PRICE $15.00

PRATER® 1925 AIRLOCKS • MILLS • SEPARATORS

Unit shown with accessories removed for illustrative purposes only.

MEGA MILL INSTALLATION/ OPERATION and MAINTENANCE MANUAL

MODEL _____

SERIAL NO _____

Before using this equipment:

- AVOID INJURY, read and understand all instructions given in this manual
- Familiarize yourself and others with the safety labels installed on this equipment
- Designate an accessible place for this manual and keep it available to all users at all times

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Introduction

This manual contains complete instructions for the installation, operation, and maintenance of Prater equipment. Reliable operation, safety, and long service life of this equipment depends on 3 important considerations:

A. The care exercised during installation.
B. The quality and frequency of maintenance and periodic inspection.
C. A common sense approach to its operation.

Safety

Safety is basic, and must be considered through all facets of the operation and maintenance on any mechanical device. Using proper tools and methods can prevent serious accidents, which might result in serious injury to you or your fellow workers.

Proper operating procedures and safety precautions are listed throughout this manual. Study them carefully and follow instructions; insist that those working with you do the same. Almost all accidents are caused by someone's' carelessness or negligence

The precautions listed may not necessarily be all-inclusive and others might occur to the user, which are peculiar to a particular operation or industry. In addition, nearly all employers are now subject to the Federal Occupational Safety and Health Act of 1970, as amended, which require that an employer be kept abreast of the myriad of regulations, which will continue to be issued under its authority.

At all times – this equipment must be operated in accordance with the instructions and precautions in this manual and on the caution plates attached to the equipment. Only persons completely familiar with the instructions and precautions in this manual should thoroughly understand these instructions and precautions before attempting to operate this equipment

FAILURE TO OBSERVE AND FOLLOW THE PRECAUTIONS MAY RESULT IN SERIOUS PERSONAL INJURY OR PROPERTY DAMAGE.

SAFETY CHECKLIST

_ **ALWAYS** operate Rotary Airlock Feeder in accordance with instructions in this manual.
_ **ALWAYS** have a clear view of unit loading and unloading points and all safety devices.
_ **ALWAYS** allow unit to stop naturally. DO NOT attempt to artificially brake or slow motion of unit.
_ **KEEP** area around unit, drive and control station free of debris and obstacles.
_ **AVOID** poking or prodding into unit openings with bar or stick
_ **DO NOT** open inspection doors while unit is in motion.
_ **DO NOT** use the Rotary Airlock Feeder for processing of material other than the specific application for which it was designed.
_ **NEVER** work on unit and related components unless electric power and motor drive have been locked out and tagged. The National Electrical Code requires a manually operable disconnect switch located within sight of motor, or a controller disconnecting means capable of being locked if not within sight of the motor.
_ **NEVER** operate unit without guards and all safety devices in position and functioning.
_ **NEVER** put your hand near, on, or in the inlet or outlet of the airlock while it is operating or stalled.

TABLE OF CONTENTS

SECTION 1
INTRODUCTION

This section provides an overview of the manual and indicates safety procedures to be followed when installing and operating the Mega-Mill.

1.1 Manual Overview

This manual describes the installation requirements, operational procedures, and routine maintenance of Prater's Mega-Mill, Model #'s MM-5, MM-9, MM-18, and MM-36. Each Mega-Mill is engineered for a specific application; there may be unique features in your particular machine that are not covered in this manual. Refer to this manual before beginning and during installation. Keep the manual available for future reference. Reliable operation, personnel safety, and long service life of this equipment depend on three important considerations:

- The care exercised during installation.
- The quality and frequency of maintenance and periodic inspections.
- A common sense approach to its operation.

To keep operating costs down and profits up, carefully follow the instructions listed for installation, operation, safety, and maintenance.

1.2 Receiving The Unit

When your shipment arrives, thoroughly inspect the mill and all related equipment. In the event of shipping damage, note the problem on the bill of lading or freight bill and make sure you obtain the driver's signature for possible claim against delivering carrier.

NOTE It is the receiver's obligation to file claims for shipping damage.

1.3 Before Installation

Be sure the installation crew or millwrights are aware of installation requirements. If they have any questions or are unsure of proper procedures, clarify the matter to avoid improper installation. **Section 2** of this manual covers important steps to ensure safe, vibration-free installation. Personnel responsible for installation should be familiar with these procedures.

In preparing for installation, make sure you provide for all appropriate safety devices. It is your responsibility to provide lockout switches, guards, and other safety devices and safety procedures to protect the machine operator or maintenance personnel.

1.4 Before Operation

Make sure operating personnel are well-trained in procedures for operating and maintaining the Mega-Mill. In particular, make sure they understand the essential safety precautions described in **Section 1.6**.

1.5 Safety Notices

Basic safety must be considered through all facets of operation and maintenance on any mechanical device. Using proper tools and methods will help prevent accidents and serious injury to you and your fellow workers.

Proper operating procedures and safety precautions are listed throughout this manual. Study them carefully and follow instructions; insist that those working with you do the same. Almost all accidents are caused by someone's carelessness or negligence.

Examples of the three types of safety notices (Warnings, Cautions and Notes) in this manual are listed below:

WARNING **Indicates a situation in which personal injury may occur.**

CAUTION **Indicates a situation in which damage to equipment or material may occur.**

NOTE Provides helpful information for proper operation of the Mega-Mill.

1.6 Mega-Mill Safety Precautions

WARNING **Operators must be instructed not to put hands, fingers or other foreign objects in the machine, and not to remove any cover, door, hatch or other protective device. Covers, doors, hatches and other protective devices are placed on this machine for the safety of the operator. Any attempt to defeat these devices could result in serious injury.**

WARNING **Electrical service to the machine must be locked out while any repairs or adjustments are being made or while any cover, door, hatch or other protective device is not in place.**

The precautions listed in this manual may not be all-inclusive and others might occur to you which are peculiar to your operation or industry. In addition, nearly all employers are now subject to the Federal Occupational Safety and Health Act of 1970, as amended, which requires that an employer be kept abreast of the myriad of regulations which will continue to be issued under its authority.

The Mega-Mill must always be operated in accordance with the instructions and precautions in this manual and on the caution plates attached to the equipment. Only workers completely familiar with the instructions and precautions in this manual should be permitted to operate the unit. The operator should thoroughly understand these instructions and precautions before attempting to operate this equipment.

Illustration 1-1 is a checklist of safety precautions and proper operating procedures.

Safety Checklist

- ✔ **ALWAYS** operate SANITARY Fine Grinder in accordance with instructions in this manual.
- ✔ **DO NOT** open inspection doors while unit is in motion.
- ✔ **NEVER** work on unit and related components unless electric power and motor drive have been locked out and tagged. The National Electrical Code requires a manually operable disconnect switch located within sight of motor, or a controller disconnecting means capable of being locked if not within sight of the motor.
- ✔ **DO NOT** use the SANITARY Fine Grinder for processing of material other than the specific application for which it was designed.
- ✔ **AVOID** poking or prodding into unit openings with bar or stick.
- ✔ **ALWAYS** have a clear view of unit loading and unloading points and all safety devices.
- ✔ **KEEP** area around unit, drive and control station free of debris and obstacles.
- ✔ **NEVER** operate unit without guards and all safety devices in position and functioning.
- ✔ **ALWAYS** allow unit to stop naturally. DO NOT attempt to artificially brake or slow motion of unit.

Illustration 1-2
Mill Safety Precautions

Illustration 1-2 shows the safety labels used on the Mega-Mill. These labels are important for worker information and must not be removed from the unit.

Illustration 1-1
Safety Labels

1.7 Operating Principle

Illustration 1-3 shows the operating principal of the Prater Mega-Mill.

The mill feeds coarse material through the top product inlet. Material either drops by gravity or is pulled within an airstream.

High speed hammers accelerate the material. Rotary action combined with turbulence and agitation produced by the hammers, dividers, and screens reduce particle size. The dividers also serve to deflect the material back into the path of the hammers. Fine particles move outward through the holes of the screens.

The finished product collects in a hopper underneath the mill, is removed by a mechanical conveying system, or is air conveyed into collecting equipment through an air pick up device.

1.8 Custom Applications

Prater Mega-Mills are used for a wide range of industrial and agricultural applications. A variety of hammers, knife blades, screens, and other grinding elements are available to meet virtually any grinding need. The Mega-Mill is available in standard mild or stainless steel.

When ordering parts or requesting information or service from Prater, be sure to state the serial number of your unit.

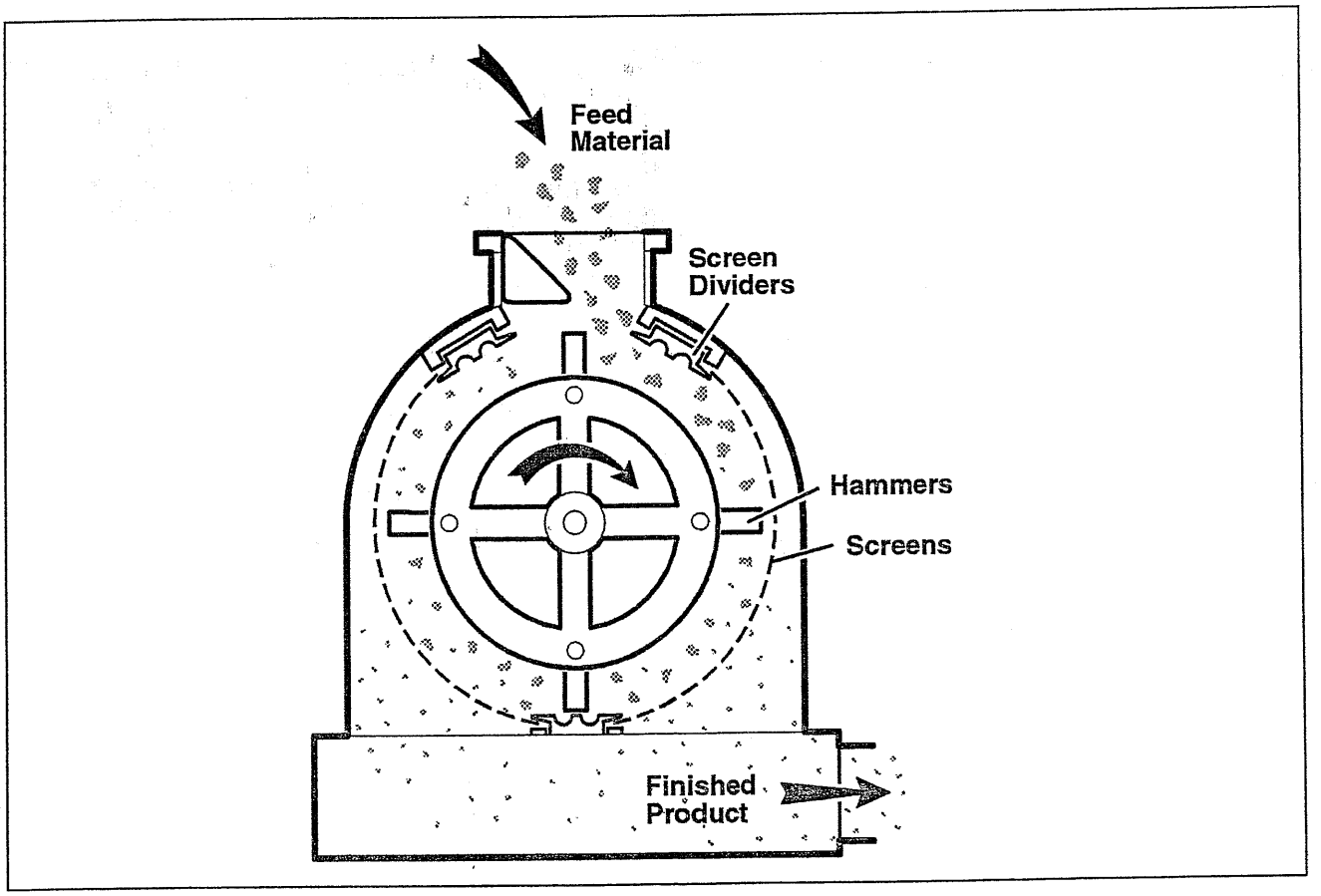


Illustration 1-3
Mega-Mill Operating Principle

SECTION 2
MEGA-MILL INSTALLATION

This section covers installation procedures to insure safe and efficient operation of the mill.

