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# High Shear Homogenizer Operation and Maintenance Manual

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Model:

**Production-Size Reversible Homogenizer**

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Unit Serial Number:

**Sample Manual**

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Customer:

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Purchase Order:

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For Service and Information Contact:

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***Chemineer, Inc.***  
A Unit of Robbins & Myers, Inc.

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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

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You have just purchased a Greerco<sup>®</sup> Reversible Homogenizer. Your Greerco<sup>®</sup> homogenizer is a high speed, high shear mixer for full-scale, batch production. Your homogenizer is a high-speed *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. This machine will NOT dry-grind.

## PRINCIPLE OF OPERATION

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Like most high shear devices, the Greerco<sup>®</sup> Homogenizer employs a high-speed turbine running in close proximity to a fixed stator to perform its shearing operation. In this homogenizer, the gap between the rotor and stator is fixed and the stator is partially enclosed by a cover plate. There is a propeller on the shaft just above the stator. The height of the propeller is adjustable depending on the nature of the application.

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 high-speed turbine also results in a strong pumping action that promotes quick and efficient tank turnover.

When the mixer is turned on, the process fluid will be drawn up from the bottom of your vessel, through the cover plate opening and into the eye of the turbine. Here the product is subjected to intense impact, acceleration and shear forces as it is pumped through the high-speed turbine and restricted stator orifices. Fluid leaves the stator in a direction axial to the shaft. The adjustable propeller provides additional turbulent pumping action in the direction of the flow. If the propeller is located just above the stator (factory default location), there will also be some additional shear imparted on the fluid. The deflector plate then redirects the upward flow toward the walls of the vessel where it is drawn back towards the eye of the turbine at the mixing head resulting in a distinct “umbrella-like” flow pattern.

## OUT OF THE BOX

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Production scale homogenizers are shipped with the wetted end completely assembled however the motor will need to be mounted and coupled to the unit. Before mounting your motor, check that the shaft on your mixer rotates freely and that no foreign materials have lodged in the mixing head.

**DO NOT AT ANY TIME RUN YOUR HOMOGENIZER DRY.**



You will receive two pieces in your shipment. A long rectangular crate containing your mixer, hanging strap and hardware and a smaller crate containing your motor. Using the supplied hardware (lock washers and screws) mount your motor to the motor support being certain to also attach the hanger strap. Standard motors are supplied with vertical lifting lugs to aid in the lifting and mounting of the motor.

IT IS RECOMMENDED THAT THE MIXER BE INSTALLED IN THE PROCESSING TANK BEFORE MOUNTING THE MOTOR AND HANGER STRAP. **DO NOT AT ANY TIME REST THE FULL WEIGHT OF THE ASSEMBLY ON THE MIXING HEAD AS MISALIGNMENT AND SEVERE DAMAGE MAY RESULT.**

Once mounted remember that the mixing head must *always* be immersed in product or some other liquid (water is fine) during operation, as this fluid is required to provide lubrication of the mixing head during operation. **SEVERE ESCALATING DAMAGE WILL RESULT FROM EVEN MOMENTARY DRY OPERATION.**

## MIXING VESSEL SELECTION

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The homogenizer will operate satisfactorily in a standard cylindrical tank. The optimum mixing vessel, however, is one with a full hemispherical bottom, as this shape will permit the smoothest fluid flow pattern. Vessels with conical or dished bottoms can also be used.

It is important to note that the mixing head will impart a great deal of energy into the process fluid. Short, squat vessels may result in overflow and splashing during mixer operation. Keep the following rules of thumb in mind when selecting your vessel.

- ⇒ Mixing head should be positioned so that the stator is approximately one stator diameter off the bottom. For light, water-like materials, the homogenizer may perform satisfactorily at other depths. In general, the mixing head should always be mounted in the bottom third of the batch and not so close to the bottom as to starve the mixing head and prevent fluid flow to the top of the batch.
- ⇒ Tank diameter should never be more than ten times the stator's outer diameter if mixer is the sole form of agitation in the tank. The optimal value will decrease as viscosity increases.



## MIXER MOUNTING

Greerco homogenizers are supplied with either cross supports or a flange for tank mounting.

