Maintenance and Repair of BioMixers

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Section 1 – Bio-mixer Start Up Procedure

BioMixer Start Up Procedure

General

The BioMixer is designed to run continuously with normal care and maintenance. As with any machine, before starting, procedures should be established to ensure that the BioMixer is not in need of maintenance. This can be easily accomplished with a "walk through" inspection of the machine.

CAUTION

The BioMixer contains moving parts that can injure or kill. Guards protect areas that are easily accessible to workers. However, other areas of the machine that are not readily accessible are not guarded. Care must be taken when working on or near the BioMixer. The BioMixer must be shut down and locked out, according to local regulations and practices, before working on or near the BioMixer or before entering the BioMixer.

The BioMixer may contain materials that can cause sickness, injury or death. Before entering the BioMixer it is imperative to take adequate precaution to provide proper ventilation or breathing apparatus. It is recommended that the BioMixer be emptied before entering and that the BioMixer be flushed out with clean water. If this is not possible, workers should be protected with full rubber suits and breathing apparatus. All regulations or practices regarding "confined space" entry must also be adhered to.

Walk Through Inspection

Before starting the BioMixer for the first time or after an extended shutdown, the BioMixer must be inspected to make sure that:

1. There are no loose or missing parts, including covers or guards, that will cause damage to the BioMixer or personnel upon start up.

2. That all lubricants are at their normal operating levels. This includes checking all carrying bearings, thrust bearings, gear boxes and the main gear and pinion set.

3. That no foreign objects are in or near any pinch points or can contact the moving parts of the BioMixer and cause damage to the machine or personnel.

4. That there are no components of the BioMixer that require immediate maintenance.

5. If the BioMixer has not been operated for more than 24 hours, one quart of oil should be added to the fill port on each carrying roller bearing housing. This oil will provide lubrication to the bearing upon initial start up and until the oiling bucket system is functioning.

WARNING

Due to the size of the BioMixer, a final check must be made to make sure that all personnel are clear of the BioMixer before start-up. Warning alarms should be installed by the owner and used prior to start-up especially in the case of starting from the remote panel. It is the responsibility of the owner to make sure that the proper start-up procedures required by local law or practice are followed by all personnel.

When the operator is positive that all personnel are clear and the machine is operational, the machine may be started.

Start-Up Procedure

The BioMixer shall be interlocked as follows:

1. Initiating a start will activate a checking process to make sure the BioMixer is "at rest" (zero potential energy).

2. If the BioMixer is not in the "at rest" position, the disc brake will release and the BioMixer will "roll back" (rotate backwards) counter-clockwise when viewed from the discharge end, until the BioMixer comes to rest (approximately 45° of travel). The "roll back" speed will be controlled by the DC injection control incorporated in the drive so that the BioMixer speed does not exceed one (1) rpm.

3. After the BioMixer has "rolled back", the main drive motor will start turning the BioMixer in the forward direction (clockwise when viewed from the discharge end).

4. Speed can be selected by the operator, either one-half (½) or one (1) rpm.

Shut-Down Sequence

1. The BioMixer motor will stop when either a normal stop or emergency stop are initiated.

2. The BioMixer's motor mounted disc brake will engage when the motor is stopped and will hold the BioMixer in this position. If the BioMixer has any load (material) in it, the BioMixer will have "stored potential energy". No maintenance (especially on the drive train) should be performed on the BioMixer until the potential energy is released.

3. Initiating the "Roll Back" sequence will disengage the disc brake and allow the BioMixer to "roll back" until the potential energy is zero. (See Item 2 in "Start Up Procedure").

   The purpose of the "roll back" control is to allow the operator to control when the BioMixer will be "roll back". In the case of an emergency, the operator may want the BioMixer to "hold" until the extent of the emergency can be determined. The controlled roll back speed protects the motors and gear boxes from over speeding.

Operation

After start-up, the BioMixer should once again be inspected to make sure there are no problems. A general walk-through should be done to review lubrication, unusual noises or vibrations and any signs of misalignment. Please consult the maintenance manual for details of the daily inspection.

Conclusion

The BioMixer is designed for many years of continuous operation. However, like any other machine, preventive maintenance is required. Performing the scheduled inspections and correcting deficiencies as they occur will prolong the life of the BioMixer mechanisms and greatly reduce the wear on moving parts. By far, proper lubrication is the most important aspect of the maintenance program. If you have any questions or comments, please contact:

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Bio-Mixer Operation

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Rollback:

- The Bio-Mixer must be in a rolled back position before normal operation. The rollback sequence must be performed after every power up or emergency stop.
- The Rollback sequence is initiated by pressing and holding both the ROLL BACK and the SLOW pushbuttons until the alarm stops. The mechanical brake is released and the electronic brake is energized until the Bio-Mixer comes to rest at a neutral position. The mechanical brake is then reapplied. Successful completion of the rollback sequence is indicated by the illuminated ROLL BACK COMPLETE pilot light.

Operation:

- The Bio-Mixer can be started by pushing and holding either SLOW or FAST until the warning alarm stops, at which time the start sequence will initiate. If the pushbutton is released before the alarm stops, the start sequence will be aborted.
- The start sequence consists of closing the appropriate speed contactors, releasing the mechanical brake and activating the electronic soft starter. When the Bio-Mixer is up to speed, a bypass contactor closes.
- While running, the Bio-Mixer can be switched from FAST to SLOW or SLOW to FAST by pressing the appropriate button.
- The STOP pushbutton will shut off the motor and automatically initiate a rollback sequence.

Emergency Stop:

- The Bio-Mixer can be stopped immediately by pressing any of the EMERGENCY STOP mushroom head pushbuttons. The emergency stop will cause all equipment to be turned off. This will stop the motor and set the mechanical brake.
- A power failure or power fluctuation will cause an emergency stop.
- Upon initial power up or after an emergency stop, if conditions are safe, use the RESET button to enable the control system. Pressing the RESET button will not cause any motion to occur.
- A rollback must be performed after a power up or an emergency stop.

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Section 2 – Maintenance and Repair of Bio-Mixers (Overview)

Maintenance and Repair of BioMixers

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-- CAUTION --

The BioMixer may contain hazardous or toxic material. Persons entering the BioMixer may require personal protective equipment including self-contained breathing apparatus. In addition, the inside of the BioMixer must be considered a "Confined Space." All applicable regulations concerning "Confined Space" entry must be followed.

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The Maintenance and Repair of BioMixers

The maintenance and repair of rotary mixers has been a subject of discussion since about 1900. Over that time period, rotary equipment mechanical designers have experimented with a variety of ideas including the following:

- Rivetted shell, welded shell, shell with stiffening rings
- Cast tires, forged tires, split tires
- Welded filler bars, bolted filler bars, full floating filler bars and no filler bars
- Self aligning carrying roll bearings, rigid carrying roll bearings, spherical carrying roll bearings
- Rigid flange mounted gears, spring plate mounted gears, cast gears, fabricated gears, steel and iron gears

This list could also include hundreds of other ideas involving seals, drives, base frames, lubrication, and alignment practices. All of these innovations and ideas have been delivered to a customer as part of an operating unit or in the form of an ermarket service.

Rotary equipment has demonstrated a very long service life. Many engineering, maintenance, and repair people have spent a lifetime maintaining, repairing, and modifying these machines. They have also been busy incorporating new ideas as technology advances.

We have learned that common sense and preventive maintenance will keep the majority of these units in operation with a minimum number of problems. Of course, there have been installations built on reclaimed swamp land or the one whose operator has instructions not to worry about every grind or groan, or passes them off as a bad day in engineering. These will generally suffer from a much higher incidence of mechanical problems.

The main requirements for long, trouble-free mixer service life are simple, few, and do not require a great deal of time on a daily basis. The most important thing is to develop an inspection routine followed by the same person for all daily, weekly, and monthly inspections. This person will develop a feel for the mixer's mechanical condition and observe irregularities very quickly. Secondly, mixer alignment, thrust adjustment and proper lubrication are essential. When awareness, alignment, and lubrication are practiced, all of the mixer components should fall into a normal, historical maintenance or replacement cycle.

A close relationship with an advisory service group can have a positive impact on maintenance reduction and life extension of your rotary mixer. A-C Equipment Services can work with you in the following ways:

- Free telephone consultations to help solve problems or plan shutdowns
- Annual inspections by people who work with these problems on a daily basis
- Alignment by people who do alignment daily
- Unbiased update on new ideas and innovations being used by a wide variety of manufacturers and service companies
- Alternative source for replacement parts
- Experienced field crews for breakdowns or major repair projects
- Engineering analysis of existing problems
- Mechanical design engineering for new mixers and for modification to existing mixers

These instructions have been put together from a wide variety of sources including plant personnel, service engineers and advisory people, seminars, and technical papers. (A major source was the Allis-Chalmers Rotary Kiln Installation and Maintenance Manual.) They are intended to cover such items as the maintenance, repair, and replacement of frames, carrying mechanisms, thrust mechanisms, tires, shell, main gearing, coupling alignment, and lubrication. Most of the information included is generic in nature and can be applied to rotary equipment regardless of the original equipment manufacturer.

We sincerely hope these instructions will start the thought process and help you to a better understanding of your rotary mixer.

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Outline of BioMixer Inspection and Service Schedule

The "Outline of Mixer Inspection and Service Schedule" was prepared as a guide to help our customers develop a maintenance program. A preventive and planned maintenance program is essential to avoid the serious problems which can occur in a "breakdown maintenance only" operation.

The outline is broken down into five categories and can be used to serve two functions.

1 **Daily Observation** and **Weekly Inspection** are the essential elements to maintain a satisfactory operation on a day to day basis. These should be done by the same person or small group of people on a regular schedule.

2. **Semi-Annual Inspection, Annual Inspection,** and **Bi-Annual Inspection** are geared toward identifying, planning for, and correcting problems on a planned basis before they become serious. The Semi-Annual Inspection is generally completed six months before the plant's scheduled shutdown. Condition of the mixer, supporting structure, and auxiliaries should be carefully examined and recorded. This information will be the basis for planning the work to be done during the plant's scheduled shutdown period.

   More or less frequent inspection, service, or maintenance intervals may be required for some outlined items. This should be determined from the plant operating and maintenance history.