2.1 Introduction

Proper installation of the Prater Mega-Mill is critical for efficient and productive operation of the mill. The proper site preparation and placement of the mill and related equipment will insure that the mill operates safely and to its fullest capacity.

The following are important considerations in Mega-Mill installation:

1. **Location.** Make sure the operating location will provide strong, vibration-free base support and allow easy access to all parts of the Mega-Mill. See Section 2.2.
2. **Leveling.** The Mega-Mill must be level and must operate without vibration. Sections 2.3 and 2.4 explain how to check for proper leveling and prevent vibration damage during operation.
3. **Debris Collection.** You must remove foreign matter from the incoming product flow. See Section 2.5.
4. **Air System.** Efficient Mega-Mill operation requires separation of the finished product from the air flow created by the normal grinding process. The method of separation is determined by the type of take-away system used in an installation and, to lesser degrees, the type of product and the fineness of the grind. See Section 2.7.

2.2 Location

The size and weight of the Prater Mega-Mill make the location and proper support of the mill extremely important for both the operation of the mill and safety of mill workers.

There are two essential considerations for Mega-Mill location: the foundation below the machine and the free clearance around it.

2.2.1 Foundation

The Mega-Mill must be placed in a vibration free location and supported by:

- Reinforced steel concrete foundation
- Adequate structural support under floor of unit to prevent oscillation
- Heavy cross bracing if on legs

Mill and motor base may be supplied installed on an optional steel "H" beam base.

2.2.2 Clearance

There should be sufficient open space in all directions around the mill to allow access for changing screens and other maintenance operations. No equipment can be resting on or supported by the mill.

2.3 Leveling

The base of the unit must be level to prevent the following potentially damaging conditions:

- Misalignment of the coupling, mill and motor
- Bending of the rotor shaft
- Bending or twisting of the mill housing or base

Any of these conditions can produce vibrations that will accelerate wear on the hammers and screens and cause possible damage to the Mill.

Before tightening fasteners, check for correct unit leveling at the corners of the mill. See **Illustration 2-1.**

To correct level:

1. Insert shims for proper alignment
2. Re-check level at corners of mill
3. Fill all gaps between the base of unit and floor with grout

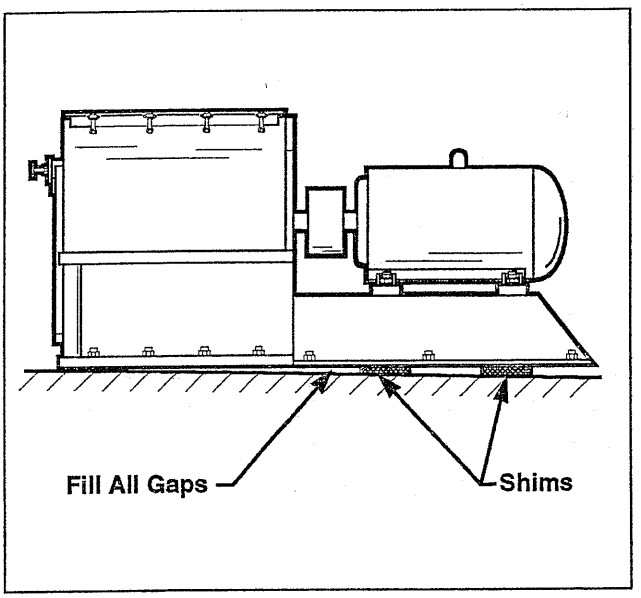


Illustration 2-1.
Pulley Alignment

CAUTION

To prevent damage such as bowing or bending, or to avoid dropping the unit, use proper supports and strong cross-bracing when raising the base of the unit for any reason.

2.4 Vibration

The Prater Mega-Mill is constructed to run without noticeable vibration. Vibration indicates a problem that must be found and corrected immediately. Left uncorrected, vibration will cause the following:

- Mill damage
- Motor damage
- Structural damage

There are several conditions that cause vibration, including:

- Uneven base (See **Section 2.3**)
- Base not contacting floor at all points (See **Section 2.3**)
- Mill and motor improperly aligned
- Loose motor fasteners
- Defective motor or mill bearings (See **Section 5**)
- Other equipment transferring vibration thru contact with mill (See **Section 2.2**)
- Worn, missing, or broken hammers (See **Section 4.4**)
- Deviation from recommended balanced hammer set-up (See **Section 4.4**)
- Material build-up on rotor
- Foreign material in grinding chamber (See **Section 2.5**)

2.5 Foreign Material Collection

The purpose of a collection system is to stop foreign elements that the mill cannot grind from entering the grinding chamber. Damage (broken hammers, ripped screens, etc.) will result if foreign material gets into the grinding chamber. Foreign material entering the grinding chamber will not exit through the screens; such material will have to be extracted by hand.

2.5.1 Magnet

A magnet will catch most ferrous material. The magnet may be built into the inlet, but for maximum protection, an additional, easily cleanable, magnet should be incorporated into the system prior to the mill. To insure against damage, take every precaution to keep foreign materials out of the grinding chamber.

A clean magnet will catch metal debris that may cause fires or damage to:

- hammers
- screens
- grinding chamber

Removing debris is important for the magnet to perform to its fullest. When installing the mill, leave adequate access to the magnet for easy cleaning.

If a self cleaning magnet is supplied with the mill, it has to be made sure that the mill is stopped before the magnets are cleaned, this helps to maintain safety regulations and prevents metal from falling into the rotation elements.

2.5.2 Additional Separation

If other foreign materials that a magnet will not catch, such as glass, aluminum, rocks, etc. are contained in the product, additional separation is needed to maintain suitable screen, hammer, and rotor life.

Leave adequate access to the material collection system when installing the mill. See **Section 2.2.**

Remove debris from the collection system before starting the mill to prevent plugging of screens. A plugged screen will lower capacity as well as reduce the effectiveness of the collection system.

2.6 Inlet and Discharge Isolation

The inlet and outlet connections should be separated from the body of the mill. Use a soft rubber gasket or other pliable material to isolate the inlet and discharge area of the mill from the feeding and discharge chute or hopper.

Separate the inlet and outlet sections from the body of the mill with a minimum metal to metal separation of 1/4 inch.

2.7 Air Relief

Allow a sufficient amount of unrestricted air (See **Section 2.7.1**) to enter and exit the machine to achieve maximum capacity. The mill cannot achieve full capacity without the correct volume of air.

Vent or set up the following with an air relief system that allows for proper air flow:

- Feed inlet (if the spouting or feeding device is built to prevent or restrict airflow)
- Bins
- Conveyors
- Bucket elevators

2.7.1 Air Relief Requirements

Table 2-1 lists the air relief requirements for the various Mega-Mill models

Table 2-1
Air Relief Requirements

MODEL	RPM	CFM
MM-5	3600	500
MM-9	3600	1000
MM-18	1800	1500
MM-36	1800	3000

WARNING **Inadequate air relief will cause the machine to release dust into the surrounding atmosphere. Dust suspended in the air can be highly explosive and personally hazardous. If inhaled over long periods of time, this dust can cause serious respiratory or internal disorders.**

To prevent the release of dust into the atmosphere surrounding the mill, maintain:

- Proper negative air relief
- A good dust collection system

2.7.2 Air Disposal

Air flow generated by the rotor of the grinder and air passing through the mill must be relieved. A different method of air relief is used for each method of conveyance of finished product from the mill. The systems shown here are only to remove this expanded air, NOT for air conveyance of the finished product. The two methods of ground product disposal are:

- Mechanical System
- Negative Air System

2.7.3 Mechanical System

(gravity discharge mill)

This system is the most common. Usually, a screw conveyor or a bucket elevator is used as the mechanical transfer device. Even with this system, there must be sufficient volume of air passing through the mill to allow proper milling and to achieve rated production capacity.

For a typical mill with a tip speed of 10,000 feet per minute (FPM), properly sized air vents in bins or bucket elevators are normally adequate. For milling dusty materials or for tip speeds in the range of 20,000 FPM, Prater recommends an air relief system mounted on a plenum (expansion) chamber built over the discharge conveyor. See **Illustration 2-2** for a typical installation.

2.8 Feeding

A uniform constant feeding process is essential for best performance. Therefore the use of a volumetric feeder is recommended, if not fed by gravity only.

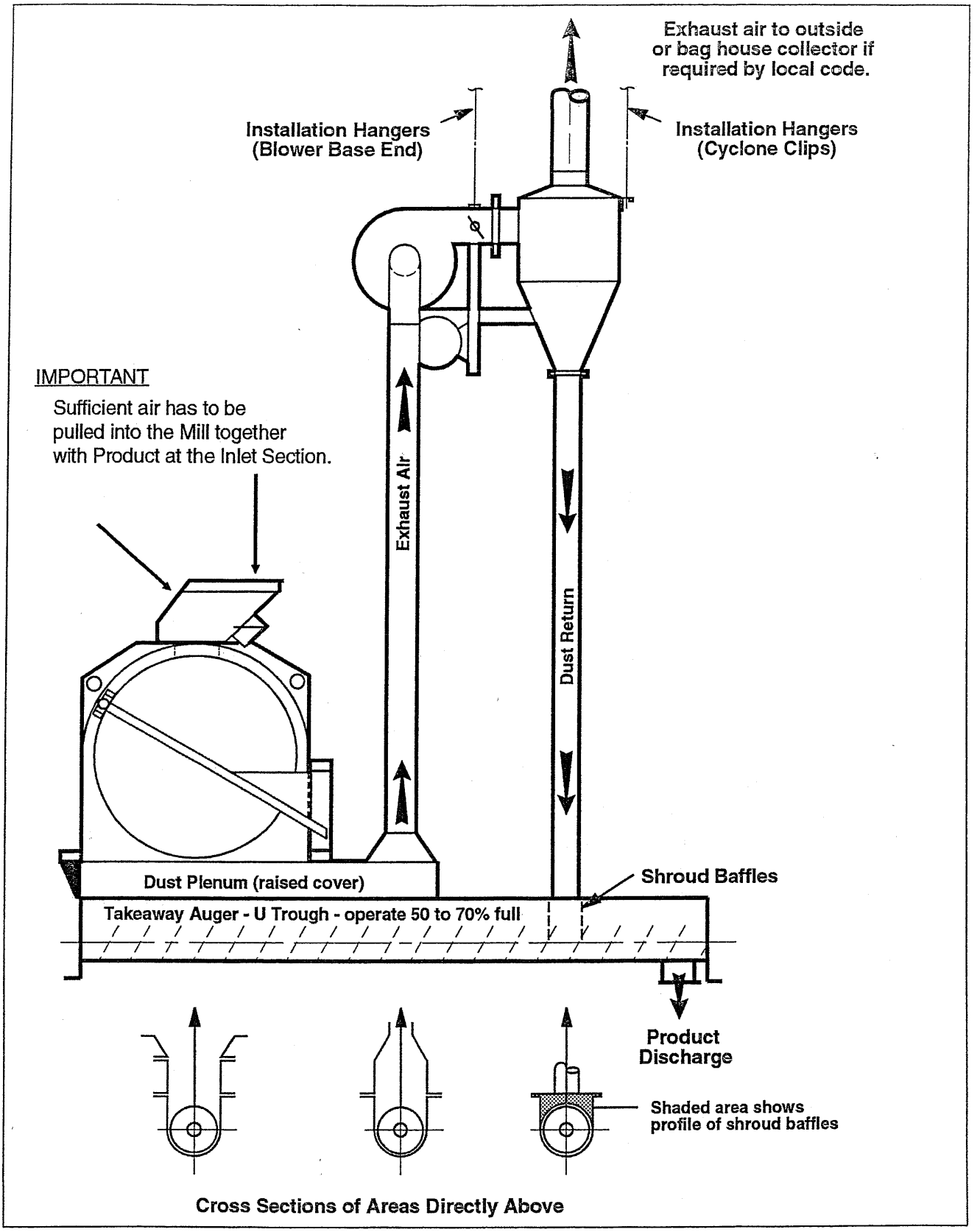


Illustration 2-2
Mechanical Air Handling System

2.8.1 Negative Air System

A negative air system requires a greater volume of air than a mechanical system. The amount of air necessary is determined by the requirements of the air conveying system plus the air relief on the mill itself. Any dust created will be handled by the dust control apparatus of the negative air system.