### CROSS SUPPORT MOUNTING.

1. Bolt the mixer bridge plate to the two supports provided
2. Attach the rubber spacer blocks to the angle iron via the bolts and wing nuts provided. The blocks should be placed so that they will rest on the tank edge and dampen machine vibration.
3. Loosening the setscrew in the bridge plate and sliding it up or down the shaft and the guide rods can then adjust mixer height. Tighten the setscrew when the mixer is 1-2 stator diameters off the bottom of your tank.

### FLANGE MOUNTING.

1. In a flange-mounted unit, a specially drilled ANSI flange replaces the bridge plate.
2. Flange gaskets are not a part of our scope of supply. It is best that you utilize the gasket appropriate to the intended service.
3. Bolt the mixer flange to its mate on your tank.
4. Adjust mixer height and secure the setscrew to hold the mixer in place.

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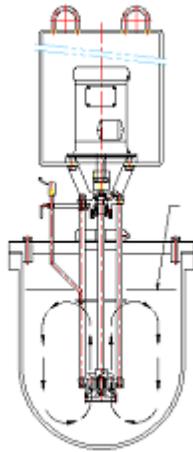
## MIXER SET-UP: UMBRELLA VS. VORTEX

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Your laboratory homogenizer comes complete with an adjustable deflector plate. This deflector plate is integral to optimal performance of your lab mixer.

### **Dispersions, Blending and Emulsifying**

These operations would require a homogenizer configured to produce an umbrella flow pattern. Your mixer motor should be wired to run in the forward direction (Clockwise when looking down at mixer head). The mixing head should be immersed in the product with the mixing head 1-2” off bottom and the deflector plate should be positioned just below the liquid level.



Typical Flow Pattern

### **Solids Incorporation**

Though not always required, solids addition is best achieved through a vortex flow configuration especially for hydrophobic (difficult to wet out or light) powders. In order to achieve the most desirable flow pattern, a certain amount of experimentation is required. Establishment of a stable vortex will be fluid, viscosity, vessel, mixing head height and deflector plate location dependent. Motor should be wired to be run in reverse (Counterclockwise when looking down on mixer head). Operator should then vary mixing head height and deflector plate location until a stable vortex is formed. Note that producing too strong a vortex will result in cavitation, collapsing of the vortex and surging. Any of these conditions will mimic dry running and result in the same escalating damage so should be avoided at all costs.

## MINIMUM LIQUID LEVEL

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It is absolutely imperative that minimum liquid level restrictions be followed. Failure to fully submerge the rotor and stator will result in dry operation and severe escalating damage. While installation specific minimum liquid level calculations are tank, machine and process dependent, a conservative rule of thumb would be to keep approximately 18-20" of fluid above the top edge of the stator.

## WIRING

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### **Motor Specifications.**

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

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



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

## MECHANICAL SEALS

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The flange-mounted Homogenizer is normally supplied with a double lip seal arrangement, but can also be supplied with a double mechanical seal. The double mechanical seal is self-contained and preloaded. If you are unsure as to the seal arrangement of your unit, the drawing will indicate the seal type.

### Double Mechanical Seals

- Need to be flushed with a barrier fluid to lubricate and clean seal faces. The fluid should be compatible with process fluids and should be at a pressure approximately 20psi higher than the process pressure.
- Seal is supplied with pipe nipples, pressure gauge and ball valve for regulation of barrier fluid flow and pressure.

Standard Factory Seal Construction (unless specified at time of order)

Viton Elastomers  
316SS Hardware  
Carbon vs. Silicon Carbide Faces

Alternate seal faces and seal manufacturers are available – Consult Factory for cost and/or design impact.



**SEAL CHAMBER MUST BE FLOODED PRIOR TO OPERATION.**

## SPEED CONTROL

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Our homogenizers are designed to run at full-speed. Decreasing the speed of the motor will decrease the available shearing forces and therefore may affect process result.

Unless specified at the time of quote/order, the standard motor supplied with a homogenizer is NOT VFD-rated.

## MAINTENANCE

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Maintenance requirements for a homogenizer are minimal. A long and trouble-free life can be expected.

