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#60 GA No-Nife Hog
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WILLIAMS

GENERAL SAFETY PROCEDURES FOR OPERATION OF WILLIAMS EQUIPMENT

THE WILLIAMS PATENT CRUSHER & PULVERIZER CO. ST. LOUIS, MO. U.S.A.
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FORM 936

GENERAL SAFETY PROCEDURES FOR OPERATION OF WILLIAMS EQUIPMENT

Because each installation of Williams Equipment involves different uses and considerations it must be understood that these safety instructions are general in nature and that each specific installation must be reviewed by the owner or plant management to insure maximum safety precautions. It is the responsibility of the owner or plant management to provide complete safety instructions and procedures for the operation of all Williams equipment, which their personnel will be involved with in the performance of their duties, and to see that all the necessary precautions are followed. All personnel who will be involved in the operation or servicing of Williams equipment must be properly trained in the operation and servicing of such equipment and must be fully familiar with these general safety procedures and the safety precautions attached to the Williams equipment.

HAZARDOUS MATERIALS WARNING

OVERSIZE OR THE WRONG TYPE OF MATERIAL FED INTO A MILL CAN CAUSE SERIOUS PERSONAL INJURIES AND PROPERTY DAMAGE, INCLUDING DAMAGE TO THE EQUIPMENT ITSELF.

No explosive, flammable or similar hazardous material is to be fed into any operating Williams equipment under any circumstances.

If there is any possibility that hazardous material could be accidentally overlooked by the personnel feeding the Williams equipment, the owner must provide suitable protection such as listed below or mandated by Federal, State, or Local regulations.

A) Inert gas atmosphere in system.

B) Explosion vents for Williams equipment and building housing the equipment.

C) Explosion suppression system.

D) Operators station protected by blast panels and shielding.

E) Water deluge system for fires.

Heat and sparks generated during the operation of some Williams equipment can cause combustible materials to ignite unless precautions are taken by the owners.

1) When personnel are working inside the mill or near the rotor the power to the driver shall be de-energized and locked out with an approved safety tag on the controls or starter.

2) Never enter or service equipment through the conveyor, feed hopper, or discharge opening.

3) Only the specified size and type material which the mill was designed to handle shall be fed into the mill.

4) The inherent ballistic action of the grinding operation can cause pieces of the material being processed to be thrown out the feed or discharge openings and injure personnel in the vicinity. It is the owner's responsibility to provide and maintain proper screens and shrouds at all the mill openings to contain the material being processed inside the hopper or mill.

5) All personnel in the vicinity of an operating mill must wear a hard hat and safety glasses in addition to any special clothing or protective equipment the particular installation may require.

NEVER ALLOW PERSONNEL TO STAND IN LINE WITH OR IN THE IMMEDIATE VICINITY OF THE FEED OR DISCHARGE OPENING OF A MILL WHILE MATERIAL IS BEING PROCESSED.

6) NEVER OPERATE A MILL FASTER THAN THE DESIGN SPEED.

7) Before starting the equipment for the first time and for normal daily operation the following precautions should be followed:

A) Check to see that all alarm signals and emergency devices are functioning properly.

B) All access doors, covers, or inspections ports are closed and securely fastened in place.

C) Infeed conveyors or chutes cleared of all materials that could enter grinding chamber until the rotor attains operating speed.

D) Make a daily inspection of the rotor condition before the start of operations noting any badly worn or broken items that could fail and replace them before using the mill.

E) All protective covers or guards on the drive connection and flywheel or shaft end are fastened properly in place.

F) The mill is empty and clear of all debris or product so the rotor is free to turn without interference and the hammers can swing on their pivots.

G) All personnel are clear of any moving parts and positioned at their assigned operating stations.

8) NORMAL OPERATING VIBRATION AND WEAR CAN CAUSE BOLTS TO LOOSEN AND ALLOW COMPONENTS TO FALL OFF THE MILL OR INTO THE ROTOR UNLESS A REGULAR REVIEW OF THE MILL IS MADE BY OPERATING PERSONNEL TO TIGHTEN ANY LOOSE BOLTS.

9) Should the rotor become jammed or the feed chute plugged do not attempt to clear the chute or open the cover while the rotor is turning and the power is connected. Before any service operations on the mill, de-energize the driver and wait until all rotor movement has ceased. If entry to the rotor area is made, after the power is locked off and the rotor movement has ceased, care should be taken to secure the rotor from turning because the rotor could turn if stepped on or physically pushed thereby causing swing hammers to fall and strike the rotor, or anyone in the vicinity.

THE ABOVE LIST IS NOT INTENDED TO INCLUDE ALL PRECAUTIONS THAT CAN BE TAKEN TO INSURE SAFE OPERATION OF WILLIAMS EQUIPMENT, BUT TO SUPPLEMENT ANY EXISTING ORDINANCES, APPLICABLE REGULATIONS AND SPECIFIC SAFETY INSTRUCTIONS BY THE OWNER OR PLANT MANAGEMENT FOR THE PARTICULAR APPLICATION OF THE WILLIAMS EQUIPMENT.

THESE SAFETY INSTRUCTIONS SHOULD BE FRAMED AND POSTED IN ALL OPERATING LOCATIONS WHERE PERSONNEL ARE STATIONED.

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HAMMER MILL INSTRUCTIONS

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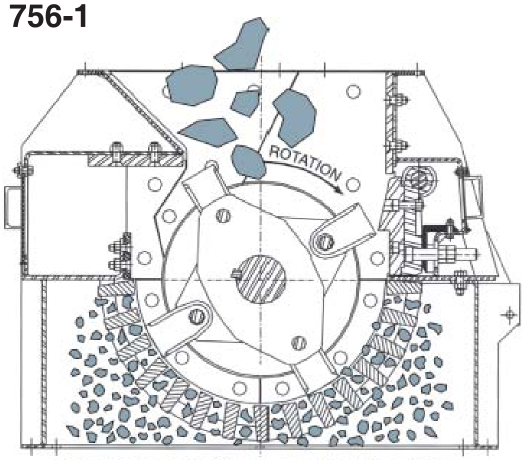
FORM 756-R2

This form is intended to serve as a guide for the installation, operation, and maintenance of your Williams Hammer Mill Equipment. This form refers to Hammer Mills, Rigid Arm Hammer Mills, Breakers and Shredders, Rotating Ring Crushers, and similar rotating Williams Grinders, Hogs, and Shredders. For convenience, they will be referred to herein as "mills."

Installation, operation, and maintenance are each discussed separately so as to give you as much specific information as possible.

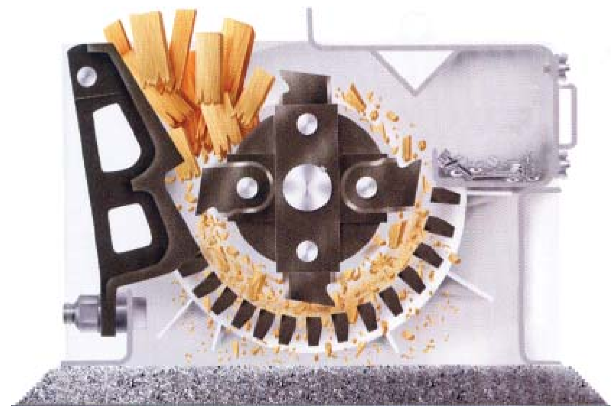
All Williams Mills, regardless of size, are run at the factory prior or shipment. They are mechanically sound when prepared for shipment and all but the largest sizes are shipped as an assembled unit. Machines too large to be shipped in one piece can be assembled without difficulty. The proper relation of the several sections will be quite obvious upon visual inspection. When properly installed, lubricated, and maintained, your Williams Mill will give you great service for many years.

FIG. 756-1



NF or GA Mill Slugger with Metal Trap

FIG. 756-2



FOUNDATION: The mill should be supported on concrete, steel, or heavy timbers, the setting to be strong and heavy enough to carry the weight of the mill and driving motors while being sufficiently rigid to assure permanent alignment of the mill and its driver. (It is highly recommended that Williams Form 902R2 - *Crusher Foundations* be referenced while designing the mill foundation.) This foundation is to be isolated from any building foundation so as not to transmit vibration into the building. The foundation is to be level and uniformly even with anchor bolts located as per specifications on **certified** Williams installation prints. Bolt the mill assembly down solidly, shimming to make certain that it remains level in both directions. Check this level along the shaft and bearing pedestals. Care should be exercised when drawing up the foundation bolts so that the mill frame is not warped out of position due to an uneven or unlevel foundation. When a mill and motor base are used, the entire assembly is set on its foundation in the same manner as described above. Next, flush in grouting material to give a good bearing between the mill and foundation. Although a Williams Mill is a heavily built machine, care must be exercised to prevent damage in handling. Whether a hoist, crane, or jack is used to lift the machine, under no circumstances should a strain be put on the mill shaft. Always lift the machine by the lower frame, placing the strain on the well braced bottom flanges. See Fig. 756-3.

The lifting lug provided on the removable cover section of many models is for your convenience in removal of this portion of the mill only and **will not** carry the weight of the entire mill.

FEED CHUTE: All mills should be equipped with adequate feed chutes. If there is any design question, check with the factory. Consult with the factory for the vertical drop distance between the feed inlet and the mill.

ACCESSIBILITY: The interior of your Williams Mill is easily reached for repairs and adjustments by simply opening the removable half of the cover. Therefore, leave sufficient room around your mill to provide comfortable working space and for the removal of the mill cover and hammer bolts. The hammer bolts are usually removed from the side opposite the drive. See Fig. 756-4.

SAFETY: It is the customer's responsibility to provide and to keep in operation - shrouds, guards, or similar safety devices - necessary to prevent material or tramp iron from being thrown out at the feed opening of the mill or feed hopper - for safety of all personnel. Please refer to Williams Form 936 - *General Safety Procedures* for operation of Williams Equipment, prior to operating equipment.

Personnel in the vicinity of the equipment when in operation should take the precaution of wearing Personal Protective Equipment (hard hats, safety glasses, ear plugs, etc.).

OPERATION

STARTING THE MILL: It is important that your Williams Mill be operated at the recommended speed. Under no circumstances should any Williams Mill be operated at a greater speed than that specified by the Williams factory, nor should the speed be lowered without factory approval. Before starting the mill, inspect the grinding chamber carefully and turn the mill by hand to be certain that it is free of all obstacles that may have found their way into the interior of the mill. Check direction of rotation to see that it is the same as that indicated by the direction arrows on the sides of the mill, or on Williams drawings.

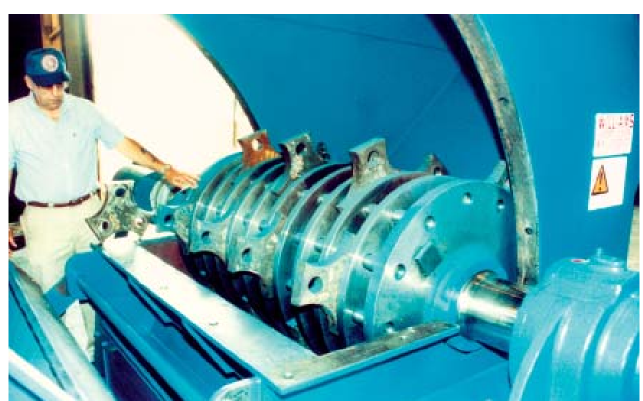
When you start the mill under power, permit it to attain full speed **before any material is fed into it.**

PROPER FEEDING: Material being fed into a Williams Mill should be spread evenly over the entire feed opening and should be conveyed into the mill continuously and uniformly at a feed rate not greater than that recommended by the factory. Keep in mind that surge feeding is inefficient as it tends to overload the mill, thereby causing the machine to use excess power. An alternate overload and underload condition of operation will average far below the results obtained by steady feeding of the right amount of material. For some materials, automatic feeders are essential - for practically all, they are beneficial.

Feed size of material should be limited to the maximum sizes recommended by the factory. Excessively large pieces of material place undue strain on the shaft and other parts of the machine. Uncrushable material such as steel and iron should be removed from the feed before it enters the mill even though the mill is equipped with a metal trap. A metal trap is by no means 100% effective and severe damage may be sustained to the mill before uncrushable material can be removed.

FIG. 756-3

FIG. 756-4



HANDLING OF PRODUCT: The chute, air system, belt or screw conveyor, etc., regardless of what conveyance system is used to remove the hammer mill product, must be of sufficient capacity to handle peak loads without temporary accumulations of product occurring under the mill. This is necessary to prevent the product from plugging the mill and shutting down its operation.

FINENESS ADJUSTMENTS: Fineness adjustments are mentioned in their order of accessibility and ease of change; and will produce a finer product. Conversely, a reversal of below recommendations will produce a coarser product.

1. On mills having adjustable breaker plates, adjust the breaker plate closer to the hammers to compensate for wear on the breaker plates and grinding plates (Note- on new mills the breaker plates have been correctly set at the factory and the mill is ready for operation).

The procedure for adjusting the breaker plate assembly is as follows: with the mill running empty, loosen the locking bolts a couple of turns and slowly turn the adjusting bolt. This will force the breaker plate to move inward toward the hammers. Alternate between loosening the locking bolts and turning the adjusting bolt in until you hear or feel the hammers lightly graze the breaker plate. Install shims (an adequate supply is always shipped with the mill) so that the breaker plate may be withdrawn approximately 1/16”. **Lock shims in place.**

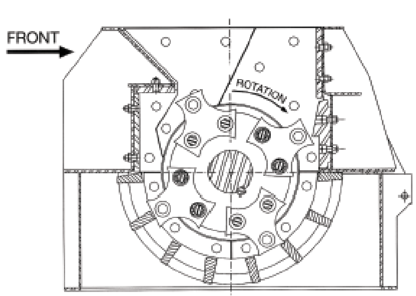
Now, tighten the locking bolts so that a moderate pull is exerted on the breaker plate assembly away from the hammers - this prevents the breaker plate assembly from chattering and insures that all shock loads derived from crushing will be directed against the shims which are designed to take this load. See Fig. 756-1 and 756-2 for adjustable breaker plates, Fig, 756-5 and 756-6 for fixed breaker plates.

2. Changing Cage Openings: By reducing the size of the cage openings, a finer product will be made, but the output is decreased as the making of a finer product places more work on the mill. See Fig. 756-7.

3. Changing the Speed: A higher speed will generally produce a product which is finer, however, there are many limitations. The maximum safe speed for the machine cannot be exceeded. Too great a speed will not allow the feed to get between the hammers, thus reducing the efficiency of the mill. An increase of speed will require more power, therefore make no change in the mill speed without first consulting the factory.

4. Decreasing the Number of Hammers: In certain instances where a coarser product is more desirable, this can sometimes be obtained by removing hammers from the mill. However, we do not recommend that this be done without first consulting the factory and it is always necessary to keep in mind that the balance of the rotor must be maintained.

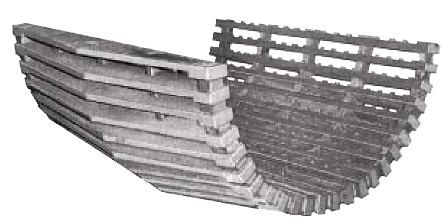
FIG. 756-5



NF or GA Mill Rigid Arm without Metal Trap

FIG. 756-6

FIG. 756-7



MAINTENANCE

LUBRICATION: Possibly no detail is as important to the life of a machine as proper lubrication of the contact surfaces of moving parts. We advise always that you lubricate as local conditions warrant for your installation, keeping in mind that care must be exercised to prevent over lubrication. **Too much lubrication will cause a bearing to heat.** Bearing operating temperatures vary with geographical location and ambient temperature at the installation. If there is any doubt about lubrication, consult factory or a qualified lubrication expert. Be sure to review Williams Form 911R - *Roller Bearings* for additional information.

GREASE LUBRICATION: For all moving parts which have a standard grease gun fitting supplied, use Mobile Grease Mobilith AW2 or its equivalent.

OIL LUBRICATION: For all moving parts which use oil as a lubricant, use an oil which has the following characteristics:

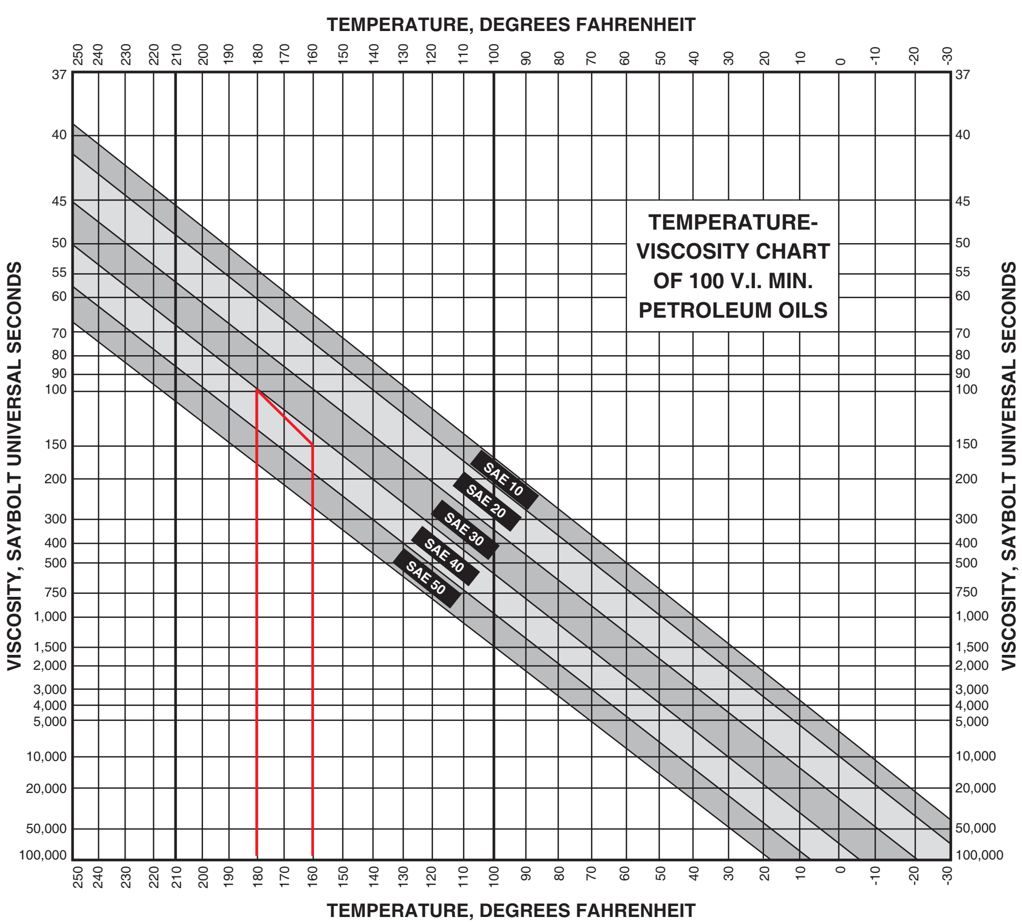
1. The viscosity of the oil should be between 105 SSU and 150 SSU at the operating temperature of the bearing. Usual operating temperature of the bearing is within the range of 160°F - 180°F.

2. The oil should yield a "Timken Okay Load" of 45 pounds minimum.

3. The oil should contain EP additives.

The viscosity of an oil is perhaps the most fundamental consideration in bearing applications. The table below provides a relative guide in determining the viscosity of oil at various temperatures.

TABLE 756-1



Viscosities of oils are usually given at either 100°F or 210°F. To determine this viscosity, find the intersection on the chart of the expected operating temperature and the Saybolt Universal Seconds (SSU). From this point draw a line parallel to the nearest curve. Where this line intersects the 100°F or 210°F coordinate will be found the viscosity in the Saybolt Universal Seconds at either of these standard base temperatures.

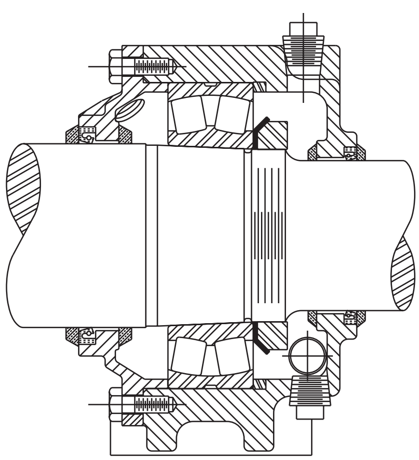
Table I is simply an oil selection guide. It is based on oils with a high Viscosity Index (V.I.) which are necessary for satisfactory bearing operation. **It is always preferable to consult a competent lubrication engineer for a more specific recommendation**, particularly if the conditions are in the areas above or below the family of curves.

Mills with oil lubricated bearings have the bearing housing filled to the proper level with the appropriate oil for normal operation. The bearings housings **must be flushed** before operating and be filled with the correct lubricant for your installation.

For installations where bearings are in an oil sump, or reservoir, we recommend that the mill run for 45 minutes in unloaded condition to lower the viscosity of the oil to the proper operating range.

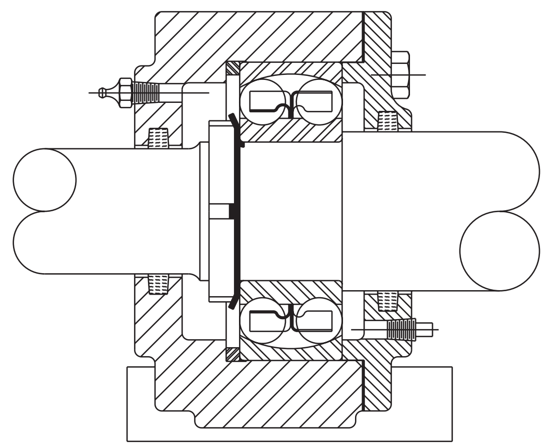
How often you should flush all bearings and reload their lubricant depends upon the conditions of location and operation. However, to establish a basis for normal operating conditions, it is recommended that bearings be flushed and re-filled once a month.

FIG. 756-8



Typical Grease Lubricated Pillow Block - Location of grease fitting may vary.

FIG. 756-9



Typical Oil Lubricated Pillow Block - Manual Lubrication.

It should be a rule that any time grit is found in a bearing, the bearing is to be cleaned and inspected for wear and the defect which allowed the grit to leak into the bearing corrected immediately. All bearing housings are designed to prevent grit from entering from the outside.

Should lubrication instructions be supplied with a bearing or mill, they take precedence over those recommended here.

HAMMER CARE & ADJUSTMENT: Whenever the nature of the work intended for the mill permits the efficient use of reversible hammers, one of Williams' standard reversible styles is installed. Of course, when "double end" reversible types can be used four wearing edges are available by reversing and also inverting the hammers. See Fig. 756-10 and 756-11. Reference Williams Form 768 - *Williams #1 Build Up Rod* and Williams Form 769 - *Williams #2 Hard Surface Rod* for additional information.

With hammers which must cut by impact as well as by sharpness, such as in a Wood Hog or Metal Turnings Crusher, after the hammer tips have become rounded from wear, they should be built up by welding rod or by forging as in the case of tool steel hammers. It is our experience that hammer tips worn down more than 3/4 inch are more expensive to repair than the purchase of new hammers. Regular maintenance to the tips is a must. After building up the hammer tips or hard surfacing - if the hammers were removed - make sure that opposing hammers weigh the same when reinstalling them into the mill to maintain balance. See Fig. 756-12.

FIG. 756-10

FIG. 756-11

Reference Williams Form 952R - *Hammers* for additional information on balancing hammers.

For any type of hammers which exhibit undue wear due to a very abrasive product, hard surfacing is recommended. Contact the factory for the proper procedure and hard surfacing rod for your particular problem.

FIG. 756-12

Note: Should build up rod or hard surfacing rod be applied to hammers while they are still assembled in the hammer mill, be sure to maintain balance between opposite rows of hammers and always connect the welding ground so that the electrical circuit **does not** pass through the mill bearings.

REPLACEMENT PARTS: Replacement parts should be ordered in anticipation of their need to prevent the possibility of a costly interruption to your production schedule. The grinding elements, particularly, should be carried in stock so as to be immediately available when needed. The grinding elements consist primarily of hammers, breaker plates, grinding plates, cage bars and/or perforated cages. A spare bearing is also a good investment.

Do Not Permit the Liners to Wear Through before replacing them. Liners protect your investment by protecting the mill frame from impact and abrasion. They are furnished in all Williams Mills which are intended for heavy duty or abrasive service.

Periodical Inspections are good operating practice. At such times, bearings, discs, hammer bolts, hammers, breaker plates, liners, liner bolts, cages, adjusting screws, and all frame members should be inspected carefully. Be sure all bolts are securely tightened.

Possible Problems:

1. Vibration. After a mill has been in service for some time, wear will affect the balance of the rotating assembly causing vibration. Another source of vibration could be from a sprung shaft. A shaft can be sprung by feeding the mill uncrushable material, loading it excessively, or feeding material larger than that originally intended for the mill.

2. Loss of Capacity or Product Size. This is largely due to wear on the crushing segments and generally can be compensated for by adjusting the breaker plates or hammers, or replacing worn parts.

3. Clogging. Clogging as explained earlier can be caused by not conveying the product away from the mill fast enough or it can be due to worn parts which do not grind properly and thus clog the mill. Other possibilities include excessive moisture, oil, etc. in the mill feed.

GENERAL INFORMATION: Always specify the Serial Number of your Williams Mill in all correspondence pertaining to it, and you will help us to render better service. Always specify the Serial Number when inquiring about, or ordering, repair parts. You will further help us to give you good service by specifying the drawing number of the repair parts required. If the name plate has been accidentally removed, the Serial Number has been stamped into the bearing pedestal on the drive side on mills manufactured as of June 1954.

Consult Williams if you have a special problem related to grinding, shredding, crushing, pulverizing, separating, or screening. We are specialists in our field and would be happy to help you.

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CRUSHER INSTALLATION

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FORM 852R

CRUSHER INSTALLATION

Congratulations on your ownership of a Williams Crusher. Whether you purchased it new and specifically built for your application, or it is a previously owned crusher, it will provide years of trouble-free service if the proper installation and service procedures are followed.