DAILY OBSERVATION

- Shell - Condition
- Carrying Bearings - Temperature
- Cooling Water - Flow & Temperature
- Riding Rings/Rollers - Surface Condition
- Thrust Roller - Surface Condition
- Shell - Axial Position
- Drive - Sound

WEEKLY INSPECTION AND SERVICE

- Carrying Bearings - Oil Level
- Thrust Bearings - Oil Level
- Carrying Bearings Seals - Leakage
- Gear (W/Oiling Pinion) - Lubricant Level
- Gear Lubrication Spray System - Function

SEMI-ANNUAL INSPECTION

- Carrying Roller O.D. - Condition
- Riding Ring O.D. - Condition
- Riding Ring and Roller - Contact Pattern

SEMI-ANNUAL INSPECTION (cont'd)

- Riding Rings -Axial Position
- Filler Bars - Condition and Welds
- Retaining Band/Blocks - Condition and Welds
- Riding Rings - "Creep"
- Carrying Rollers - Thrust Position
- Riding Ring Bore - Lubricate
- Gear Contact - Pattern
- Gear and Pinions - Pitch Line Runout
- Gear Flange - Welds, Loose Bolts
- Gear Spring Plates - Welds, Pins
- Feed End Air Seal - Condition
- Drive System Components - Vibration, Noise
- Corrosion Protection System - Check Voltage

ANNUAL INSPECTION AND SERVICE

- Carrying Bearings - Change Oil*
- Thrust Bearings - Change Oil*
- Gear Guard (W/Oiling Pinion) - Change Oil*

**On new mixers or after replacing/reversing gear, change oil after first month of operation.*

- Gear Spring Plates - Check Welds and Pins
- Gear Flange Bolts - Check Tightness**
- Gear Joint Bolts - Check Tightness**

*** On new mixers or after reversing/replacing the gear check after first month of operation.*

- Gear and Pinions - Pitch Line Separation
- Gear and Pinion Teeth - Condition
- Gear Guard - Remove Lubricant Build-Up
- Wear Bars and Sacrificial Anodes - Condition
- *****Entry into mixers may be hazardous. Specialized safety equipment may be required. Please follow local regulations for confined spaces.***
- Inspect and Service Speed Reducers, Couplings, Motors, etc., per Manufacturer's Instructions.
- Carrying Roller Support Bases - Condition
- Carrying Rollers - Check Thrust Adjustment
- Check Centerline Alignment

BI-ANNUAL INSPECTION

1. Gear - Check Radial Alignment
2. Drive Components - Check Alignment
3. Carrying Bearing Assemblies - Clean and Inspect

A-C Equipment Services recommends that annual inspection and alignment be done with the assistance of a service advisor. An annual inspection and alignment is a valuable aid in long service life and for determining future maintenance requirements.

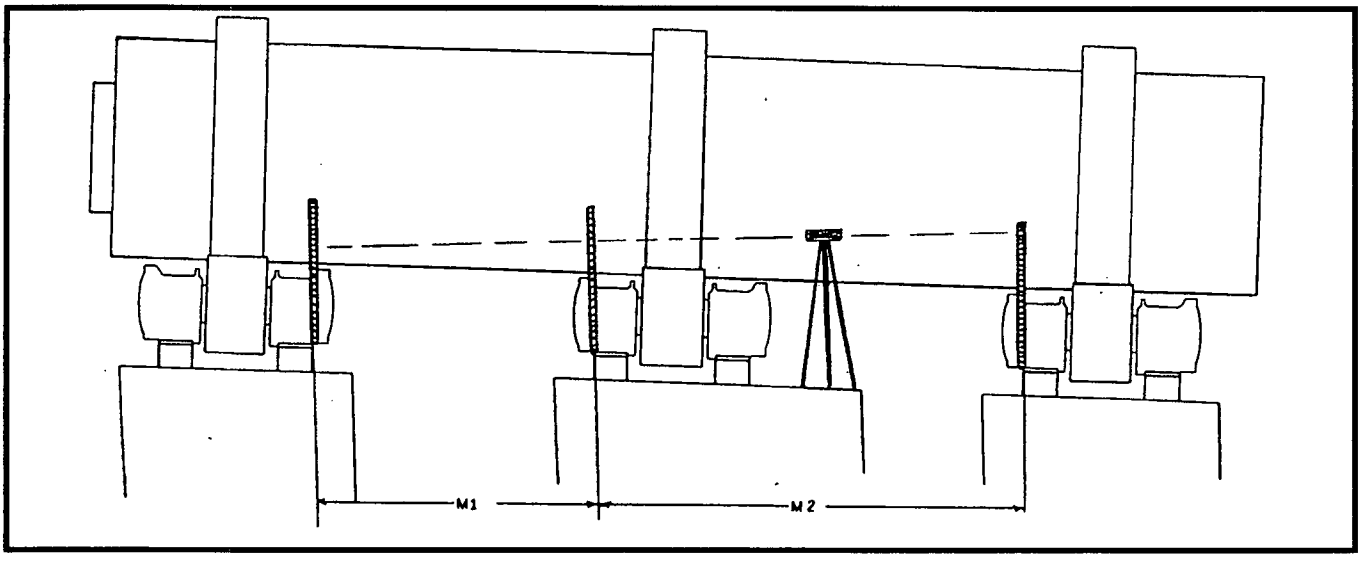


Figure 2 -- Check mixer frame elevations on the machined surfaces.

Deviations in slope and transverse levelness are often encountered as a result of pier tipping, grout failure, frame failure, or errors in the original installation. Depending on the degree of deviation, thought should be given to resetting the frame to the proper slope and level. In some cases, deviations can be corrected with shims, designed and machined for correction in both directions, placed under the bearing housing (consult A-C Equipment Services Corporation for assistance with shim design). In most cases, including substantial deviations in elevation, deviations that have not resulted in bearing or other mechanical problems will be recorded and adjusted for in the final alignment correction.

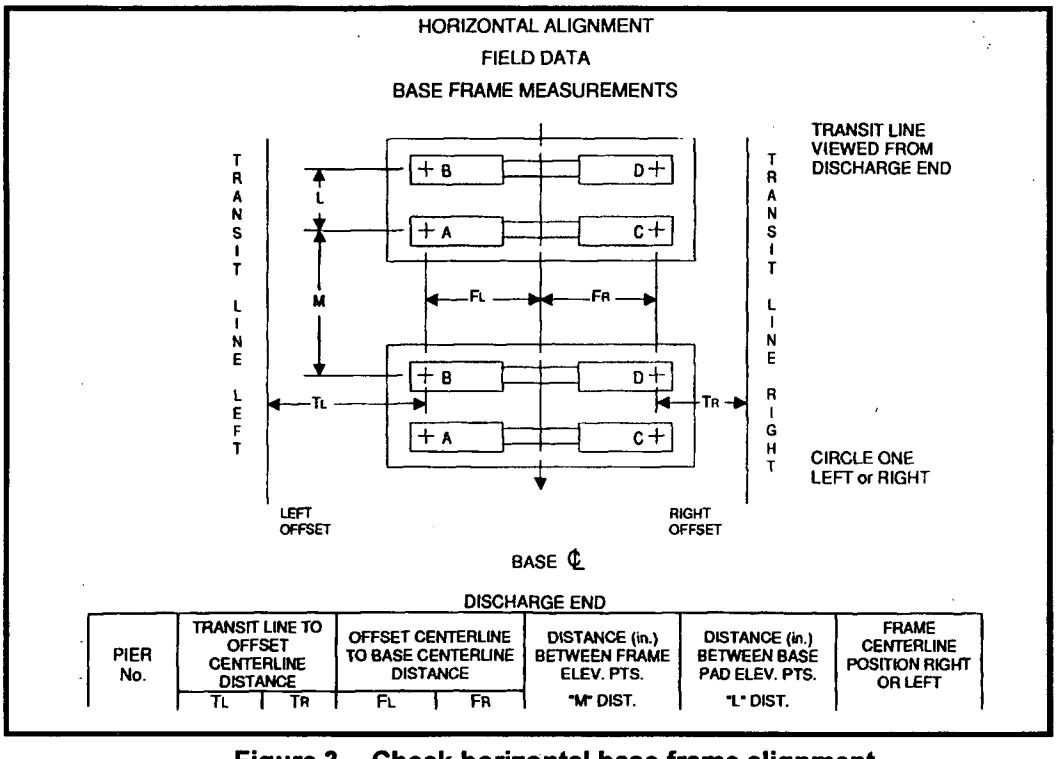


Figure 3 -- Check horizontal base frame alignment.

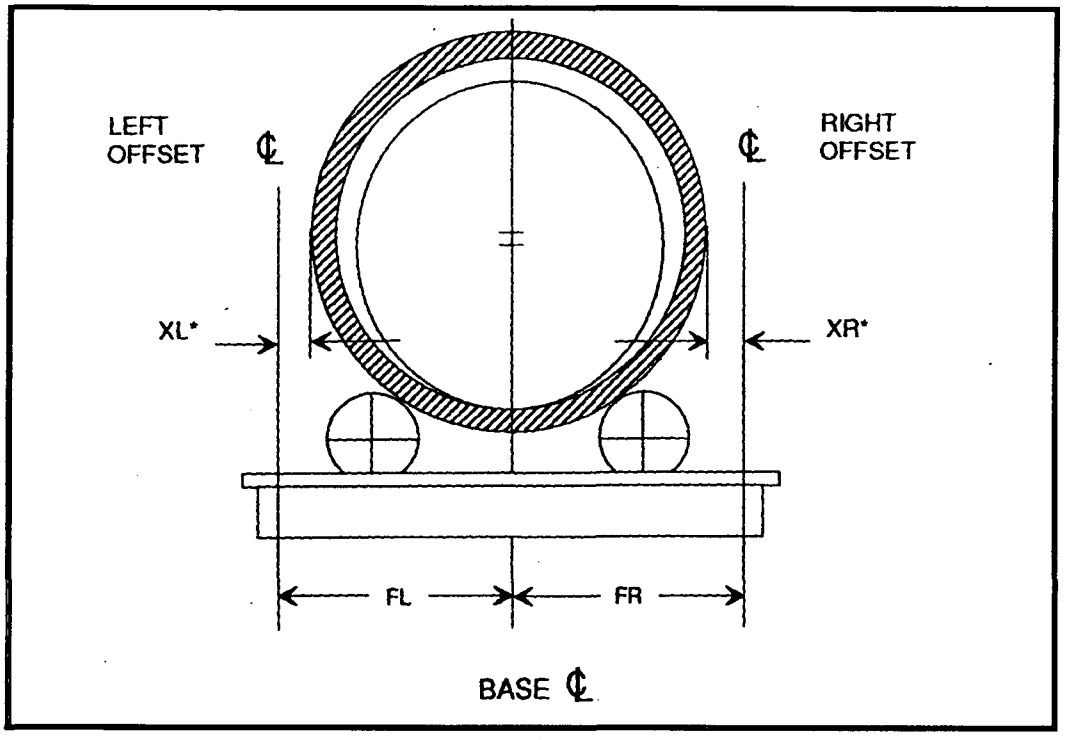


Figure 4 -- Plum lines establish the centerline position in relation to frame marked centerlines.