2.9 Air Flow

The production efficiency of the Mega-Mill depends upon two interrelated factors: the speed of rotation and the amount of airflow. You must establish the airflow requirements with the milling rotor running but without product feed. Maintain the airflow constant at the volume stated in machine specifications during all normal operating conditions.

The speed of the mill rotor and the selected screen assembly will determine the fineness of the product leaving the machine.

2.9.1 Air Volume Checks

To allow frequent, accurate checks of airflow, mount permanent measuring devices in the clean air side of the system. At least one measuring device should be within the clean discharge airstream or between dust-collector and main blower.

Obtaining accurate readings on air flow depends upon choosing the right check point. Select a checkpoint that is two to three feet away from bends, inlets and outlets, valves, or other obstacles in duct work. Pitot tube readings should be taken near the center of ducts, away from side turbulence.

Daily checks on the proper air volume ensure a safe performance of the system. Checks are also necessary if:

- Feed product is changed.
- Rotor speeds are changed.
- Screen assembly is changed.
- The system is started after a long shut-down.

A permanently mounted pitot in a clean-air duct is a common method used to check the velocity pressure of air passing through a pipe. The **Appendix** section of this manual outlines a measuring device using a simple U-shaped glass tube filled with water and marked with inch scales to allow direct pressure readings in water column inches. The **Appendix** also contains a conversion table listing air volumes for various pressure readings and duct diameters.

2.10 Electrical Requirements

Install connections to meet all national and local electrical codes. Consult with your local power company before installation.

NOTE The National Electrical Code requires a manually operable disconnect switch located within sight of the motor, or a controller disconnecting means capable of being locked if not within sight of the motor.

Effective October 31, 1989, OSHA requires that all energy disconnect devices be capable of accepting a lock-out/tag-out device. This requirement is mandatory for any new equipment being installed or for replacement, repair or modification of older equipment. The employer must:

- Produce a written program explaining the procedure
- Conduct an annual inspection to verify compliance
- Provide documented employee training in these procedures

The Prater Mega-Mill may be started "across the line" if such a procedure is acceptable to your local power company. In order to limit overload on the power supply, larger motors may require reduced voltage starters to "soft start" motors in many areas.

2.10.1 Electrical Interlocking

As a general guide, the last piece of process equipment is started first with subsequent starts working up to the mill.

CAUTION **A time delay is always required between start-up of the mill and start up of the feeder, to allow mill to reach full operating speed before product is introduced.**

2.11 Coupling Installation Instructions

WARNING **Because of the possible danger to person(s) or property from accidents which may result from improper use or installation of products, it is extremely important to follow the proper installation and operational procedures.**

- All rotating power transmission products are potentially dangerous and can cause serious injury. They must be properly guarded in compliance with OSHA standards for the speeds and applications in which they are used. It is the responsibility of the user to provide proper guarding.
- Failure to secure capscrews properly could cause coupling component(s) to become dislodged during operation resulting in personal injury.

STEP 1:

Inspect both driving and driven shafts and hub bores making sure they are free from dirt and burrs. Be sure the keys fit shafts properly. Mount both hubs to the shafts securing only one hub; the other hub should be loose for minor adjustment of spacing. Where tapered bushings are used, follow bushing manufacturer's instructions, if hub is bored for an interference fit, we recommend heating the hub in water, oil bath or an oven and quickly positioning it on the shaft. Do not spot heat hub as it may cause distortion.

STEP 2:

Place half of the elastomer element around hubs and secure with self-locking capscrews. The elastomer element will space the other hub. It is important to have capscrews properly tightened. See Table 2-2 for recommended capscrew torques and instructions. Now secure the other hub.

Table 2-2. Capscrew Torques

Max. HP	Ft. Lbs	Nm
30	17	23
100	30	56
300	75	100

STEP 3:

Mount other hub of the elastomer element to hubs. Be sure to secure rings to the spacer element if provided. Tighten all capscrews to the recommended capscrew torques in Table 2-2 and you're done!

Spacer coupling installation is shown; the same procedure applies for the standard design coupling.

IMPORTANT Capscrews have self-locking patches which should not be reused more than twice.

Capscrew can be further used with application of a thread-locking adhesive.

Do Not Lubricate Capscrew threads.

Allowable Shaft Engagements

Shafts can be flush with the hub (not shown), recessed below the face of the hub, or extended beyond the hub face.

CAUTION **Do not start motor or jog without the complete coupling being properly secured to driving and driven equipment shafts.**

Equipment Alignment

Coupling alignment is directly related to equipment and coupling life

Although Omega couplings can withstand gross misalignment, care should be taken for best possible alignment to assure optimum performance. The calipers straightedge alignment procedure is described below. If greater alignment accuracy is desired, a dial indicator method is recommended. There are occasions when equipment manufacturers require more specific alignment tolerances, in which case the manufacturer's recommendations should be followed.

1. To correct for angular misalignment, use calipers to check the gap between hubs. Adjust or shim equipment until the gap is the same at all points around the hubs.
2. To correct parallel offset, place a straightedge across the hub flanges in two places at 90° to each other. Adjust or shim equipment until the straightedge lays flat on both sides.
3. Tighten down connected equipment and recheck alignment.
4. Install elastomer element, lightening all capscrews to the values shown in Table 1 as described on the reverse side.
5. If practical, recheck and tighten capscrews after several hours of operation.

SECTION 3
MEGA-MILL OPERATION

This section describes machine operation and procedures to follow before starting the mill.

3.1 Introduction

Pre-run inspections and safety checks throughout operation insure that the mill is in proper operating condition. Other aspects of operation covered in this section include: start-up and shut-down sequence, motor rotation, and the inlet diverter.

3.2 Pre-Run Inspection

Before starting the Mill, check the following:

- The inside of the mill for foreign material, i.e., nuts, bolts, wire.
- The magnet or other collection device for any accumulation of debris.
- The couplings for proper alignment.
- The inspection doors to see that they are closed and properly secured.
- The electrical starting equipment, meters, disconnect switches, and other control devices to insure that they are clearly visible and readily accessible.
- The guards to see that they are properly mounted.

3.3 Start-Up Sequence

This start-up sequence is intended as a general guide. The start-up sequence you use will depend on your specific operation and any unique characteristics of your installation.

As a general guide to electrical interlocking, you turn on equipment in reverse order from product flow. The fan providing air flow is usually started first followed by outlet equipment, the Mill, and the input equipment. The device that feeds product into the system will be the last piece of equipment to be started.

CAUTION **A time delay is always required between start-up of the mill and start-up of the feeder to allow the mill to reach full operating speed before product is introduced.**

Here is a start-up check list:

1. Start each piece of equipment, beginning with the fan.
2. Check each motor as it starts for proper rotation and proper amperage.
3. Check interlocks to make sure they are working and in the proper sequence.
4. After all the equipment except the feeder has been started, check for proper air flow and pressure readings. (See **Section 2.8.**)

When all equipment is running properly, continue the start-up sequence:

5. Begin product feed into the system at a low rate (always less than 50% of full rated capacity).
5. Check product for desired fineness.
7. Slowly increase feed to its maximum load condition (amperage). The maximum load for your motor is stamped on the motor nameplate. Use the amperage listed for the voltage you are using.

CAUTION **Load reading on your ammeter should never exceed the value stamped on the motor.**

NOTE Under some circumstances, full load amperage may not always be attained. Due to the nature of some products, screen plugging may occur before full load conditions are reached.

8. Re-check the fineness of the material and the capacity after reaching the maximum load condition.

WARNING **Do not open mill or attempt any form of inspection until the mill has come to a complete stop and the electrical disconnect has been locked into the open position.**

3.4 Shut-Down Sequence

For a typical Mega-Mill operation, the shut-down sequence will simply be the reverse of the start-up sequence. Check that you do not have special considerations in your installation that require different procedures. Here is the typical shut-down sequence:

1. Stop the product feed into the mill.
2. Stop other inlet equipment.
3. Stop the mill.
4. Stop outlet equipment.
5. Stop fans.

3.5 Rotation

To equalize wear on the hammers and/or screens, the rotation of all Prater mills can be reversed. The mills can be reversed by either changing motor leads or using an electrical reversing switch.

CAUTION **Change the position of the inlet diverter to correspond to the direction of the mill's rotation. See Section 3.6.**

3.6 Inlet Diverter

The purpose of the inlet diverter is to keep material and air from exiting the mill through the inlet. The position of the inlet diverter is determined by the rotation of the mill. See Illustration 3-1

Remember to correctly reposition the diverter when changing direction of the mill.

If the diverter is not properly positioned, the product will not feed properly and Mill capacity will be reduced.

WARNING **Do not attempt any maintenance until mill has come to a complete stop and electrical disconnect is locked in the open position.**

To change position of the diverter:

1. Loosen set screws on both sides.
2. Reposition diverter to opposite side.
3. Tighten set screws into locking holes on side plate.

When operating with very high capacity or very coarse grind, the diverter may be left out to increase flow. The amount of flow keeps the material from going back out the inlet making the diverter unnecessary in these situations.

OPTIONAL:

The diverter is also available as a device which can be operated from the outside. (Adjusted to clockwise or counterclockwise rotation).