It is not unusual to find one of our crushers starting a second or third career after a long, productive service life for the original owner.

The purpose of this brochure is to provide a helpful guide or checklist for the various necessary steps to insure the safe and successful installation of Williams crushing equipment.

In planning the installation of a crusher, the primary consideration must be operating safety. Proper feeding, material handling, and provisions for service are necessary operating provisions. The power of the motor and speed of the crusher rotation will be determined by the quantity and size of the product desired within the design limitations of the particular size crusher.

OPERATING CONTROLS

A uniform load on the crusher motor is the most efficient method of operation for both the crusher and its motor. This can be accomplished in several ways, but the best arrangement is by a feed control device that measures the current the motor is drawing, which in turn controls the feed equipment to maintain a selected percentage of the crusher motor full load by sequencing the feed device to regulate the material flow into the crusher.

This load control is the surest way to prevent overloading and plugging of the crusher and to protect the crusher motor from overheating and tripping the circuit breaker or causing other electrical and mechanical problems.

The electrical circuit breaker or starter to control the crusher motor should be conveniently located within sight of the crusher and clearly identified with provisions for lockout during service operations. The control circuit should have an interlock to prevent the feed device from operating when the crusher motor is not energized or running. This will prevent the crushing chamber from being filled with material that would not allow the rotor to start or plug up when the crusher motor was de-energized purposely or by overload.

When the control circuit has provisions for remote starting of the crusher, ample warning signs shall be posted near every access opening on the crusher and its inlet and outlet hoppers.

SERVICE PROVISIONS

When locating the crusher in a building or near other machinery, always allow sufficient clearance to open the crusher cover and perform necessary service operations. The hammer bolts are usually removed from the side of the crusher opposite the drive to allow sufficient clearance to withdraw the full length of the hammer bolt from the rotor. When rebuilding or replacing the hammers, which is the most frequent service operation, it is always necessary to open the crusher cover. Hammers are sometimes built up to original profile by welding while they are in position on the rotor. It is almost always necessary to use a mechanical lifting device to open the cover unless the crusher is equipped with a hydraulic cover opening system. Where mechanical equipment will be used to open the crusher cover, provisions should be made for the safe, secure attachment of the lifting devices which will allow for the movement of the cover as it lifts off or pivots open. The lifting equipment for the cover need not to be permanently mounted, but the brackets or track it is supported by should be securely installed either on the surrounding structure or the crusher feed hopper; whichever provides for the safest opening of the crusher cover.

FEED CONVEYORS

The most common way of feeding a crusher is by a conveyor - either a belt or apron pan that dumps into a hopper above the crusher. Other alternatives are bucket elevators, vibratory pan feeders, or screw conveyors, and sometimes rotary pocket feeders are used to introduce the material into the feed hopper. Whichever feed device is used, it is important to avoid surges in loading and keep the bed of material flowing into the crusher as uniform as possible.

Feed devices such as bucket conveyors and screw conveyors are somewhat self-metering in that only a given amount of material is carried by each flight or bucket. Apron pan and belt conveyors, on the other hand, do not usually carry uniform height or width load so more careful control is necessary in the loading volume regulation with this type of material handling equipment. When material is dumped onto a conveyor either by a bucket loader of a truck, some type of height regulating or strike off device is needed to level the bed of material to a uniform height as it travels along the conveyor. This is sometimes done with two-stage conveyors, each traveling at different speeds, to spread the load or else using a surge bin to maintain an even flow into the crusher. Whichever conveyor or feed device is used, it should be freestanding or self-supported and not connected rigidly to the crusher or feed hopper to avoid vibration problems transmitted through the structure.

Normally, the infeed conveyor is on am incline for a portion of its length up to the feed hopper, which usually requires cleats or pushers attached to the belt or apron pans to elevate the bed of material without slipping. There should be no offsets or projections of the side skirts or shrouds along the conveyor that would catch or snag material on the infeed conveyor and cause blockage on the flow of material into the crusher. Where possible, the infeed conveyor should run horizontal for a few feet before it enters the feed hopper so the material will glow off the end of the conveyor more uniformly and keep the gap under the conveyor to a minimum where it exits the feed hopper. Where the conveyor enters the feed hopper, the opening should be high enough to permit the longest item going up the conveyor to pivot off the end into the crusher without jamming in the feed hopper or against the conveyor shroud.

The greater distance above the crusher rotor that the infeed conveyor introduces material into the feed hopper, the less chance there is of material being blown or thrown back down the infeed conveyor. There is, of course, a limit of how high above the rotor the conveyor entry is practical, but two out of three times the hammer circle diameter is a general rule for a minimum feed heights of most material handled by the conveyor.

Depending upon the height above the rotor where the conveyor enters the feed hopper, the conveyor should be covered or shrouded for a considerable distance back from the opening to prevent the material that is being crushed from blowing or flying down the infeed conveyor.

In most instances, a shroud two or three times the conveyor width in length extending back from the feed hopper entry with substantial curtain at the beginning of the shroud will provide sufficient emission control for most crushing operations where dust or powder is not being produced by the grinding process. Dust control will require additional precautions and very possibly a separate collecting system to eliminate the hazard or nuisance of dust because the large volume of air that is moved by the crusher rotor during operation.

It is very difficult to seal under an infeed conveyor equipped with cleats or pushers where it exits from the feed hopper, a dribble chute is often required to catch the material blown or thrown out under the conveyor and carry it to the discharge conveyor. The dribble chute should not have any offsets or constrictions that would cause the material to plug and fill up the chute. As a matter of precaution, the dribble chute should have an access door conveniently located near floor level for clean out.

Where damp material is conveyed into the crusher, it may be necessary to provide drip pans beneath the exposed return side of the conveyor.

Conveyors need lubrication and service which should be included in the installation plans to provide convenient access for maintenance of bearings and rolling members of the conveyor, as well as, the drive equipment.

FEED HOPPERS

The purpose of the feed hopper or chute is to spread the material being crushed uniformly across the full width of the rotor and to contain the crushing action inside the crusher. The feed hopper should be substantially constructed of steel plate and structural sections proportional to the size of the crusher it is to be used with and the type of material being crushed.

Whenever possible, the crusher feed hoppers should be isolated from both the crusher and its conveyor while it is supported by a separate structure independent of the crusher foundation.

Even when the hopper is isolated from the crusher, it should have sufficient stiffening and cross bracing to prevent any unsupported spans of metal from acting as a drum due to air or material flow or from vibration of the crusher transmitted through the foundation or support structure. Often, a slight vibration of the crusher can be magnified by a feed chute or hopper through it's structural resonance until a serious vibration condition develops which can best be corrected by isolating the hopper. The minimum isolation for the feed hopper should be a 1/2 inch resilient pad inserted between the hopper flange and the top of the crusher frame.

The hopper should have easy access for service, designed so the segment of the hopper above the crusher cover will have a flanged section that can be unbolted from the hopper and pivoted open as part of the crusher cover. Provisions for this should be made when planning the crusher installation to allow sufficient room to fully open the cover without interference from the building or adjacent machinery. Where possible, provide a separate reinforced access door for the hopper in addition to the crusher cover opening. When material is not evenly introduced through the feed opening of the hopper, it is often necessary to provide baffles or guide chutes inside the hopper to spread the material across the full width of the rotor for equal utilization of the crusher hammers.

DISCHARGE CONVEYORS

The discharge conveyor or crushed product removal equipment should have capacity greater than the infeed conveyor plus an allowance for surges and any increase in volume due to fluffing of material being crushed.

The operating controls for the feed equipment should be interlocked with the discharge conveyor controls to prevent material from being introduced into the crusher unless the crusher and the discharge conveyor is operating.

The section of conveyor immediately under the crusher is subject to impacts from the grinding operation, so shock protection in this area is required. Belt conveyors should be provided with closely spaced impact idlers in this area. An apron pan conveyor or a vibratory conveyor is usually suitable for service in this location under a crusher. Allow as much distance as possible beneath the crusher for the discharge conveyor to provide room for surges and to center the load on the conveyor without interfering with the crusher foundation. This is especially important when using a vibratory pan conveyor which is best installed with a downward slope away from the crusher to positively move the crushed material, which may change its density from moment to moment.

Whenever possible, the discharge equipment should carry the product away from the crusher perpendicular to the rotor so the maximum foundation support will be provided beneath the crusher bearings. The discharge conveyor should be tightly shrouded to control dust and noise emissions or reverse airflow through the crusher.

Air swept hogging or shredding operations require careful design of the discharge chute and blast gate to maintain the proper velocity and volume of air through the pneumatic conveying duct to insure that material does not accumulate in the bottom of the crusher or duct that would impede the air flow and its carrying capabilities.

Additional conveyor operating information is available in Williams Form 898.

FOUNDATIONS

The foundation of the crusher has a most significant role in the successful operation of the installation and control of vibration.

The foundation provides the mass to dampen the crusher's normal operating vibration and absorb impact shocks. The general rule for crusher foundations is to provide a reinforced concrete pedestal extending as one unit under both the crusher and its drive that weighs at least three times the equipment it will support.

The arrangement of the foundation geometry is very important to react against the forces developed by the crusher operation. The height of the foundation should never be greater than its width unless spread footing is used under the foundation to prevent rocking and distribute the weight so that the soil loading is never more than 500 pounds per square foot.

The foundation pressure on the supporting soil is very important when dealing with a dynamic condition. The soil loading should not cause an interaction of the crusher vibration with the soil's natural frequency due to its deflection that would result in foundation critical. This is especially important when moisture in the soil is involved to insure the foundation had adequate support and impose a soil loading no more than a quarter of the recommended static values for the particular type of soil under the proposed crusher foundation.

Additional information is available in Williams Form 902 - Crusher Foundations.

When the crusher is set on the foundation, make certain it is level and supported uniformly to avoid distortion of the bearing pedestals when the anchor bolts are drawn tight. Assemblies shipped from the factory that are mounted on structural base plates should be properly aligned before connecting the drive motor after they are mounted on the foundation.

Additional information is available in Williams Form 901 - Alignment.

We suggest you have your foundation plans reviewed by qualified structural engineers having expertise in dynamic loading.

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WILLIAMS

CRUSHER FOUNDATIONS

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TRADE MARK

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2701 North Broadway, St. Louis, Missouri 63102 USA
Phone: (314) 621-3348 Fax: (314) 436-2639
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FORM 902R4

FOUNDATIONS

Contrary to appearance, machinery foundations can be the most problematic component in a machine system. The motors, crushers, turbines, control panels, and ancillary meters, valves, and others appear more complex than a block of reinforced concrete or a simple arrangement of steel beams and columns between them and the earth. That may be why many machine buyers and installers find themselves in an expensive quagmire with a new machine performing out of specifications. Not enough engineering horsepower was applied to the machinery foundation design.

Machines such as steam turbines, centrifugal compressors, reciprocating compressors, fans, shredders, crushers, and others require foundations that have been designed and installed by experienced and knowledgeable engineers. The time to avoid problems is in the planning and design stage. There are the usual considerations of adequate static stiffness, stability, alignment with internal and external components, force path to earth, isolation from external influences, and isolation of the external world from machine. Then, **there is the need to avoid high vibrations**.

High level vibrations are harmful for the machine because they damage its structure and, if left uncorrected, cause breakdown. Vibrations also harm the machine surroundings by generating continuum vibrations in the soil and in buildings, propagating over long distances, and damaging buildings or other installations. Vibrations can insidiously result in damage to neighboring machinery. Moreover, vibrations represent an additional soil loading at the location of the foundation, they shake the soil particles that may lead to compaction and possibly to dangerous subsidence or tilting of the machine foundation.

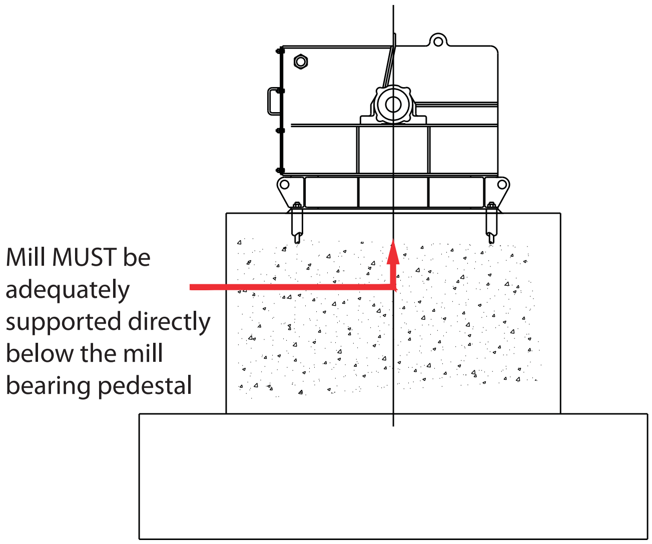
BASIC CONSIDERATIONS

The best foundation is provided by a poured in place reinforced concrete structure under the crusher and its driver. The foundation must have the required rigidity to sustain the alignment of machinery on it and with external ancillary devices.

A generally accepted rule-of-thumb is the foundation weight (mass) be at least three times the mass of supported machinery for centrifugal machines and four to five times for impacting (crushers) or reciprocating type of machines. The mass acts as an inertia block to stabilize the foundation. The optimum distribution of the foundation mass would be to have as much weight as possible directly under the crusher and its bearings to provide the maximum inertia damping next to the rotating equipment. The height of the foundation should never be greater than the width perpendicular to the rotor unless an integral pad or spread footing is used beneath the structure.

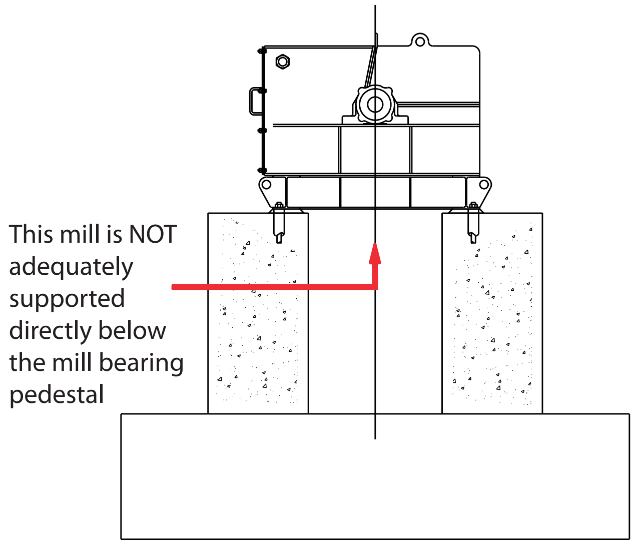
Whenever possible arrange the discharge from the crusher to be carried perpendicular to the rotor to allow solid support under the sides of the mill and the bearing pedestals.

RECOMMENDED



DO provide continuous support directly under the bearing pedestals.

NOT RECOMMENDED



DO NOT mount mill on a foundation that does not provide support directly under the bearing pedestal.

RECOMMENDED

NOT RECOMMENDED

The desirability of low soil loading under a foundation subject to vibration cannot be over-emphasized. It is not safe to use conventional static soil bearing support values for dynamic loading conditions.

The foundation should rest on bedrock or solid earth, completely independent of other foundations and separated from all adjacent concrete work by shock absorbing pads between the meeting surfaces. If necessary, pilings should be placed as the initial foundation layer. The tendency to consider pilings as a panacea for foundation/soil problems should be avoided. Their use also requires specialized engineering.

Batter piling may cause piles to lose the damping expected from them. Environmental considerations are important with their use as much as without them. Machinery center of gravity should be placed over a pile groupings' center of resistance to avoid rocking in operation, which can change the natural frequencies in a short time.

The foundation must be designed to avoid resonant vibration conditions, one of the most insidious problems because it amplifies normal vibrations and is usually expensive to cure. Engineering textbooks suggest foundation design include facility to change a foundation's properties (natural frequency , among others) after machine installation. That might include space for bracing, hollow columns to accept mass changing material, moisture control of subsoil (drainage), columnar collars for strengthening, etc.

Below is a plot showing how rapidly, as the operating frequency approaches a natural frequency, a vibration level is amplified at resonance:

E is the damping factor.

v is the floor natural frequency (cpm).

w is the operating speed (rpm).

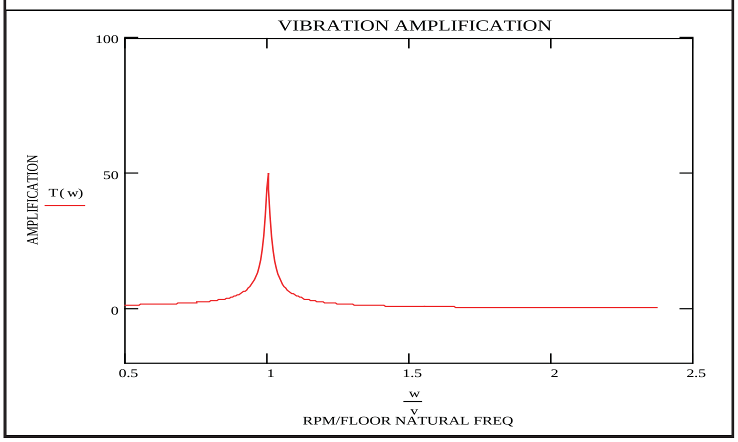
T is the amplification factor.

$E := .01$

$v := 1900$

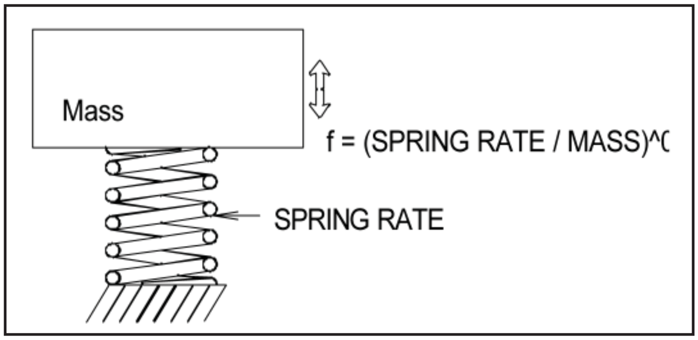
$w := 100, 110 .. 4500$

$$T(w) := \left[\frac{\left[1 + \left(2 \cdot E \cdot \frac{w}{v}\right)^2\right]}{\left(1 - \frac{w^2}{v^2}\right)^2 + \left(2 \cdot E \cdot \frac{w}{v}\right)^2} \right]^{.5}$$



Resonance arises when the foundation or one of its major components has a natural frequency[1] at or close to the machinery running frequency. The most common vibration creator in machinery is the rotor unbalance that excites the rotor and from it the surrounding elements, at the rotor's turning speed (rpm). A crusher is especially susceptible to vibration problems because its unbalance changes and can become high, at a fast rate, due to the constant uneven wear on the hammers. That wear is a natural consequence of its work.

Any natural frequency (cpm or cycles per minute) of the foundation or a major component should be 20 to 25% away from the crusher's rotating speed (rpm or revolutions per minute). For example, if the crusher's rotating speed is 900 rpm, the foundation's natural frequency should be less than (900) – (900)(.25) cpm or greater than (900) + (900)(.25) cpm. "Greater than" is preferred since the crusher will not have to traverse the natural frequency to get to operating speed during start.[ii]



This is a simple model to demonstrate the basic concept of natural frequency. The mass will bounce (vibrate) up and down after being pushed down and released at a rate (frequency) determined by (spring rate (lbs/in) /mass (lb-sec^2))$^{.5}$.

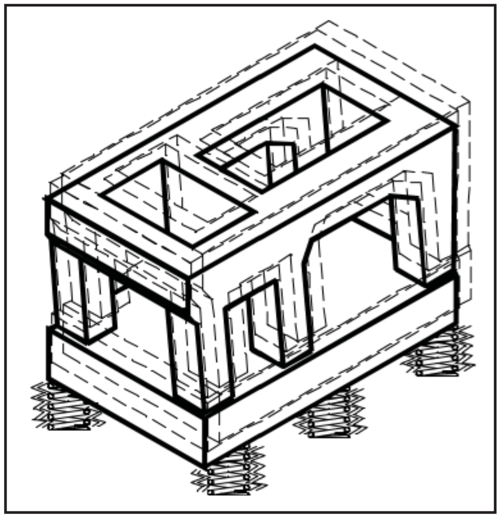
Avoiding the resonance situations requires competent engineering by all concerned. Williams Crusher Co. will supply the following information so that you can proceed with your foundation design.

- Certified drawing of machine assembly
- Functions of machine
- Weight of machine and its rotor components
- Location of center of gravity both vertically and horizontally
- Speed ranges of machine and components or frequency of unbalanced primary and secondary forces

Knowledge of the soil formation and its representative properties is required for static and dynamic analysis. The following parameters are generally required:

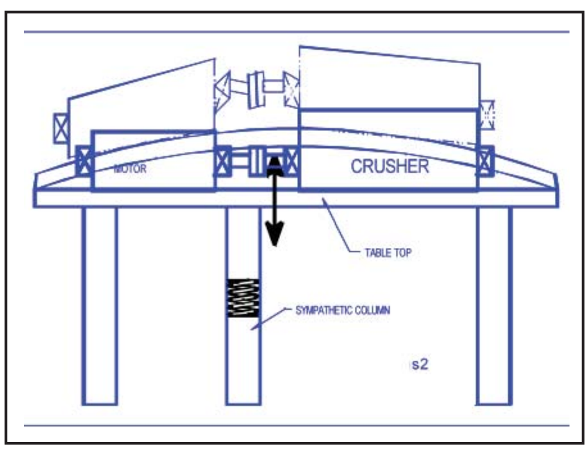
- Density of soil
- Poisson's ratio
- Shear modulus of soil at several levels of strain (or magnitude of bearing pressure)
- Coefficient of sub-grade reaction of soil, if the above parameters are not accurately known
- The foundation depth and the bearing pressure at which the above parameters are applicable
- Other information required for the static design of the footing

The soil becomes the spring for the entire machine system with the system as the mass. That translates into a situation similar to the one below. The coil springs show how the soil reacts and can form a condition of spring and mass bouncing as energetically as the small system mentioned previously.

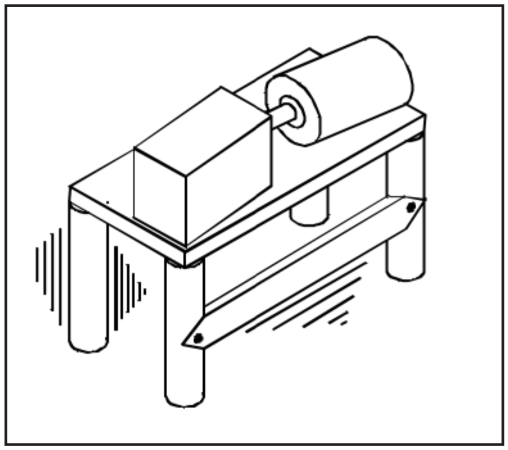


When that happens, it is usually time to start calculating the time and expense to change the mass and/or spring rates.

Vibration problems are not limited to the whole foundation and the supporting soil. Components of the foundation can have natural frequencies that will resonate with machine operating speeds. The drawing below shows the tabletop and a column beneath it vibrating together because their natural frequencies are close to the machine system operating speed.



Major components on a machine base are not the only trouble makers. A minor part can also resonate enough to cause problems to the mounted machinery and nearby personnel. The lower drawing suggests two of those.



STRUCTURAL STEEL FOUNDATIONS

If a structural steel foundation is required for any crusher installation, it should be carefully designed to avoid natural frequencies close to operating speed and its harmonics and sufficiently rigid to assure permanent alignment of the crusher and its driver. It must be designed to carry with minimum deflection the weight of the equipment, plus the loads imposed by the material handled and the dynamic forces set up from the crushing operation.

The crusher frame is to be rigidly connected to the structural foundations using shims to adjust for foundation and frame irregularities to prevent distortion of the crusher frame. The distortion can cause vibrations as problematic as vibrations from unbalance. Resilient mounting pads between the bottom flange of the crusher and the structural steel foundation are to be avoided at all times, unless they are beneath an inertia base supporting both the crusher and its driver. Vertical supports should be placed directly under the crusher bearings wherever possible. If this cannot be done, the bearing loads must be transferred properly to the nearest vertical load path.

Structural steel foundations are generally more sensitive to imbalance because more structural members are available to have natural frequencies matching the operating speed. Our crushers are dynamically balanced on a properly designed concrete foundation to 5 mils displacement or less prior to shipment from our factory. Crushers subsequently mounted on a structural steel foundation will most likely vibrate at a higher level if the steel foundation is more compliant than our balancing foundation.

All structural steel crusher foundation plans should be reviewed by a qualified structural engineer with experience and expertise in dynamic loading just as any other foundation plans.

SWING HAMMER CRUSHERS ON STRUCTURAL STEEL FOUNDATIONS

The unique characteristic of a swing hammer crusher that is different from all other rotating machinery is the starting pulse generated by hammers extending from their position of rest to a radial position on start-up. Even a perfectly weight matched set of hammers will have a significant starting pulse until they are extended to a rigid radial position. This pulse is transmitted to the support structure which responds at its natural frequency or critical and is further excited by several more heavy shocks in rapid order until the hammers are fully extended at about 200 rpm. As the crusher continues to accelerate to operating speed it rapidly passes through any foundation or structural criticals below the operating speed until it attains full speed where the vibration pattern can then be determined in a few seconds while the rotor is at a constant speed.

If the support structure is resonant at or near a multiple of the crusher operating speed the initial starting pulse is reinforced by the forcing frequency at operating speed to create a serious vibration disturbance in a non-uniform manner. This means that the vibration pattern of phase and amplitude is not the same on two consecutive starts of the crusher. This is particularly true if the critical frequency is at or near the crusher operation speed. A critical or resonant condition vibration pattern at or near operating speed is characterized by a significant increase in vibration amplitude for a very slight change in operating speed and a ninety degree or more shift in phase angle. This can best be demonstrated as the rotor coasts down from full speed and observed on the vibration analyzer meters in the filter out mode because the coast down time is considerably longer than the acceleration to full speed.