After the carrying mechanism frame elevations have been checked, the longitudinal centerline of the frames should be confirmed. To do this establish a straight line, preferably with a transit, along the side of the mixer from pier number 1 to the last pier at the other end of the mixer. See Figure 3. The line should be at a distance where visibility is unobstructed and at an equal distance from the frame centerline marks of the two extreme supports of the mixer. Measurements should be taken and recorded from the transit line to the frame centerline marks at all intermediate piers. This provides a mapping of all frame centerlines to a straight line and can be used in calculating the final alignment correction

The next step is to establish offset centerlines equidistant from the marked frame centerline. These lines should be established on each side of the mixer at an equal distance from the marked frame centerlines. Lay a straight edge along the offset centerlines, bridging the frame on each side. Using a pole extended above the horizontal centerline of the riding ring, hold a plumb line against the outside diameter of the riding ring. Careful readings of the distance between the plum line and the offset centerlines, extended by the straight edge, should be taken and used to determine actual distances from the plumb line to the marked frame centerlines. See Figure 4.

The plumb readings will indicate the relationship between the mixer centerline and the marked frame centerline. These should be recorded for later use in calculating the final alignment correction.

The actual measured distance between plumb lines on opposite sides of the mixer will also be used when determining riding ring radius for vertical axis alignment measurement.

As a final note on horizontal axis alignment measurement, all measurements should be taken very carefully to obtain data with the smallest possible error. In most cases the plumb line will sway when held against the riding ring. This can be caused by an out of round carrying roller, a warped shell, an out of round tire, or by the wind. (Most likely an out of round tire.) In all cases use the mean of the readings on each side of the mixer as the evaluation distances.

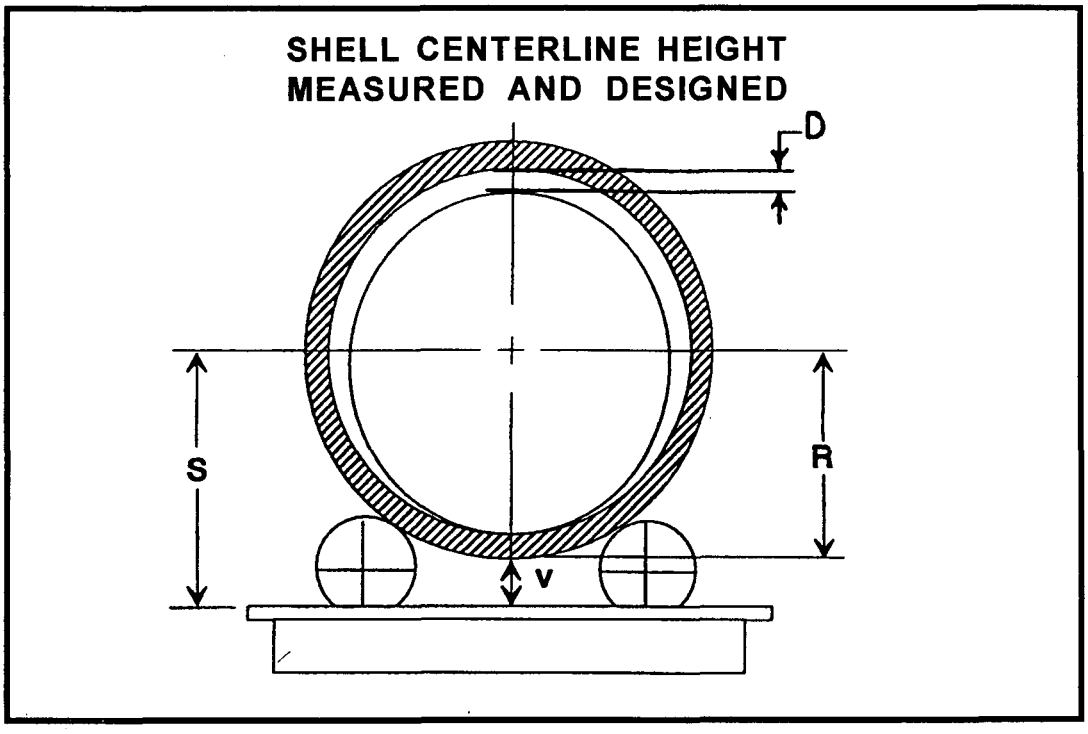


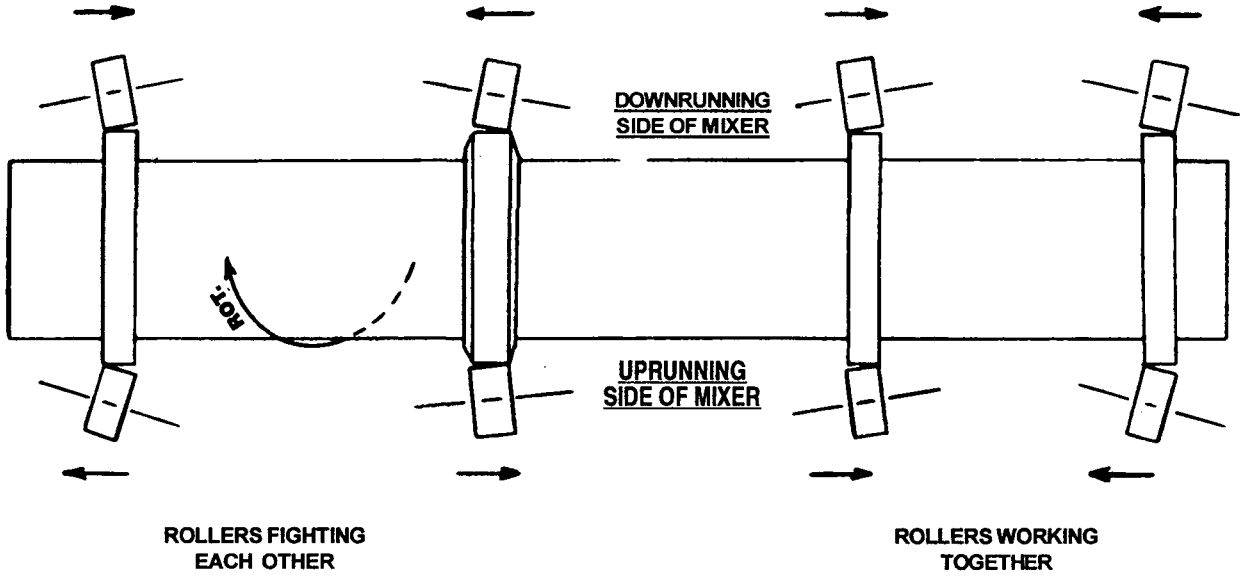
Figure 5 -- Measure shell centerline height.

After the horizontal axis of the shell has been measured and recorded, the next step is to measure the vertical axis of the shell.

The foundation or installation drawing of your mixer will indicate a dimension from the machined surfaces of the carrying mechanism frames upward to the mixer centerline. Three factors will be used to establish an actual field measurement of this dimension. The first measurement used is the actual riding ring radii recorded during the shell horizontal centerline measurement procedure. Subtract from the riding ring radii, a correction factor for actual riding ring clearance due to design, filler bar wear, and shell distortion. The third factor, which is added to the result of tire radii minus clearance correction, is the height from the top of the carrying mechanism frame to the lowest point of the riding ring at the mixer centerline. This dimension can be determined by squaring up from the inside edges of the diagonally opposite machined surfaces on each frame. A line, extended between the two squares and held at an equivalent position on both squares, will establish this dimension when the line is raised until just touching the lowest point on the outside face of the riding ring. See figure 5.

Record the shell vertical axis measurements for later use in calculating the final alignment correction.

Once a complete set of measurements including support frame position, horizontal centerline position, and vertical centerline position has been collected and recorded, the next step is to calculate a set of combined carrying roller adjustments. Combined carrying roller adjustments incorporate all of the horizontal, vertical, and frame corrections required into a single consolidated adjustment plan. There are several reasons why this method is preferred over adjusting individually for each horizontal, vertical, or frame correction. Combined carrying roller adjustments allow for the least number of adjustments and for adjustments of the smallest magnitude. This is important not only because moving the rollers is the most difficult part of an alignment job but also due to the risk of mechanical problems that can occur when moving the rollers.



NOTE: Arrow indicates mixer thrust reaction to "cutting" carrying rollers as shown.

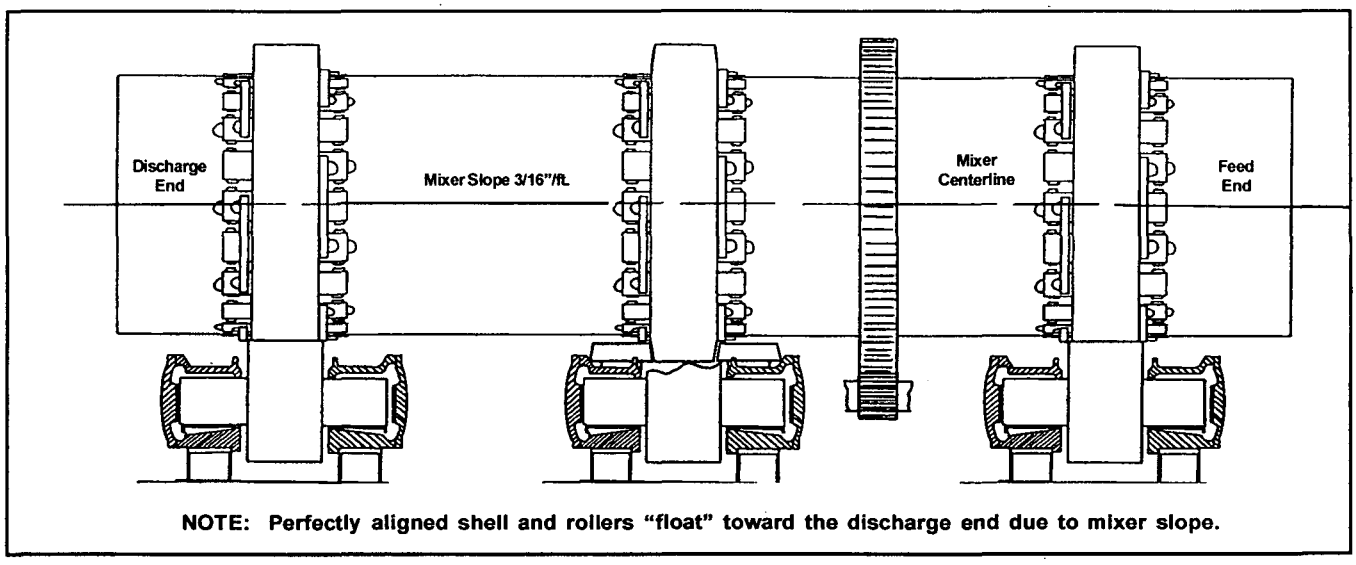
Figure 6 – Carrying roller thrust relationships.