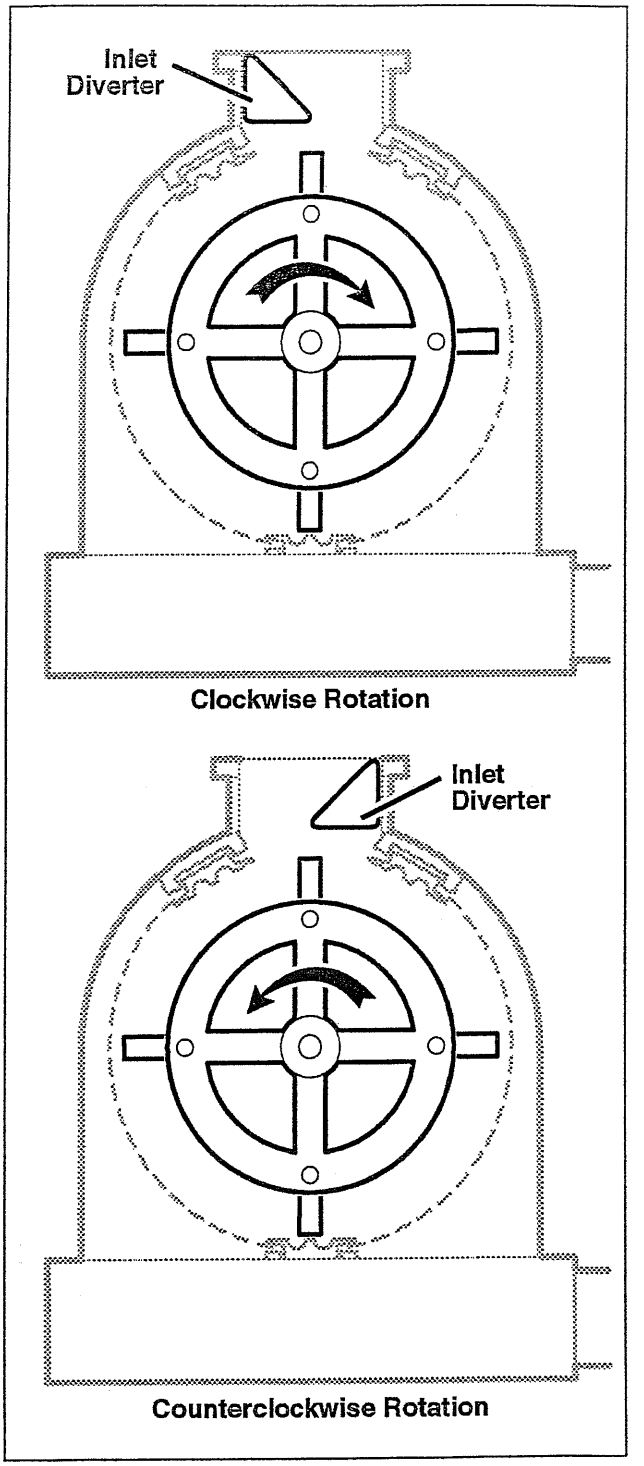


Illustration 3-1
Inlet Diverter Positioning

NOTES

SECTION 4
MAINTENANCE

This section describes the general maintenance and replacement procedures for the Prater Mega-Mill

4.1 Introduction

The Mega-Mill is designed to operate with little maintenance. Routine inspections and regular maintenance will identify any worn or broken parts before they become a problem. Worn or broken parts are damaging to the mill and its output. When operated without vibration or foreign materials entering the grinding chamber, only those parts subject to the heaviest wear, i.e. hammers, screens, and screen dividers will require maintenance.

WARNING

Do not open mill or attempt any form of inspection until the mill has come to a complete stop and the electrical disconnect has been locked in the open position.

4.2 Routine Inspection

Regular inspections are required to give advance warning of a problem. The simple, yet rugged, design of the Mega-Mill provides easy access for maintenance, cleaning, and service.

To decrease down-time, regularly inspect the machine and output. The output of the mill as well as regular inspections will determine when screens and/or hammers should be replaced, as well as give advance warning of a problem.

Maintain an inventory of standard wear items such as hammers, screens and screen dividers.

Regularly check and remove debris from magnets or other foreign material collection systems. If the magnet or other collection system is dirty it could allow damaging materials to enter the grinding chamber, as well as decrease the amount of material flowing into the mill. The magnet or collection system should be cleaned before each start up. If you find a large amount of foreign material getting into the grinding chamber or a product that is prone to contamination, you may need to clean the magnet or collection system more often.

4.3 Screens

The screens control the particle size of the final product. Inspect and clean the screens frequently to maintain the desired output. The screens may require re-rolling, interchange, or replacement if they are showing signs of wear. Worn screens cause:

- Lower capacity
- Increased power costs
- Non-uniform final product
- Coarser output

To check for signs of wear, visually inspect the output of the product as well as the screens themselves. Look for:

- Coarse final product
- Lower capacity
- Worn edges of the screen holes (rounded) See **Illustration 4-1.**
- Oval shaped screen holes See **Illustration 4-1.**

Excessive wear to screens can be caused by:

- Extremely abrasive product
- Extremely fine product
- Excessively high feed rate
- Incorrect divider-to-hammer clearances (See **Section 4.5** for instructions on this critical clearance.)
- Foreign material in the grinding chamber

When screens show signs of uneven wear consider these options to extend the life of the screens:

1. Reverse the rotation of the motor if one side is getting more wear than the other.
2. Turn screens around if there is uneven wear from front to back or side to side.
3. For screens with punched round holes, you can re-roll the screens to put the sharp edge on the inside and the worn edge on the outside. (Special screens that have formed holes rather than punched holes cannot be re-rolled.)

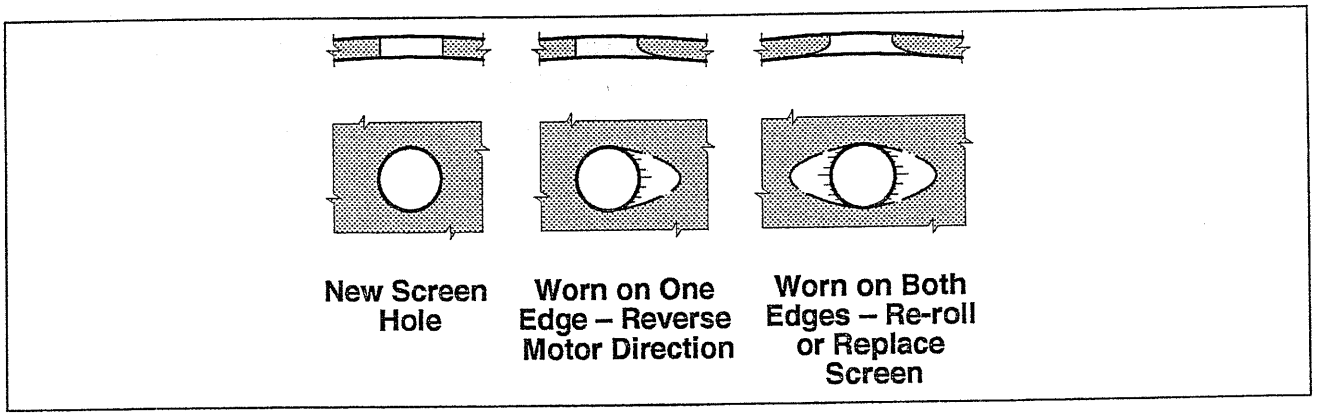


Illustration 4-1
Signs of Screen Wear

4.3.1 Screen Replacement

(See Illustration 4-2)

To remove worn screens:

1. Turn off the mill and allow mill to come to a complete stop.
2. Disconnect and lock out electrical power to the mill. See **Section 2.9** for electrical requirements
3. Open mill front access door.
4. Unlock quick release clamps (at top left and right of mill inlet).

NOTE The bottom screen divider is NOT adjustable.

5. Slide screens out through access door.

To insert new screens:

Reverse steps 1 through 5 above.

Firmly seat new screens in lower (fixed position) screen divider before tightening upper screen dividers.

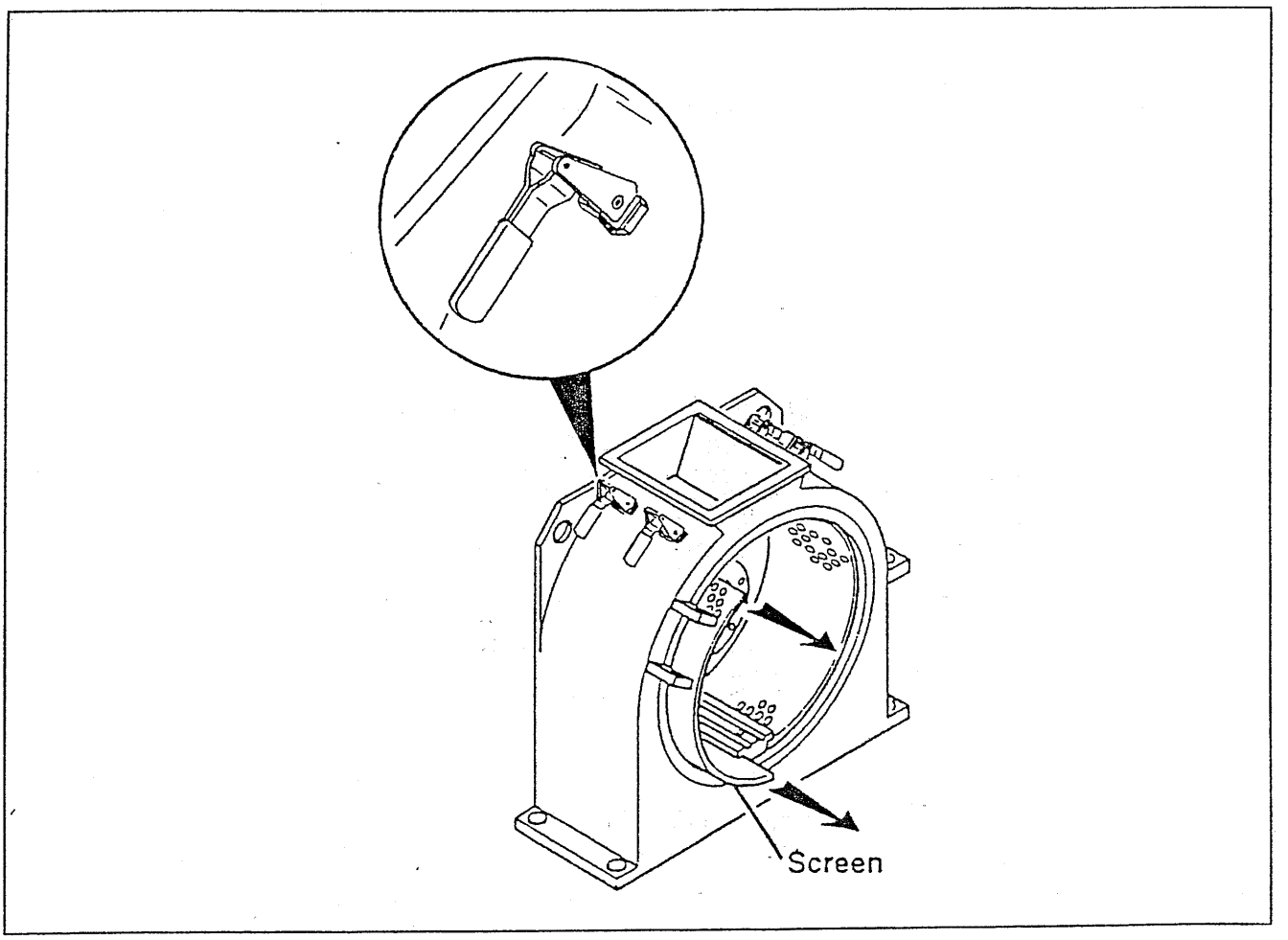


Illustration 4-2
Screen Replacement

4.4 Hammers

Prater supplies a wide range of grinding devices to meet virtually every milling need including swivel hammers, rigid hammers, and knife blades. All hammers are pre-weighed and shipped as balanced groups, and may be bench assembled since they need no additional balancing.