What a critical implies is that a very little force can be magnified significantly by the structures natural tendency to vibrate at or near the forcing frequency. This can be controlled sometimes by dynamic balancing to a more rigorous standard than normally required. When the crusher is mounted on a rigid or solid foundation that affords adequate damping of operating vibrations; criticals are seldom encountered. The crusher starting pulses are similar to bump test used to determine the structures natural frequencies. That test is performed by striking the structure with a sharp blow with sufficient energy to excite a vibration pulse or wave that can be measured and observed by a vibration analyzer. All structures have a natural frequency in both horizontal and vertical directions, which are influenced by their loading and sub-grade support. Steel structures have a much greater tendency to respond to vibration of equipment mounted on them because they have less inherent damping and are not normally designed to resist vibration. On the other hand concrete structures normally afford greater damping because of their lower natural frequencies due to the greater mass of concrete provided it is designed to meet nominal foundation criteria.

This is why a swing hammer crusher mounted on an elevated structural steel foundation can be easily dynamically balanced without hammers. Then when the matched weight set of hammers are installed on the rotor the vibration pattern changes dramatically where it is almost impossible to control the vibration or to see a repeat of the vibration pattern on two successive runs or starts.

The only effective answer for this situation is to provide a non-resonant foundation, which always entails considerable additional expense or to dynamically decouple the forcing frequency by changing the crusher operation speed. Options available for changing crusher speed include a different speed motor and changing to a belt drive that offers many possible speed variations by sheave combinations that permits operating the crusher out of the critical influence of the foundation.

ANCHOR BOLT LOCATIONS

Check the certified dimension drawings for the anchor bolt location and size. When anchor bolts or inserts are cast in the concrete, it is very important to construct a well braced template to accurately locate and position the anchor bolts or inserts in the foundation until the concrete has set. To compensate for small measuring errors, place a sleeve around each bolt to allow for adjustments when the concrete has set. The sleeve should have about an inch clearance around the bolt, which will require a plug at the top to keep out the concrete, and center the bolt in the sleeve.

BEDPLATES AND SHIMS

When the foundation design calls for a structural bedplate cast in the concrete foundation, the centerlines and elevation must be established by a survey so the crusher will be in the correct position called for on the certified dimension drawing when set on the bedplate.

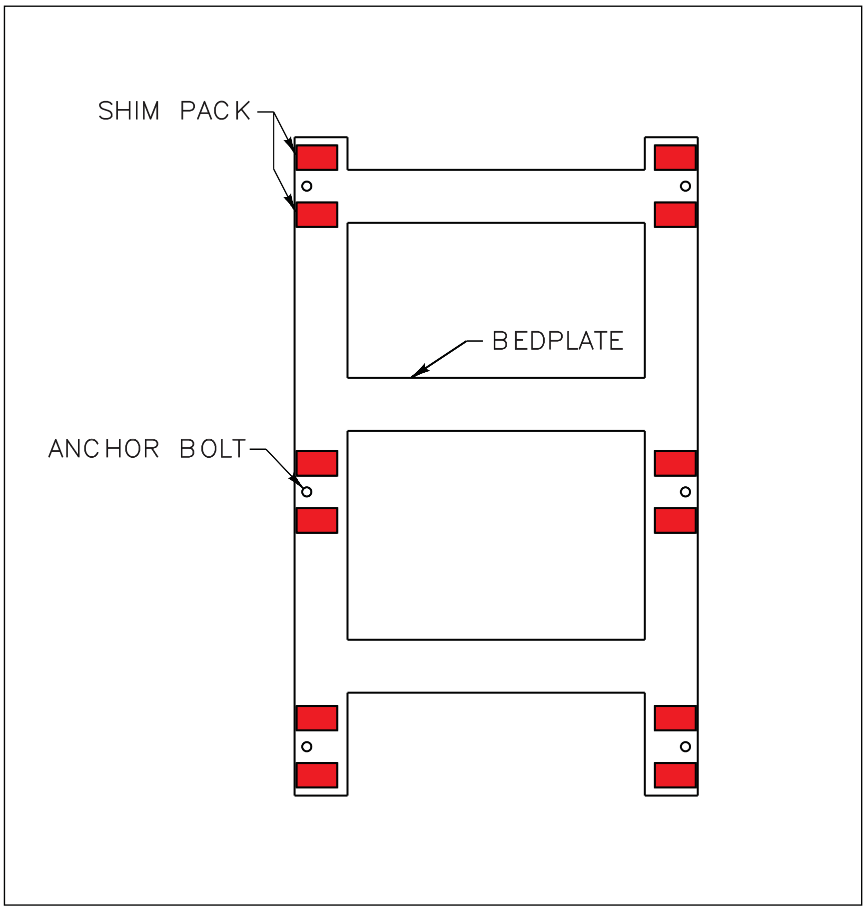
To determine the necessary length the anchor bolt must project above the foundation, check the certified dimension drawings for shaft centerline elevation and its height above the foundation. Then allow for the grout or shim thickness, the crusher bottom flange thickness, the height of the nuts and washers and extra threads for draw-down.

When prepping the foundation area where the mill base or bed plate is to be installed. Make sure the anchor bolts were installed per the Williams supplied drawings and information.

Make sure the foundation area is level and clean of any dirt and debris. Confirm that base plates and foundations are installed and leveled to specifications.

Make sure that baseplates and machine feet are clean, deburred and free from dents in the areas to which machinery will be mounted.

Use clean, flat shims. If you must cut thicker shims from steel stock, be sure they are clean, flat and deburred, shims should be uniform in size and shape. Typical shim sizes are 3-4" wide, and the full length of the mill flange.



Install shim packs on each side of the anchor bolts as shown above and below. This provides a solid support of the equipment once the anchor bolts are tightened and will help provide a solid bond between the bed plate/mill base and the foundation. Select shim thickness that results in no more than 3-4 shims in a shim pack to prevent a spring effect.

NOTE: MINIMUM WIDTH OF SHIMS 3-4" LENGTH SHOULD BE THE SAME AS THE FLANGE OR THE WEB OF THE SUPPORT BEAM

GROUT

The crusher should be properly shimmed, leveled, aligned and grouted onto its foundation. Allow for 1 – 3 inches of grout to be placed between the crusher and its foundation. Look at your certified dimension print for depth of grout recommendation.

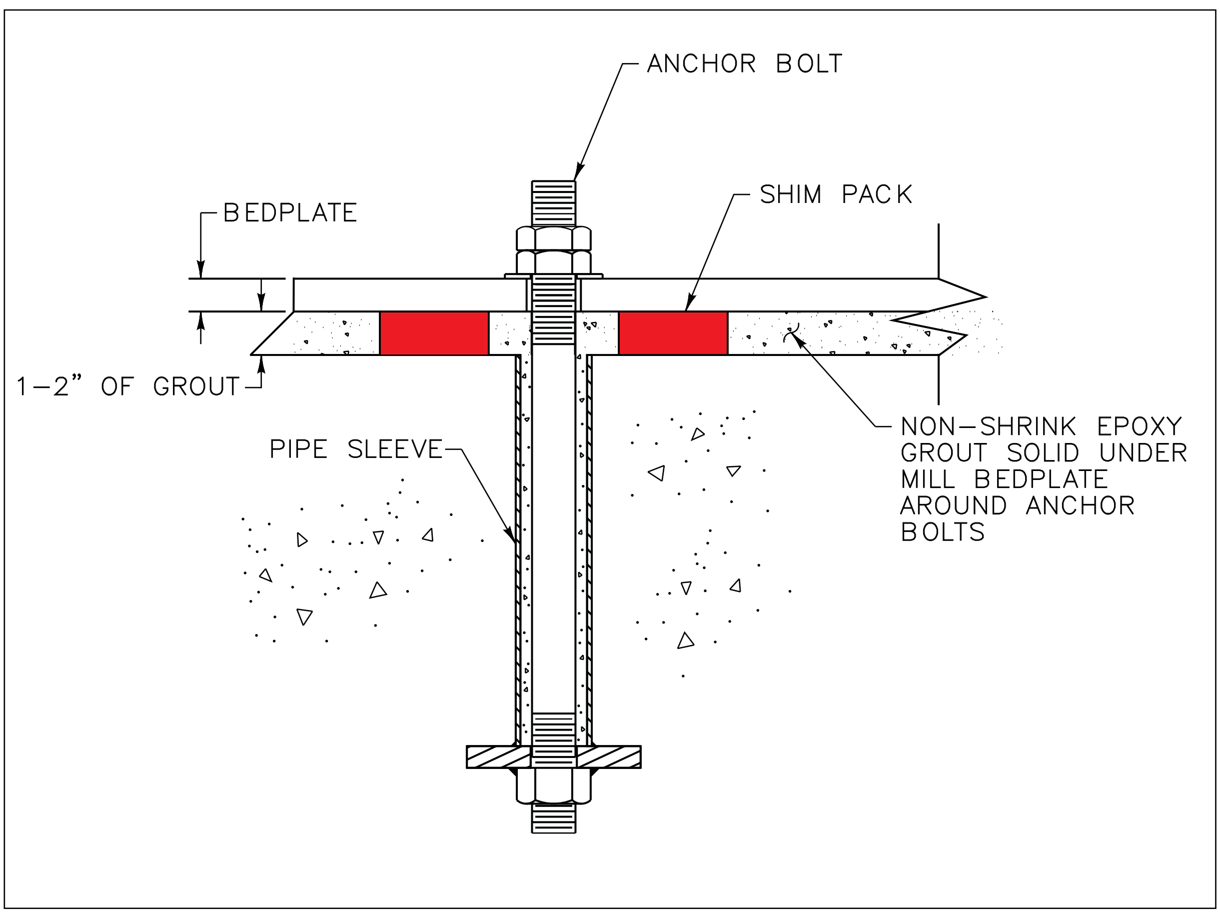
When new equipment is being commissioned, high vibrations often are caused by improper grouting performed by hurried construction crews. As equipment ages, many vibration problems arise that can again be traced to the foundation. Shims and hold-down bolts tend to loosen over the years, causing grout to turn to dust. Result is a condition known as "soft foot." Grout, therefore, is one of the keys to establishing and maintaining precise alignment of rotating equipment.

We only recommend a two-part epoxy grout.

Epoxy grouts offer quick curing, high tensile and compressive strengths, and the ability to bond to both concrete foundation and machinery steel.

Five Star Products Inc., Fairfield, Connecticut, offers a full line of epoxy grouts for your consideration.

Grout must be placed to provide for full support under the base flanges of the mill or the structural steel bedplate provided with the mill.



[ii] "Any beam, column, floor, or other material system (bearing pedestal, rotor/bearing/pedestal/foundation/earth, building/earth), having the properties of mass (weight) and elasticity is capable of making a free or natural vibration. If the system is displaced from its rest or unstrained (not stretched) configuration, elastic strain introduces internal forces and moments which oppose the strain. For brevity and by analogy with a simple mass-spring (weight hanging from a spring or a cantilevered beam or a tuning fork) system we shall refer to the effects of this elastic strain as a "restoring force." If, the system is suddenly released, the restoring force accelerated the system back toward its rest position but by the time it has arrived there it has acquired momentum and overshoots the rest position. This brings into action a restoring force in the opposite direction which resists the overshoot, brings the system momentarily to rest, and immediately accelerates it back again through the rest position, and so an. This free vibration goes on until the system is brought to rest by damping which dissipates (as heat) the energy of the free vibration.

The frequency of this free vibration is the "inherent **natural frequency**."

P.146, Seismic Mountings for Vibration Isolation, Macinante, Wiley Interscience, John Wiley & Sons, 1984.

"A bridge or, for that matter, any structure, is capable of vibrating with natural frequencies. If the regular footsteps of a column of soldiers were to have a frequency equal to one of the natural frequencies of a bridge which the soldiers are crossing, a vibration of dangerously large amplitude might result. Therefore, in crossing a bridge, a column of soldiers is told to break step."

P.376, University Physics, Sears and Zemansky, Addison Wesley, Reading, MA, 1962.

[ii] Decades ago resonance caused less trouble in engineering design than today, and it is precisely the higher probability of resonances that is a primary reason for this paper. Older type constructions, machines, buildings, and steel structures used thicker and more rigid parts, resulting in fairly high natural frequencies. At the same time machine speeds used to be relatively low, so that the troublesome high vibrations arising from resonance, that is, the coincidence of a speed of rotation with a natural frequency, occurred less often. With the progress of engineering techniques, structures became more slender and flexible, their natural frequencies decreased while machine speeds increased. Thus, the range of natural frequencies approached that of rotational speeds, leading more frequently to resonance and its associated high vibration levels and problems.

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FORM 768R2

STOODY
A Thermadyne Company

Stoody Nicromang®
Shielded Metal Arc Welding Electrode

DESCRIPTION

Stoody Nicromang deposit is an austenitic manganese steel with excellent impact strength. It has a high deposition rate and work hardens under impact. Deposits can be flame cut. It is designed for build up and joining of manganese steels and is not recommended for buildup of carbon steels. There is no limit to deposit thickness. When welding, the interpass temperature should not exceed 500°F.

TYPICAL DEPOSIT CHARACTERISTICS

Abrasion Resistance	Moderate
Impact Resistance	Excellent
Hardness as Deposited	200 HB
Hardness as Work Hardened	HRC 52
Magnetic	No
Surface Cross Checks	No
Machinability	Poor
Deposit Layers	Unlimited
Maximum Interpass Temperature	500°F

ALLOY TYPE

Austenitic Manganese Steel

TYPICAL APPLICATIONS

- Railroad Frogs and Crossings
- Crusher Equipment Parts
- Manganese Steel Castings
- Wobbler Spindles
- Coupling Boxes

OPERATIONAL CHARACTERISTICS / WELDING PARAMETERS

Diameter, In. (mm)	**1/8 (3.2)**	**5/32 (4.0)**
Current, Amp. DCEP	100 – 160	140 – 200
Position	Flat / Horizontal	Flat / Horizontal
Rod Length	14”	14”

Diameter, In. (mm)	**3/16 (4.8)**	**¼ (6.4)**
Current, Amp. DCEP	170 – 225	230 – 330
Position	Flat	Flat
Rod Length	14”	18”

Diameter, In. (mm)	**5/16 (8.0mm)**
Current, Amp. DCEP	270 – 390
Position	Flat
Rod Length	14”

STANDARD SIZES

Diameter	Packaging	Part #
1/8” (3.2mm)	60#	45150850
1/8” (3.2mm)	10#	45150810
5/32” (4.0mm)	60#	45151050
5/32” (4.0mm)	10#	45151010
3/16” (4.8mm)	60#	45151250
3/16” (4.8mm)	10#	45151210
¼” (6.4mm)	60#	45151650
¼” (6.4mm)	10#	11498800
5/16” (8.0mm)	60#	45152050

Stoody Company
5557 Nashville Road • Bowling Green, KY 42101
1-800-227-9333

PDS-MN-E-001
Revision 2
08/02/02

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RECOMMENDED HARD SURFACE ROD STOODY® 21

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FORM 769R3

STOODY
A THERMADYNE Company

Stoody® 21
Shielded Metal Arc Welding Electrode

DESCRIPTION

Stoody 21 is a tubular electrode with good impact and abrasion characteristics. Deposits are not machinable or forgeable. Stoody 21 bonds well with carbon, low alloy, and manganese steels. Deposits are slightly magnetic on carbon and low alloy steels, but no on manganese steels, and will develop cross checks.

TYPICAL APPLICATIONS

Typical applications include:

- Compactors
- Mill Hammers
- Buckets and Bucket Teeth
- Dredge Pumps

TYPICAL DEPOSIT CHARACTERISTICS

Abrasion Resistance	Good
Impact Resistance	Moderate
Hardness	
On Carbon Steel	HRC 52 – 56
On Manganese Steel	HRC 46 – 50
Magnetic	
On Carbon Steel	Slightly
On Manganese Steel	No
Surface Cross Checks	Yes
Machinability	No
Deposit Layers	2
Hot Wear Applications	Up to 800°F

OPERATIONAL CHARACTERISTICS / WELDING PARAMETERS

Diameter, In. (mm)	**1/8 (3.2)**	**5/32 (4.0)**
Current, Amp. DCRP	90 – 130	120 – 160
Position	Flat	Flat

Diameter, In. (mm)	**3/16 (4.8)**	**¼” (6.4”)**
Current, Amp. DCRP	140 – 220	175 – 300
Position	Flat	Flat

ALLOY TYPE

Eutectic Chromium Carbides in an Austenitic Matrix

STANDARD SIZES & PACKAGING

Diameter	Packaging	Part #
1/8” (3.2mm)	10# Box	11172700
1/8” (3.2mm)	50# Bulk Pak	10205200
5/32” (4.0mm)	10# Box	11172900
5/32” (4.0mm)	50# Bulk Pak	10205600
3/16” (4.8mm)	10# Box	11173000
3/16” (4.8mm)	50# Bulk Pak	10205700
¼” (6.4mm)	10# Box	11173100
¼” (6.4mm)	50# Bulk Pak	10205800

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ALIGNMENT OF ROTATING EQUIPMENT

WILLIAMS Patent Crusher & Pulverizer Company

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FORM 901

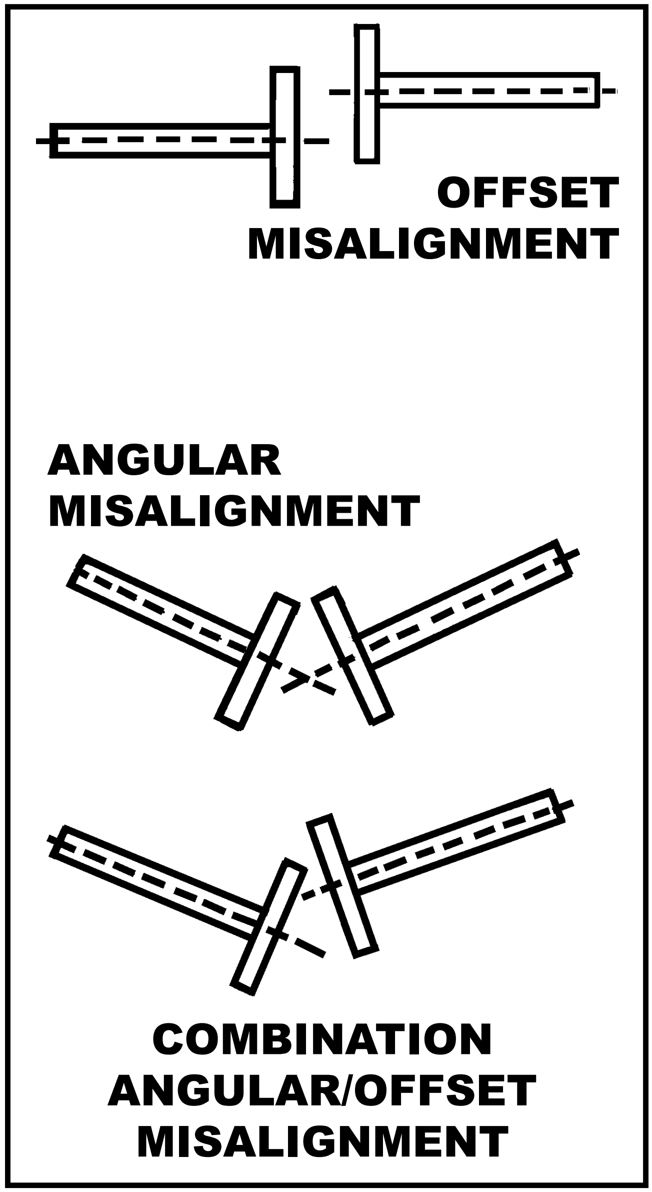
ALIGNMENT OF ROTATING EQUIPMENT

The reliable, trouble-free, and efficient operation of any type of rotating equipment depends a large extent upon its correct alignment with the driver, whether direct coupled or belt driven.

Perfect alignment is attained when the bearings of the rotating equipment are concentric with the bearings of the driving equipment and the shafts of both units are parallel.

The faster the rotating speed of the connected equipment, the more precise the alignment must be to avoid destructive vibrations and stresses.

Both belt driven and direct coupled rotating equipment require a careful alignment at installation and periodic checks on the alignment after it has been in operation for a few weeks.



Misalignment may be the cause of:

A) Excessive vibration, particularly in the axial direction.

B) Premature bearing failure.

C) Excessive coupling wear.

D) Noisy operation.

Factors that may change the alignment of rotating equipment are:

A) Settling of the foundation.

B) Distortion or deflection of the baseplate supporting the rotating equipment.

C) Shift of the driver or crusher on the foundation.

D) Temperature differences causing different shaft heights.

There are two types of misalignment, although the general case is a combination of both.

In offset misalignment, the shaft centerlines are parallel but do not intersect. This can be called “run out”.

In angular misalignment, the centerlines of the shafts intersect but the shafts are not on the same axis. This shows up as a gap difference across the coupling face.

NOTE: ***DO NOT*** **attempt balancing corrections on a machine until the alignment has been approved because the vibration pattern will be affected by alignment changes.**

SETTING THE DRIVE MOTOR

The motor is always aligned to the crusher after it has been leveled and securely bolted in place. The connection can either be a flexible coupling or a belt drive.

Follow the motor manufacturer's recommendations and specifications for setting the motor on the foundation with a height allowance for shim packs and installing the mating coupling half, when the motor is direct connected to the crusher.

It is recommended that the fabricated steel base or sole plates under the motor be provided with horizontal and axial jacking bolts to facilitate aligning the motor to the crusher.
Always set the motor so the gap between the faces of the coupling halves is at least the normal distance specified by the coupling manufacturer, but never less than .1250 inches, for protection from thrust or expansion.

Large motors are usually set lower than the crusher by a few thousandths to a maximum of four thousandths. When the driver heats up under normal operating conditions, it will expand and bring the coupling in line. The holes for the anchor bolts in the motor feet or baseplate should be at least a quarter inch larger in diameter than the anchor bolts to facilitate adjusting the motor for its alignment. After precise alignment, the motor should be securely bolted and doweled in place. Shear blocks are recommended when it is not practical to install dowel pins in the motor base.

PLACEMENT OF SHIMS

The baseplate under the motor should have a finished elevation that will provide room for at least 1/16" to 1/8" of shims in a mix of sizes from .010" to .060" thick beneath the motor feet for final adjustment.

Never use shims less than .010" thick, nor more than five pieces in a shim pack to avoid a "spongy" shim set.

Shims should be horseshoe-shaped to straddle the anchor bolts and large enough to support the weight of the equipment across the width of each foot.

LARGE CRUSHER ALIGNMENT TOLERANCE

The acceptable offset or parallel alignment of direct coupled large Williams crushing equipment shall be no greater than .005" in both horizontal and vertical directions.

Acceptable angular alignment or gap of direct coupled large Williams crushing equipment shall be within .004" per foot of coupling diameter.

Correct excessive offset (parallel) and angular (gap) misalignment by arranging the proper size shims under the drive motor. Retest alignment after each change of motor position or shim pack height when the anchor bolts have been drawn down tight. Check alignment using the methods outlined at the end of this Bulletin.

All readings must be taken with all of the anchor bolts tight and having about the same torque.

ALIGNMENT TOLERANCE OF OTHER SIZE EQUIPMENT

When equipment is received mounted on a structural base plate, it has been aligned at the factory. Experience has shown that structural bases, no matter how rugged or deep in section, will always twist in handling or shipping. Therefore, the alignment must always be checked across the coupling after installing the unit on the foundation and the drive motor has been shimmed until it is properly aligned with the crusher.

Couplings of smaller Williams equipment rotating at speeds of 1200 rpm or more must be aligned so the offset (parallel) alignment is within .006" Total Indicated Runout or actual .003" and the angular or gap is within .003" for the alignment to be acceptable.

All bolts used to mount the baseplate to the foundation should be SAE Grade 5 or better, and have a proper diameter to suit the mounting bolt holes. Use proper shimming between baseplate and foundation when tightening the anchor bolts to insure a level baseplate. After satisfactory alignment has been obtained, it would be advisable to operate the motor separately to check for the proper rotation and vibration. If the drive motor runs satisfactorily, close up the coupling following the manufacturer's recommended procedure and lubrication instructions when both driver and crusher are securely bolted to the bedplate.

To maintain proper alignment, it is recommended that the motor be doweled to the mounting base or be provided with shear blocks welded to baseplate when it has been determined to be operating satisfactorily. This will also make it easy to realign the motor if it should ever be removed for service.

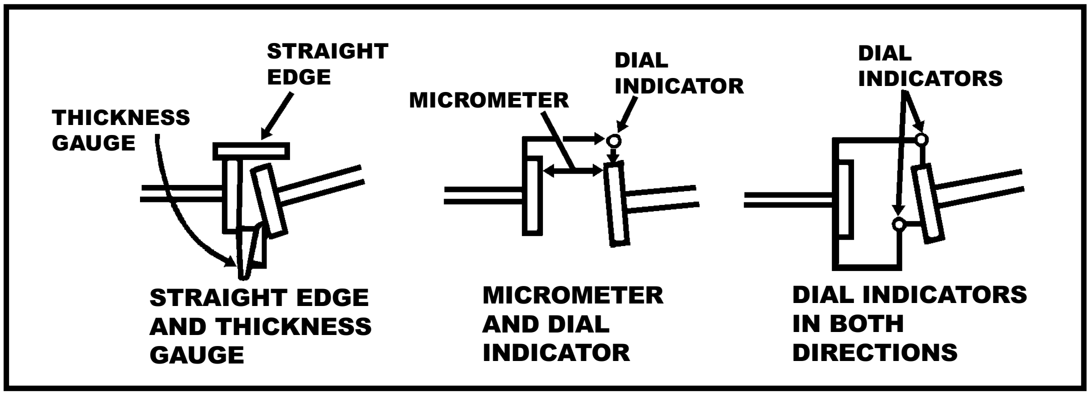
BELT AND CHAIN DRIVE ALIGNMENT

V-Belt drives do not require alignment to as close tolerances as direct coupled equipment, but unless the belts enter and leave the sheaves in a relatively straight line, wear is accelerated and vibration, primarily in the axial direction, results. To check alignment of a belt drive use a long straight edge or for longer centers between shafts use a taut steel wire. Position the straight edge or taut steel wire along the outside face of both sheaves and measure the offset to the straight line. Make sure that the width of the outside land is equal on both sheaves when using this method. The maximum gap or offset in sheave alignment should be no greater than 1/8" (.125") from the straight edge or line for drives with less than four belts. Drives that have four or more belts should be aligned with a gap of 1/16" (.0625") or less.