At this point, all of the measurements have been taken and adjustments calculated for repositioning the mixer on the proper slope and centerline. **Before making any of the adjustments, it is essential to inspect the gear and pinion mesh condition. Do not make carrying roller adjustments that adversely affect the mesh of the gear and pinion.**

Adjusting carrying rollers for centerline and slope alignment can upset the bearing oil film and result in squealing or hot bearings. Some mixers require very small adjustments spaced hours apart and others can be adjusted more quickly. When adjusting the mixer for centerline and slope alignment, also **be aware** of the thrust load.

With the mixer shell now in centerline and slope alignment, the carrying roller thrust alignment should be checked and adjusted as required. In most cases, it is preferable to adjust the thrust alignment so the mixer rides the downhill thrust roller less than 100% of the time. This mixer position is referred to as a slight amount of "float" and is accomplished by "cutting" (adjusting away from parallel) each roller a small but equal amount.

Any misalignment or "cutting" of the carrying roller introduces wear between the carrying roller and the riding ring. If not done properly, "floating" can lead to excessive wear with one roller working against the other. See Figure 6. When a carrying roller is aligned parallel to the axis of rotation of the mixer, the carrying roller and shaft will be downhill due to their own weight. The roller load will be carried by the downhill bearing thrust plate.



NOTE: Perfectly aligned shell and rollers "float" toward the discharge end due to mixer slope.

Figure 7 – Mixer and carrying roller shafts are to bear downhill.

When a carrying roller is "cut" for final alignment, the "cut" should be such that it will relieve the thrust roller of load, but add to its load. Therefore, the carrying roller shaft thrust load, if any, should always be in the direction of the discharge end (downhill). (i.e., the carrying roller shafts should always bear against the cap of the downhill bearing.) Roller shafts not bearing in the downhill direction are either overloading the thrust roller or are part of a wear system with other rollers which have been cut too severely. See Figure 7.

Although all rollers should always be downhill, they should be thrusting downhill as lightly as possible. To achieve this condition, the thrust direction of each roller should first be determined. This can be done by sounding the bearing caps with a heavy hammer, or preferably, by measuring the distance between the sides of the roller and each bearing housing. The shorter of the two dimensions will be found at the bearing housing toward which the roller is thrusting.

At this point beware. All carrying rollers are designed with clearance for shaft float between the uphill and downhill bearing thrust mechanisms. However, carrying rollers with shaft or bushing damage, grooves from contamination, or heavy wear may not change thrust position when thrust alignment is adjusted. An experienced alignment person will quickly identify this condition and work to minimize its affect on overall thrust alignment.

On rollers found to be thrusting in the downhill direction, adjust the appropriate bearing inward so as to make the roller move uphill. Move the bearing inward approximately 0.020". Continue adjusting in 0.020" increments until the roller moves uphill or until a change in roller thrust direction has been clearly indicated.

To verify the amount the bearing is moved during each adjustment, set a dial indicator against the bearing housing. If the roller has not moved uphill after .060" movement of the bearing, adjustment should be shifted to the other bearing, which should be moved outward using the same increment procedure. This is done so that excessive movement does not disturb the centerline alignment.

When the roller starts to move uphill, the final adjustments are made to the bearing whose inward movement is appropriate to make the roller move downhill. Move the bearing approximately 0.005" at a time until the roller moves downhill. If the coarse adjustment has been done carefully the roller will move downhill within 0.020" bearing movement (four .005" moves) or less.

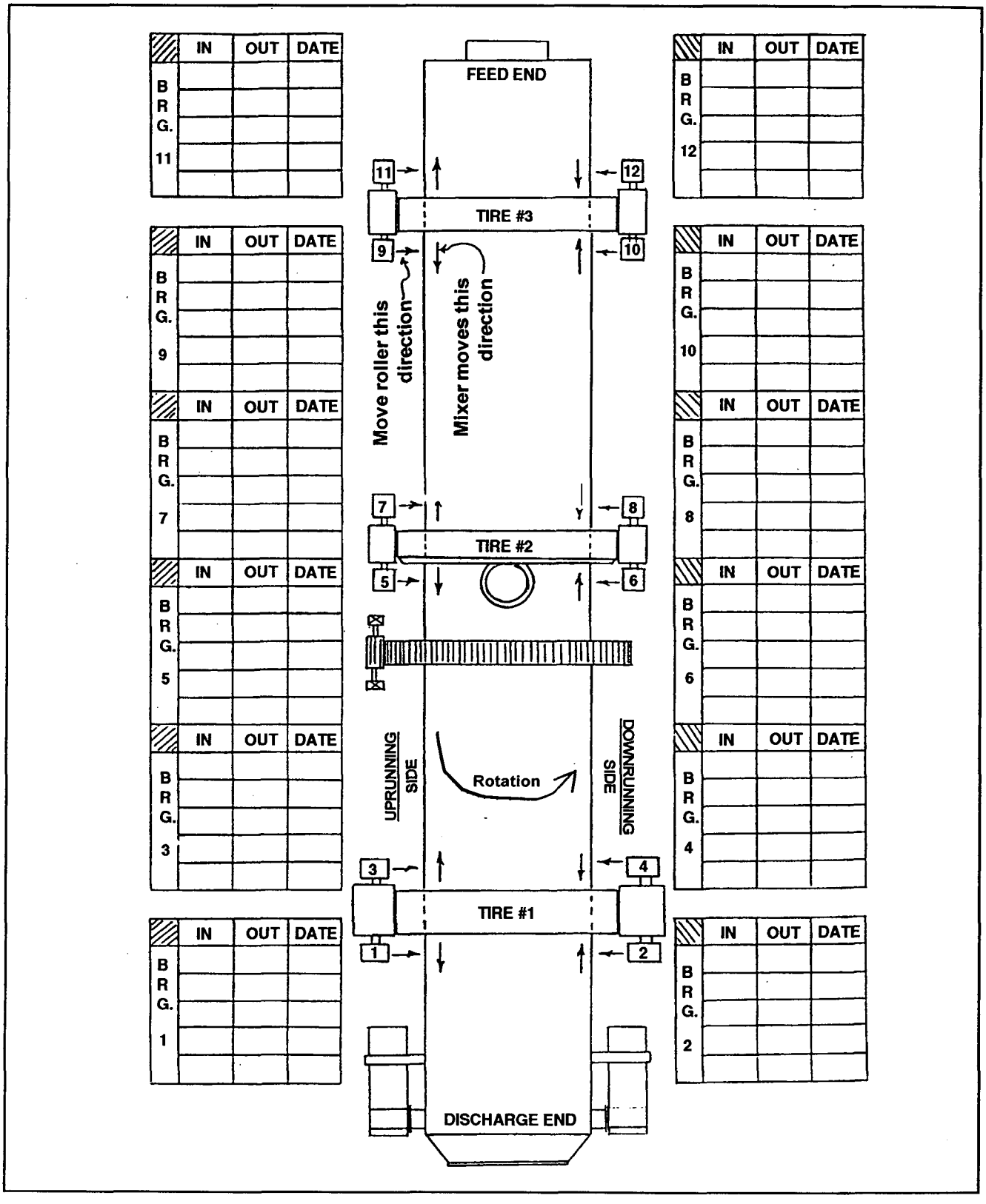


Figure 8 – Bearing adjustment record.

With the carrying roller approaching a position exactly parallel to the axis of mixer rotation, the carrying roller may respond quite slowly to the adjustment which will cause it to thrust in the opposite direction.

During any carrying roller adjustment process, the final movement of any bearing should be inward, even if it becomes necessary to move a bearing an extra amount outward to achieve this.

On rollers found to be thrusting in the uphill direction, start with the bearing whose inward adjustment will cause the roller to move downhill, use the same coarse adjustment procedure until the roller moves downhill. Then use 0.005" adjustment until the roller moves uphill. Then a final 0.005" adjustment to move the roller downhill.

After all carrying rollers have been adjusted, the carrying rollers and riding rings may not have full contact across their faces. No change in carrying roller adjustment should be made solely to obtain full contact. It is better to allow the rolling surfaces to wear in to full contact than it is to cut the rolls to obtain full contact. A roller cut to obtain full contact, without regard to its affect on thrust alignment, will require a compensating adjustment of another roll resulting in wear that will destroy full contact.

Note: Rollers with less than 30% contact may not react properly during thrust adjustment. In those cases, the reason for poor contact will have to be identified and some corrective action taken before proper thrust alignment can be achieved. See TROUBLESHOOTING section.

All movements of all bearings should be recorded during the adjustment process, as should all future adjustments of any bearing. These records will be an aid to maintain proper mixer alignment. See Figure 8.

A simple rule will help in determining which bearing to move for a required direction of carrying roller movement or thrust. Stand on the UPRUNNING Side of the mixer. If it is desired to move the mixer To The RIGHT, move the Bearing On Your RIGHT Inward. The carrying roller, of course, will move to the left. Move the right bearing on the downrunning side inward to accomplish the same result. To move the mixer to the left, reverse the procedure. When deciding which roller to adjust, always remember that the mixer and the **carrying roller thrust forces will move in opposite directions whenever an adjustment is made. See Figure 9.**

Note that all of the alignment and adjustment work must be accomplished while the mixer is operating at full production. It is beneficial to observe the main gear and pinion pitch lines as a rough guide to maintaining proper gear mesh while the alignment and adjustment is being done. It may be necessary to reposition the mixer by an adjustment of the carrying rollers to obtain proper gear mesh. Mixer gear mesh cannot always be observed with the machine in operation. It is important to check gear mesh during the annual shutdown inspection in order to make corrective adjustments as part of the alignment adjustments.

The A-C Equipment Services Corporation alignment methodology has been developed by several A-C alignment specialists over the past twenty years. The advantages over many other techniques are cost minimization with equal if not greater accuracy. Each machine has unique characteristics and presents specific problems. An experienced alignment specialist cannot be replaced by gadgetry and his importance should not be underestimated.

NOTE

Inspection and thrust alignment should be completed on an annual basis for all mixers.