Hammers will wear, but should not break under normal operating conditions. Check the hammers in the mill frequently for wear. Worn hammers can result in:

- Vibration
- Coarser output
- Increased motor amperage
- Lower capacity

To check for signs of wear, visually inspect both the product output and the hammers themselves. Signs of wear include:

- Edges worn to over 1/2" on both sides **See ¥Illustration 4-3**
- Decreased output
- Coarser output

Mill output is the most important consideration for determining when hammers should be replaced. When the fineness of the product is not being achieved or the output is decreased, worn hammers could be the cause. Excessive wear to hammers may be caused by:

- Extremely abrasive product
- Extremely fine product
- Excessively high feed rate
- Foreign material in the grinding chamber

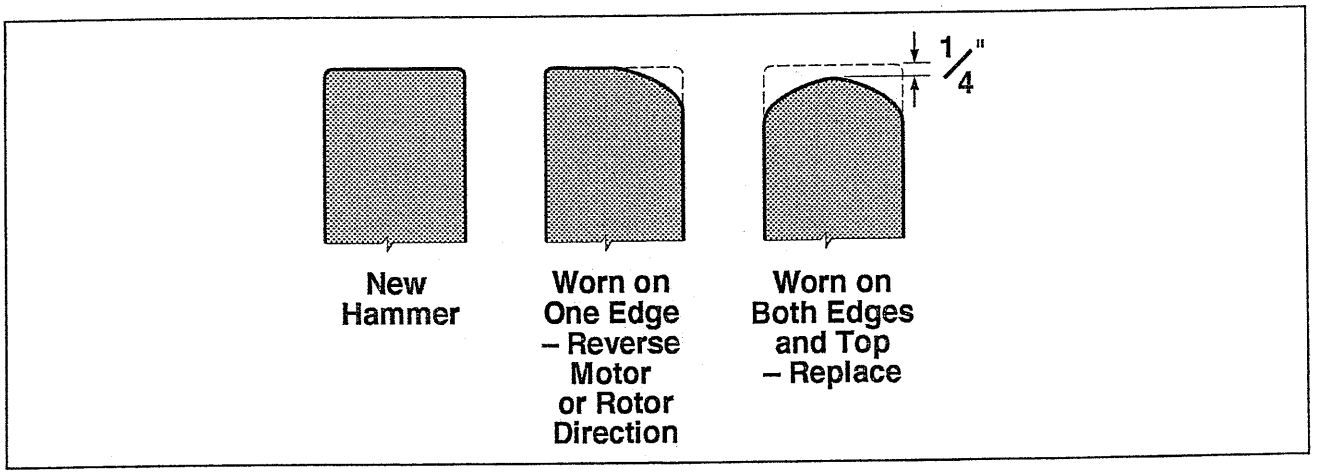


Illustration 4-3
Signs of Hammer Wear

4.4.1 Hammer Replacement

(See **Illustration 4-4** and the main exploded view illustration)

When replacing hammers due to wear, always replace a full set. If replacing a hammer because of breakage, also replace an opposing hammer to maintain balance. Never replace one hammer.

As **Illustration 4-4** shows, you can replace hammers without removing the rotor assembly from the mill.

To remove worn hammers:

1. Remove screens (See **Section 4.3.**)
2. Remove pin cover washers and screws on front rotor ring. (The end of each pin has been drilled and tapped to allow attachment of a pulling tool.)

NOTE Before disassembly, check the configuration of the hammers on your mill to insure correct reassembly. Bench assembly will make hammer replacement quicker and easier.

3. Remove support pins one at a time. Slowly pull each support pin out while holding the rearmost hammer assembly until the assembly drops free. Remove each hammer assembly from the mill. Repeat this until all assemblies have been removed from that pin; then go on to the next support pin.
4. Remove the hammer pin from each hammer assembly. Slowly pull the hammer pin while catching the spacers and hammers as they drop free.

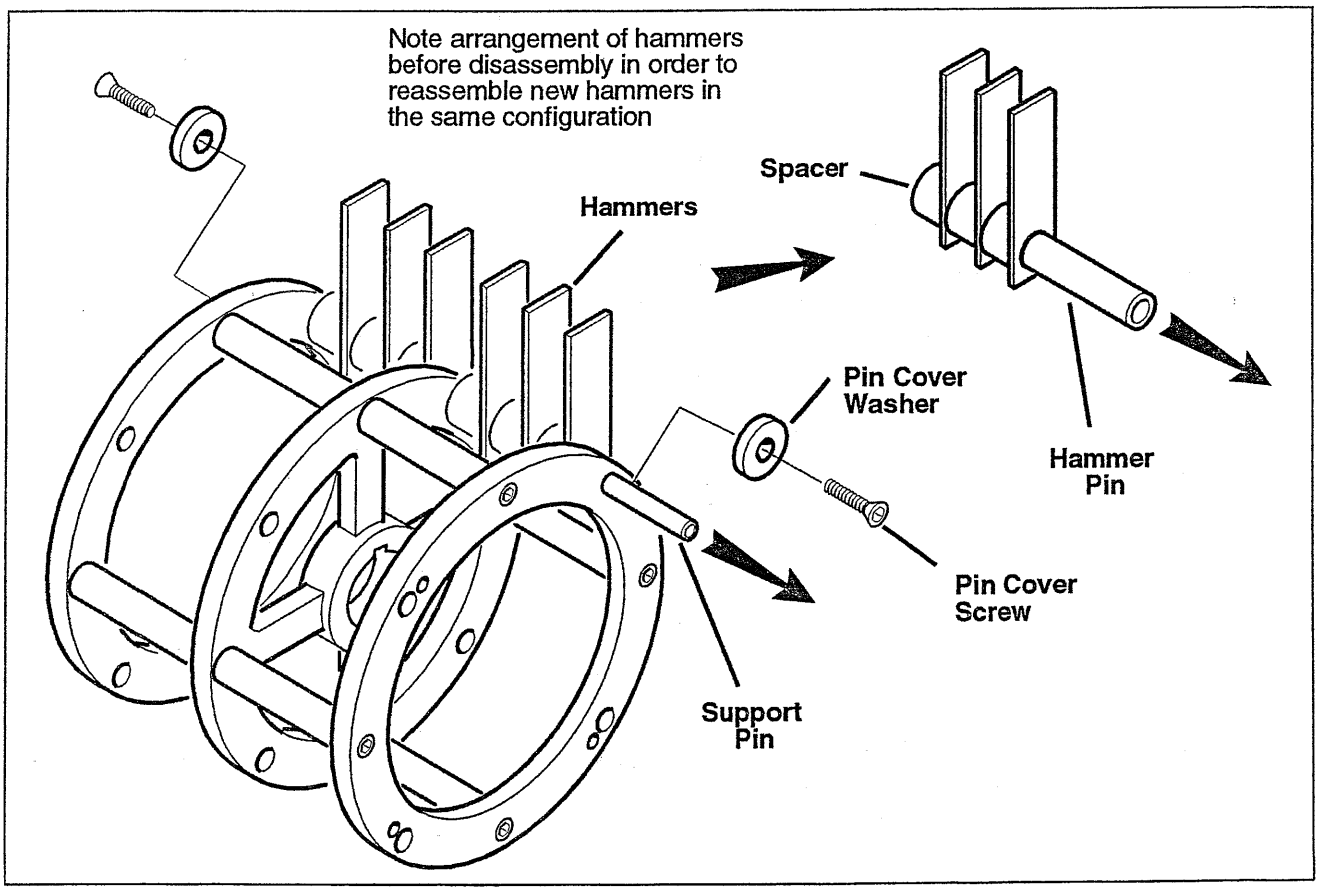


Illustration 4-4
Hammer Removal

To Install hammers:

CAUTION **Always reassemble hammers to match original configuration. Use balanced sets of hammers to prevent vibration.**

1. Reassemble spacers and new hammers on hammer pins, in the original configuration, to make-up new hammer assemblies.
2. Insert support pin through rotor ring and through each new hammer assembly. Start with front assembly and continue until the last hammer assembly is in position.
3. Lock pin in place from both ends with pin cover washer and screw. Repeat this procedure for all support pins.
4. Measure hammer to screen divider distance at each location. All hammers must be an equal distance from the screen dividers. See **Section 4.4.2**

4.4.2 Hammer To Screen Divider Measurement

Measure from the corner of the hammer to the face of the screen divider while holding the hammer at an angle. See **Illustration 4-5**. All hammers must measure the same distance from all dividers. For new hammers, the minimum clearance is 5/32" at each divider.

Hammers come in balanced sets. If they do not measure the same distance all the way around the rotor, the screen dividers may not be centered. Call your Prater representative if you encounter difficulties.

CAUTION **Do not mix hammers from different bundles. This will cause vibration. If hammers are shipped loose or are mixed, balance the hammers in sets of 4 or 5 to within 1 1/2 grams.**

4.5 Screen Dividers

The screen dividers hold the screens in place as well as deflecting material back into the path of the hammers for more efficient grinding. Screen dividers are normal wear parts that occasionally need replacement. The top screen dividers that tighten to hold the screen in place are adjustable. The bottom retaining divider is not adjustable. The bottom divider may be removed for replacement but should never be tightened or loosened to accommodate a screen.

Always indicate your Mega-Mill serial number when ordering screen dividers.

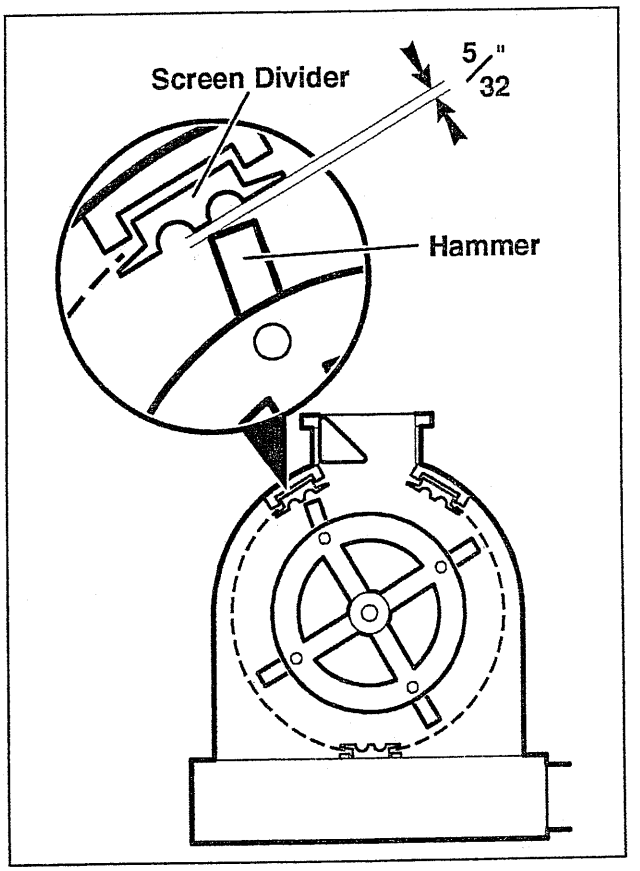


Illustration 4-5
Hammer/Screen Divider Measurement

4.6 Bearings

The mill is equipped with precision ball bearings which are permanently greased and sealed and need no regreasing.

Once the bearing lifetime is over, the bearings simply have to be replaced (See **Section 4.7**).

Regularly performed inspection will indicate the condition of the bearing next to the rotor.

4.7 Bearing Assembly

After the rotor is taken out, the bearing cover disc and the inner bearing cover can be removed.

Also the coupling on the motor side of the shaft has to be disconnected.

The shaft can now be pulled out towards the door, exposing both bearings.

The rear bearing (motor side) is smaller in diameter than the front bearing (rotor side) which should make the disassembly very easy. After bearings have been inspected or replaced eventually, the smaller bearing should be tightened on to the shaft using the SKF washer and SKF nut. Now the shaft with both bearings is moved into the bearing housing, until the outer race of the larger bearing touches the shoulder inside of the bearing housing.

The front bearing has to be locked in place by bolting the inner bearing cover to the bearing housing. Now it has to be checked and made sure that there is a clearance gap (about .04") between the flange of the inner bearing cover and the bearing housing.

The bearing cover disc is held in place by the rotor securing screw.

NOTES

TROUBLESHOOTING

This section covers the more common day-to-day operating problems for the Prater Mega-Mill. Possible causes are listed along with their suggested solutions.

5.1 Introduction

This section is offered as a general guide to analyzing problems. If after reviewing this section you have not identified your problem, contact a Prater representative for further assistance.

5.2 Excessive Vibration

Excessive vibration is an indication that something has changed and needs correction. Stop mill and inspect.

WARNING

Do not open mill or attempt any form of inspection until Mill has stopped all motion and the electrical disconnect has been placed in the open position and locked with a key lock. Never attempt to assist mill slow down by any means mechanical or otherwise.