### **Lubrication**

The mixing head is lubricated by the process fluid and should be kept submerged during operation. Machine bearings have been lubricated at the factory prior to shipment. It is important that you do not add to the grease during installation. Some seepage may occur during initial operation as grease heats up and expands in bearing housing. Excess grease can be wiped away. Once equilibrium is reached no additional seepage should occur.

Bearings should be greased in accordance with established plant protocol that accounts for the mixer's environment. For example, hot, dry, dusty environs will require more service than standard atmospheric conditions.

Standard Factory Grease Specification:

*Dow Corning 44 High Temperature Bearing Grease, Light Consistency*

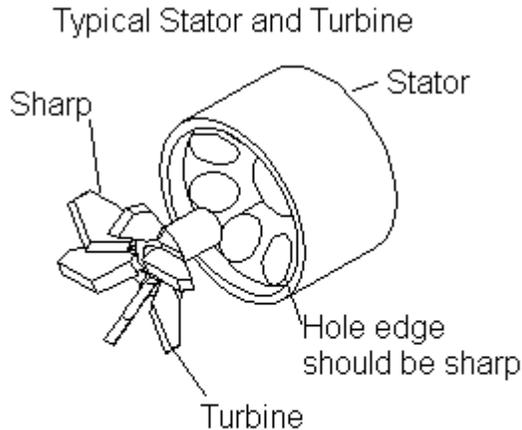
FDA Approved Grease Option (Requested at Time of Quote):

*Dow White EP Bearing Grease*

Motor lubrication should be in accordance with manufacturer's recommendations.

### Normal Wear

“Normal wear” will be confined to the replaceable turbine sleeve and stator bushing. Both components are made of wear resistant Stellite<sup>®</sup>. If abrasive materials are being processed, wear may also occur on the cover plate. Rate of wear will, of course, be process fluid dependent.



Check for damage on both the stator and turbine cutting area

### Common Failures

The *most* common cause of damage to high shear equipment is physical. Contamination of your product with foreign material (hard objects such as tramp metal, stones or the occasional piece of hardware) will cause substantial damage. It is imperative that hard objects be kept out of your tank.

### Daily Maintenance

The mixer should be cleaned after each use by running it briefly in plain water, detergent or suitable solvent. Simple cleansing will keep the mixing head from becoming caked with dried product, which may impede the necessary lubrication of the mixing head by future process fluids during operation.

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## HOMOGENIZER DISASSEMBLY

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It is recommended that qualified personnel familiar with the nature of this high shear equipment perform all maintenance procedures.

1. **Uncouple mixer from motor** by loosening the setscrew on the motor component and sliding it back. The two coupling halves should disengage at the center where the rubber insert can be seen.
2. **Remove motor (if necessary)**. Be sure the motor is supported by an overhead crane or forklift apparatus and remove the four (4) anchor bolts. Slowly lift the motor off your mixer.

Once the motor has been removed, we recommend inverting the mixer and standing it on the motor support on a flat surface (Feasibility may be limited by mixer size.) We will start at the mixing head and work back to motor.

### MIXER HEAD DISASSEMBLY:

3. **Remove Cover Plate Assembly**. Remove the SS safety wire that secures the three cover plate screws on the stator face and unbolt the cover plate.
4. **Remove Turbine**. Remove the cotter pin that secures the turbine hex nut on the shaft and slide the turbine from the shaft.

**CAUTION: Turbine blades may be sharp.**

If you have difficulty removing the turbine, there may be significant damage to the Stellite bushing(s). Refrain from striking the turbine blades with a hammer to loosen. Should substantial wear/damage have occurred, a gear puller might be necessary to remove the turbine.

5. **Inspect the condition of the turbine sleeve and stator bushing**. Stellite components should be smooth. There should be absolutely no gouges or nicks out of the surface. Any scuffing would be considered “normal” wear.
6. **Remove Shims Behind Turbine**. Shims may have been placed on the shaft behind the turbine. These shims were

installed at the factory to properly set the clearance between the rotor-stator. This gap should be between 0.008” and 0.012”. If you reassemble the machine with the same components, you will need these same shims. If you change mixing head components you may need to add to or reduce the number of shims.