It is also important to check that the faces of the sheaves are parallel and mounted square on the shaft which can be determined by use of a spirit level. The same alignment check will apply to the sprockets of a chain drive such as used for an apron pan conveyor or similar equipment. Most belt misalignment is caused when moving the drive motor to tension the belts.

Belts should be tightened just enough to prevent slippage under rated load. Some belt slipping or squeal may be allowed in starting high inertia loads to avoid excessive belt tension which overloads the bearings of the connected equipment.

METHODS OF CHECKING COUPLING ALIGNMENT



Protect belts from grease and oil as well as chips that may shorten their life by an approved OSHA type enclosure.

Offset and angular misalignment can be measured by any of the methods shown above. Dial indicators must be securely mounted on the coupling to avoid errors in measurement which give more accurate readings than straight edges when used correctly.

Coupling alignment checks can be done by two methods: (1) with a dial indicator, or, (2) with a steel straight edge, feeler gauge, and taper gauge. It is recommended that both methods be used to cross check the alignment because each have advantages and conveniences. The dial indicator gives a better check on offset (parallel) alignment while the taper gauge is best for the angular (gap) check across the coupling faces.

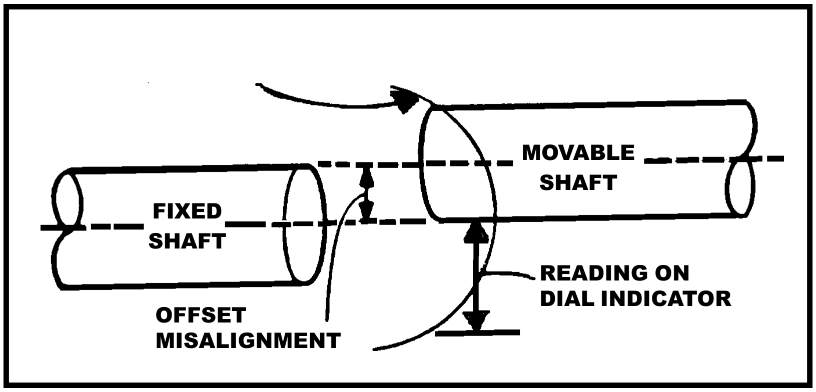
Since the location of the crusher half of the coupling is established when the crusher rotor is mounted, and the crusher has been grouted, any necessary adjustments will have to be made by moving the driver. When in correct alignment, the faces of the coupling halves are parallel and the hubs are concentric.

DIAL INDICATOR METHOD

(1) **<u>Offset Alignment:</u>** Fasten indicator bracket on driver coupling hub so the indicator dial button is perpendicular when it is contacting the alignment surface of the crusher coupling hub. Be sure the indicator mounting bracket is rigidly and securely attached to the driver coupling hub, which may require a special wrap connection bracket for the indicator.

Rotate the motor with the indicator mounted on the coupling half and take readings at four points: top, each side, and bottom on the crusher half of the coupling that remains stationary, when swing hammers are mounted on the rotor. When the rotor is without swing hammers, match mark the hubs and rotate both driver and crusher rotor together to measure parallel (offset) alignment to avoid any error from the hub being out of round.

Difference between the two side radial readings indicates the motor must be shifted sideways. Difference between the top and bottom readings indicates the driver must be raised or lowered by adding or removing the same thickness of shims under all four corners of the motor. The correction amount in each case is one half the difference between the two readings of the dial indicator.



**ARC SCRIBED BY ZERO
POSITION OF DIAL INDICATOR**

When the zero position of a dial indicator is rotated around the axis of the fixed shaft, the distance from the arc to the motor shaft is twice the actual misalignment of the shaft centerlines.

The indicator should always be set to “0” at the top position. If the indicator does not return to zero after the coupling has been turned through a
complete rotation, something is wrong, and the readings should be repeated until the indicator returns to zero.

(2) <u>**Angular Alignment:**</u> Position the dial indicator on the bracket attached to the motor hub by the above method so it will contact the shoulder of the crusher coupling hub perpendicularly in an axial direction. Rotate the motor with the indicator mounted and take readings at four points: top, each side and bottom. Adjust the motor position until the same reading is ob tained all around the coupling.This equalizes the clearance or gap between the hub faces.

Where the hubs of the coupling have been distorted by removal, dial indicator method is not practical.

STRAIGHT EDGE AND TAPER GAUGE METHOD

(1) <u>**Offset Alignment (parallel):**</u> Place a straight edge across the adjacent coupling halves. Raise or lower the motor by shimming until the straight edge lies true at top and bottom positions of the coupling. Placing the straight edge on each side of the coupling halves will show the required horizontal correction. Shift both ends of the motor sideways an equal amount to adjust horizontal offset. The vertical offset can be determined accurately only when the hori zontal offset has been corrected.

(2) <u>**Angular Alignment (gap):**</u> The clearance between the coupling faces at the four cardinal points can be equalized by adjusting the motor position until the readings on the taper gauge are equal at all four points. Since the coupling hub faces are more accurately machined than the shoulder of the hub, this method is not only easier and quicker, but more accurate than a dial indicator. Angular alignment can be checked best when the offset alignment has been corrected in both directions.

COUPLING LUBRICATION

The coupling should be lubricated or greased the same as any other power equipment. For type and amount of lubrication, follow the coupling manufacturer's recommendations.

Pack the space between and around the grid of Falk Steelflex type couplings with as much Mobilux #2 Grease or NLGI density 2 grease with EP additives as possible. Then wipe off excess grease flush with top of grid before assembly of coupling cover. All couplings should be inspected and re-greased annually for normal operating conditions. For extreme duty or dirty environment, inspection and re-greasing should be every six months or less. It is better to hand pack the grease into the coupling grid and between the faces before the cover halves are closed to insure the grease is uniformly distributed around the entire coupling rather than pumping grease through a fitting in the cover which often does not cover the entire grid and results in premature wear of the coupling grid.

NOTE: ***It is good practice to check alignment after operating the equipment under load for two or three weeks.***

All couplings are to be protected with an OSHA approved type guard which must be in place when the crusher is operating.

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HAMMERS

THE WILLIAMS PATENT CRUSHER & PULVERIZER CO. ST. LOUIS, MO. U.S.A.

TRADE MARK

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FORM 952R

HAMMERS

These hammers have been designed and manufactured from the alloy steel best suited for the application they have been ordered for. The foundry maintains careful control over each step of the hammer production to insure they are the highest quality.

Following the foundry's checks for soundness, size, and hardness, they are gauged again in our plant and ground to the exact dimensions of the cutting tip profile.

When the order calls for the hammer tips to be hard surfaced, the shop applies the specified material according to the manufacturer's instruction for the particular type of coating.

The cast hammers are then accurately weighed to 0.05 pounds for hammers weighing up to 100 pounds. Hammers weighing more than 100 pounds are weighed and marked to the closest quarter pound. A Nissan paint marker is used to label the weight near the hammer eye. For example: 48.15 is forty-eight and fifteen hundredths pounds.

It is very important that the hammers are installed on the rotor so that every pair of hammers opposite each other in any of the disc openings weigh as close as possible to each other, across the entire width of the rotor. This is necessary to maintain satisfactory dynamic balance, which keeps the operating vibration to a minimum that will insure a long service life for the rotor bearings.

When possible, run the crusher without hammers after all the material has been removed from the rotor to check for dynamic balance before installing a new set of hammers. If the rotor without hammers runs smooth, it should not change its vibration level when the hammers are properly installed.

The following table is a guide for arranging hammers with suggested maximum weight difference in pounds for hammers opposite each other and the maximum total difference in pounds between opposing rows.

ALLOWABLE WEIGHT DIFFERENCE (IN POUNDS)

	1800 RPM (rotor speed)		1200 RPM (rotor speed)		900 RPM (rotor speed)	
HAMMER SIZE BY WEIGHT	**Per Hammer**	**Per Row**	**Per Hammer**	**Per Row**	**Per Hammer**	**Per Row**
Up to 50 lb. Hammers	0.25	0.50	0.35	0.85		
50 to 100 lb. Hammers			0.35	1.25	0.50	2.00
100 to 150 lb. Hammers			0.50	1.60	1.00	2.25
150 to 200 lb. Hammers					1.00	2.50
200 to 400 lb. Hammers					2.00	3.00
Above 400 lb. Hammers					2.00	3.75

It is suggested that the rows of hammers be assembled outside the crusher in the pattern they will be installed on the rotor to check that the weights of hammers opposite each other are as close as possible from among the group of hammers required to make a set. One method would be to designate each hammer bolt by a letter and each disc opening by a number starting at the end of the hammer bolt, that will receive the first hammer. Since there are several rotor configurations and various hammer location patterns each arrangement will have to be set up to suit the particular crusher installation. For example: on a rotor with four rows of hammers, the hammer in row A disc 1 will be opposite the hammer in row C disc 1 and so forth across the rotor, then rows B and D will be opposite each other and should be equal as possible, but do not have to weigh the same as rows A and C.

Sometimes it is helpful to set up a chart to plot the hammer locations so the weights can be arranged to be equal to each other for hammers on opposite sides of the rotor.

WILLIAMS

INSTRUCTIONS FOR INSTALLING NEW CAGE BARS IN DOWN-RUNNING MILLS

1. Lock out mill motor and follow safety procedures per Williams Form 936.

2. Open mill cover to provide access to cage bars.

3. Note opening of size and arrangement of cage bars.

4. Loosen bottom side liners, which are held in place by bolts through the side of the crusher frame.

5. Attach the lifting equipment, or sling, to both ends of cage bar so both ends will move equally as the cage bar is hoisted out of the crusher. This will prevent it from wedging against the side of the frame, if one end is moved ahead of the other.

6. When the cage bar is out of the support ring, it can be picked up with the mobile hoisting equipment and lifted through the cover opening or slid out to the side, whichever provides the easiest access. Cage bars in the portion of the cage opposite the cover opening will require special care to keep them from sliding down the cage support ring when personnel are in the way.

7. Continue the above procedure until all the cage bars have been removed from the cage support ring.

8. Remove all material in cage recess groove.

9. Examine the cage support ring for any defects or unusual wear before replacing the cage bars, and make necessary repairs.

10. Installing new cage bars is essentially the reverse of the above procedure. Cage bars with the smallest openings are to be installed first. See "Typical Hog Cross Section" on reverse side.

11. To pull the cage bars into position on the upper end of the support ring opposite the cover opening, it may be necessary to attach a pair of come-alongs to the back of the breaker plate or the frame above the cage support ring. Keep cage bars tight against each other in the support ring.

12. When all the cage bars are in place, it may be necessary to use filler bar to fill out the cage groove to insure the cage bars remain tight when the cover is closed.

13. Close cover and retighten bottom side liner bolts.

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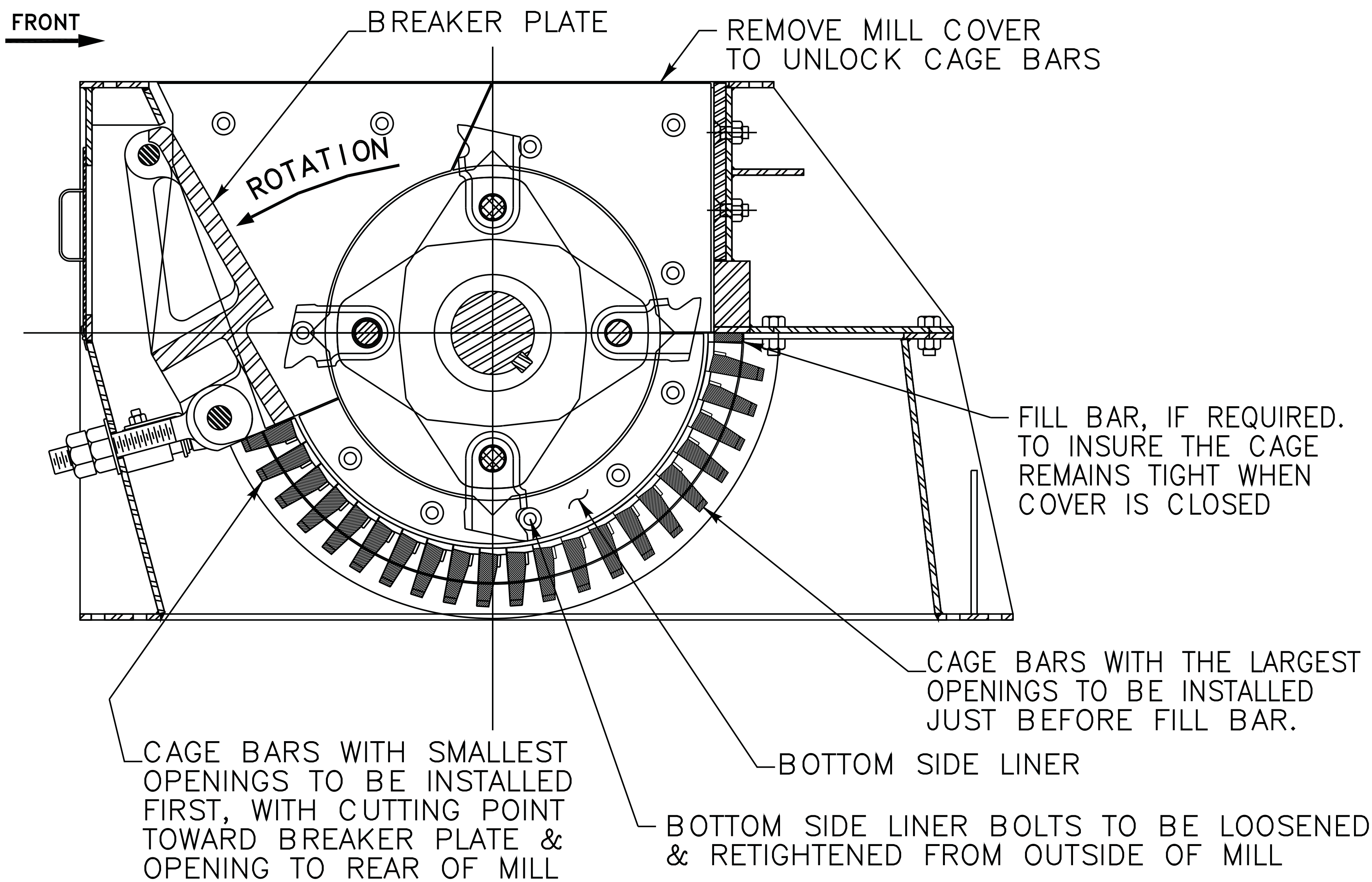
TYPICAL HOG CROSS SECTION



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ROLLER BEARINGS

- Installation
- Operation
- Lubrication
- Service

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FORM 911R
REV. 2008

BEARINGS

The purpose of this manual is to provide a guide for the operation and maintenance of the roller bearing pillow blocks used on the rotors of Williams equipment. The same principles will apply for the lubrication and maintenance of all anti-friction bearings in all types of Williams equipment.

Accordingly, this manual is divided into the following parts:

SECTION I. BEARING OPERATION AND INSPECTION

A properly installed anti-friction type pillow block bearing on a piece of Williams equipment requires no adjustments during its normal service life. The bearing mountings and pillow blocks are engineered to rigidly support the bearing and keep it aligned.

When the rotor is properly installed in the shredder housing (See ASSEMBLY AND INSTALLATION) the bearings will automatically be aligned and in proper position for a long service life.

Long life of bearings is assured by maintaining proper alignment with the drive, proper belt tension, and good lubrication at all times. Incorrect alignment of flexible couplings or belt drives can produce vibration and thrust. Too much belt tension often causes overheating of bearings.

Prolonged operation of a bearing with a severe vibration problem above 5 mils (.005”) will cause premature failure and expensive repairs. Excessive heat in a bearing (above 200^{o}F) when operating will quickly destroy the effectiveness of the lubricant, and will result in premature failure of the bearing.

When either heat or excessive vibration develops, corrective action should be undertaken immediately to find the cause and remedy the problem.

The oil level gauge on the side of the bearing housing should be inspected several times each operating shift. The oil level should be at the center of the glass when the rotor is stationary and slightly below halfway when operating. A higher oil level will cause heat and churning of the oil in the bearing housing, which will contribute to oil oxidation.

Note any change or discoloration in the oil, which would indicate contamination or oxidation is taking place. If so, drain and replace the oil immediately.

Roller bearings are less sensitive to over-lubrication than ball bearings, but under-lubrication can destroy them quickly.

The bearing housing oil seals should be included in the daily inspection to insure they are functioning properly to retain the lubricant and keep foreign matter out of the bearing. Oil seals require a small amount of lubricant to prevent frictional heat and subsequent destruction when the shaft is rotating. Oil seals should permit a slight seepage of oil past the sealing surfaces to minimize seal friction and heat. If the seal leaks excessively it can easily be replaced as described in the section on BEARING MAINTENANCE.

The slingers should be tight against the face of the bearing housing to protect the oil seals, and the inside slingers should be snug against inside faces of housing and cap to help prevent oil leaks. Most problems with slingers and oil seals are the result of mishandling the rotor during installation. When properly handled and installed the oil seals will function correctly for years.

Several times an operating shift, check the bearing housing temperature to note any abnormal rise in temperature. Normal bearing operating temperatures will be in the range of 160^{o} – 180^{o}F, which will allow the palm of the hand placed on the top of the bearing housing to remain for approximately 2 –3 seconds. If the bearing housing is warmer than this, remedial steps should be taken to insure proper service life of the bearing.

Periodically, check to see that the bearing housing hold down bolts are tight and the stop blocks are snugly in place, especially after a severe vibration or shock. A sudden rise in vibration can often be accounted for by the loosening of bearing housing hold down bolts, which should be re-torqued.

Refer to the section on LUBRICATION for recommendations on types of oil or grease and frequency of changes or re-lubrication.

A field check on vibration can be made without instruments because a vibration level of 1 to 3 mils (.001” to .003”) will allow a new nickel to stand on edge on top of the bearing housing for a few seconds. When a vibration is in the range of 3 to 5 mils (.003” to .005”) at an operating speed less than 1800 RPM it is possible to stand a new nickel on edge on top of the bearing housing for 2 or 3 seconds. A vibration level more severe than this should be investigated and corrective measures taken to control the cause. This check is valid only for shredders operating without material being fed, with all the hammers free to pivot on their bolts or pins.

SECTION IIA. LUBRICATION OF BEARINGS

The importance of proper lubrication cannot be overstated in the operation of a shredder because the bearing life depends upon it. Shredder duty is among the most difficult applications for anti-friction bearings so the lubricant selection is vital to its performance. The higher speed large shredders require a circulating oil lubrication system to insure an adequate supply of oil for both cooling and lubricating the bearing.

The bearing housing is designed to provide a sump through which the rolling elements of the bearing will pass. The oil level should be no higher than the center point of the lowest rolling element which can be gauged by the center of the sight glass on the side of the bearing housing.

OILS

Oil used for shredder bearing lubrication should be a highly refined mineral oil of medium body (SAE 30 to 40) that is non-oxidizing with good de-foaming properties and contain extreme pressure (EP) additives. The viscosity of the oil should be between 105^{o}F and 150^{o}F SSU at the anticipated operating temperature range of 160^{o}F to 180^{o}F or between 500 and 750 SSU at the standard base temperature of 100^{o}F. The oil should yield a minimum TIMKEN OK load of 45 pounds.

Oils that conform to the above specifications have been found to provide satisfactory service over the past several years in many large shredder installations. However, it is always preferable to consult a competent lubrication engineer for more specific recommendations, particularly if the conditions at the installation site are unusual.

CIRCULATING OIL SYSTEMS

When circulating oil systems are used the entry or feed is made through the center hole in the top of the housing, the drain should be made from both sides of the bottom of the housing through drain lines having inserts to maintain the proper oil level in the bearing. Lines to bearing housings should have flexible connections. Shredder bearings are given a coating of a basic lubricant at the factory to protect them from corrosion in transit and storage.

The bearing housings **MUST BE FLUSHED** before operating and filled with the correct lubricant for the installation.

High-speed shredder installations may require the oil level be lowered below center of oil sight glass to avoid heat build up due to churning. The oil level can be controlled by adjustment of the flow control valves on the lubrication circulation system or simply draining the sump on static system.

Abnormal bearing temperature may indicate faulty lubrication. Normal temperature may range from cool or warm to the touch, up to a point too hot to touch for more than a few seconds, depending on bearing size, speed and surrounding conditions. If the bearing is too hot to touch for more than a few seconds it is prudent to check the temperature by applying a thermometer at the top of the bearing housing. The bearing housing temperature is usually 10^{o}F lower than the bearing temperature. If the bearing housing temperature is 180^{o}F or higher, immediate steps should be taken to determine the cause and make corrections.

If the shredder is equipped with a water-cooled heat exchanger on the lubrication circulation system, make certain that clean cooling water is flowing to oil cooler. Verify the cooling water passages in the heat exchanger are not obstructed preventing proper cooling of the circulating oil.

PERIODIC LUBRICATION INSPECTION AND CHANGES

Frequency of oil changes in a static system with a bearing lubricated solely by the oil in the housing will depend on several local operating conditions.

Deterioration of oil is caused by heat, oxidation, catalytic reactions, and dirt or water contamination. Therefore, periodic oil changes must be made. The most desirable approach to the question of when to replace the oil is a continuous program of oil sampling and laboratory analysis.

After the initial two weeks of operation, the oil in the bearing housings should be changed on installations without oil circulation systems.

FLUSHING BEARING HOUSING

It is recommended that the bearing housing be thoroughly flushed out after the original oil has been drained. Fill the bearing housing to the center of the sight glass with SAE 10 straight mineral flushing oil, which should not contain additives. The shredder should be brought up to operating speed (without load) and immediately shut down. Drain off flushing oil and refill with recommended operating lubricant to proper level.

After the break-in procedure outlined above it is recommended that the oil be changed and the bearing housing flushed once a month to establish a basis for normal operating conditions. Then, depending on the condition of the oil drained from the bearing housing, the change period may be extended, but never more than every three months of operation.

In a shredder installation with an oil circulating system, test the lubricant at least every six months. If a change in the appearance is noted, check the oil immediately.

Change filters when indicating devices denote plugging of the element or when fluid analysis reveals a change is needed.

COLD WEATHER OPERATION

The heater in the circulating lubrication system reservoir is to be connected so it will operate even when the rest of the system is shut down to maintain a uniform 80ºF to 90ºF in the reservoir. Shredders installed in area where the ambient temperature drops below 20ºF when they are shut down should have the oil circulation system operate continuously to maintain a uniform temperature on the bearings. It may be necessary to heat trace the drain lines from some outside installations to insure proper flow back to the reservoir.

SECTION IIB. GREASE LUBRICATION

The pillow block bearings on Williams' equipment designed for grease lubrication are normally equipped with zerk type fittings unless otherwise specified.

Normal procedure when re-greasing bearing housings is to remove the drain plug and clean away any hardened grease from the opening so the old grease can be purged and any excess new grease can flow out.

The many types of grease available are of different qualities and compositions so it is necessary to select the grease carefully to insure dependable bearing service.

Bearings on Williams' equipment designed for grease have been lubricated at the factory with a LITHIUM based grease that has a No. 2 consistency, which is suitable for normal operating conditions. For best results, re-lubricate with lithium base grease or a grease that is compatible with the original lubricant. Mixing of different greases is not recommended. If necessary to change to a different grade, make, or type of lubricant, flush bearings thoroughly before changing.

GREASE SPECIFICATIONS

A good bearing grease must have the following properties:

1. Freedom from chemical or mechanical active ingredients such as free lime, iron oxide, and similar minerals or solid substances.

2. It must not separate or change in consistency, harden, or form acid.

3. A melting point (dropping point) considerably higher than the operating temperatures.

A grease conforming to the following specification will provide proper lubrications for most Williams pillow block bearing applications designed for grease:

1. **Lithium Soap Base**
2. **NLGI No. 2**
3. **Worked Penetration Range at 77ºF 265/295**
4. **ASTM Dropping Point ºF 380**
5. **Mineral Oil Viscosity SUS at 100ºF 750**
6. **Contain Non-Corrosive, Extreme Pressure Lubricity Additives, & be Water Resistant**

The lubricants listed below are typical products ONLY and should not be considered as exclusive recommendations:

Normal Ambient Operating Temperature Range 0ºF to 150ºF
NLGI Grade No. 2 (with EP additives)

METHODS OF RE-LUBRICATION

Before applying grease, the fitting on the bearing housing should be wiped clean, and the lever mechanism of the grease gun should be worked several times until trapped air is expelled and grease begins to come out of the nozzle. The drain plugs at the bottom of the cap and housing should be removed. Any dried or caked grease should be cleared from the drain area.

Grease should be applied while the machine is running. Add approximately 40 – 50 strokes of the lever from the hand-operated grease gun once a month to the grease zerk fitting on the top of the bearing housing. On some of the newer model bearing housings and housing caps there are grease zerk fittings on the sides. These zerk fittings are for lubricating the seals. Whenever the bearings are lubricated, a couple strokes of grease should be added to the seals.
(Reference Drawing # 61J-C-1955 on Page 13)

To avoid over-packing, the drain should be left open, after the gun has been disconnected, until no more grease is expelled from the drain. This is done to make sure the volume of grease has adjusted itself to the space in the housing, and to avoid overpacking. This may require anywhere from five to thirty minutes depending on the temperature and the size of the drain. Excess grease in the housing cavity will cause overheating. If grease is not expelled from the housing it may be necessary to disassemble the housing and clean the old grease out manually.