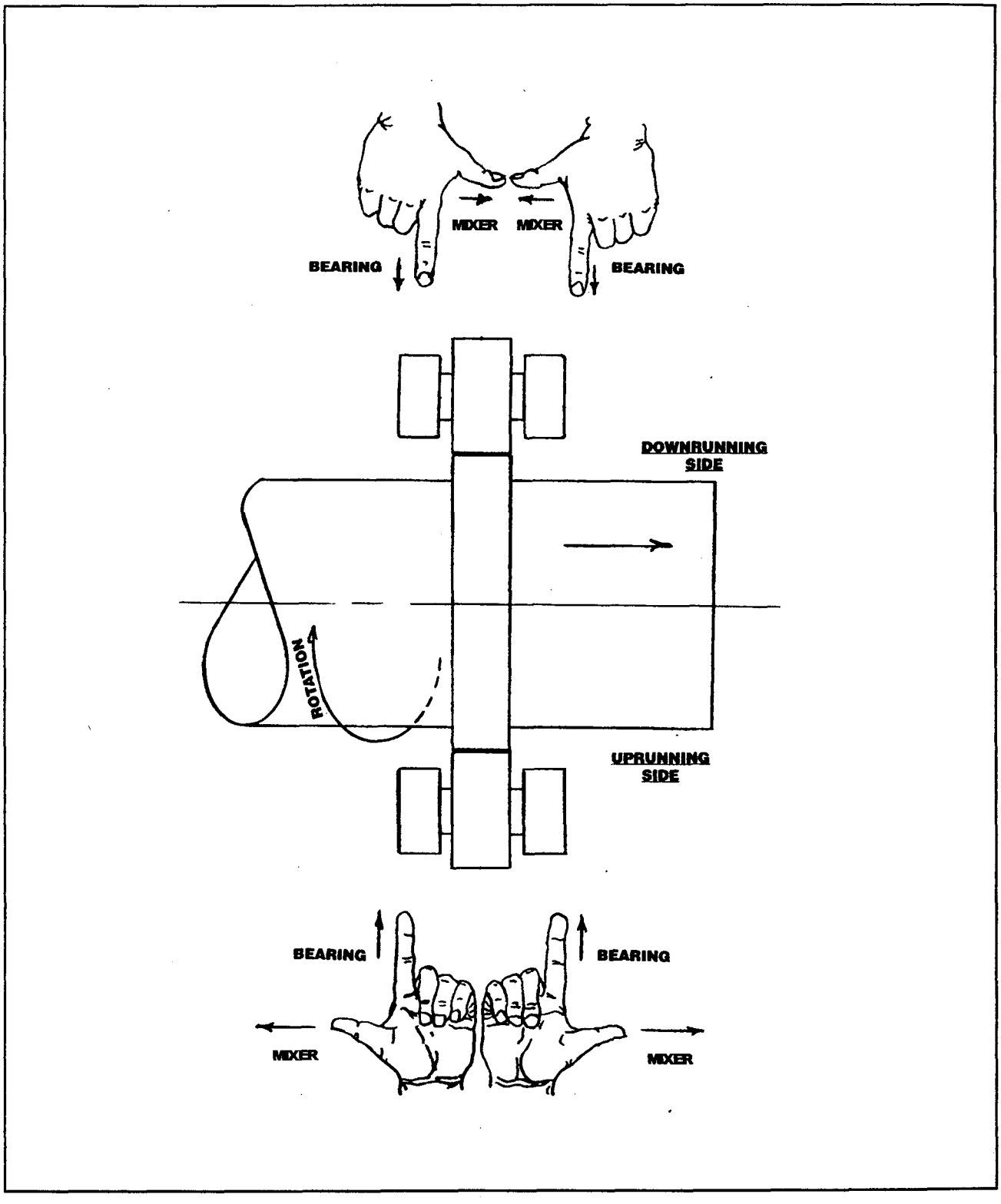


Figure 9 -- Rule for roller adjustment

TIRE CLEARANCE "CREEP" MEASUREMENT

Riding ring creep or the relative movement between the mixer and riding ring is an indicator of the operating clearance between the tire and shell. Tire clearance affects both mixer alignment and shell ovality. The relative movement "creep" can be measured as follows:

- Place a chalk mark on the riding ring side face and at the same location on the riding ring retaining band.
- After 5 or 10 revolutions of the mixer, measure the distance between marks.
- Divide the distance measured by the number of revolutions. The result is the relative movement or creep.
- Divide the creep by p (pi) to find riding ring clearance.

The riding ring clearance measurement is used to correct alignment due to wear and to help validate conclusions drawn from ovality measurements. Creep measurements should be taken as part of the plant semi-annual inspection and kept as historical data. Creep measurements must also be taken as a component of every alignment project.

DRIVE SYSTEM

In most designs, the mixer drive is located close to the thrust riding ring to maintain the proper relationship between the main gear and the pinion, regardless of the expansion and contraction of the mixer.

The main gear is manufactured in halves, with fully machined teeth to permit reversing of the gear for double life. On most mixers, the gear is bolted to a rigid flange which is welded to the shell.

Some rigid flange mounted gears have experienced repeated alignment problems. These problems are attributed to the relative movement between the gear flange and gear during expansion and contraction of the mixer shell. Rigid flange mounted gears can generally be retrofitted with a spring plate type gear mounting.

The pinion is mounted on or manufactured as part of the pinion shaft and is coupled to the lowspeed shaft of an enclosed gear reducer.

The reducer and the pinion shaft assembly are fixed to the foundation on the same slope as the mixer. The main drive motor is usually coupled to the highspeed shaft of the gear reducer, with the motor also mounted on the same slope as the mixer. Ball bearing motors should always be used, since oil will run out of the bearing on a sleeve bearing motor.

Proper mesh of the main gear and pinion should be maintained. Improper meshing of the teeth results in a jerky or vibrating motion of the mixer. In no case should the pitch lines overlap, this causes excessive wear and overloading of the pinion shaft and bearings. Proper adjustment of the carrying rollers will prevent this condition.

If adverse clearance is allowed to continue, resulting in scoring of gear teeth and peening of pinion teeth, it will be necessary to reverse the gear and pinion before such action is normally necessary.

Misalignment of the mixer or pinion may also cause the teeth to wear to a taper, resulting in inferior gear action and shorter life.

Mesh of the gear and pinion should be checked at regular intervals. Any wear or adjustment on the carrying rollers will change the mesh. If the pinion is meshing too deeply, the mixer should be raised to its original position by moving the carrying rollers toward the centerline of the mixer.

All drive system elements should be maintained and lubricated according to the instructions or a schedule developed from equipment histories.

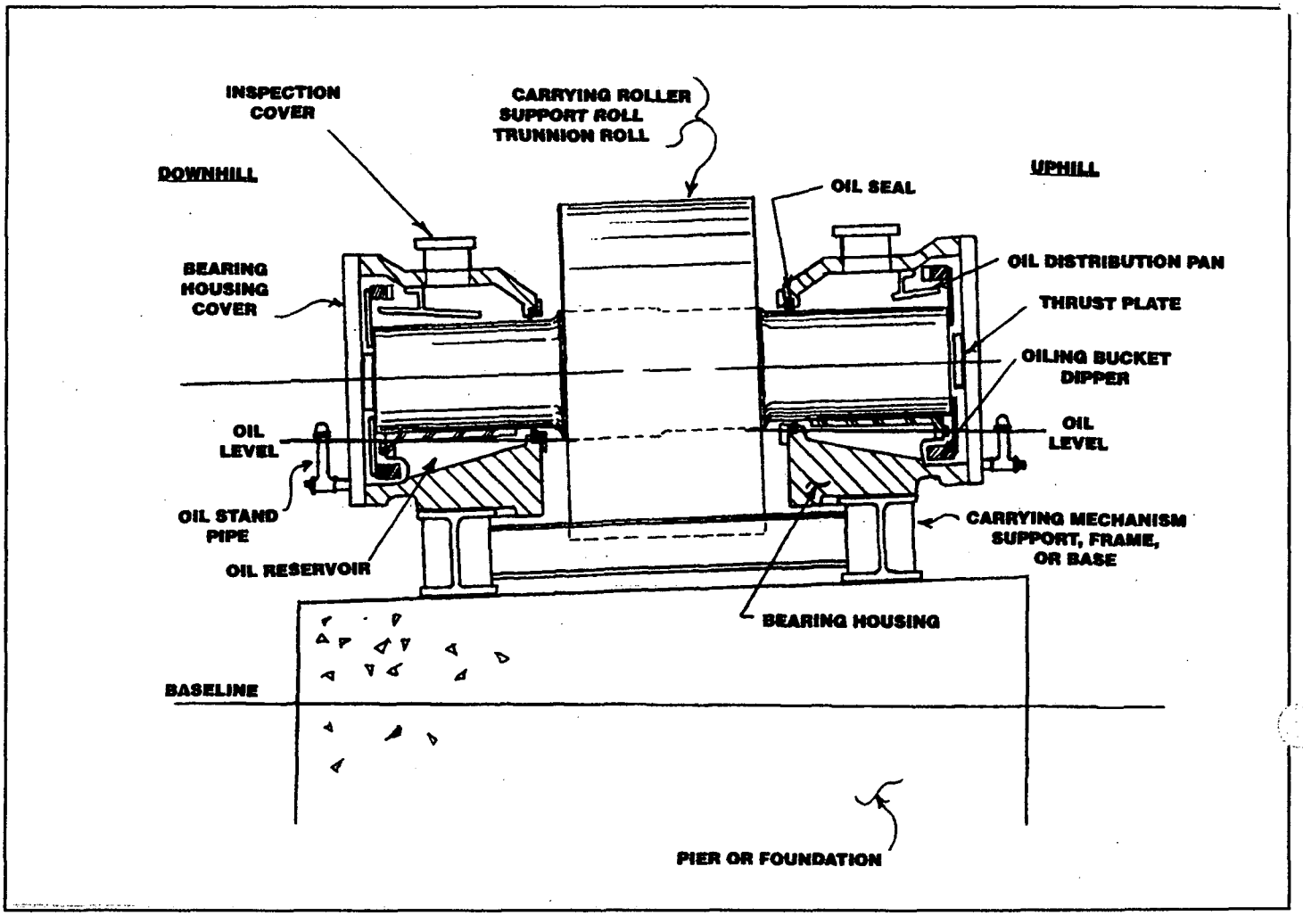


Figure 10 – Typical carrying mechanism assembly

Flexible couplings should be lubricated with a specially formulated coupling grease. Couplings should be aligned as close to perfect as possible and not exceeding 25% of manufacturer's recommended maximum misalignment on new installations. Remember that couplings may be designed for misalignment but the bearings in reducers and motors are not.

Several simple steps can be followed to maximize drive train life.

1. Maintain proper lubricant type and level.
2. Maintain proper gear alignment and depth of gear mesh. Improper mesh can cause vibration and jerky operation, premature wear, and overloading of drive components.
3. Maintain pinion and gear guard seals to exclude contaminants.
4. Check automatic lube system and/or oiling pinion operation frequently and maintain lube equipment in top shape.
5. Maintain mixer alignment and a shell free of warps or doglegs to insure proper gear mesh.
6. Align all drive couplings within .002" or 25% of manufacturers recommended allowance.
7. Maintain all drive elements according to equipment instructions.
8. Inspect gear spring plate welds, spring plate pins, flange bolts, and joint bolts on a regular basis. If any bolts are found loose or broken, all bolts should be retorqued and gear alignment checked.

HOW TO PREVENT HOT BEARINGS FROM HAPPENING

Most bearing problems begin with a loss of or insufficient oil film. Often this occurs in only a small portion of the bearing surface. Heat generated by metal to metal contact in this area raises bearing oil temperatures causing a dramatic drop in viscosity. A viscosity of 750 S.S.U. at 100 deg.F drops to 70 S.S.U. at 210 deg. F.

