rings, limit the life of o-rings and damage the machines ability to seal properly and may lead to misalignment of mixing head.

GAP SETTING CALIBRATION

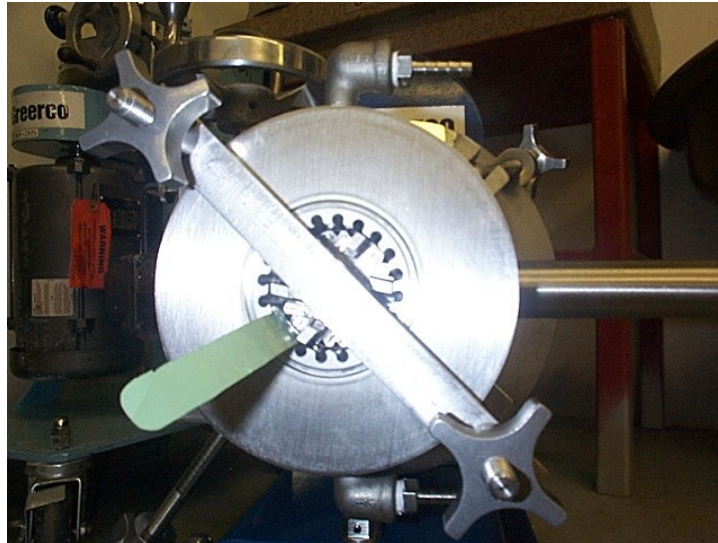
1.0 Getting Started

- 1.1 Disconnect the electricity to the unit.
- 1.2 Remove Coupling Guard
- 1.3 Disconnect Motor Coupling so Shaft may be Turned by Hand
- 1.4 Turn Gap Setting Dial to Zero
- 1.5 Remove Inlet Cap and Visually Inspect Rotor and Stator

2.0 Finding Zero

When the zero is set at the factory, a dial indicator is placed on the shaft to ensure that there is a 0.003-0.005” gap between the rotor and stator when the indicator is at “zero”. A modified version of the head plate is used to simulate assembled alignment and to properly seat the stator housing while mounting a dial indicator on the shaft. If the stator housing is not properly positioned, there is a tendency for the gap setting to be much greater than 0.003-0.005” when the machine is properly assembled. A modified spare inlet cap is not necessary for use in gap-setting adjustments. Proper assembly can be mimicked to

insure alignment and stator seating by using a drilled piece of bar stock as shown in the following photo.



Procedure is as follows.

- 2.1 Loosen the lock screws located just above the shaft/coupling at the rear of the mixing head. (Note: This allows the rotor to “bottom out” in the next step, and the gap to be a *true* zero.)
- 2.2 Turn the shaft counter-clockwise by hand while *slowly* decreasing the gap between the rotor and stator. Continue decreasing the gap until a slight rub of the rotor and stator is felt.
- 2.3 Begin to open the gap by turning the gap adjustment hand wheel until you no longer hear or feel contact between the rotor and stator.
- 2.4 Continue widening the rotor-stator clearance until there is a 0.003-0.005” clearance between the rotor and stator. *This is theoretical zero on a Greerco Colloid Mill.* Use of either a dial indicator or Mylar feeler gauge for gap setting measurement will provide the best results.
- 2.5 Re-tighten the lock screws until they make contact and lock them in place with lock nuts.
- 2.6 Reset the gap setting indicator dial per section 3.0

3.0 Setting Zero

- 3.1 Turn dial in both directions ensuring that movement stops at the point where lock screws were tightened and that there is no “rubbing” or dragging when shaft is turned by hand. Repeat section 2.0 if any rotor/stator “rubbing” occurs.
- 3.2 Remove the window frame and the small window covering the index ring.
- 3.3 Undo the three (3) screws on the dial index ring
- 3.4 Align the zero on the index ring with the arrow/indicator on the housing.
- 3.5 Retighten the three (3) screws
- 3.6 Replace the window.

4.0 Testing Zero

- 4.1 Test the machine setting at zero by turning by hand and ensuring that there is no rubbing

5.0 Replace Coupling and Operate

NOTES ON MACHINE REBUILDS

As you make component changes to the equipment, be aware of the following:

- If the rotor and stator have been replaced, the mill will need to be recalibrated. See preceding procedures.
- Use caution to be sure that o-rings have not been “pinched” when placing stator within the stator housing.
- Before operating, be certain that the shaft operates freely at the zero gap setting.

SPARE PARTS

A complete assembly drawing of the colloid purchased is included as part of this manual. The recommended spare parts are denoted with an asterisk on this drawing. These are parts that, over time, will need replacement. It is recommended that the customer maintain an inventory of these parts as protection against down time due to wear or accidental damage such as foreign objects entering the mill. For convenience, multiple discounted spare parts kits are available for maintenance of the machine.

Replacement Elastomer Kits

Available for all lip seal configurations, this kit contains all machine o-rings and required lip seals

Consumable Spares Kit

Available for any shaft seal configuration, this kit contains all o-rings, bearings, shaft seals and retaining rings. *Please specify machine serial number at time of quote/order.*

Complete Machine Rebuild Kit

Available for any shaft seal configuration, this kit contains all wearing parts including shaft, rotor, stator, o-rings, bearings, seals and locknuts. *Please specify machine serial number at time of quote/order.*

Should you need to order parts, please contact your local Chemineer-Kenics/Greerco representative, as listed on the front of this manual, or our factory in North Andover, MA at (978) 687-0101.