GREASING NEW BEARINGS

The bearing and housing grease reservoir should be packed with one of the greases listed above or an equivalent. Hand packing at time of assembly is generally preferable to greasing through a fitting because it is quicker and assures the proper amount of grease will be worked into all cavities of the bearing.

When hand packing, complete greasing of bearing is assured if grease is worked in at one side of the bearing until grease appears on the opposite side.

Housing reservoirs should be packed with grease to a level approximately level with the bottom of the shaft before it is pushed on the bearing. Then the bearing cap reservoir should be packed with grease

to the bottom of the shaft as it is slid into position. For a 5” bearing assembly it will take approximately two pounds (approx. 907g) of grease to hand pack the bearing, housing and cap reservoirs.

The drain plug should be left out when the new bearings are started up so any excess grease can be expelled as the surplus grease is flung off the raceways to avoid over-filling the housing.

BREAK-IN PERIOD

During the initial start-up period, after installing a new bearing, or the initial start-up of a new machine, there may be a break-in period during which the bearings will operate with above normal (160ºF-180ºF) temperatures. The outer race of the taper bore spherical roller bearing is common to two sets of rollers. During the assembly process, the outer race is rarely centered evenly between the two sets of rollers. When the outer race is off-center, the diametrical clearance on one side will be too tight. The reduction of the diametrical clearances on one side of the bearing will cause the bearing to heat up. This heat buildup is normal and necessary. The temperature increase of the bearing will force the outer race to move in an axial direction until it reseats itself, or the diametrical clearances are equal between the two sets of rollers.

During the break-in period, the bearing temperatures should be monitored and closely watched. If the bearing housing temperature increases above 200ºF, the machine should be shut down and the bearing allowed to cool down to ambient temperature. Once the bearing has cooled off, the machine can be restarted. It is not uncommon for this process to be repeated a couple of times before the outer race has taken seat.

Once the bearing has reseated itself, the temperature will usually drop to normal operating ranges (160ºF-180ºF) or below.

The normal stress of shipping and handling is usually enough to cause the outer race to shift in an axial direction. As a result of this movement, abnormally high temperatures during the initial start-up of new machines are to be expected, until the outer race has re-seated itself.

SECTION IIIA. ROLLER BEARING MAINTENANCE & SERVICE

Service on all taper bore Model “O” roller bearings used in Williams’ equipment from 5” through 12” is essentially the same. The main difference is the shaft for the 5” size is not gun drilled for hydraulic connections to assist in removing and replacing the bearing.

The bearings can be removed and replaced with the rotor in the shredder frame, provided sufficient clearance is available at the ends of the shaft to remove the flywheel and coupling half (see section on FLYWHEEL MOUNTING) before loosening the bearing hold down bolts.

CAUTION – DO NOT REMOVE NEW BEARING FROM ITS WRAPPING UNTIL IT IS ACTUALLY READY TO MOUNT.

BEARING HOUSING REMOVAL

Bearing housing for 5” bearings are doweled to the support pedestal with two #7 taper pins that must be removed before the housing can be moved.

Bearings 8” and larger have stop blocks with tapered keys that lock the bearing housing to the pedestal that must be removed before the housing can be moved. Unbolt the keepers that retain the tapered keys so they can be forced out of their slots by use of a hydraulic jack between their ends and the sides of the shredder frame. As the keys are removed, identify them with their slots using a marking device or paint so they will not get mixed up during reassembly.

When the ends of the bearing housings are clear and clean, scribe a match mark at each end of the bearing housing with a mating match mark on the sole plate of the pedestal. This will ensure the bearing housing is properly relocated and aligned with the rotor in the correct position when the bearing housing is reassembled.

If the bearings are to be replaced while the rotor is in the shredder, the shaft will have to be supported on blocking or suspended by a cable sling when the bearing housing is removed. (See section on ROTOR REMOVAL.)

On shredders with circulating lubrication systems, the hydraulic connections and drain lines will have to be disconnected and capped before the bearing housing can be removed. Be sure to provide a container to catch the oil from the bearing housing when the drain lines are removed. Depending on size of bearing there will be anywhere from a pint to several quarts of oil in the bearing housing.

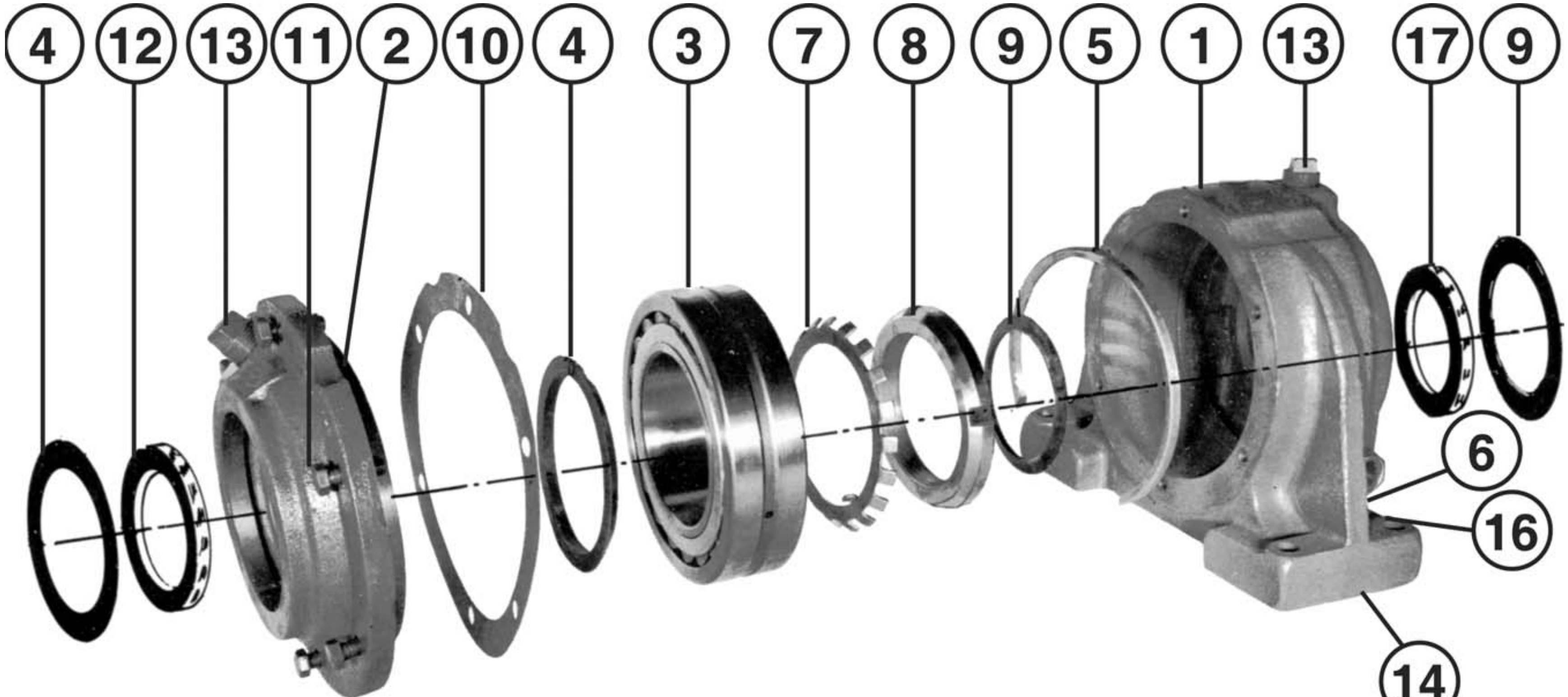
The bearing housing hold down bolts for 8” and 11” bearings have been torqued using a slugging wrench so the same procedure will be required for their removal. The hold down bolts for 12” bearing housings are 3.5” in diameter and have been tensioned while they were heated by electrical Cal-Rod units, which will have to be reconnected to heat the bolts to 350^{o}F for removal of the nuts.
(See 144-B-3906)

When the anchor bolt nuts have been loosened several turns, or about a quarter of an inch, the rotor can be raised and blocked so the bottom of the bearing housing is about an eighth of an inch above the support pedestal or sole plate, if the rotor is not to be removed from the housing for the bearing change.

ITEM NUMBER	**When Ordering Repairs, Give:** Part Wanted, Quantity, This Drawing Number, and Your Mill Number	PATTERN NUMBER	QUANTITY IN MACHINE
1	Pillow Block Housing	BC-286	1
2	Pillow Block Cap	BC-287	1
3	Roller Bearing		1
4	Oil Slinger, Large Bore (Should lightly rub Pillow Block Cap)		2
5	Stabilizing Ring (Used on Drive Side Only)		1
6	Oil Sight Gauge		1
7	Bearing Locknut Washer		1
8	Bearing Locknut		1
9	Oil Slinger, Small Bore (Should lightly rub Pillow Block Housing)		2
10	Gasket		1
11	Capscrews		6
12	Oil Seal, Large Bore		1
13	Inspection Port Pipe Plug		2
14	Oil Drain Plug		2
15	Oil Line Connection		1
17	Oil Seal, Small Bore		1
16	Not shown is a Thermocouple connection located opposite to the oil sight gauge (6) in bearing housing (1)		

PARTS LIST FOR MODEL "O"
5" TAPER BORE BEARING
WITH STATIC OR CONTINUOUS OIL LUBRICATION
DRAWING NUMBER 61J-B-3051

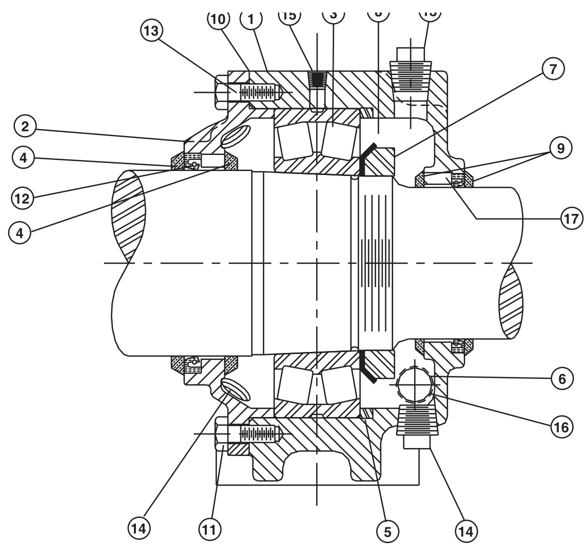
WILLIAMS
PATENT CRUSHER and PULVERIZER CO., Inc.



NOTE: SHOULD ROTOR OR BEARINGS BE REMOVED, WHEN REASSEMBLING, ALWAYS REMOVE INSPECTION PORTS (13) AND CHECK TO SEE IF OIL SLINGERS (9) ARE CORRECTLY POSITIONED AGAINST THEIR MATING SURFACES. IF NOT, PRY INTO POSITION

WHEN REMOUNTING BEARING -- MEASURE INTERNAL RADIAL CLEARANCE OF BEARING WITH A SHIM GAUGE -- FORCE BEARING ON SHAFT IN EASY STAGES UNTIL THE ABOVE NOTED RADIAL CLEARANCE IS REDUCED **.0025 IN.** TO **.0035 IN**.

SEE CHART ON PAGE 21.



WILLIAMS PATENT CRUSHER and PULVERIZER Co., Inc.

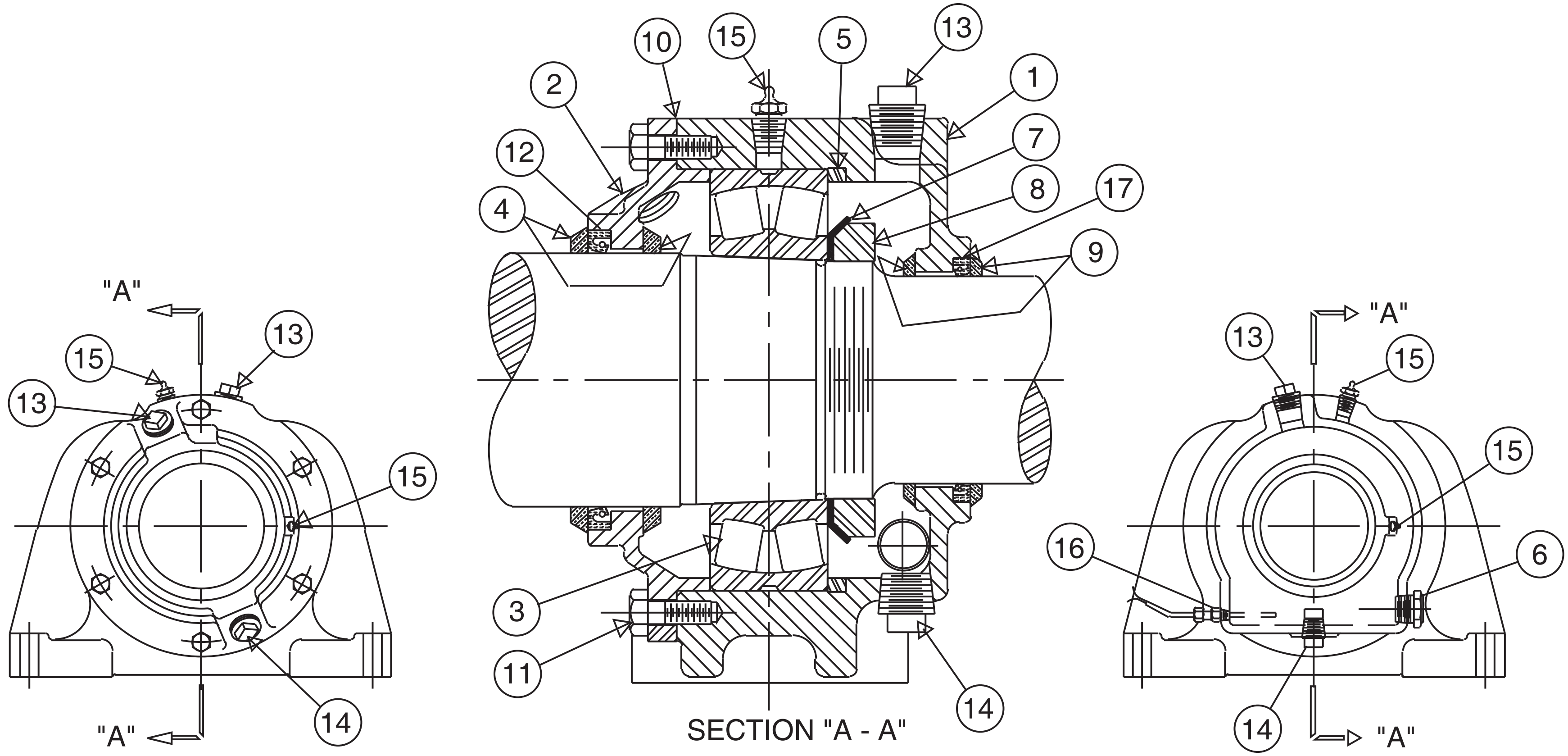
PARTS LIST FOR MODEL "O" 5" TAPER BORE PILLOW BLOCK WITH CONT. OIL LUBRICATION

DRAWING NUMBER 61J-B-3051

ITEM NUMBER	**When Ordering Repairs, Give:** Part Wanted, Quantity, This Drawing Number, and Your Mill Number	PATTERN NUMBER	QUANTITY IN MACHINE
1	Open Pillow Block Housing		1
2	Pillow Block Cap		1
3	Roller Bearing		1
4	Oil Slinger, Large Bore (Should lightly rub Pillow Block Cap)		2
5	Stabilizing Ring (Used on Drive Side Only)		
6	Oil Sight Gauge		1
7	Bearing Locknut Washer		1
8	Bearing Locknut		1
9	Oil Slinger, Small Bore (Should lightly rub Pillow Block Housing)		2
10	Gasket		1
11	Capscrews		6
12	Oil Seal, Large Bore		1
13	Inspection Port Pipe Plug		2
14	Oil Drain Plug		2
15	Grease Zerk		3
16	Thermocouple (Optional)		
17	Oil Seal, Small Bore		1

PARTS LIST FOR MODEL "O"
5" TAPER BORE BEARING
WITH GREASE LUBRICATION
DRAWING NUMBER 61J-C-1955

WILLIAMS
PATENT CRUSHER and PULVERIZER CO., Inc.



NOTE: SHOULD ROTOR OR BEARINGS BE REMOVED, WHEN REASSEMBLING, ALWAYS REMOVE INSPECTION PLUG (13) AND CHECK TO SEE IF OIL SLINGERS (4) ARE CORRECTLY POSITIONED AGAINST THEIR MATING SURFACES. IF NOT, PRY INTO CORRECT POSITION

WHEN REMOUNTING BEARING -- MEASURE INTERNAL RADIAL CLEARANCE OF BEARING WITH A SHIM GAUGE -- FORCE BEARING ON SHAFT IN EASY STAGES UNTIL THE ABOVE NOTED RADIAL CLEARANCE IS REDUCED **.0025 IN.**

SEE CHART ON PAGE 21.

WILLIAMS PATENT CRUSHER and PULVERIZER Co, Inc.

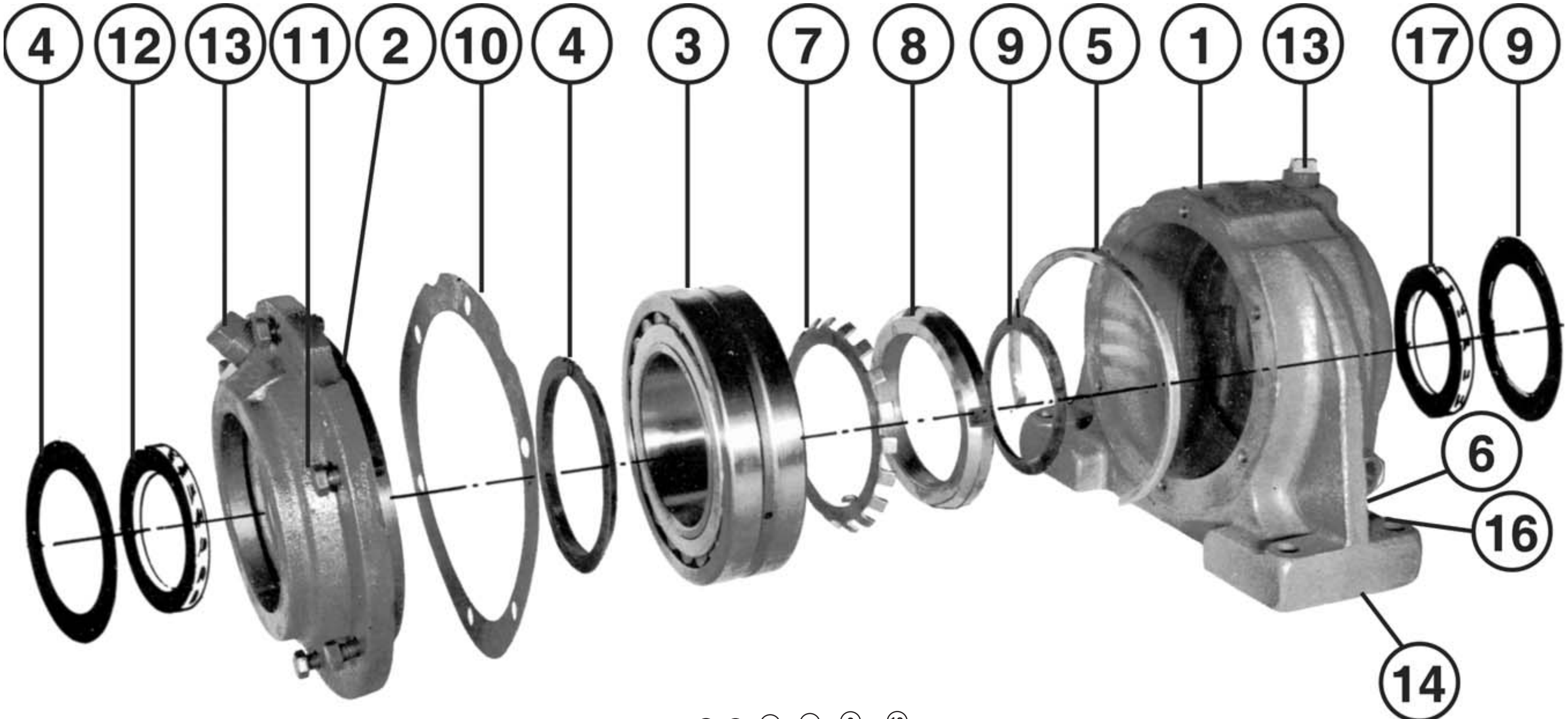
PARTS LIST FOR MODEL "O" 5" TAPER BORE, OPEN HOUSING BEARING WITH GREASE LUBRICATION

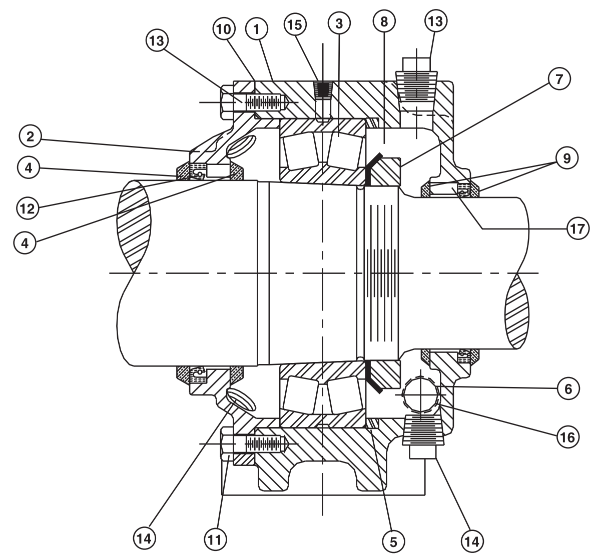
DRAWING NUMBER 61J-C-1955

ITEM NUMBER	**When Ordering Repairs, Give:** Part Wanted, Quantity, This Drawing Number, and Your Mill Number	PATTERN NUMBER	QUANTITY IN MACHINE
1	Pillow Block Housing	SS-550	1
2	Pillow Block Cap	SS-551	1
3	Roller Bearing		1
4	Oil Slinger, Large Bore (Should lightly rub Pillow Block Cap)		2
5	Stabilizing Ring (Used on Drive Side Only)		1
6	Oil Sight Gauge		1
7	Bearing Locknut Washer		1
8	Bearing Locknut		1
9	Oil Slinger, Small Bore (Should lightly rub Pillow Block Housing)		2
10	Gasket		1
11	Capscrews		6
12	Oil Seal, Large Bore		1
13	Inspection Port Pipe Plug		2
14	Oil Drain Plug		2
15	Oil Line Connection		1
17	Oil Seal, Small Bore		1
16	Not shown is a Thermocouple connection located opposite to the oil sight gauge (6) in bearing housing (1)		

PARTS LIST FOR MODEL "O"
8" TAPER BORE BEARING
WITH STATIC OR CONTINUOUS OIL LUBRICATION
DRAWING NUMBER 61J-B-3052

WILLIAMS
PATENT CRUSHER and PULVERIZER CO., Inc.





WILLIAMS
PATENT CRUSHER and PULVERIZER Co., Inc.

PARTS LIST FOR MODEL "O"
8" TAPER BORE PILLOW BLOCK
WITH CONT. OIL LUBRICATION

DRAWING NUMBER 61J-B-3052

NOTE: SHOULD ROTOR OR BEARINGS BE REMOVED, WHEN REASSEMBLING, ALWAYS REMOVE INSPECTION PORTS (13) AND CHECK TO SEE IF OIL SLINGERS (9) AND (4) ARE CORRECTLY POSITIONED AGAINST THEIR MATING SURFACES. IF NOT, PRY INTO POSITION

WHEN REMOUNTING BEARING -- MEASURE INTERNAL RADIAL CLEARANCE OF BEARING WITH A SHIM GAUGE -- FORCE BEARING ON SHAFT IN EASY STAGES UNTIL THE ABOVE NOTED RADIAL CLEARANCE IS REDUCED **.0035 IN.** TO **.0050 IN**.

SEE CHART ON PAGE 21.