In an effort to prevent hot bearings, we must first address the problems causing loss of oil film.

1. Use silicone or permatex sparingly to seal bearing housing openings. Excess sealants are often transported with the oil and block portions of the oil entry groove in the bushing.

2. Keep carrying roll shaft clean in the area between the bearing housing and carrying roll to avoid seal damage and consequent oil contamination.

3. Maintain clean water jackets to promote heat transfer away from carrying bearing oil.

4. On bearings with a history of high temperature, install an oil circulating system with a heat exchanger. A simple pump and heat exchanger is sufficient. Monitor shaft temperature for early warning and make operational changes as needed to cool hot bushings down.

5. Maintain oil at recommended level.

6. Change trunnion bushings in pairs to maintain proper slope and full bearing contact.

7. Maintain proper carrying roll shaft surface condition. Shafts with minor grooves can be field polished. Major grooves require machining for cleanup or built up with weld and machining to original specifications.

8. Check frame alignment whenever a bearing fails. Grout under carrying mechanism frames often fails gradually over a number of years. Bushings "wear in" to compensate for this change. When a new bushing is installed in a bearing on a failed frame, shimming or regrouting may be necessary to achieve full contact between shaft and bushing

9. Check the clearance on new bushings. If clearance is below the minimum acceptable amount, check for contamination between the bushing O.D. and housing I.D., check the machined dimensions of the new bushing, and check the bearing housing bore dimensions. High temperatures, generated by bearing failure, can permanently distort the housing bore. Housing bore must be straight within .005".

10. Maintain mixer alignment to insure proper load distribution between bearings. This includes proper thrust alignment of each carrying roller to reduce heat generated by the thrust plate or collar.

11. Maintain roller and tire surface parallelism to insure proper load distribution between bearings on the same carrying roller. Roller and tire grinding may be necessary to attain this condition.

12. Correct shell defects, i.e. doglegs or other deformation that can cause bearing overloading.

13. Determine effect of additional loads, i.e. production increases on mixer design parameters.

CARRYING ROLLER BUSHING INSPECTION AND REPLACEMENT

Annual inspection and service should include the following for each carrying roller bushing and housing.

1. Drain oil and pull housing cover.

2. Inspect thrust plate or collar.
   a. Check thickness.
   b. Inspect for scratches, gouges, etc. from contamination.
   c. Check fastener tightness.
   d. Clean oil pockets and grooves.

3. Inspect oiling buckets and housing oil troughs.
   a. Remove all buildup.
   b. Check fastener tightness.
   c. Inspect for damage from interference.

4. Inspect bushing.
   a. Clean oil entry groove.
   b. Check bearing lug, bolts, and position in housing.

5. Clean oil pan.
   a. Check bolt tightness.

6. Check oil seal.
   a. Clean shaft between seal and carrying roll.
   b. Inspect seal for signs of leakage or seal damage.

7. Replace bearing cover using one of the following methods for sealing. See cover sealing instructions.
   a. Velumoid gaskets.
   b. Silicone or permatex No. 2.

NOTE

Care must be taken to avoid excess sealant being squeezed into the housing oil reservoir, as it could end up in the bushing oil entry groove.

8. Remove water jacket cover and inspect for calcium buildup and accumulations of foreign material.

9. Check water flow and clean drains.

10. Replace bearing housing lubricant to recommended level.

Carrying roller bushing replacement can be accomplished by the following general procedure.

1. Mark bearing housing position in relation to support frame for each housing on affected pier.
2. Raise and crib mixer at pier with bushing to be replaced.
   a. Raise mixer by one of the following methods:
      - Jacking the tire with hydraulic jacks and a properly designed saddle for load distribution.
      - Jacking on the shell with hydraulic jacks and a properly designed saddle for load distribution.

NOTE

Internal shell bracing may be required.

      - Moving the rollers in to raise the mixer, cribbing it in place and then backing the rollers out.

NOTE

Never leave mixer load supported by jacks while working on bearings. Always install cribbing or blocking after raising mixer.

3. Drain oil from bearing housing.

4. Remove bearing housing end cover, oil pan, oiling buckets, and oil seal.
   a. Place shim stock or plastic over top centerline of shaft for protection when lifting.

5. Raise roller and shaft just enough to remove load from bushing.
   a. Roller and shaft may be lifted with a cable and crane or jacked with a hydraulic jack and the proper cribbing to prevent damage to the roll face. If a cable is wrapped around the shaft, a piece of rubber should be placed in between cable and shaft to prevent damage to the shaft.
   b. Crib or block roller securely after lifting. Never work with load on the jack.

6. Remove bushing.
   a. Bushing must be supported during removal.

7. Clean housing and inspect carrying roller shaft.
   a. Thoroughly remove all buildup and foreign material from housing.
   b. Inspect shaft and if cleanup is required, the bearing housing may have to be removed. Circumferential grooves can generally be removed by hand or hand held tool using emery cloth. Shaft refinishing should be done with the bearing housing removed to permit adequate access.

8. Install new bushing.
   a. Inspect bearing housing again for contamination. Even a single small piece of grit can reduce bearing clearance and heat transfer from bushing to housing.
   b. Slide bushing into position. Some bearing housing designs permit the use of bluing to check shaft contact area. This should be done if practical.

9. Lower carrying roller and shaft onto bushing.
   a. Check bearing clearance by inserting feeler gauge between bushing and shaft on each side of the shaft. The sum of these measurements should be approximately equal to .0015" x shaft diameter.
10. Install oil pan, oiling buckets, oil seal, and housing cover. See cover sealing instructions.
11. Move carrying roller into operating position.
12. Fill bearing housing to correct level with oil.
13. Lower mixer onto carrying rollers.
14. Connect water lines and check flow.
15. Monitor bearing temperature during startup. Bearing housing temperatures will generally run slightly over ambient temperature at their pier. Monitor temperature each hour and watch for rapid rises (30 deg.F - 50 deg.F) in a one hour period.
16. Check mixer alignment and thrust adjust carrying rollers after the mixer is back in operation.

Bearing Housing Cover Sealing Instructions.

1. Clean both sides of joint thoroughly.
2. File or dress all burrs.
3. Use velumoid gasket. If using Permatex or silicone, apply 1/4" wide bead not greater than 1/32" thick to form a complete ring just inside the bolt holes.
4. Pull joint together evenly.
5. Clean off excess. AVOID EXCESSIVE THICKNESS. MATERIAL SQUEEZED INTO THE HOUSING COULD END UP IN THE BUSHING OIL ENTRY GROOVE.

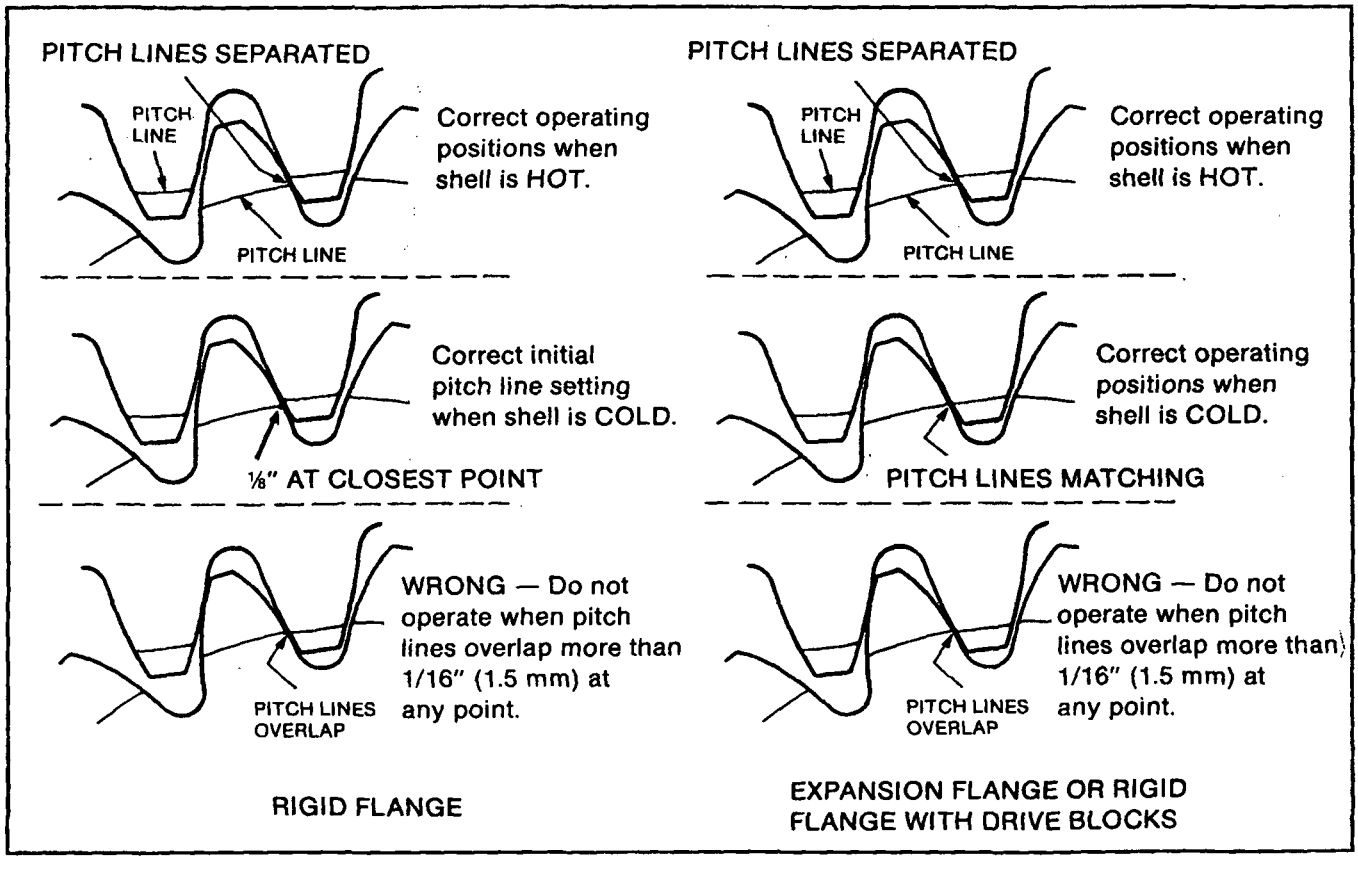


Figure 11 -- Setting gear and pinion.

INSTALLATION OF RING GEAR

Before mounting the gear remove all protective coatings, grease, paint, slushing compound, burrs and upsets from the mounting surfaces. Also carefully review all supplier manuals (when applicable) and drawings furnished that apply to installation of gear and drive components.