Symptom	Possible Cause	Suggested Solution
Final product is too coarse.	1. Improper screen size	1. Install proper screens.
	2. Worn or damaged screens.	2. Rotate or replace screens.
	3. Feed rate too high	3. Adjust to proper feed rate.
	4. Improper air flow.	4. Correct or adjust air flow.
	5. Worn hammers.	5. Rotate or replace hammers.
	6. Improperly installed screens.	6. Install screens properly.
	7. Feed product change. a. moisture b. size c. fat content d. chemical differences	7. Inspect feed product and adjust system as required.

Symptom	Possible Cause	Suggested Solution
Final product is too fine	1. Improper screen size.	1. Install proper screens.
	2. Screens blinding a. hygroscopic material b. heat sensitive material c. high moisture d. high fat content	2. Clear screens and check feed product. Contact your Prater representative if further assistance is required.
	3. Air flow too low a. duct restricted b. dust collector plugged c. blower damper closed d. filters dirty e. blower drive belt slipping	3. Adjust to proper air flow a. Remove restriction b. Clean dust collector c. Open blower damper d. Replace filters e. Retension belts
Low capacity.	1. Screens worn a. abrasive product b. fibrous product c. tramp materials	1. Rotate or replace screens.
	2. Screen size too small.	2. Install proper screens.
	3. Improper air flow.	3. Adjust to proper air flow.
	4. Non-uniform feed causing fluctuating mill motor amperage of more than 10%.	4. Correct feed to mill, feed must be smooth and non-pulsating.
Excessive mill vibration.	1. Missing, broken, damaged or worn hammers.	1. Replace damaged or broken hammers. Replace all if worn.
	2. Material build-up in rotor.	2. Clear rotor of obstruction.
	3. Foreign material in grinding chamber.	3. Remove foreign material - inspect magnet and collection system.
	4. Mill or motor shaft bent.	4. Replace shaft and related parts.
	5. Bad bearings.	5. Replace bearings.
	6. Hammers locked under pin.	6. Free hammers, check for damage.
	7. Coupling misalignment.	7. Readjust coupling.
	8. Loose base bolts.	8. Tighten bolts to original torques.
	9. Improper hammer pattern.	9. Install hammers correctly.
	10. Worn screen clamps.	10. Replace screen clamps.
	11. Weak base structure.	11. Provide adequate base structure.
	12. Material build-up on rotor.	12. Clean rotor.

Symptom	Possible Cause	Suggested Solution
Excessive Wear.	1. Product very abrasive.	1. Contact your Prater representative.
	2. Product too fine.	2. Contact your Prater representative.
	3. Feed rate too high.	3. Adjust feed rate to proper level.
	4. Product contaminated with foreign matter.	4. Clean product.
Bearing Failure.	1. Improper coupling alignment.	1. Align coupling properly.
	2. Excessive grease in bearing.	2. Clean & grease bearing or replace.
	3. Inadequate lubrication.	3. Grease bearing.
	4. Foreign materials in bearings.	4. Clean & grease bearing or replace.
	5. Improper bearing alignment.	5. Install bearing properly.
	6. High vibration.	6. Correct vibration problem.
	7. High ambient temperature.	7. Use high temperature grease.

5.3 Mill Data

If problems cannot be diagnosed by using the Troubleshooting Guide, contact your Prater representative. Before calling for assistance, collect the data listed below. This information is essential in establishing the cause of problem conditions and determining solutions.

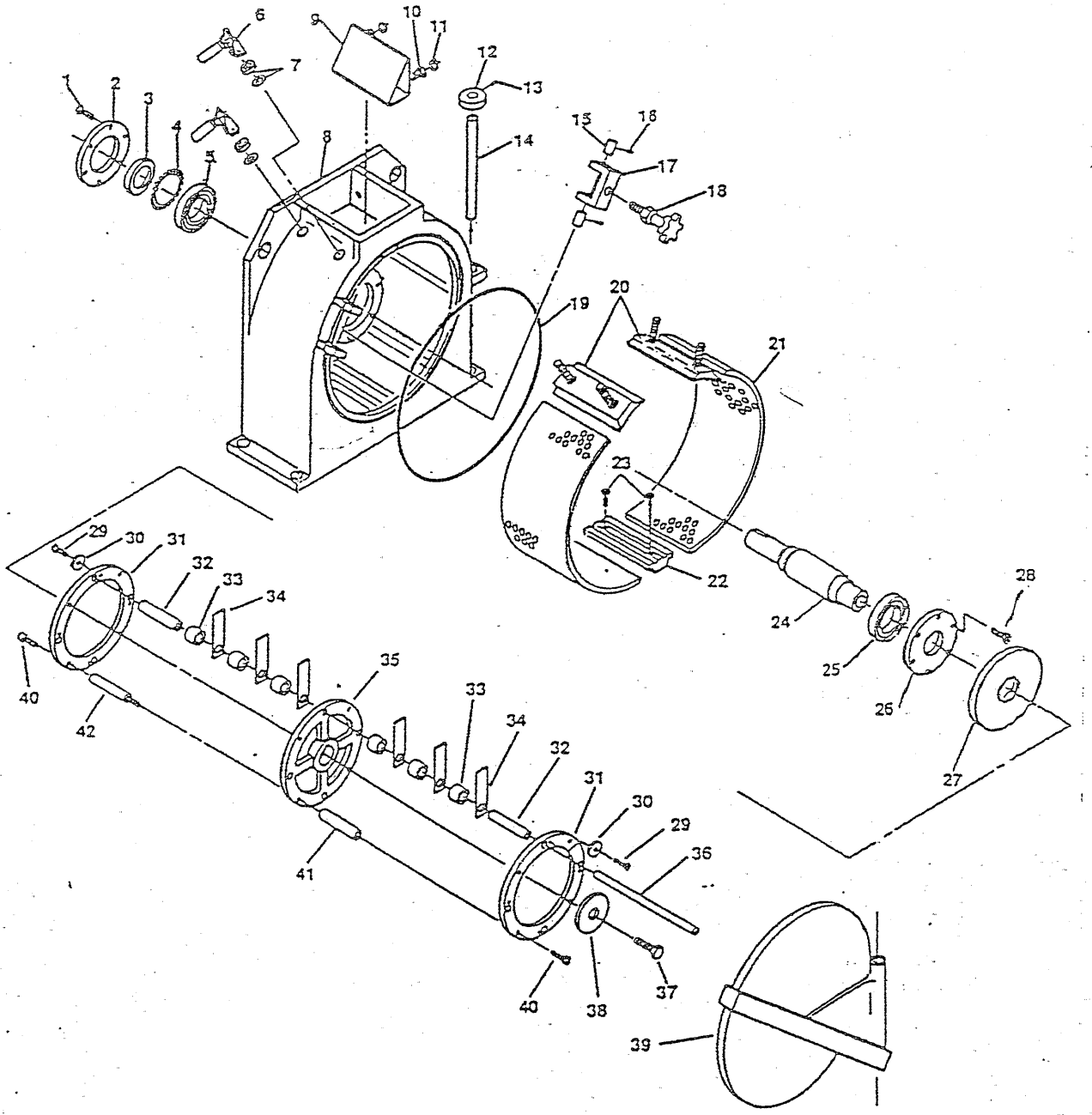
1. Size of mill
2. Perforations of screen
3. Motor horsepower
4. Idle amperage
5. Amperage with product load
6. Capacity at full load
7. Fineness analysis of fee and ground product — anticipated and actual — moisture content
8. Problem — requirements of product
9. Air flow and static pressure — ahead and behind mill
10. Blower motor amperage with and without product (if used)
11. RPM of mill
12. Direction of rotation and location of inlet diverter

NOTES

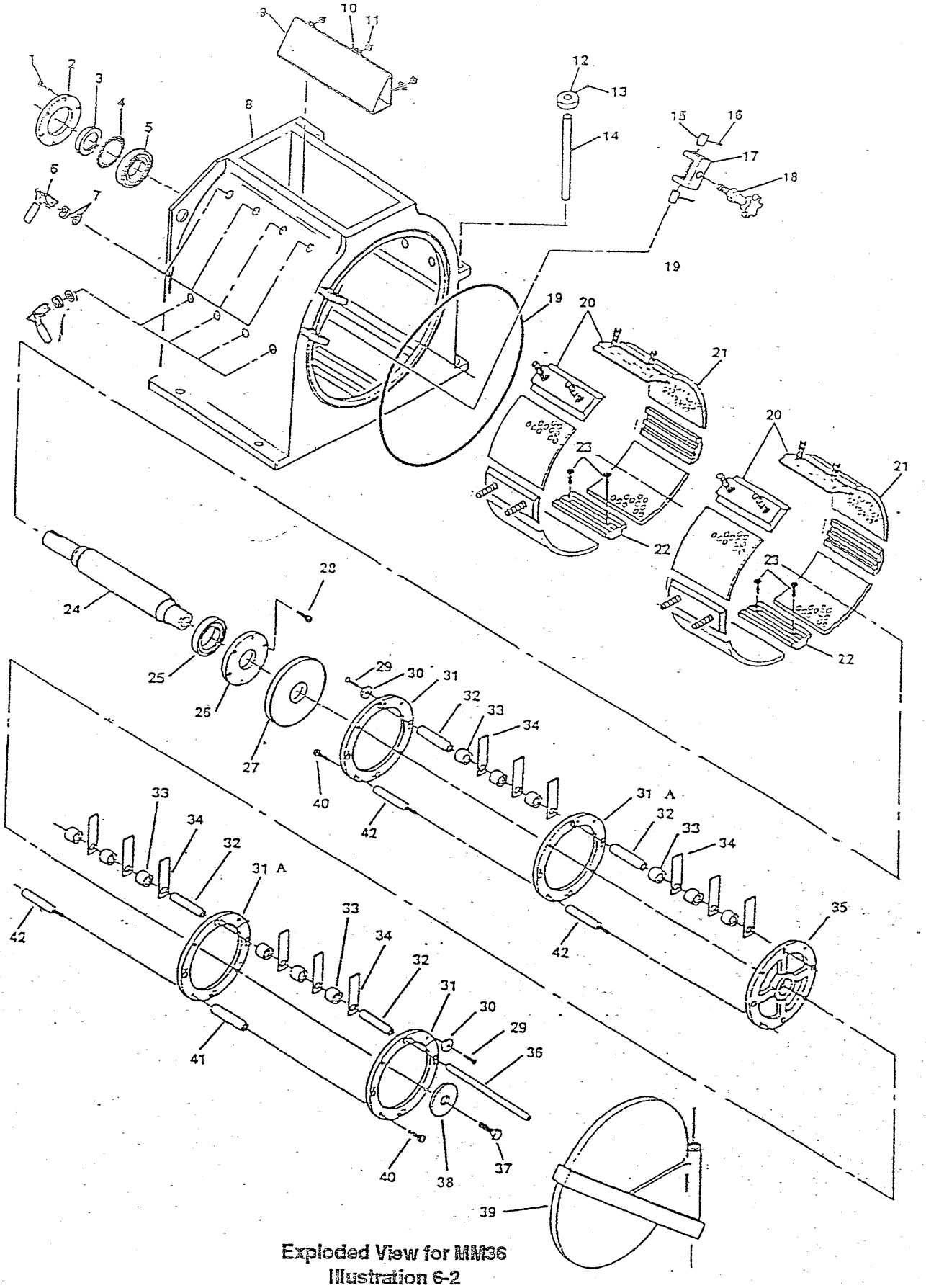
SECTION 6 PARTS LIST

1. Screw, (Outside Bearing Cover)
2. Outside Bearing Cover
3. Lock-nut
4. Lock-washer
*5. Ball Bearing, (Drive Side)
6. Quick Release Screen Clamp
7. Belleville Washers
8. Mill Housing
9. Diverter
10. Locknut, (Diverter)
11. Lock-washer, (Diverter)
12. Olite Bearing
13. Set Screw
14. Door Hinge Pin
15. Door Lock Bushing
16. Set Screw
17. Door Lock
18. Hand Knob
*19. Door Gasket
*20. Top Screen Divider
*21. Screen
*22. Bottom Screen Divider
23. Bottom Screen Divider Bolt
24. Mill Shaft
*25. Ball Bearing (Mill Side)
26. Inner Bearing Cover
27. Bearing Cover Disc
28. Screw, (Inner bearing Cover)
*29. Retaining Screw
*30. Retaining Washer
31. End Disc
31A. Carrier Disc (MM9 & M36 only)
*32. Hammer Pin
*33. Spacer
*34. Hammer
35. Main Rotor Disc
*36. Support Pin
37. Bolt, (Rotor Lockup)
38. Washer, (Rotor Lockup)
39. Mill Door
40. Screw, (Rotor Spacer Pin)
41. Rotor Spacer Pin
42. Rotor Spacer Pin

*Recommended parts to stock to minimize down time especially on a 24 hrs a day 7 days a week operation.