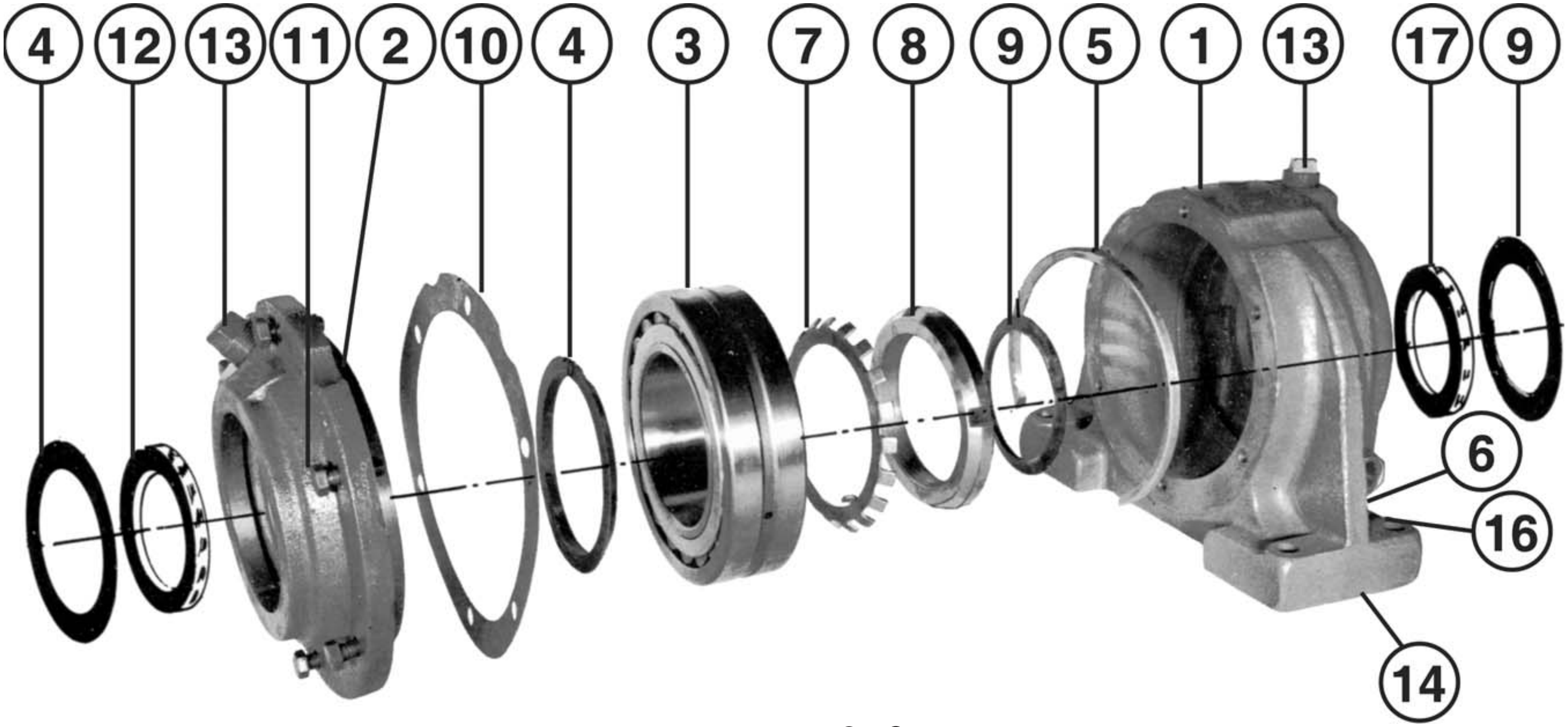
ITEM NUMBER	<u>**When Ordering Repairs, Give:**</u> Part Wanted, Quantity, This Drawing Number, and Your Mill Number	PATTERN NUMBER	QUANTITY IN MACHINE
1	Pillow Block Housing		1
2	Pillow Block Cap		1
3	Roller Bearing		1
4	Oil Slinger, Large Bore (Should lightly rub Pillow Block Cap)		2
5	Stabilizing Ring (Used on Drive Side Only)		1
6	Oil Sight Gauge		1
7	Bearing Lockplate, Capscrews & Safety Wire		1
8	Bearing Locknut		1
9	Oil Slinger, Small Bore (Should lightly rub Pillow Block Housing)		2
10	Gasket		1
11	Capscrews		6
12	Oil Seal, Large Bore		1
13	Inspection Port Pipe Plug		2
14	Oil Drain Plug		2
15	Oil Line Connection		1
17	Oil Seal, Small Bore		1
16	Not shown is an Air Breather located on the face of the bearing housing (1)		

PARTS LIST FOR MODEL "O"
11" and 12" TAPER BORE BEARING
WITH CONTINUOUS OIL LUBRICATION

(Note: These bearings are available only with continuous oil lubrication)

DRAWING NUMBER 61J-B-3919

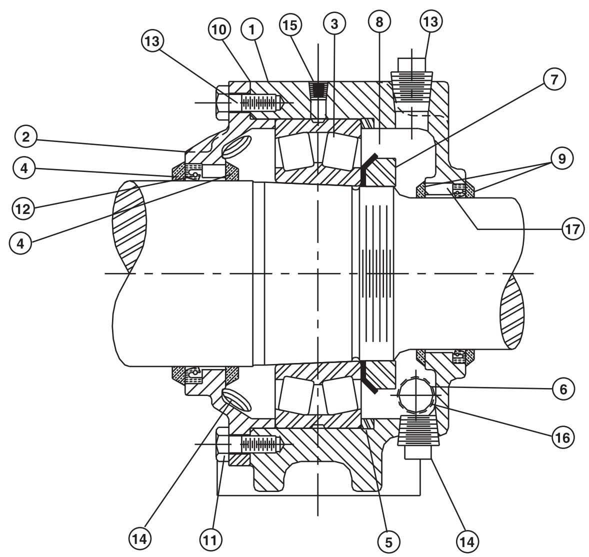
WILLIAMS
PATENT CRUSHER and PULVERIZER CO., Inc.



NOTE: SHOULD ROTOR OR BEARINGS BE REMOVED, WHEN REASSEMBLING, ALWAYS REMOVE INSPECTION PORTS (13) AND CHECK TO SEE IF OIL SLINGERS (9) AND (4) ARE CORRECTLY POSITIONED AGAINST THEIR MATING SURFACES. IF NOT, PRY INTO POSITION

WHEN REMOUNTING BEARING -- MEASURE INTERNAL RADIAL CLEARANCE OF BEARING WITH A SHIM GAUGE -- FORCE BEARING ON SHAFT IN EASY STAGES UNTIL THE ABOVE NOTED RADIAL CLEARANCE IS REDUCED **.0045 IN. TO .0065 IN. (11"),** and **.0050 IN. TO .0070 IN. (12")**.

SEE CHART ON PAGE 21.



WILLIAMS
PATENT CRUSHER and PULVERIZER CO., Inc.

PARTS LIST FOR MODEL "O" 11" & 12" TAPER BORE PILLOW BLOCK WITH CONTINUOUS OIL LUBRICATION

DRAWING NUMBER 61J-B-3919

Install a lifting eye in the tapped hole provided in the top of the bearing housing and connect it to a lifting device that will permit the housing to be moved along the shaft and clear the end without binding or interference. **CAUTION:** This eye is to lift the bearing housing only and never to lift the rotor assembly.

Complete the removal of the bearing housing hold down bolts.

Listed below are the parts drawings for the different size bearings that use similar index numbers for the assembly items that are referred to in this discussion.

PILLOW BLOCK BEARING HOUSINGS						
BEARING SIZE IN.	PARTS DRAWING	BEARING WEIGHT LBS.	HOUSING PATTERN	WEIGHT	CAP PATTERN	WEIGHT
5	61J-B-3051	22	BC286	110	BC287	22
8	61J-B-3052	122	SS550	630	SS551	90
11	61J-B-3919	265	SS646	965	SS636	160
12	61J-B-3919	408	SS825	2255	SS717	335

BEARING HOUSING DISASSEMBLY

Before proceeding with the disassembly, clean the shaft on both sides of the bearing housing of all corrosion, debris and scale until bright metal shows, then give it a coat of light oil. This will allow the slingers and oil seals to slide along the shaft without their being damaged or broken. The slingers and oil seals are molded from a compressed synthetic rubber compound that is ideal for the application, but can be damaged or broken by mishandling, such as forcing or prying with improper tools. Carefully work the larger slinger (Item 4) away from the bearing housing cap toward the rotor about four inches along the cleaned and lubricated shaft. Remove the cap screws (Item 11) holding the housing cap (Item 2) to the bearing housing, and carefully pry the cap away from the housing.

OIL SEAL REMOVAL

It should not be necessary to remove the oil seal (Item 12) from the housing cap for the cap to slide along the shaft if the shaft is smooth and clean. If the oil seal (Item 12) is to be removed for inspection or replacement, use the proper tools to pull it out of its groove in the cap or housing. A cotter key puller is an ideal tool to pry into the oil seal butt joint. Pull one end out of the groove until the fingers can grasp it. When about a fourth of the seal is clear of the groove, grasp the spring with the hooked tool and pull it from the slot in the seal to relieve the pressure on the seal lip, which should allow the seal to come out the rest of the way without too much strain. Unhook the ends of the spring and remove it from the shaft. Separate the ends of the seal sideways and it can be slipped off the shaft. Inspect the oil seals for hardness and wear which would prevent them from doing their job of retaining the lubricant and keeping foreign material and moisture out of the bearing housing. If the seal appears free of defects or grooves, set it aside for re-installation. However, it is good practice to replace the oil seals when changing a bearing.

BEARING HOUSING CAP POSITION

Slide the housing cap along the shaft until it contacts the slinger (Item 4) that had been moved previously. The larger size bearing housing caps will have to be held upright on the shaft to keep them out of the way while changing the bearing. This can be done easily by wiring the cap to the side of the shredder housing or to the sling supporting the shaft.

The inside large diameter slinger (Item 4) can remain in place if it is in good condition while the bearing is being replaced.

REMOVING HOUSING FROM BEARING

Slide the small diameter slinger (Item 9) away from the face of the bearing housing and off the end of the shaft using a lubricant to ease its travel along the shaft. Remove and inspect the oil seal (Item 17) from the end of the bearing housing using the procedure described previously.

It will be necessary to support the larger bearing housing so it can be moved axially without binding or interference and allow it to clear the end of the shaft for removal.

The inside of the bearing housing has been honed and lapped to a snug fit on the outer ring of the bearing so a pulling device or effort will be required to slide the housing off the bearing. Set the bearing housing aside where the finished machined surfaces will be protected and rest it on blocking so the bottom mounting pads will not be damaged.

Flush out any oil remaining inside the housing with solvent and make certain that the sight glass (Item 6) is cleaned, then dried thoroughly. Spray or wipe the machined surfaces of the housing with a light machine oil to protect them from rust while the bearing is being replaced.

The drive side bearing housing has a stabilizing ring (Item 5), which should also be cleaned and replaced in the housing.

The inside small diameter slinger (Item 9) is next removed from the shaft to be cleaned and inspected. If found to be in good condition, set it aside for reassembly.

BEARING REMOVAL

Straighten up the tabs of the lockwasher (Item 7) on 5” and 8” bearings, or unbolt and remove the lockplate (Item 7) on 11” and 12” bearings so the locknut (Item 8) can be loosened. Use a spanner wrench that fits the locknut to loosen it on the shaft. If a spanner wrench is not available, use a blunted bar ground to fit the locknut slots for turning the locknut. Back the locknut off a few turns until it is 1/8” to 1/4” away from the bearing face. This will keep the bearing from shooting off the end of the shaft when it is freed from the tapered mounting seat on the shaft, by the hydraulic pressure or puller.

A conventional bearing puller that contacts the inner ring will be required to remove 5” bearings from the tapered mounting seat of the shaft.

CAUTION: Do not attempt to drive the bearing off the tapered mounting because of possible damage to the critical finish of the tapered mounting surface.

HYDRAULIC REMOVAL METHOD

To remove 8" and larger bearings, connect a hydraulic pump capable of delivering 10,000 psi to the 3/8" NPT tapped hole in the end of the shaft from which the bearing is to be removed.

Slowly apply pressure with the hydraulic pump until the bearing pops free, which will sound like an explosion, but the locknut acting as a safety measure will keep it on the shaft.

Remove the locknut and slide the bearing off the shaft using a fabric sling for the larger size bearings.

Clean the tapered mounting seat and examine it for nicks and burrs or other signs of fatigue and wear. If the tapered mounting is acceptable, the shaft is ready for installing the replacement bearing.

If the large diameter slingers (Item 4) have been found satisfactory, leave them in place along with the bearing housing cap; otherwise they should be replaced at this point. Should the slingers require replacing, carefully tap them onto the shaft with a soft-faced hammer and move them up the shaft several inches so they will be out of the way.

Be sure to slide the bearing housing cap onto the shaft before mounting the inside slinger (Item 4) on the shaft.

MOUNTING TAPERED BORE SPHERICAL ROLLER BEARINGS

Cleanliness during this operation is a must, and every effort should be made to provide a moisture and dust free environment. The installer should keep hands, tools and working area clean, because the bearing is a precision unit and any foreign material will be detrimental to its operation.

Unwrap the new bearing when all the necessary preceding operations have been completed and the proper tools are on hand to complete the mounting without delay to avoid contaminating the bearing with dirt or metal particles.

Do not remove the coating of "slush" – rust preventative oil applied at the factory for protection against corrosion. This preservative is compatible with grease and oil and does not need to be removed unless a synthetic lubricant is to be used.

The distance the bearing is forced onto the tapered seat determines the fit of tapered bore spherical roller bearings. This results in a reduction of diametrical clearance (DC) in the bearing through expansion of the inner ring. It is necessary to determine the initial DC before mounting, and to check the DC reduction during mounting until the specified DC is established.

To properly determine the initial DC, the following procedure is recommended. A feeler gauge with at least 3" long blades with a smallest blade thickness of .0015" will be required.

The following table of diametrical clearances before installation and recommended reduction of clearance is provided by the bearing manufacturer.

TABLE OF DIAMETRICAL CLEARANCES

BEARING SIZE		DIAMETRICAL CLEARANCE BEFORE INSTALLATION (inches)		REDUCTION OF DIAMETRICAL CLEARANCE (inches)		MINIMUM DIAMETRICAL CLEARANCE (inches)
inch	mm	min.	max.	min.	max.	After Mounting
5	130	.0063	.0081	.0025	.0035	.0030
8	200	.0088	.0114	.0035	.0050	.0040
11	280	.0118	.0156	.0045	.0065	.0055
12	300	.0130	.0169	.0050	.0075	.0060

CHECK DIAMETRICAL CLEARANCE

Lubricate the tapered mounting seat with a light machine oil. Slide the bearing (Item 3) onto the shaft until it is resting firmly on the tapered mounting seat with the inner and outer ring faces parallel. Slide the lockwasher (Item 7) and the locknut (Item 8) onto the shaft and run them up against the face of the bearing just had tight to hold it in position. Inspect the tangs of the lockwasher removed in the disassembly for cracks or signs of fatigue and replace if necessary.

Press down firmly on the top of the outer ring and oscillate the outer ring two or three times. This “seats” the inner ring and rolling elements. Position the individual roller assemblies so that a roller is at the bottom of the inner ring – on both sides of the bearing.

Press the two bottom rollers inward and upward to assure their being in contact with the center guide flanges as well as the inner ring raceways. With the rollers in the correct position, insert a blade of the feeler gauge (see chart for size range) between two of the bottom rollers. Move it carefully under the bottom roller between the roller and outer ring raceway. **NOTE: DO NOT ROTATE BEARING WHEN PASSING FEELER BETWEEN ROLLER AND OUTER RING!** Repeat this procedure using progressively thicker feeler gauge blades until one is found that will not go through. The blade thickness that preceded the “no-go” blade is the measure of diametrical clearance (DC) before installation.

Example: A 5” (130mm) bearing is to be mounted on a tapered shaft.

a. **By measurement with a feeler gauge, the initial DC is .0075”**

b. **Reference to table indicates a proper fit is obtained when DC is reduced by .0025” to .0035” or approximately .0030”.**

Initial Clearance . . . . .0075”

Reduction of DC . . . . .0030”

Clearance after mounting . . . . . .0045”

c. **The locknut is tightened until the DC reaches .0045”**

NOTE: Tapered bore bearings must have the proper amount of diametrical clearance before installation to provide for the required mounting reduction of DC and to compensate for any further internal reduction from abnormal temperature conditions.

MOUNTING THE BEARING

Manual Method: When the required DC reduction has been determined, tighten the locknut (Item 8) with a spanner wrench until snug. If a spanner wrench is not available, use a blunted bar ground to fit locknut slots for tightening.

Lay a soft steel or brass bar along the shaft, in contact with the locknut and strike the bar several sharp blows with a hammer at several positions around the locknut. These blows drive the inner ring of bearing further up on the tapered shaft and release the pressure on the locknut threads, allowing the nut to be tightened easier. Continue to tighten the locknut (Item 8) while periodically measuring the DC at the unloaded roller, making sure it is firmly seated against the inner race and against the guide flange. When the proper amount of DC reduction is obtained the final clearance measurement on both faces of the bearing should be recorded for future comparison or reference.

Hydraulic Mounting Method: The larger size tapered bore bearings, 8” and up, can be eased onto the tapered mounting using the hydraulic method. Connect the hydraulic pump to the end of the shaft by the 3/8” NPT fitting. Tighten the locknut (Item 8) with the lockwasher (Item 7) on 8” bearings until it is firmly against inner ring of bearing. On 11” and 12” bearings, the locknut (Item 8) should be positioned with bolt holes outward and bearing directly against the face of the bearing inner ring. Introduce 2000-3000 psi oil pressure while tightening the locknut until proper DC is obtained.

SECURING LOCKWASHER

When the recommended reduction of DC has been attained, the bearing is in its proper position on the shaft. Find a lockwasher (Item 7) tang that is nearest a slot in the locknut on 5” and 8” bearings. If slot is slightly past tang don’t loosen nut, but further tighten so that the next nut slot clockwise meets a washer tang. Bend tang into the slot. The locknut (Item 8) on 11” and 12” bearings is secured by the tang of the lockplate (Item 7) inserted in a notch in the shaft, then bolted and wired to the face of the locknut. Do not loosen nut, but further tighten if necessary to allow tang to fit into notch on shaft.

ASSEMBLY OF BEARING HOUSING

Slide the small diameter inside oil slinger (Item 9) on the shaft until it is within a couple of inches of the locknut (Item 8) so it will contact the inside of the bearing housing.

Wipe the inside machined surfaces of the thoroughly cleaned bearing housing with a light machine oil. If this is the DRIVE SIDE bearing housing, it will have the stabilizing ring (Item 5) against the shoulder inside the housing.

NOTE: Only the DRIVE SIDE bearing housing has a stabilizing ring. Wipe the outside of the bearing with a light coat of machine oil to help it slide into the bearing housing.

Check to see that the housing gasket is in place on the housing cap before proceeding.

Hoist the bearing housing (Item 1) and slide it on the end of the shaft until it contacts the outer race of the bearing. Square the bearing outer race with the bore of the bearing housing so they are concentric. The bore of the bearing housing is honed to fit snug on the bearing so it will require some force to move it onto the bearing. Several light blows on the reinforcement gussets on both sides of the bearing housing will help move the housing onto the bearing without damage.

LOCATION OF HOUSING ON BEARING

The bearing housing is in the proper position on the drive side bearing when the inside shoulder with the stabilizing ring is flush against the bearing. This can be checked by removing the lubrication connection plug (Item 15) from the top of the housing to see if the lubrication groove of the bearing outer ring is centered in the hole. The outboard or “floating bearing” housing is in the correct position when the bearing is centered in the axial travel limits of the housing. This can be checked by observing through the lubrication connection hole (Item 15) if the inboard edge of the lubrication groove is centered in the opening.

NOTE: For Impact Dryer Mills or Hot Hogs where the rotors are subjected to heat, the outboard bearing may be positioned for maximum outward expansion. Maintain 1/8” minimum clearance between the bearing and the cap.

Slide the bearing cap (Item 2) into position, making certain it contacts the inner slinger (Item 4), and draw it against the bearing housing by tightening the cap screws (Item 11) equally around the cap.

Lower the rotor until the bearing housing contacts the pedestal supports or sole plate after checking to be sure the match marks on the ends of the bearing housing line up with marks on the support pedestal that were scribed prior to disassembly.

INSTALL BEARING HOUSING OIL SEALS

The RUP pattern oil seal (Item 12 & 17) is installed in the grooves in the end of the bearing housing and cap with the lip facing inward and butt joint at the top.

CAUTION: All split seals are presized for the proper bearing housing at the factory. DO NOT ATTEMPT TO ALTER THE AS-RECEIVED SIZE ON JOB SITE.

1. Separate seal ends sideways and slide it over the shaft with the lip pointing toward the mounting groove. Lubrication on the seal, shaft and mounting groove will facilitate installation. Position the butt joint at the top.

2. Lubricate the spring and install it around the shaft with hooked end connection 90^{o} away from butt joint. Insert the spring in the lip groove of the seal, which may require a small hooked tool to handle the spring and guide it completely into the lip groove.

3. Align seal ends and start the butt joint into the groove of housing by finger pressure, then slide the fingers around the seal simultaneously in both directions with a wrapping motion to start the inner edge of seal into the groove around its entire circumference before forcing any part fully into the groove. Then gently tap (only on the outer edge of seal) until it is seated in the housing groove, with the outer edge flush with the housing face.

Slide the outside slingers (Item 4 & 9) into position on both sides of the housing until they are contacting the machined face. Open the inspection port plugs (Item 13) to see that the inside slingers are flush against the inside of the housing. If the fingers were positioned properly on the shaft, they were snug against inside of bearing housing and cap when drawn into position. If they are not flush, they can best be moved when the shaft is rotating by using a round end rod inserted through the inspection hole (Item 13) and riding against the slinger edge until it moves flush against the inside of the housing. Use care to prevent any debris entering the bearing housing when the inspection plugs are removed, and replace them promptly.

A slight leak past the oil seals when the machine is running is to be expected, and will actually be helpful in lubricating the seal lip to prevent heat and wear. If leakage is severe, check to see the seal is seated properly, or else it could have been damaged during installation. Sometimes additional lip pressure by shortening the seal spring will correct leakage.

COMPLETE MOUNTING THE BEARING HOUSING

The bearing housing hold down bolts and lubrication lines are connected along with miscellaneous other items installed in the reverse order of their removal. See section on ASSEMBLY AND INSTALLATION.

The correct procedure for installation of bearing housing hold down bolts for 12” bearings is covered in Form 895A.

SECTION IIIB. INSTALLATION, LUBRICATION & OPERATION OF STRAIGHT BORE BEARINGS

Cylinder, or straight bore bearings are mounted on their shaft with a slight interference fit. Mounting is simplified by heating the bearing in an oil bath for 20 to 30 minutes at 200^{o} to 250^{o}F until it has expanded sufficiently to slide easily on the shaft.

See Drawing 61J-B-2668 for exploded view of bearing assembly and the index number of the items referred to in this text. All areas inside bearing housing (Item 1) and cap (Item 2) that are not machined are thoroughly cleaned and coated with GE red Glyptol or equivalent varnish.

The large felt seal (Item 8) is inserted in the groove of the housing cap (Item 2) before the cap is slid on the shaft along with the gasket (Item 9). Make certain that the drain plug (Item 12) is installed in the housing gap.

The oil bath to heat the bearing should not be allowed to go above 250^{o}F and the tank should have support blocks and a screen to keep the bearing away from the heat source while in the oil bath that may cause localized high temperature and reduce race hardness.

The heated bearing (Item 3) is slid on the bearing seat squarely against the shoulder. The lockwasher (Item 5) and the locknut (Item 6) are then installed to keep the bearing against the shoulder. As the bearing cools, the locknut should be tightened holding the bearing against the shoulder.

The oil bath leaves a thin film of oil on the bearing, which will prevent rust until it cools. But as soon as possible the bearing should be packed with the proper grease.

When the bearing has cooled and the locknut is fully tightened, bend a tang of the lockwasher (Item 5) into a slot of the locknut (Item 6). If slot is past the tang do not loosen the nut, but further tighten so that the next slot clockwise meets a washer tang.

The small diameter seal (Item 7) is inserted in the groove in the outside face of the bearing housing (Item 2). To minimize fretting corrosion during operation and to ease the installation on the bearing, coat the inside of the housing with a light machine oil. The drive side bearing has the stabilizing ring (Item 4) inserted in the bearing housing before it is slid on the bearing.

Make certain the outer ring of the bearing is square with the housing bore before attempting to slide it in place. If the outer ring becomes misaligned and stuck, do not force it further into the housing. Use a brass or soft steel bar and tap the outer ring until it becomes free and is realigned.

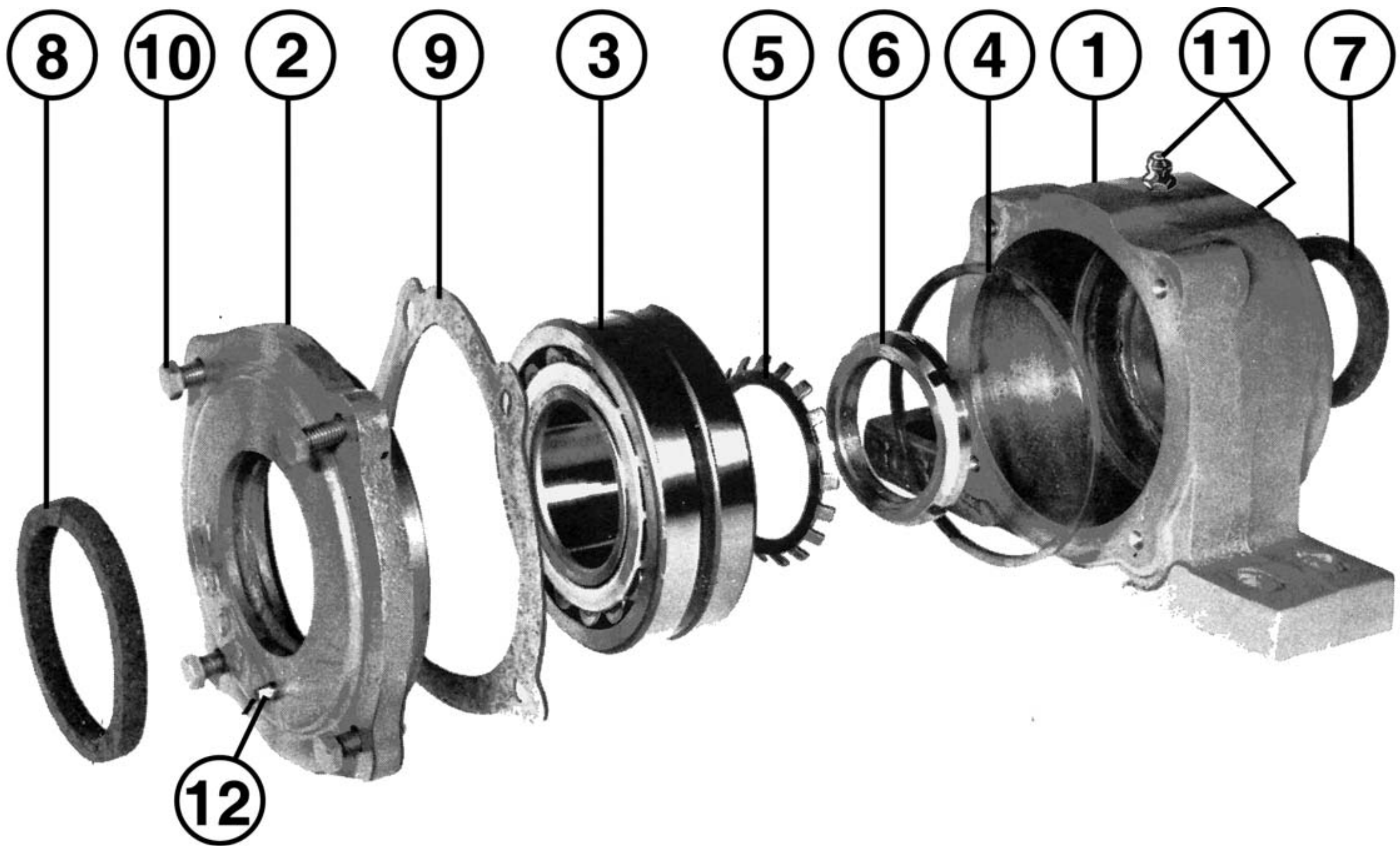
Check to see that the bearing housing is approximately one third to half full of grease when the housing cap (Item 2) is slid into place. Tighten the cap screws (Item 10) with the gasket (Item 9) in place to hold the housing cap firmly in place. The assembly is complete when the lubrication plug (Item 11) is in place on the bearing housing.