Mount gear on gear flange or in the case of a spring plate mounted gear on temporary alignment fixtures.

The split gear joints must be drawn up tight before attempting radial and axial alignment of the gear. There are three types of joints on split gears, depending on the gear supplier. All three methods use shrunk clearance bolts to draw the joint up tight, but vary in method of alignment bolts. The first method makes use of a tapered bolt with a split sleeve. The second method requires fitted bolts and the third method uses set screws with their axis on the plane of the joint. Consult the gear supplier's manual for instructions.

With the gear joints tight, the gear is now ready for radial and axial alignment. See gear alignment instruction sheet.

INSTALLATION AND ALIGNMENT OF PINION ASSEMBLY

Preliminary alignment can be made by using the scribed pitch lines on the side of the gear and pinion. These scribe lines should be tangent or slightly separated but should never overlap. See Figure 11.

Rotate the gear to a position such that the point of maximum plus radial runout is in contact with the pinion. Initial alignment should be made at this point.

Fix the gear so that it will not rotate. Torque the pinion against the gear in the direction of its normal rotation. Check the contact and backlash clearance on both sides of pinion and gear with feeler gauges. See Figure 12. Contact and clearances should be checked at four points. If the gear and pinion axis are parallel, the contact and backlash will be the same on either end of the tooth.

After aligning the pinion, by shimming and shifting the pinion shaft bearings, a contact pattern should be made.

To make the contact pattern test, the pinion teeth should be coated with Prussian blue or heavy oil pigments available at a local paint store. Use dark colors such as ultramarine blue or black if heavy oil pigments are used.

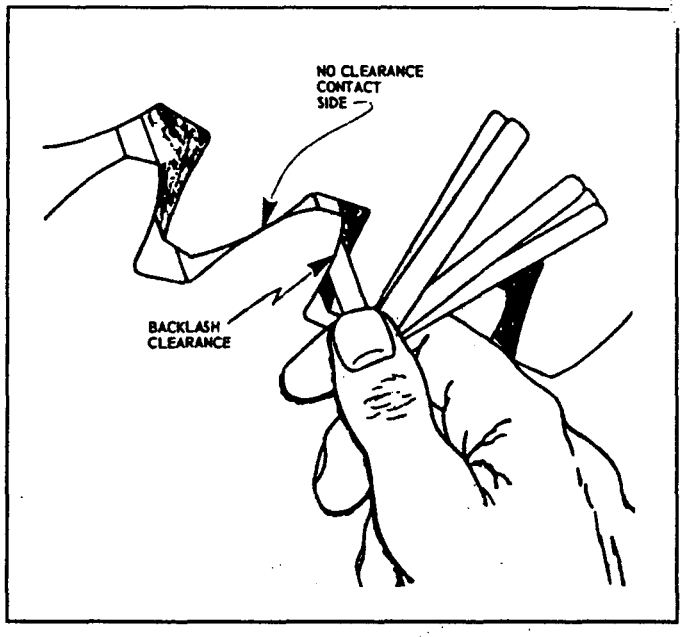


Figure 12 – Check contact and backlash clearance with feeler gauge.

A thin coating of blueing is applied with a brush to about six pinion teeth.

When a blued pinion is rotated, it will transfer blueing to the mating gear teeth where contact is made. Slowly rotate pinion to obtain the contact pattern.

A careful alignment check will indicate if one of the pinion shaft bearings should be moved slightly or shimmed. After corrective measures are taken, backlash should again be checked and another pattern test made. Properly aligned gears will show a contact pattern across at least 70 percent of the gear face for spur gears and 80 percent for other gears. Contact pattern tests should be made at four positions of the gear, 90 degrees apart.

The final contact and backlash readings are to be recorded. The final contact Blueing pattern is to be recorded.

GEAR GUARD

Installation of the gear guard is a matter of joining the segments of the guard and positioning the guard. It is imperative that the guard is carefully and properly positioned so that clearances exist to allow for thermal expansion of the mixer and for correct seal alignment at the pinion shaft.

LUBRICATION

Rotary mixers use a wide variety of lubricants to meet the specific requirements of each component. Lubricants are required for the main gear and pinion, couplings, reducers, carrying rollers, thrust rollers, tires, and the seals on some machines. Lubricant specifications and quantities for each application should be found in the instruction manual.

Main gear and pinion lubrication is accomplished by an oiling pinion or a spray type lube system.

1. Oiling pinion system consists of an oiling pinion that transfers oil from a reservoir to the pinion. The pinion then transfers oil to the main drive gear. This system has few moving parts and is very dependable. Lubricant viscosity and quantity must be monitored during changes in ambient temperature. It may be necessary to heat trace and insulate the oil reservoir for winter operation. House cleaning may be a problem due to quantity of lubricant applied and condition of the gear guard and pinion shaft seals.

2. Spray type lubrication using a viscous lubricant continuously supplies a clean measured amount of lubricant, reducing house cleaning problems and providing efficient lubrication.

   The spray lubricator can be of several types, but most operate with an air motor pump and air purged nozzles. The major components can be housed in a heated area and the lube line to the spray panel can be heat traced and insulated. Timers generally control lube cycles and an alarm is incorporated to indicate the equipment is inoperative.

   Lube frequency and quantity are generally determined by actual practice.

On new installations or whenever the gear is cleaned, the main gear and pinion should be coated with lubricant before start-up.

A cleanout door and drain plug should be provided on the gear guard for waste lubricant removal.

Carrying and thrust mechanism oil types and quantities are specified based on operating and ambient temperature. Synthetic oils may be desirable in some situations to provide a flat viscosity curve and allow continuous operation at higher bearing temperatures.

Drive system bearings, reducers, couplings, etc. should be lubricated according to their instruction manuals. Pinion bearings may be packed full of grease due to low speed operation. A synthetic oil will help to extend drive reducer life. Specially formulated coupling grease should be used in all couplings as these are often neglected during normal maintenance.

Air seal lubricants, if required, should be according to design recommendations. All greases will have to be high temperature type.

Tire lubrication can be accomplished in a variety of ways. Tire outside diameters should be graphite lubricated. A graphite block and holder can act as a guard for the tire-roll pinch point on the down running side of the mixer. The block will ride on the roll depositing graphite that is then transferred to the tire. The tire then transfers graphite to the opposite side roll. Tire bore should be lubricated with a graphite and water slurry. Do not use oil or grease type lubricant that attracts contamination.

RIDING RINGS AND ROLLERS

When the mixer is at normal operating temperature and full production, the riding rings should be centered over the carrying rollers. This condition should be verified after a new installation and maintained for the life of the mixer. Retaining band wear, thrust roller wear, and warps in the shell can alter this position. This condition should be corrected as soon as possible to avoid forming out of round conditions, ridges or tapers on the tire and roll faces.

Sometimes it becomes necessary to reface riding rings and carrying rollers. This can be done in the field with no interruption to full production. A grinding rig can be used to grind both the rings and rollers while the mixer is in operation. It is essential to carefully monitor the following points:

1. That the mixer is not moved off its centerline.
2. That the slope is not changed.
3. That the proper mesh between the pinion and main gear is maintained.

Tire and roller grinding should only be done in conjunction with an alignment. This ensures that adjustments made will compensate for material removed during grinding, correct mixer centerline alignment and properly distribute thrust.

Carrying roller shafts often end up with a groove in the oil seal area. Wear in this area can be reduced by cleaning the exposed shaft area between the side of the roll and the bearing housing on a regular basis. Good housekeeping in this area also makes it much easier to see a leaking seal and extends seal life.

ALIGNMENT OF RIDING RINGS

Riding rings should not wobble as the mixer rotates since it is impossible to obtain full contact between the carrying rollers and the riding ring under such conditions. Figure 13 shows a method for determining the amount of runout in a ring.

Two pointers are constructed of steel angles and placed as shown. The use of two pointers eliminates the effect of any mixer "float". These pointers should be mounted on the mixer pier away from the carrying mechanisms and should extend to the centerline of the mixer. The edge of each pointer should be approximately one inch from the machined outer edge of the riding ring.

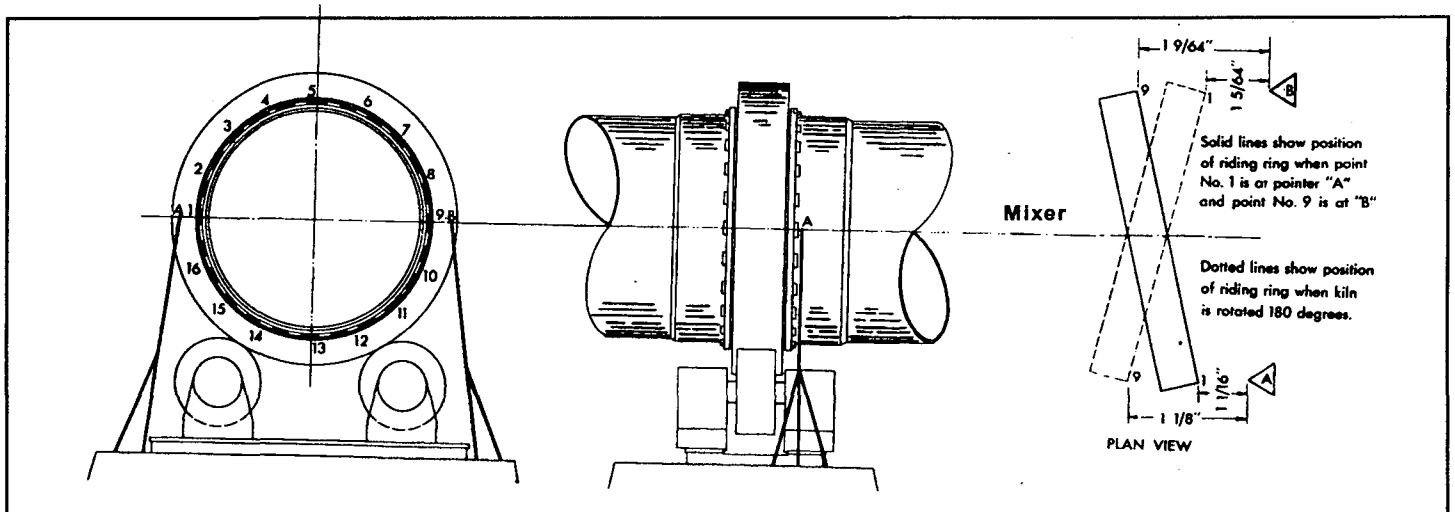
The riding ring must be fixed against downhill or uphill set of the retaining blocks or bands by small wedges driven between the riding ring and the opposite set of blocks or bands at several points around the circumference of the ring or by jack bolts.

Measurements are taken from reference marks on the pointers to the machined sides of the riding ring. A set of readings taken at 16 equally-spaced points around the circumference of the ring will indicate the location and magnitude of maximum runout. If the runout at any location exceeds 1/32", it must be corrected by relocating the retaining blocks or bands and riding rings. Riding ring runout should be 1/32" or less.