Exploded View for MM5, MM9, MM18
Illustration 6-1



Exploded View for MM36
Illustration 6-2

APPENDIX A
MILL MONITOR

Data Sheet VS Unit

mGard is the ultimate range of robust mechanical trapped key products. Trapped key technology offers purely mechanical access locks (removing the need for expensive wiring). mGard offers an extensive variety of modular interlocking solutions.

Description:

The VS unit measures the regenerative voltage produced by a motor and prevents removal of the gate key until the machine has come to rest. It is typically used to ensure a trapped key sequence can only begin when the machine has come to rest. The VS unit is used where there is a 'run down period', such as mixers or high inertia roller systems. Once the key is released, the machine cannot be re-started until the gate key has been returned. The VS unit is a combination of an independently certified 'Back EMF' unit, a safety relay and a solenoid controlled lock.

The lock also has a positively guided rotary switch fitted to it and a lamp indicates when the gate access key can be removed. The VS unit is particularly useful in situations where there is a variable rundown period or where the use of an electronic timer would introduce inefficiencies. The VS unit is housed in a Polycarbonate enclosure and sealed to IP65.

The VS unit monitors the supply lines to the motor. It is designed to detect shorts or open circuits on each input line. On request the sensitivity threshold can be altered to operate with non standard motors. A single phase version is available on request. A security label is provided to indicate if the setting has been changed after initial installation.

The motor is controlled via two independent external contactors (see external wiring diagrams on page 4). Monitoring contacts are used to identify a failure of a contactor. If this happens, the other contactor is held off until the fault is rectified.

If the motor starts turning (through stored potential energy in the system or by maintenance), the machine cannot be restarted even if the key has been returned to the unit.

For installations where multiple access points are needed, the released key can be inserted into a separate mGard key exchange unit. This can be a BM, DM or XM unit and a wide variety of sequences can be generated. See relevant BM, DM or XM Data Sheets.

Fortress Interlocks

Data Sheet VS Unit

Technical Specification

Automatic self-test when control voltage is applied.
Output circuit is redundant - Two channel operation.
Measuring inputs for single or three-phase motors.
Feedback control loop for monitoring external contactors/relays.

The VS unit prevents further operation in the following cases:
- Power supply failure.
- Component failure.
- Interruption of measuring circuits.
- Coil defect in a relay/cable break.

With every on-off cycle of the machine, the relays are automatically tested to make sure they open and close correctly.
External 22mm LED lamp indicates that the key release solenoid has been energised.
Internal Semiconductor output (Galvanically separated).
Semiconductor output 24 V DC/50mA ,PNP short-circuit proof.
External voltage supply for semiconductor output 24 V DC +/-20 %.
Internal LED for Operating Voltage (For Installation / maintenance / Checking).
Internal LED for channel 1 and channel 2 (For Installation / maintenance / Checking).
Internal LED for switching status (For Installation / maintenance / Checking).

Electrical Data
Operating Voltage : 24Vac, 24Vdc, 110Vac, 230Vac.
Voltage Tolerance UB 85-110 %.
Frequency Range (AC): 50 ... 60 Hz.
Residual Ripple (DC): 20%.
Power Consumption (Key release solenoid de-energised: 11VA / 7 W.
Power Consumption (Key release solenoid energised: 21VA / 12 W.

Life
Mechanical Life 1 x 10^7 cycles.
Electrical Life (1A/230V AC, cos θ =.1) 1 x 10^5 cycles.

Features
Hysteresis per channel:
Response time Uan = 20 ... 500 mV.
Release time Uab = 2xUan.
Delay-on Energisation approximately: 1 s.
Delay-on De-Energisation approximately: 170 ms.
Delay-on Energisation after failure and applying operating voltage again approximately: 2 s.

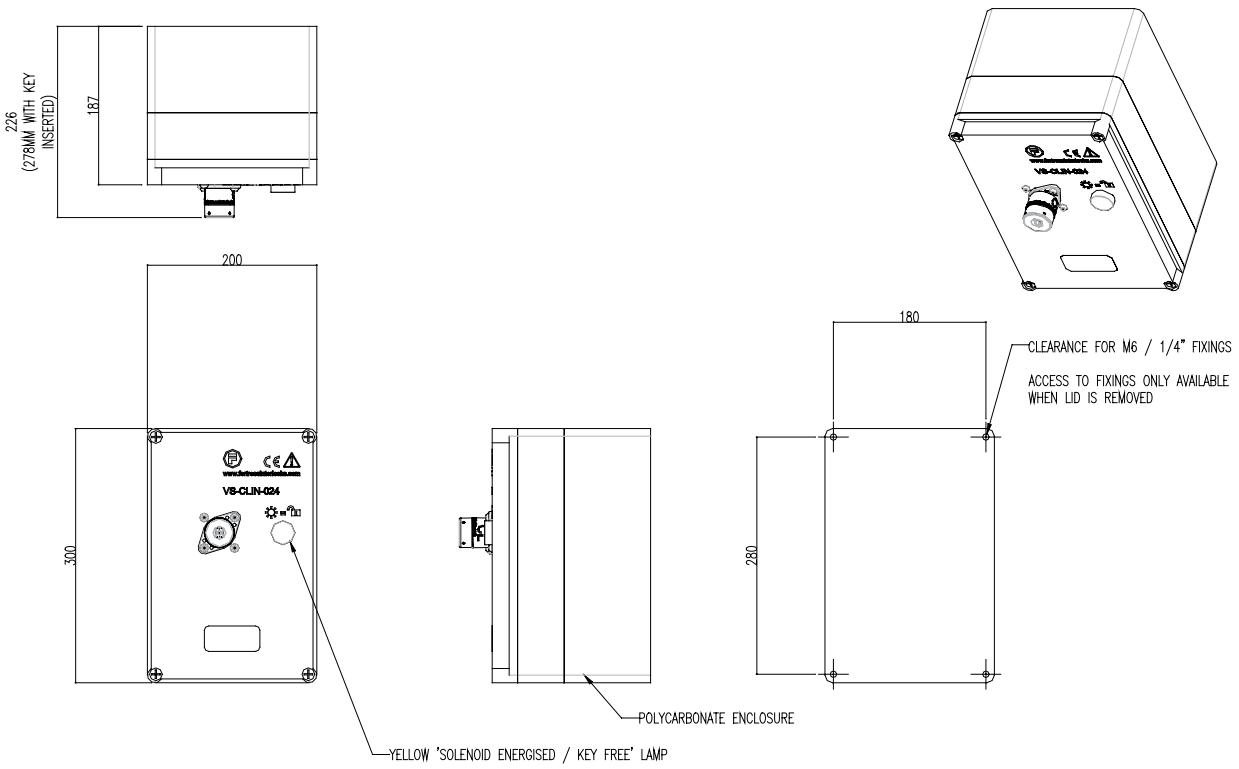
Input Voltage 110 ... 500 V AC maximum voltage: 690 V AC.
Frequency range 0 ... 150 Hz.
Input Impedance approximately: 660 k.

Fortress Interlocks

Data Sheet VS Unit

Part Numbers:

VS-CLIL-024 - VS unit: CL type lock with Stainless Steel internals, padlockable dust cover, 24V supply.
VS-CLIL-110 - VS unit: CL type lock with Stainless Steel internals, padlockable dust cover, 110V supply.
VS-CLIL-230 - VS unit: CL type lock with Stainless Steel internals, padlockable dust cover, 230V supply.
VS-CLIN-024 - VS unit: CL type lock with Stainless Steel internals, no dust cover, 24V supply.
VS-CLIN-110 - VS unit: CL type lock with Stainless Steel internals, no dust cover, 110V supply.
VS-CLIN-230 - VS unit: CL type lock with Stainless Steel internals, no dust cover, 230V supply.
VS-CLIS-024 - VS unit: CL type lock with Stainless Steel internals, Stainless Steel dust cover, 24V supply.
VS-CLIS-110 - VS unit: CL type lock with Stainless Steel internals, Stainless Steel dust cover, 110V supply.
VS-CLIS-230 - VS unit: CL type lock with Stainless Steel internals, Stainless Steel dust cover, 230V supply.
VS-MLIL-024 - VS unit: ML (Master) type lock with Stainless Steel internals, padlockable dust cover, 24V supply.
VS-MLIL-110 - VS unit: ML (Master) type lock with Stainless Steel internals, padlockable dust cover, 110V supply.
VS-MLIL-230 - VS unit: ML (Master) type lock with Stainless Steel internals, padlockable dust cover, 230V supply.
VS-MLIN-024 - VS unit: ML (Master) type lock with Stainless Steel internals, no dust cover, 24V supply.
VS-MLIN-110 - VS unit: ML (Master) type lock with Stainless Steel internals, no dust cover, 110V supply.
VS-MLIN-230 - VS unit: ML (Master) type lock with Stainless Steel internals, no dust cover, 230V supply.
VS-MLIS-024 - VS unit: ML (Master) type lock with Stainless Steel internals, Stainless Steel dust cover, 24V supply.
VS-MLIS-110 - VS unit: ML (Master) type lock with Stainless Steel internals, Stainless Steel dust cover, 110V supply.
VS-MLIS-230 - VS unit: ML (Master) type lock with Stainless Steel internals, Stainless Steel dust cover, 230V supply.