The flywheel side or outboard bearing is assembled in the same manner as above except the stabilizing ring (Item 4) is not used.

ITEM NUMBER	**When Ordering Repairs, Give:** Part Wanted, Quantity, This Drawing Number, and Your Mill Number	PATTERN NUMBER	QUANTITY IN MACHINE
1	Pillow Block Housing		1
2	Pillow Block Cap		1
3	Bearing -- Ball or Roller		1
4	Stabilizing Ring (Used on Drive Side Only)		
5	Bearing Locknut Washer		1
6	Bearing Locknut		1
7	Outside Dust Seal Ring		1
8	Inside Dust Seal Ring		1
9	Gasket		1
10	Cap Screws		
11	Lubrication Fitting (For Location, see below)		1
12	Lubrication Drain Plug		1

PARTS LIST FOR TYPE "O" ROLLER & BALL BEARING PILLOW BLOCKS

DRAWING NUMBER 61J-B-2668



<u>OPERATIONS FOR MOUNTING BEARING ASSEMBLY</u>

A. Slip bearing cap (2) over shaft.
B. Slip bearing housing gasket (9) in place on cap.
C. Press bearing (3) on shaft. Apply pressure to inner race only.
D. Mount & tighten lock washer (5) and lock nut (6).
E. Slip stabilizing ring (4) in housing for <u>drive side</u> only.
F. Slip housing (1) over bearing & fasten cap (2) to housing.
G. Bolt down housing to bearing pedestal.

FOR DISMANTLING - REVERSE PROCEDURE.

WILLIAMS PATENT CRUSHER and PULVERIZER Co., Inc.

PARTS LIST FOR TYPE “O” ROLLER & BALL BEARING PILLOW BLOCKS
DRAWING NUMBER 61J-B-2668

DISASSEMBLY

The removal of a bearing is the reverse of the preceding steps except a hydraulic or mechanical split ring puller is used to push the inner ring of the bearing off the shaft.

INSTALLATION

The rotor with the bearing assemblies is installed in the frame so the end disc is centered in the opening when the drive side or fixed bearing is securely bolted to its pedestal. The outboard, or flywheel side bearing housing is slid along the shaft as far as it can move in both directions and the limits of its travel is marked on the shaft. The bearing housing is then centered between these marks so the bearing can “float” in the housing when the shaft expands or contracts.

LUBRICATION

Straight bore bearing housings are designed for grease lubrication of the bearing unless specified otherwise.

The grade and type of grease used for the bearing depends on the application and temperature as well as the daily hours of operation.

An anti-friction bearing requires a comparatively small amount of lubricant, and over-lubrication will only cause trouble.

An important rule to remember is DO NOT OVER-LUBRICATE anti-friction bearings; however, lubrication must always be present in the bearing to avoid damage.

In the higher speed ranges, too much grease will cause churning and overheating that results in separation of the grease components and breakdown in lubricating values.

Normal operating temperatures are in the range of 150^{o} to 170^{o} F with a slight showing of grease at the seals to indicate the bearing is properly lubricated.

Many factors such as bearing size and speed and the environment determine how often the bearing should be relubricated. It is not possible to predetermine when new grease must be added because of the gradual way the lubricating value is reduced over a period of time. In establishing a greasing schedule, previous experience with similar equipment operating under comparable conditions is the best guide. Bear in mind that it is better to add small amount of grease at frequent intervals than a large amount infrequently.

The bearing size (bore diameter) and speed compared with the operating hours serve as a good estimate of the lubrication frequency or period.

The following chart lists various size mills and the suggested maximum greasing period:

MILL SIZE	MAXIMUM OPERATING SPEED	MAXIMUM GREASING INTERVAL HOURS
GP106	3600	2000
GP1512-18	3600	1200
ROCKET 10-30	3600	1200
METEOR 6-18	1800	1200
111 IMPACTOR	3600	1200
"C" SERIES	1800	300
200 IMPACTOR	1800	300
METEOR 20-24	1800	300
240 IMPACTOR	1800	150

When applying grease to the bearing housing through the fitting, make certain the fitting is wiped clean before connecting the grease gun, and the drain plug is removed from the housing cap to allow purging of the old grease. Sufficient grease should be added at each greasing to fill the bearing housing cavity from one-third to one-half full. If fill cannot be determined visually, make an estimate of the size of the cavity and measure the amount of grease expelled by a stroke of the gun.

TROUBLE	OBSERVED CHARACTERISTICS	PROBABLE CAUSE	CORRECTIVE ACTION
TEMPERATURE	High bearing temperature after first start	Grease redistribution	Allow machine to cool, then restart
	Continuously high during operation	Churning of lubricant	Use lower oil level or less grease, or stiffer grade of grease.
		No lubricant	Add lubricant, check seals
		Excessive axial load	Check outer ring location in housing of "floating" bearing to allow thermal expansion.
	Hottest at center of bearing housing	Bearing misaligned	Bearing outer ring should be square in housing and housing perpendicular to shaft in both directions.
		Bearing housing pinching bearing ring	Debris under bearing housing causes distortion of housing when holding bolts are drawn down, that pinches outer ring of bearing. Clean and true bearing pedestal.
		Excessive radial load	Use correct fit of inner ring on shaft for straight bore bearings. Use bearings with greater internal diametrical clearance. For preloaded paired bearings, use lighter preloads. Balance rotor.
		Raceways pitted	Pitting usually result of electrical current flow due to improper ground when welding on rotor. Replace bearing.
	Hottest at faces of bearing housing	Slingers dragging against seal	Ease slinger away from face of seal a slight amount for clearance of 1/32" or less.

TROUBLE	OBSERVED CHARACTERISTICS	PROBABLE CAUSE	CORRECTIVE ACTION
EXCESSIVE VIBRATION	During acceleration or de-acceleration periods	Critical speed of machine components or feed chute	Isolate feed chute from mill, stiffen or support ducts or other components to change their criticals.
	During operation at a fixed speed	Foundation critical	May require change in operating speed of mill to avoid critical.
		Unbalanced rotating parts	Dynamically balance rotating parts. Determine if rotor or hammers are the cause of the unbalance by running rotor without hammers.
		Running at higher than rated speed	Refer to instruction manual for correct speed.
		Misalignment	Align to tolerances called for in instruction manual
		Bearing brinelled	Replace bearing, avoid excessive loading at mill or operating with unbalanced rotor.
		Machine loose on foundation	Retighten hold down bolts, but do not distort frame, which will increase vibration.
	During operation at fixed speed, but at a changing amplitude	Hammers held out of position by feed material	Reduce feed of oversize material into the mill or increase hammer size.
		Structural critical	Dynamically de-couple mill from forcing frequence by stiffening frame or isolating components that are responding to vibration from mill operation. May require changing mill speed if isolation is not practical. Condition can be positively identified by vibration analysis.
		Cover or components loose	Tighten all bolts holding accessories and covers on regular schedule.

TROUBLE	OBSERVED CHARACTERISTICS	PROBABLE CAUSE	CORRECTIVE ACTION
NOISE	High pitch, steady tone	Excessive axial load	Correct outer ring location in housing of "floating" bearing to allow thermal expansion.
		Excessive radial load	Check internal clearance on preloaded roller bearings and increase clearance to allowable maximum
		Misalignment of bearings	Correct alignment so that bearings are square with shaft in all directions
		Lack of lubricant	Regrease or add oil as necessary. Determine cause.
		Bearing exposed to vibration while machine is idle	Carefully examine bearing for wear spots separated by distance equal to ball or roller spacing. Replace bearing. Condition known as false brinelling.
		Wrong type of grease or oil causing breakdwon of lubricant	Refer to lubrication instructions for proper type of grease or oil for bearing.
		Replacement bearing selected with inadequate internal clearance for operating conditions where heat is conducted through shaft and expanding the inner ring.	Replacement bearings should have identical markings as original factory equipment.

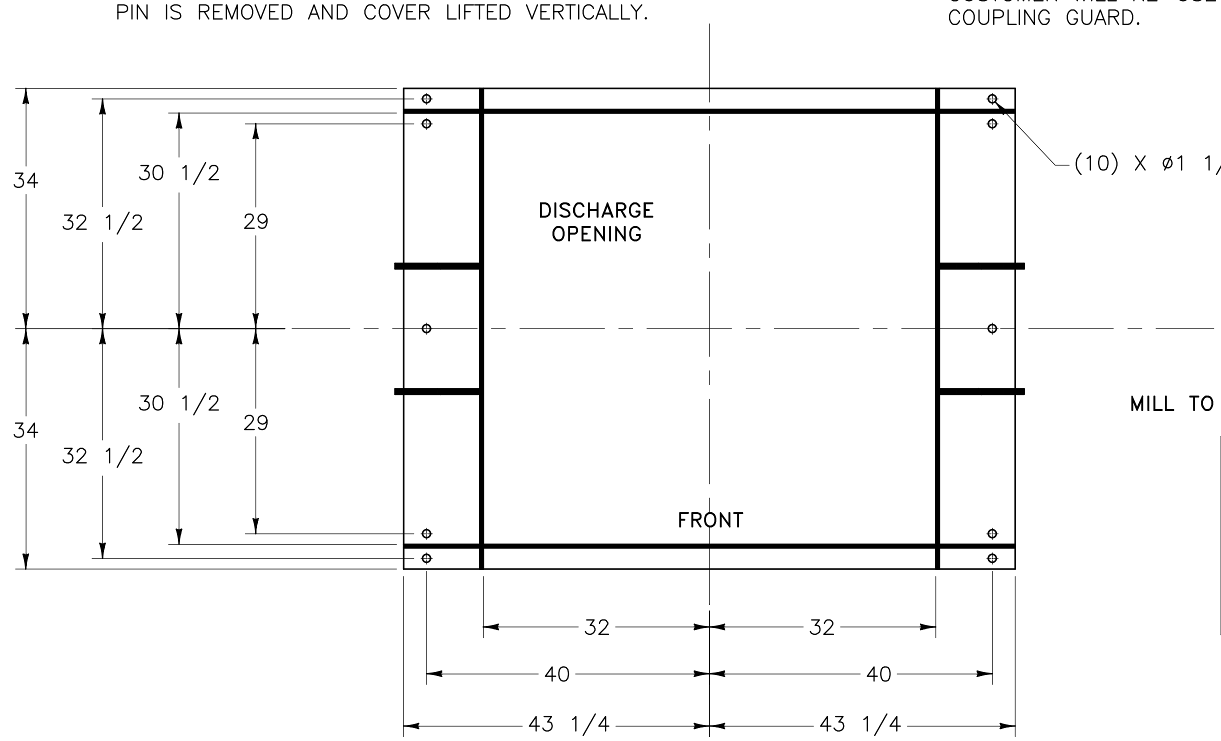
TROUBLE	OBSERVED CHARACTERISTICS	PROBABLE CAUSE	CORRECTIVE ACTION
NOISE	Intermittent rumbles, rattles, clicks, etc.	Too much clearance in bearing.	Adjust preload on bearing.
		Excessive wear in raceways	Replace bearing.
		Loose machine parts or bearing hold down bolts	Tighten all hold down bolts, closures and other machine components.
	Low pitched clicking	Foreign material in bearing	Flush bearing, replace oil and check seals for wear, or use better practice in handling relubrication of bearing.
	Intermittent high pitched noise or squeal	Rollers or balls skidding	Use thinner grease or oil. Possible preload of bearing not adequate. Check clearance.
	Low pitched, continuous or intermittent noise or rumble.	Rotor or shaft rubbing housing	Correct machine parts or position of cover
		Too much clearance in bearing	Check for correct preload on bearing.
		Raceways pitted	Clean all parts and replace bearing and seals. Pitting is usually result of electric current going through bearing when welding on rotor without proper ground.
		Bearing brinelled	Replace bearing and avoid overloading.
		Resonant vibration of machine or hopper	Isolate hopper from mill, stiffen or sound-deaden thin panels and large flat surfaces. Tighten all hold down bolts on mill and support structure.

WILLIAMS

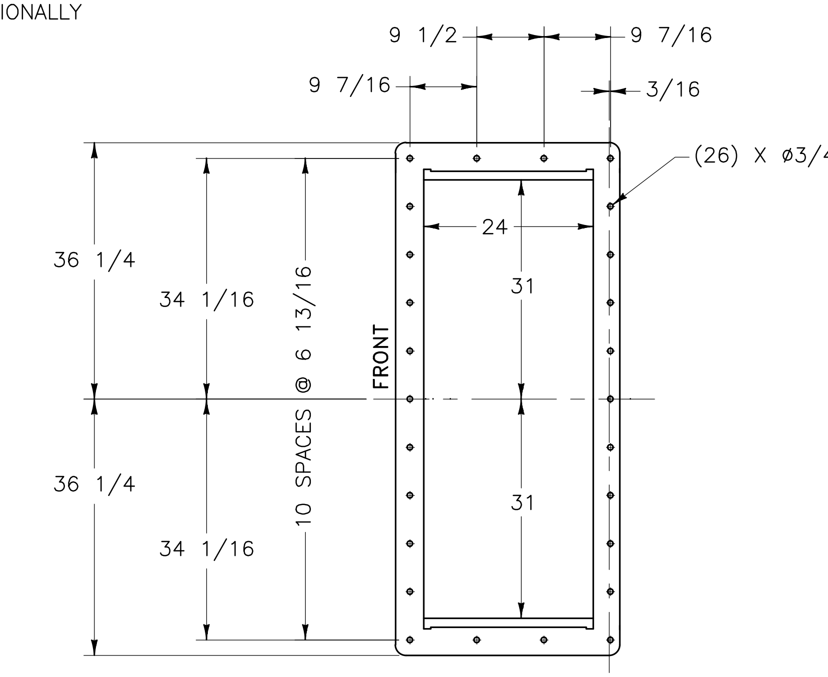
* NOTE CLEARANCE NECESSARY FOR REMOVAL OF HAMMER BOLTS & COVER. LESS CLEARANCE IS NEEDED IF HINGE PIN IS REMOVED AND COVER LIFTED VERTICALLY.

THIS MILL IS A DUPLICATE OF S/N 21443 AND IS TO BE DIMENSIONALLY INTERCHANGEABLE WITH S/N 14978 & S/N 21443.

CUSTOMER WILL RE-USE EXISTING MOTOR, COUPLING, AND COUPLING GUARD.



SECTION "A-A"

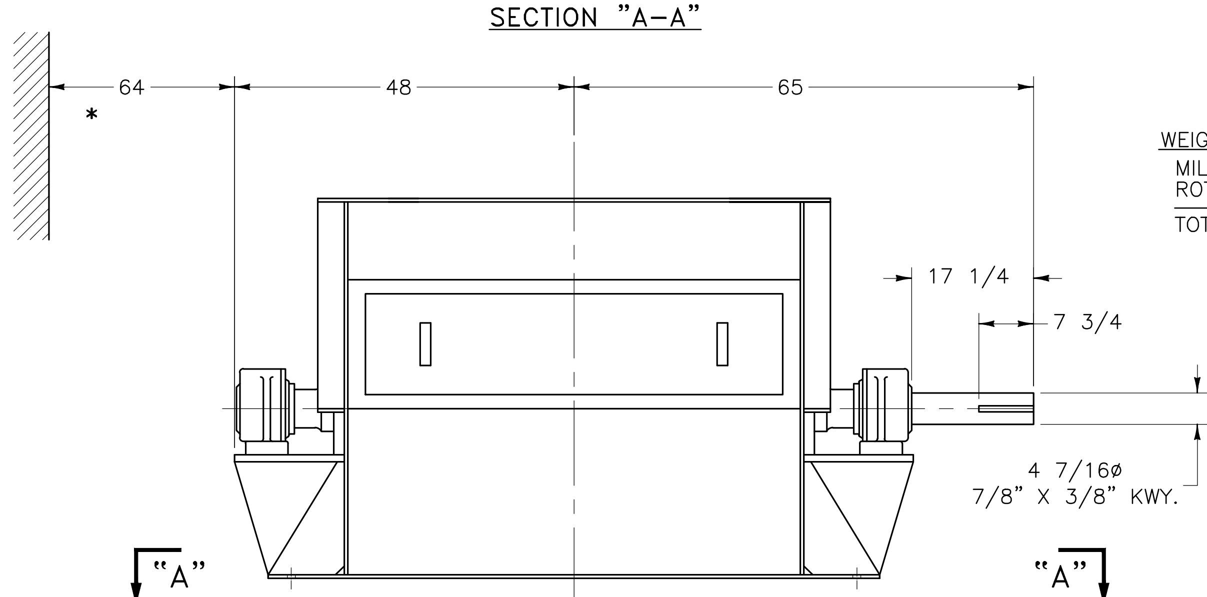


TOP VIEW FEED OPENING

WK^2 = 5,039 LB-FT^2

MILL TO OPERATE AT APPROXIMATELY 1,200 RPM

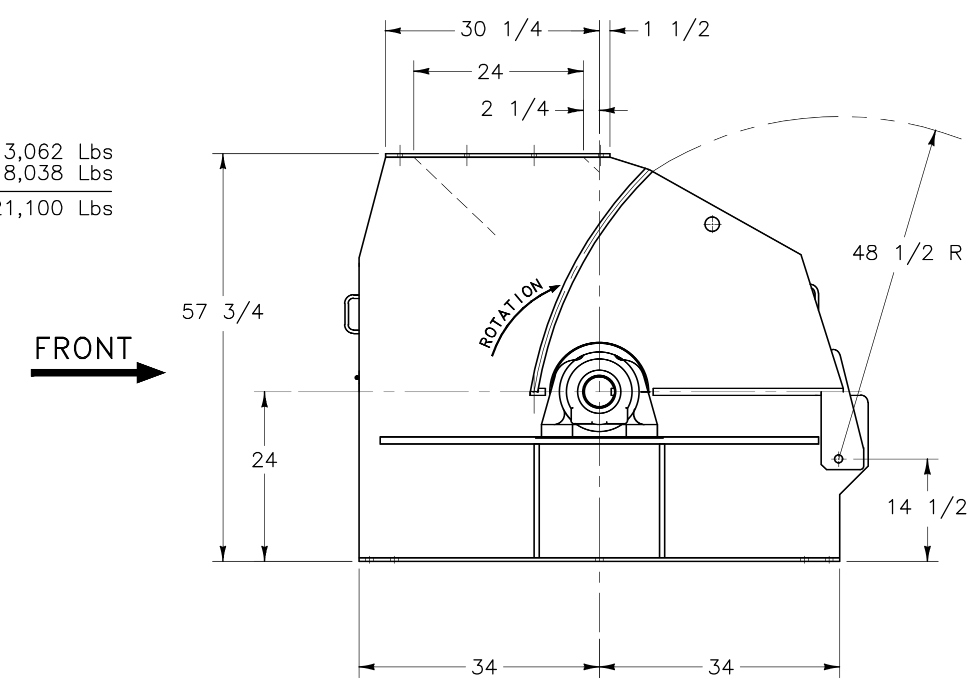
DIMENSIONS CERTIFIED FOR
GEORGIA PACIFIC
#60 GA NO-NIFE HOG
CUST P O # 01554479
WILLIAMS PAT.CRUSHER & PULV.CO,INC
S N # 21771 S O # N19-000014
APPD BY: ASHLEY WILLIAMS DATE 4/12/19



FRONT ELEVATION

WEIGHTS:

MILL (LESS ROTOR)	13,062 Lbs
ROTOR	8,038 Lbs
TOTAL WT.	21,100 Lbs



RIGHT SIDE ELEVATION

ALL DIMENSIONS ARE IN INCHES [mm] AND ARE SUBJECT TO CHANGE UNLESS CERTIFIED. FOR CONSTRUCTION OR INSTALLATION USE A CERTIFIED SHEET ONLY.

CAPACITY & DUTY:
SAME AS S/N 14978 & S/N 21443 WHEN REGULARLY AND UNIFORMLY FED WITH BARK (PINE AND HARDWOOD) FROM A DE-BARKING OPERATION WILL PRODUCE A MINUS 2" PRODUCT AT A RATE OF 45-50 TPH WITH 300 HP MOTOR ATTACHED.

SIZE #60 SHOWN CODE #6

SUPPORT MILL ON CONCRETE FOUNDATION HAVING WT. 3-4 TIMES WT. OF MILL/BASE/HOPPER COMBINED. DESIGN FOUNDATION TO SUPPORT FULL LENGTH OF BASE FLANGES UNDER BEARING AND GROUT PER WILLIAMS FORM 902. (ALL FOUNDATIONS BY OTHERS)

THIS DRWG SUPERSEDES | THIS DRWG SUPERSEDED BY | THIS PRINT WAS ISSUED

ZONE	SYM	DATE	INITIALS	REVISION DESCRIPTION
GEN	A	4/12/19	EAW	CERTIFIED FOR CONSTRUCTION

TOLERANCES
FRACTIONAL DIMENSIONS ± 1/64"
DECIMAL DIMENSIONS
ZERO TO 7.999" ± .001"
FROM 8" UP ± .002"
ALL THREADS U.S. FORM NC
CLASS 2 UNLESS OTHERWISE NOTED

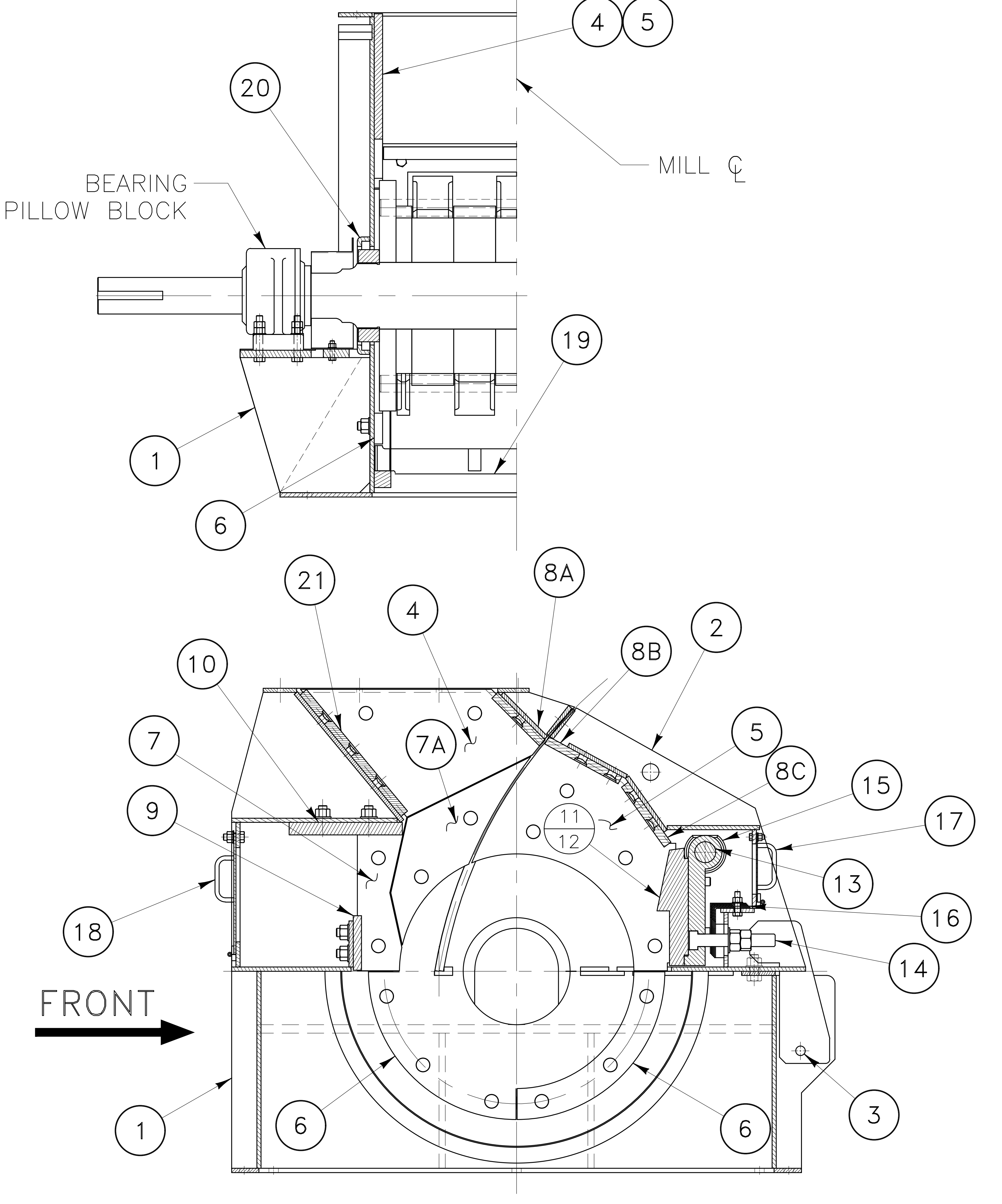
FINISHES
f_1 ROUGH CUT TO CLEAN UP
f_2 FINE LATHE CUT
f_3 FINE LATHE CUT & FILE SMOOTH
f_4 FINE LATHE CUT & GRIND

WILLIAMS PATENT CRUSHER AND PULVERIZER CO.
ST.LOUIS,MO.