7. **Remove the Turbine Sleeve (if necessary).** Support the turbine sleeve at its shoulder and press turbine hub through. Alternately, a gear puller can be used. Do NOT let turbine drop to floor as blades may bend.
8. **Inspect the condition of the turbine and stator.** Turbine should have sharp edges; no nicks and all blades should lie at the same angle. If distortion or wear is present turbine must be replaced. Check for indications of heat build-up or wear if the bushing(s) are damaged. Stator should have a smooth surface free of dings and gouges.
9. **Remove the stator (if necessary).** Unscrew the four pairs of jam nuts and hex nuts from the guide rods. Match mark each guide rod with the matching stator mounting hole, so that the stator can be re-mounted in the same place. Lift the stator off the guide rods.

NOTE: Stator must be replaced in exactly the same orientation as it was originally supplied unless a new stator is being installed.

10. **Press out the stator bushing (if necessary).**

The mixing head may be reassembled by reversing the above procedure.

11. **Remove the deflector plate. (if necessary).** Disassemble by removing the nuts that fasten it to the deflector rod.

**12. Support Disassembly.**

- a. Bridge Plate (standard)** – Loosen the setscrews securing the support flange to the guide rods and slide the entire assembly off the shaft and rods.
- b. Flange Mount (special order)** – Loosen the setscrews securing the support flange to the guide rods and slide the entire assembly off the shaft and rods.

**13. Guide Rod Removal.** Guide rods will pull out of the motor support after the jam nuts and hex nuts have been removed. Match mark each guide rod and mounting hole so that they can be returned to their original position. Also note the location of any shims, which may have been placed between the guide rod and motor support.

**SHAFT & BEARING ASSEMBLY DISASSEMBLY:**

- 14. Remove the coupling half** from the shaft by loosening the setscrews.
- 15. Remove the thrust cap screws.** The thrust cap is found on the underside of the motor support.
- 16. Remove shaft with bearings intact.** Gently remove the shaft from the motor support by pressing on the end of the shaft.
- 17. Remove Bearings & Spacer.** Unscrew the exposed locknut and press the bearings off the shaft.

NOTE: The top bearing is shielded (not sealed) due to the high speed of the unit. Take care not to damage the shield during disassembly or reassembly. Also note that this bearing is configured with an o-ring to prevent rotation. The lower bearing is clamped in place by the thrust cap.

- 18. Inspect condition of thrust cap lip seal.** This shaft seal is used to contain the bearing grease and limit its ability to travel down the shaft. The lip seal consists of an elastomeric and an anti-friction (most likely Teflon) element. The rubber portion of the seal should be flexible and dark in color. If your lip seal is brittle, dry, gray, cracked and/or pitted it should be replaced.

When replaced, the seal should be pressed into the thrust cap with the “lip” pointing up. The lip should then be lightly greased for ease of installation.

## HOMOGENIZER RE-ASSEMBLY GUIDELINES

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Reassembly may be completed by reversing the above procedure.

THESE CAUTIONARY NOTES MUST BE OBSERVED.

- **Pressing Stator Bushing** – The back (flat) side of the stator and the bushing should be flush.
- **Pressing Turbine Sleeve** – Support the turbine in center, between the blades and press until back (hub) is flush. If the turbine is supported on the blades, the blades will bend and the turbine will be destroyed.
- **Clearance** – Set the turbine-stator gap by installing the required number of shims on the shaft behind the turbine. This gap can be checked with a feeler gauge and should be set from 0.008”-0.012” at its lowest point. If the stator has been changed or if the stator and/or turbine have worn, it may be necessary to shim guide rods to obtain proper clearance or center stator over shaft.
- **Securing Turbine** – Be sure that both the hex nuts and cotter pin are re-installed prior to operation of the mixing head.
- **All Threaded Connections Should be Securely Tightened**

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## NOTES ON MACHINE REBUILDS

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

- If the rotor and stator have been replaced, the rotor-stator gap setting will need to be re-set and confirmed prior to operation.
- Before operating, be certain that the shaft rotates freely.
- Guide Rods MUST be square. Severe vibration and damage to shaft and guide rods will result if guide rods are out of square.
- Locknuts should not be used more than two times, as locking ability is lost with repeated use.

## SPARE PARTS

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Included, as part of this manual, is a complete assembly drawing of your mixer. 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.

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 at (978) 687-0101.