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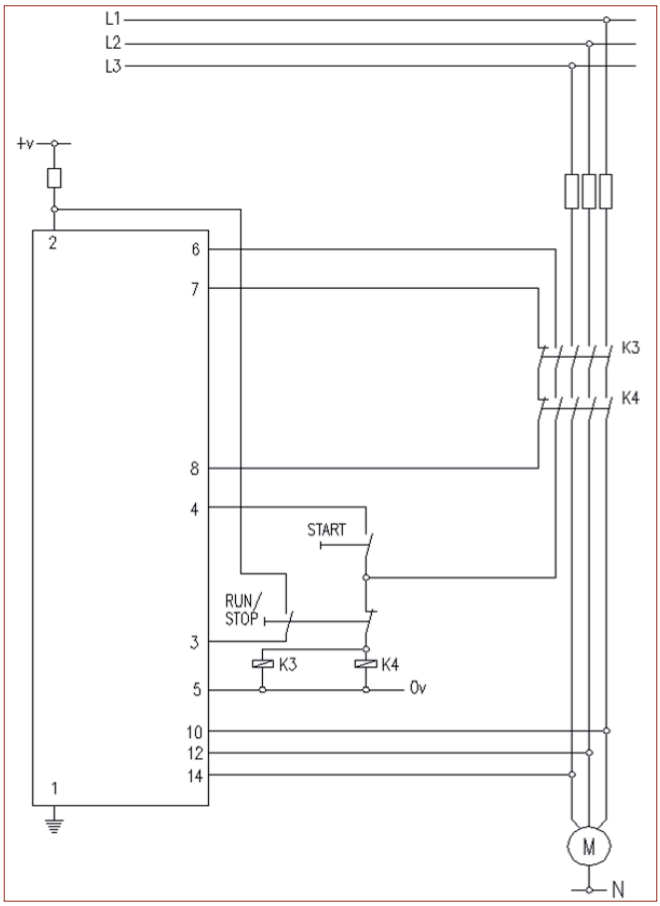
Data Sheet VS Unit

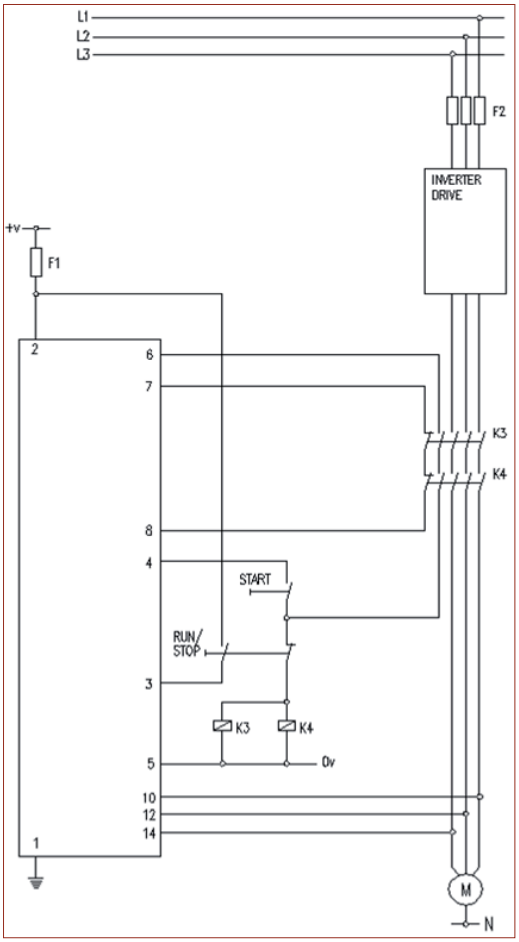
External Wiring Diagram - Contactor

This wiring is used to operate the motor via two independent contactors. Monitoring contacts are used to identify a failure of one contactor. If this happens, the other contactor is held off until the fault is rectified.



External Wiring Diagram - Inverter

If an inverter is to be used, it should be positioned as shown.



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APPENDIX B
AIR FLOW ABSTRACT

B.1 Air Flow Determination

Proper air flow is essential for efficient production. This discussion outlines methods for measuring air flow in an operating system.

B.2 Air Flow and Air Pressure Relationships

We must first review some basic principles of air flow and pressure, and then show how to obtain the required value of Velocity Pressure. In the illustrations that follow, we show a simple U-shaped glass tube connected to an air duct with flexible tubing. The U-tube holds water and has marked graduations showing inches of water column on both legs of the tube.

In determining static pressure, one end of the U-tube is open to atmospheric pressure and the other end is connected to a port at the side of the air duct as shown in Figure B-1.

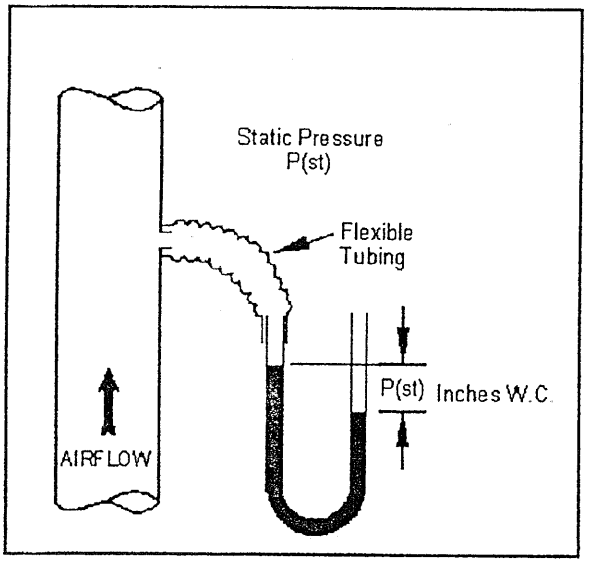

Figure B-1
Static Pressure

The total pressure measurement differs from static pressure in that a rigid elbow extends into the duct to gage the force of the moving air stream as shown in Figure B-2.

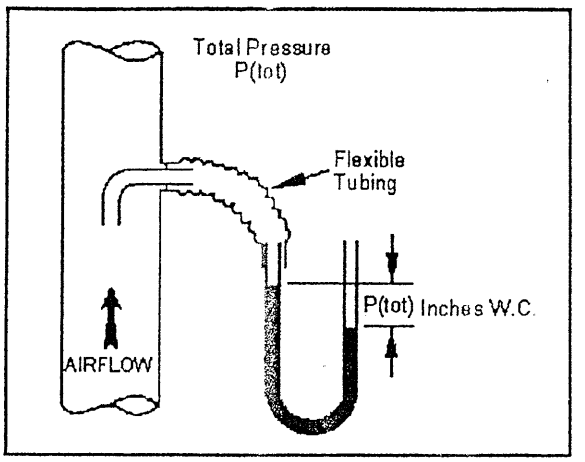

Figure B-2
Total Pressure

The velocity pressure measurement connects both ends of the U-tube to the air duct; one to the side and the other in the air stream with a rigid elbow as shown in Figure B-3.

The three types of pressures are related in the manner:

$$P_{tot} = P_{vel} + P_{st}$$
$$P_{vel} = P_{tot} + P_{st}$$

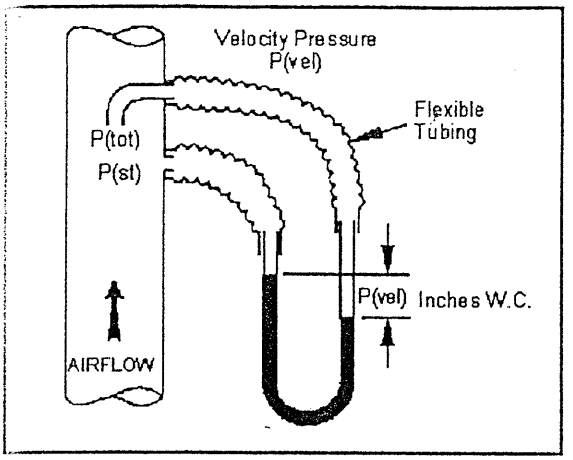

Figure B-3
Velocity Pressure

B.3 Sample Calculation

The following example shows how to calculate air flow in cubic feet per minute.

If using the U-tube as shown in Figures **B-1**, and **B-2**, you measure:

- P_{st} at 14.0" W.C. (inches water column)
- P_{tot} at -12.5" W.C. (inches water column)

and you know

- the duct diameter to be 10"

Then you can use the formula:

$P_{tot} = P_{vel} + P_{st}$

To calculate the correct air flow in cubic feet per minute as follows:

1. $-12.5 = P_{vel} + (-14.0)$
2. $P_{vel} = 14 - 12.5 = 1.5$

Using Table **B-1**, locate the intersecting columns for P_{vel} at 1.5, and Duct Diameter at 10".

The Air Flow for this example is 2675 CFM.

Velocity Pressure can also be measured with a pitot tube in a configuration such as shown in Figure **B-4**. The determination shown has the advantages of simplicity and of providing a direct reading of Velocity Pressure in inches water column.

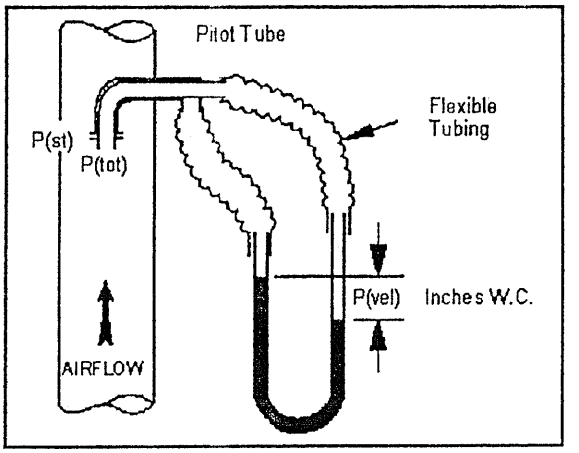

Figure B-4
Pitot Pressure

B.3.1 Velocity Pressure and Air Volume

With a value for P_{vel} obtained by any appropriate method, Table **B-1** allows a direct reading of air flow in cubic feet per minute. The table covers duct diameters up to 18 inches and Velocity Pressures up to 2.40 inches of water column.

NOTE THE EXAMPLES SHOWN DESCRIBE THE NEGATIVE AIR SYSTEMS. IN POSITIVE SYSTEMS THE TOTAL PRESSURE WOULD BE HIGHER THAN THE STATIC PRESSURE.

DUCT DIAMETER ⇒ (inches)		4	5	6	8	10	12	14	16	18
DUCT AREA ⇒ (square feet)		.0873	.1464	.1964	.3491	.5454	.7854	1.069	1.396	1.767
VELOCITY PRESSURE (inches W.C.)	AIR SPEED (fpm)	AIR FLOW (cubic feet per minute)								
.10	1266	110	173	249	442	690	994	1353	1767	2237
.20	1791	156	244	352	625	960	1407	1914	2500	3165
.30	2194	191	299	431	766	1197	1723	2345	3063	3877
.40	2533	221	345	497	884	1381	1989	2708	3536	4478
.50	2832	247	386	556	989	1544	2224	3027	3953	5004
.60	3102	271	423	609	1083	1692	2436	3316	4330	5481
.70	3351	292	457	658	1170	1828	2632	3582	4678	5921
.80	3582	313	488	703	1250	1954	2813	3829	4861	6329
.90	3799	332	518	746	1326	2072	2984	4061	5303	6713
1.00	4005	350	546	787	1398	2184	3145	4281	5591	7077
1.10	4200	367	573	825	1466	2291	3299	4490	5863	7421
1.20	4387	383	598	852	1531	2393	3445	4690	6124	7752
1.30	4566	399	623	897	1594	2490	3586	4881	6374	8068
1.40	4739	414	646	931	1654	2584	3722	5066	6616	8374
1.50	4905	428	669	963	1712	2675	3852	5243	6847	8677
1.60	5066	442	691	995	1768	2763	3979	5415	7072	8952
1.70	5222	456	712	1026	1823	2848	4101	5582	7290	9227
1.80	5373	469	733	1055	1876	2930	4220	5743	7500	9494
1.90	5521	482	753	1084	1927	3011	4336	5902	7707	9756
2.00	5664	494	773	1112	1977	3089	4448	6055	7907	10008
2.10	5804	506	791	1140	2026	3165	4558	6204	8102	10255
2.20	5940	518	810	1167	2074	3240	4665	6350	8292	10496
2.30	6074	530	828	1193	2120	3313	4770	6493	8479	10733
2.40	6205	542	846	1219	2166	3384	4873	6633	8662	10964

Table B-1
Air Volume Measurement

FINE GRINDERS
HAMMERMILLS
CRUSHER/FLAKE BREAKERS
COMPACTORS/BRIQUETTERS
AIR CLASSIFIERS
ROTARY SIFTERS
VIBRATING SCREENS
ROTARY FEEDERS
QUICK-TAKE-APART AIRLOCKS
MINI-SIFTERS
BATCHING SYSTEMS
MODULAR WEIGHING SYSTEMS
BAGGING CONTROLS

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