GA SERIES MILL ORC COVER W/ ADJUSTABLE BREAKER PLATE CODE #6

DRAWN BY	TRACED BY	DATE	SCALE	CHECKED BY	DRWG NO	REVISION
EAW		6-27-13	3/4" = 12"		7H-D-13295	A

ZONE	SYM	DATE	INITIALS	REVISION DESCRIPTION	ZONE	SYM	DATE	INITIALS	REVISION DESCRIPTION



WILLIAMS PATENT CRUSHER AND PULVERIZER CO. ST. LOUIS, MO.	PARTS DRAWING FOR "GA" SERIES TYPE "K" HOG W/ ORC COVER & EXTRA INLET LINER	SHT No. 1 OF 2 DWG No. 7J-B-7273

PART No.	WHEN ORDERING REPAIRS GIVE { PART WANTED, ALSO QUANTITY, THIS DRAWING NUMBER AND MACHINE SERIAL NUMBER	QUANTITY IN MACHINE
1	MILL BOTTOM	1
2	MILL COVER	1
3	COVER HINGE ROD	2
4	CENTER SIDE LINER (1 L.H. & 1 R.H.)	2
5	COVER SIDE LINER (1 L.H. & 1 R.H.)	2
6	BOTTOM SIDE LINER	4
7	FRONT SIDE LINER (1 L.H. & 1 R.H.)	2
7A	MIDDLE SIDE LINER (1 L.H. & 1 R.H.)	2
8A	FEED CROSS LINER (TOP)	2
8B	FEED CROSS LINER (MIDDLE)	2
8C	FEED CROSS LINER (BOTTOM)	2
9	METAL TRAP CROSS LINER	2
10	TOP CROSS LINER	2
11	BREAKER PLATE (BC–420H)	3
12	BREAKER PLATE (BC–534H)	0
13	BREAKER PLATE HINGE ROD	1
14	BREAKER PLATE JACK BOLTS (2 ANCHOR, 3 ADJUSTING)	1 LOT
15	BREAKER PLATE HOLDER (GA–603)	1
16	BREAKER PLATE SHIMS	FULLSET
17	COVER ACCESS DOOR	1
18	METAL TRAP ACCESS DOOR	1
19	CAGE BARS (SA–100 3 BARS @ 1" BALANCE @ 3")	FULLSET
20	SHAFT SEALS (HALVES) (SS–884)	4
21	FEED INLET LINER	2

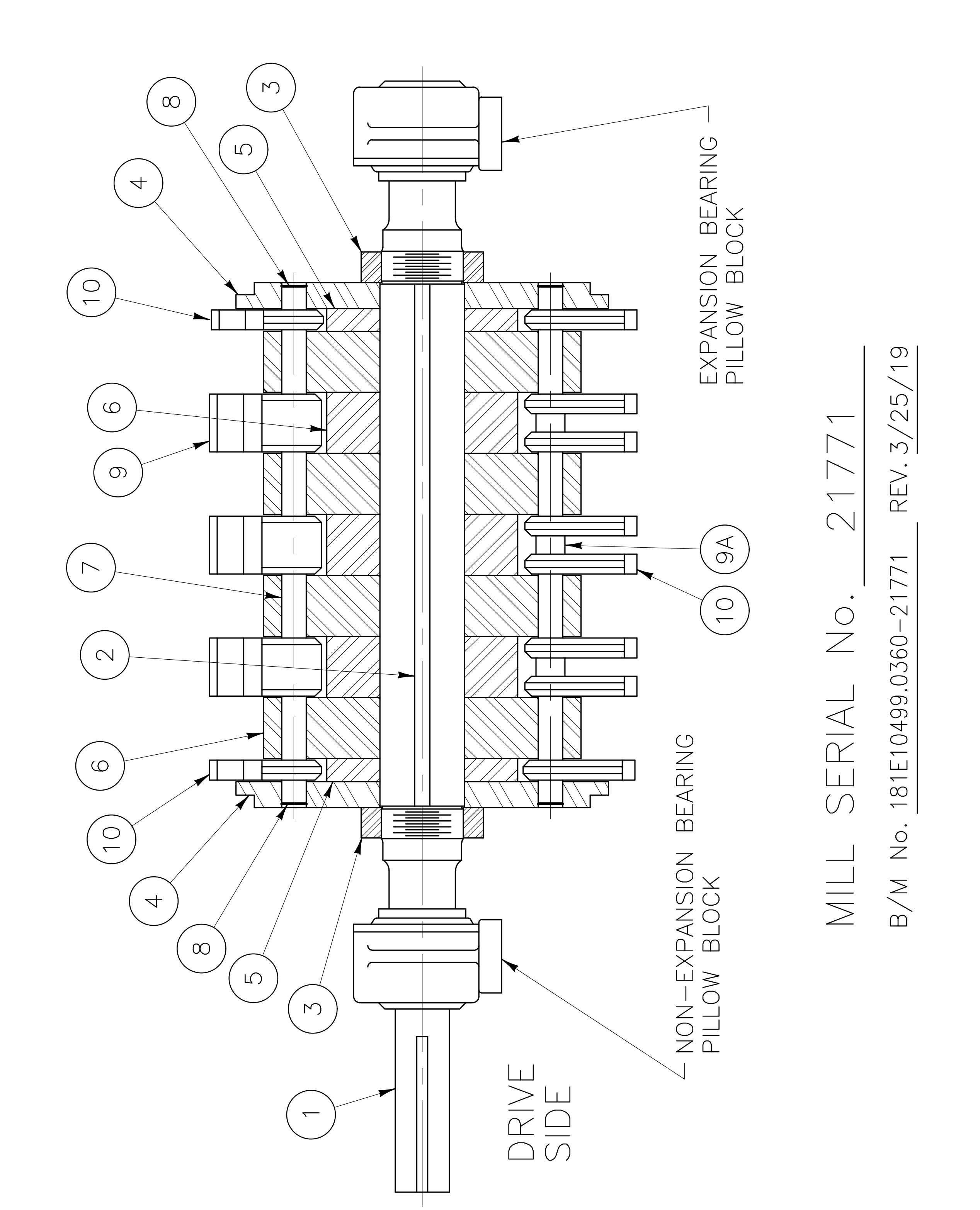
FOR EXPANSION BEARING PILLOW BLOCK
SEE SEPARATE PARTS LIST No. 61J–E–15881

FOR NON–EXPANSION BEARING PILLOW BLOCK
SEE SEPARATE PARTS LIST No. 61J–E–15879

MILL SERIAL No. 21771

B/M No. 7E15239–60–21771 REV. 3/25/19

WILLIAMS PATENT CRUSHER AND PULVERIZER CO. ST. LOUIS, MO.	PARTS LIST FOR "GA" SERIES TYPE "K" HOG W/ ORC COVER & EXTRA INLET LINER	SHT No. 2 OF 2 DWG No. 7J–B–7273



WILLIAMS PATENT CRUSHER AND PULVERIZER CO. ST. LOUIS, MO.	PARTS DRAWING ROTOR FOR 300 SERIES or TYPE "GA" MILL	SHT No. 1 OF 2 DWG No. 181J-B-6095

PART No.	WHEN ORDERING REPAIRS GIVE { PART WANTED, ALSO QUANTITY, THIS DRAWING NUMBER AND MACHINE SERIAL NUMBER	QUANTITY IN MACHINE
1	MAIN SHAFT (OAL = 110-11/16")	1
2	MAIN SHAFT CENTER KEY	1
3	SHAFT LOCK-NUT	2
4	END DISC	2
5	END CENTER DISC	2
6	LARGE CENTER DISC	11
7	HAMMER BOLT	4
8	HAMMER BOLT RETAINING RING	8
9	CENTER HAMMER (BC-472)	22
9A	CENTER HAMMER SPACER	NA
10	END HAMMER (BC-473)	4

FOR EXPANSION BEARING PILLOW BLOCK
SEE SEPARATE PARTS LIST No. 61J-E-15881

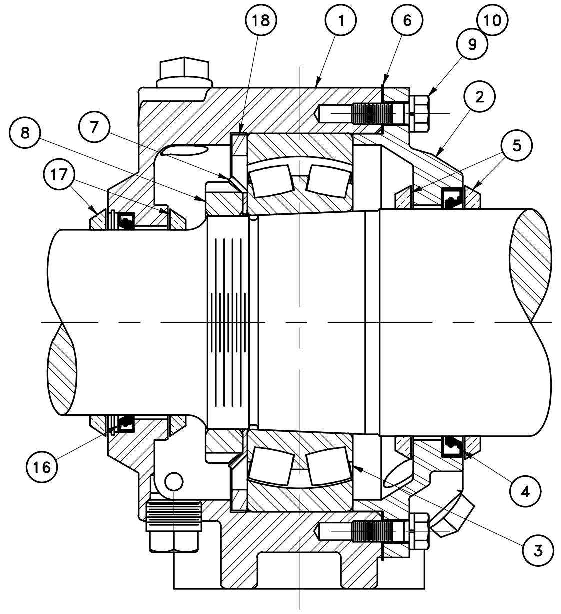
FOR NON-EXPANSION BEARING PILLOW BLOCK
SEE SEPARATE PARTS LIST No. 61J-E-15879

MILL SERIAL No. 21771

B/M No. 181E10499.0360-21771 REV. 3/25/19

WILLIAMS PATENT CRUSHER AND PULVERIZER CO. ST. LOUIS, MO.	PARTS LIST ROTOR FOR 300 SERIES OR TYPE "GA" MILL	SHT No. 2 OF 2 DWG No. 181J-B-6095

ITEM LIST		
ITEM	QTY	DESCRIPTION
1	1	5" MOD "O" CAST IRON BRG HOUSING
2	1	CAST IRON BEARING CAP 5" MOD "O"
3	1	22226K W33 MB C3 ROLLER BEARING
4	1	LARGE BORE OIL SEAL H1/L5
5	2	LARGE BORE OIL SLINGER
6	1	GASKET FOR BRG HSG
7	1	BEARING LOCKWASHER FOR 22226
8	1	BEARING LOCKNUT FOR 22226
9	6	BOLT HH GR5 1/2" X 1-1/2"
10	6	LOCKWASHER HELICAL 1/2"
11	3	ZERK FITTING STRAIGHT 1/8" NPT
12	4	PIPE PLUG SQ HD IRON 1"
13	1	PIPE PLUG SQ HD IRON 1/4"
14	1	PIPE PLUG VENTED 1"
15	1	PIPE BUSHING M/F SCH 40 1/2" X 1/8"
16	1	SMALL BORE OIL SEAL H1/L5
17	2	SMALL BORE OIL SLINGER
18	1	STAB RING 9.00 OD X .384



CROSS SECTION
NO SCALE

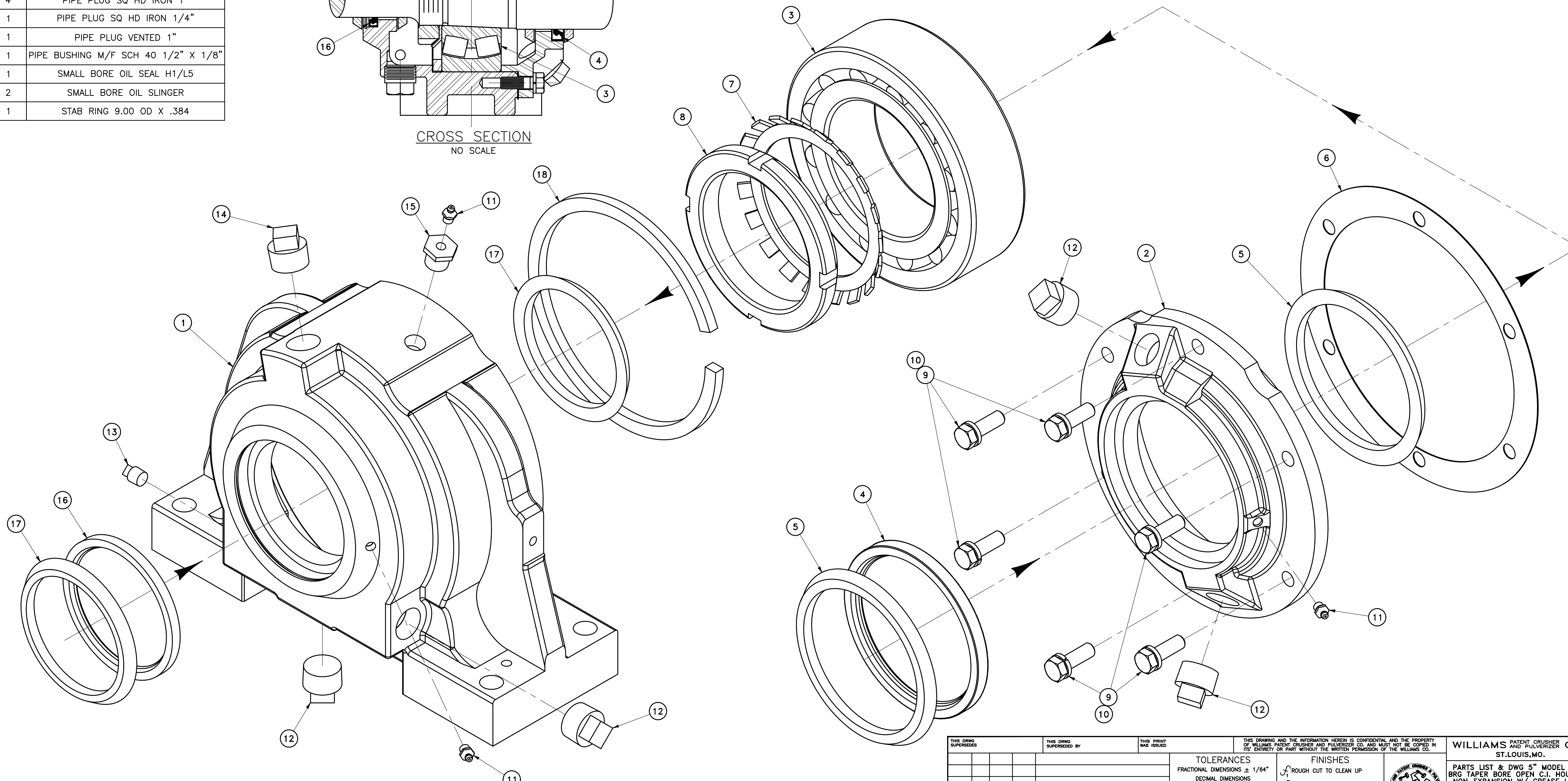
DIAMETRICAL CLEARANCE BEFORE INSTALLATION (INCHES)		REDUCTION OF DIAMETRICAL CLEARANCE (INCHES)		MINIMUM DIAMETRICAL CLEARANCE AFTER MOUNTING (INCHES)
MIN.	MAX.	MIN.	MAX.	
.0063	.0081	.0025	.0035	.0030

MILL SERIAL No. 21771

B/M No. 61E15867 REV. 3/25/19

NOTES:

1. SHOULD ROTOR OR BEARINGS BE REMOVED, WHEN REASSEMBLING ALWAYS REMOVE UPPER INSPECTION PLUGS (12 & 14) AND ENSURE OIL SLINGERS (5 & 17) ARE CORRECTLY POSITIONED AGAINST THEIR MATING SURFACES. IF NOT, PRY THEM INTO THEIR CORRECT POSITIONS.
2. WHEN REMOUNTING BEARINGS, MEASURE INTERNAL RADIAL CLEARANCE OF BEARING BY INSERTING A FEELER GAUGE THE FULL LENGTH OF A ROLLER BETWEEN THE MOST VERTICAL UNLOADED ROLLER AND THE OUTER RACE ROLLER PATH TO DETERMINE INTERNAL RADIAL CLEARANCE OF BEARING. MAKE NOTE OF THIS MEASUREMENT. FORCE BEARING ON SHAFT IN EASY STAGES UNTIL THE ABOVE NOTED RADIAL CLEARANCE IS REDUCED BY .0025" TO .0035" ACCORDING TO THE TABLE AT LEFT.
3. VOLUME OF GREASE IN HOUSING RESERVOIR SHOULD BE APPROXIMATELY 15 CU. IN. (APPROXIMATELY 8 OUNCES OF GREASE) UNDER NORMAL OPERATING CONDITIONS.



THIS DRWG SUPERSEDES	THIS DRWG SUPERSEDED BY	THIS PRINT WAS ISSUED

ZONE	SYM	DATE	INITIALS	REVISION DESCRIPTION

TOLERANCES
FRACTIONAL DIMENSIONS ± 1/64"
DECIMAL DIMENSIONS
ZERO TO 7.999" ± .001"
FROM 8" UP ± .002"
ALL THREADS U.S. FORM NC
CLASS 2 UNLESS OTHERWISE NOTED

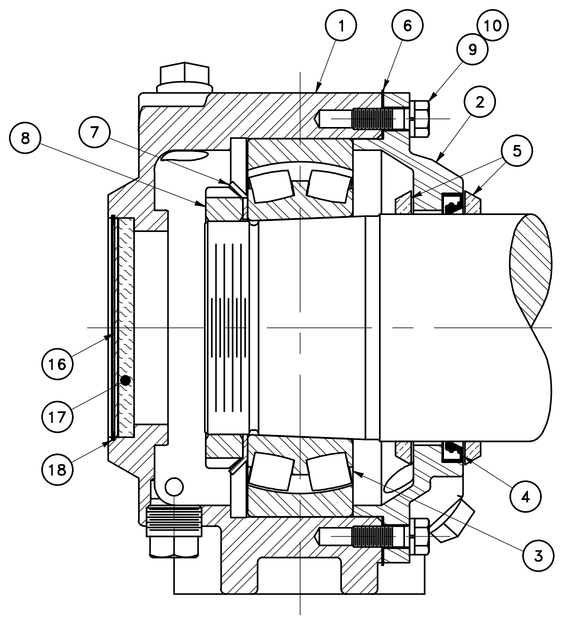
FINISHES
f_1 ROUGH CUT TO CLEAN UP
f_2 FINE LATHE CUT
f_3 FINE LATHE CUT & FILE SMOOTH
f_4 FINE LATHE CUT & GRIND

WILLIAMS PATENT CRUSHER AND PULVERIZER CO.
ST.LOUIS,MO.

PARTS LIST & DWG 5" MODEL "O" BRG TAPER BORE OPEN C.I. HOUSING NON-EXPANSION W/ GREASE LUBE

DRAWN BY	TRACED BY	DATE	SCALE	CHECKED BY	DRWG NO	REVISION
MJL		10-7-15	NONE	CB	61J-E-15879	

ITEM LIST		
ITEM	QTY	DESCRIPTION
1	1	5" MOD "O" CAST IRON BRG HOUSING
2	1	CAST IRON BEARING CAP 5" MOD "O"
3	1	22226K W33 MB C3 ROLLER BEARING
4	1	LARGE BORE OIL SEAL H1/L5
5	2	LARGE BORE OIL SLINGER
6	1	GASKET FOR BRG HSG
7	1	BEARING LOCKWASHER FOR 22226
8	1	BEARING LOCKNUT FOR 22226
9	6	BOLT HH GR5 1/2" X 1-1/2"
10	6	LOCKWASHER HELICAL 1/2"
11	3	ZERK FITTING STRAIGHT 1/8" NPT
12	4	PIPE PLUG SQ HD IRON 1"
13	1	PIPE PLUG SQ HD IRON 1/4"
14	1	PIPE PLUG VENTED 1"
15	1	PIPE BUSHING M/F SCH 40 1/2" X 1/8"
16	1	BEARING END PLUG
17	1	BEARING END PLUG SEAL
18	1	RETAINING RING



CROSS SECTION
NO SCALE

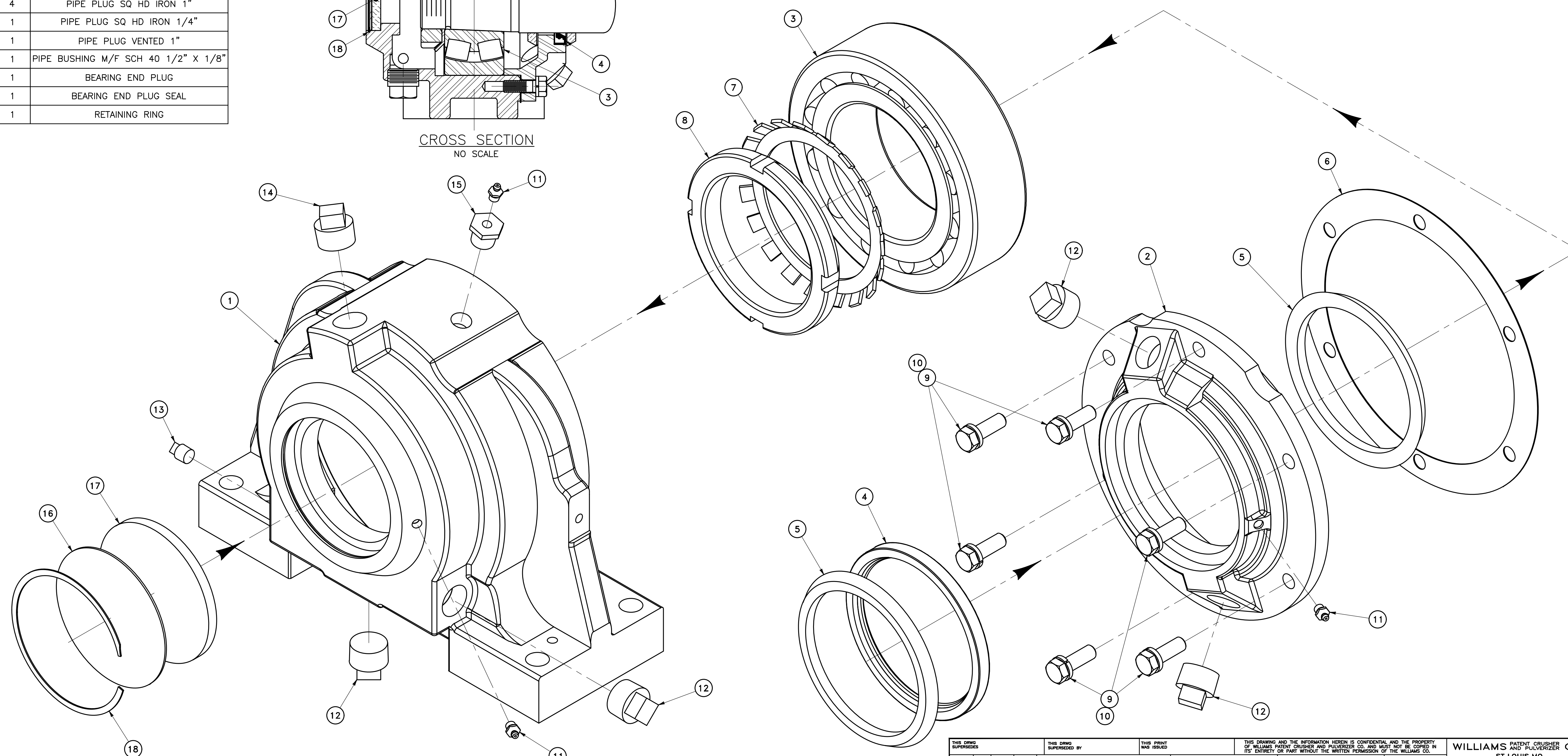
DIAMETRICAL CLEARANCE BEFORE INSTALLATION (INCHES)		REDUCTION OF DIAMETRICAL CLEARANCE (INCHES)		MINIMUM DIAMETRICAL CLEARANCE AFTER MOUNTING (INCHES)
MIN.	MAX.	MIN.	MAX.	
.0063	.0081	.0025	.0035	.0030

MILL SERIAL No. 21771

B/M No. 61E15869 REV. 3/25/19

NOTES:

1. SHOULD ROTOR OR BEARINGS BE REMOVED, WHEN REASSEMBLING ALWAYS REMOVE UPPER INSPECTION PLUG (12) AND ENSURE OIL SLINGER (5) IS CORRECTLY POSITIONED AGAINST ITS MATING SURFACE. IF NOT, PRY IT INTO THE CORRECT POSITION.
2. WHEN REMOUNTING BEARINGS, MEASURE INTERNAL RADIAL CLEARANCE OF BEARING BY INSERTING A FEELER GAUGE THE FULL LENGTH OF A ROLLER BETWEEN THE MOST VERTICAL UNLOADED ROLLER AND THE OUTER RACE ROLLER PATH TO DETERMINE INTERNAL RADIAL CLEARANCE OF BEARING. MAKE NOTE OF THIS MEASUREMENT. FORCE BEARING ON SHAFT IN EASY STAGES UNTIL THE ABOVE NOTED RADIAL CLEARANCE IS REDUCED BY .0025" TO .0035" ACCORDING TO THE TABLE AT LEFT.
3. VOLUME OF GREASE IN HOUSING RESERVOIR SHOULD BE APPROXIMATELY 15 CU. IN. (APPROXIMATELY 8 OUNCES OF GREASE) UNDER NORMAL OPERATING CONDITIONS.



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ZONE	SYM	DATE	INITIALS	REVISION DESCRIPTION

TOLERANCES
FRACTIONAL DIMENSIONS ± 1/64"
DECIMAL DIMENSIONS
ZERO TO 7.999" ± .001"
FROM 8" UP ± .002"
ALL THREADS U.S. FORM NC
CLASS 2 UNLESS OTHERWISE NOTED

FINISHES
f_1 ROUGH CUT TO CLEAN UP
f_2 FINE LATHE CUT
f_3 FINE LATHE CUT & FILE SMOOTH
f_4 FINE LATHE CUT & GRIND

WILLIAMS PATENT CRUSHER AND PULVERIZER CO.
ST.LOUIS,MO.

PARTS LIST & DWG 5" MODEL "O" BRG TAPER BORE CLOSED C.I. HOUSING EXPANSION W/ GREASE LUBE

DRAWN BY	TRACED BY	DATE	SCALE	CHECKED BY	DRWG NO	REVISION
MJL		10-7-15	NONE	CB	61J-E-15881	