The table in Figure 16 shows how these readings are tabulated and interpreted.

INSTALLATION OF CARRYING AND THRUST ROLLERS

Clean the top machined surfaces of the frame, making sure all burrs and particles of dirt are removed. Coat the surfaces with lubricant before installing the mechanism assemblies.



0 to 180° ROTATION				180 to 360° ROTATION			
Location of Ring	Reading at "A"	Reading at "B"	Diff. B-A	Location of Ring	Reading at "A"	Reading at "B"	Diff. A-B
1-9	1 1/16"	1 3/64"	3/64"	9-1	1 1/16"	1 3/64"	3/64"
2-10	1 1/32"	1 1/64"	3/64"	10-2	1 1/32"	1 3/64"	3/64"
3-11	1 1/32"	1 3/64"	3/64"	11-3	1 3/64"	1 1/16"	3/64"
4-12	1 3/64"	1 3/64"	1/32"	12-4	1 1/16"	1 1/32"	1/32"

Total runout at any location = ½ (column 4 + column 8)
Total runout at location 1-9 = ½ (3/64 + 3/64) = 1/32"
Total runout at location 2-10 = ½ (3/64 + 3/64) = 3/64"
Total runout at location 3-11 = ½ (3/64 + 3/64) = 3/32"
Total runout at location 4-12 = ½ (1/32 + 1/32) = 1/32"

Figure 13 – Method for determining runout of riding rings.

The carrying and thrust mechanisms must be thoroughly cleaned prior to installation. The following procedure should be followed:

1. All removable or bolted parts should be taken apart.
2. Remove all grease, dust, permatex, etc., found on such contact surfaces as bearings, seals, etc. Protective grease is placed on bearing surfaces before shipment but does not represent the type of lubricant required for operating service.
3. Sand, chips, dust, etc., should be cleaned from all points and pockets where lubricants, water, or air will later be contained or passed, and parts reassembled.
4. During initial installation of the machine, or if the machine is not to be placed in immediate operation, or if the machine is to be idle for any appreciable length of time, each bearing should be filled with enough oil to completely cover the shaft. This is to prevent rusting of the normally exposed portion of the shaft due to the oil film draining off. Also during this time, care should be taken to prevent dirt or foreign matter from entering the bearings.

THRUST ROLLER ALIGNMENT

The thrust roller should be installed on the down-running side of the mixer centerline, as shown in Fig. 14. This will prevent any lifting effect on the thrust roller.

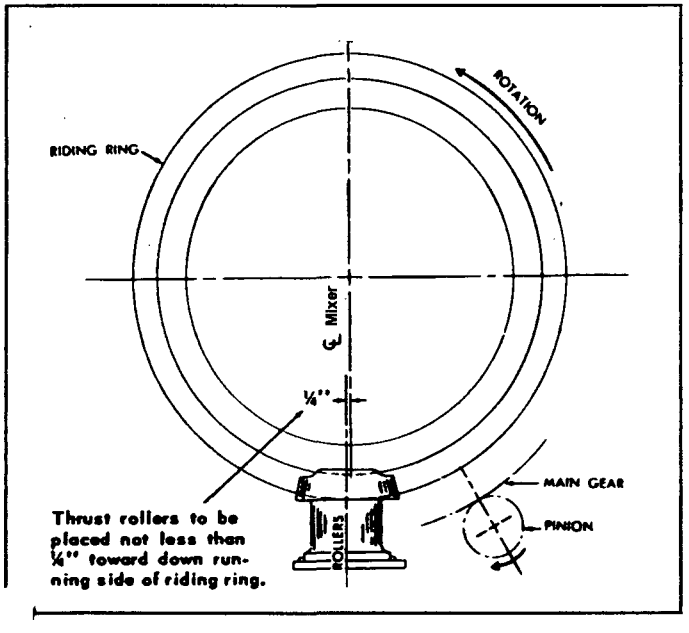


Figure 14 -- Method for determining runout of riding rings.

FRAMES (CARRYING MECHANISM)

The mechanism frames must be set at the elevations and locations shown on the installation drawings for the mixer. Proper mechanism frame alignment is essential for reliable operation, therefore, every attempt should be made to align the frames as accurately as possible. Frame centerlines must lie on the vertical plane through the mixer centerline and deviation from specified elevation and axial spacing must not exceed 0.06 inches.

The machined surface on top of the mechanism frame (consisting of four individual machined pads) must be set transversely level and axially to the slope shown on the installation drawings. Again, mechanism frame alignment is essential for reliable carrying mechanism operation and every attempt should be made to set the frame as accurately as possible. In no case should deviations in original settings exceed the following:

- Maximum axial deviation from the slope and maximum transverse deviation from level of the top of the mechanism frame must not exceed 0.002" per foot.
- On the top of each individual pad the edge nearer the carrying roller shall in no case be high relative to true slope.

A precision slope block and beam type straight edge are essential tools for carrying mechanism frame alignment.

PREPARING AND PLACING GROUT

After assuring that the foundation is clean, roughed up and damp, and the frames are properly installed, grouting of these frames can be undertaken. The grout should be of non-shrink type. A-C Equipment Services does not recommend epoxy grouts for this application. A-C Equipment Services also does not recommend grouts containing unstable ferrous particles be used. Mixing procedures and water requirements for grout must be followed precisely.

Foundation bolts are grouted to the top of the foundation first. Then a form is built around the frame for grouting. It is most important to pour from one side and work in the grout to eliminate air bubbles beneath the frame. A pier cap should be poured to reach the level indicated on the installation drawings.

NOTE

Pier cap should be doweled to concrete pier.

GROUT CURING

The grout should set from 18 to 24 hours at a temperature about 70 deg.F., before the forms are removed. If the temperature is below 70 deg.F., the period should be longer. Standard grouts should set for at least seven days before equipment is put into operation. This is especially advisable if the live load develops vibration. If a special grout is used, instructions given by the grout supplier must be carefully followed.

After removing the forms, the surface should be smoothed with a surfacing stone and pointed up wherever faults, cracks, or spalling have occurred. The edge of the grout should be kept damp for several days, after which a good commercial curing compound should be applied.

Remember, a quality grouting job is vital to dependable operation of heavy machinery. Because it seems such a basic and simple requirement of proper installation procedure, some of the preparations called for in grouting instructions may appear to be too trivial for careful consideration. Past experiences of qualified service advisors reveal that no detail can be overlooked if a serviceable foundation is to be laid.

INSTALLATION AND REPAIR PROJECT PLANNING

This is a general outline intended to provide information to facilitate the development of a project plan. Mixer repair projects, i.e. shell and gear replacement are more successful and cost effective when planned far in advance and based on a realistic schedule.

1.0 CONCEPT

A rough draft of next years major repair requirements should be put on paper 6-8 months in advance.

a. Check availability and delivery of parts.
   - — Mixer tires require 26-30 weeks for delivery.
   - — Mixer shell requires 12-16 weeks for delivery. Shorter lead times can increase material and manufacturing costs by up to 50%.
   - — Most other parts require 5-15 weeks for delivery

b. As early as possible, consult with A-C Equipment Services. A telephone call is very inexpensive and may help avoid possible pitfalls. We can give you estimated costs, deliveries, times required for a professional repair and discuss the difficulties you may encounter during the repair.

2.0 CONTRACTOR QUALIFICATION

a. Small, non-technical projects can be done with a local contractor under the close supervision of the plant engineering and maintenance department. Supervision is essential. A top notch contractor, inexperienced with rotary mixers, may fail to understand the operating requirements of your mixer.

b. Small to medium size projects involving alignment or special welding procedures should be done by a local contractor under the supervision of an advisory engineer or done by an experienced service company. Cutting costs on this type project is often a false economy.

c. Large projects involving gear replacement, shell replacement, and a tight schedule should only be undertaken by an experienced service company. A rotary mixer is not just a piece of pipe. A high quality, on schedule, long life repair is much more likely when it is the contractor's everyday work.

3.0 CONTRACTOR SELECTION

Select a contractor and lock in a project date as early as possible. Your shutdown is scheduled during the same season as everyone else in your industry. The most qualified service people market on a national basis and are often unavailable if not scheduled months in advance.

4.0 COORDINATION

- Ask contractor for written project sequence and schedule a minimum of four weeks in advance.

- Review contractor schedule to determine his time requirements for controlling the mixer and review for conflicts with other scheduled maintenance.
- Expedite parts deliveries.
- Physically inventory all required parts.
- Spot check dimensions on fabricated, long delivery and one of a kind parts.

5.0 PERFORMANCE

a. Closely monitor early days of project.
- Is project properly manned?
- Does contractor have adequate supervision?
- Does contractor have proper tools and equipment?
- Does contractor have enough tools and equipment?
- Are plant safety procedures being followed?
- Is housekeeping being maintained?
- Are the project sequence and schedule being followed?

b. Ask technical questions.
- If a contractor looks like he doesn't know what he's doing, he probably doesn't.

c. Observe.
- Weld rod storage.
- Preheat and post heat procedures.
- Location of ground cable connections.
- Weld deposition quality.
- Bearing cleaning and assembly.
- Machine surface cleaning and deburring.
- Bolt torquing
- All alignments. Readings on a scrap of paper are often found to be incorrect.

d. Develop punch list – Review daily.
- Develop a list of items required for the project to be completed. Furnish contractor with a copy of the list to insure all items are known and complete before his exit. Include all required items to complete repairs as well as site clean up, scrap removal, and paperwork items required.

A written project plan and adherence to the plan will result in a high quality on time repair.

INSPECTION UPON ARRIVAL OF PARTS

As soon as the equipment arrives at the plant, it should be carefully inspected to determine any shortage or damage, checking each item with the shipping manifest. Should any shortage or damage be found, it should be immediately called to the attention of the local freight agent of the carrier over which the shipment arrived and proper notation be made by him on the freight bill. This will prevent any controversy when claim is made to the carrier and will facilitate prompt and satisfactory adjustment.

The A-C Equipment Services machinery is painted, and exposed machined surfaces covered with suitable protective coating before shipment was made. Look for signs of damage to these coatings and for scuffing or abrading of the protected surfaces. Parts that were supported on machined surfaces for shipment should be removed from blocking or cradles. Inspect the areas that had been in contact and apply additional protective coatings, if necessary.

PROTECTION FOR NEW AND USED EQUIPMENT

Apply protective coatings wherever necessary. Machined surfaces can be coated with a semi-hard film, rust preventative coating. Acceptable coatings are as follows:

Tectyl 506 - Valvoline Oil Company
Nox Rust 369 - Daubert Chemical Company
Rust Veto 342- E. F. Houghton Company
Cortec VC1-389 - Cortec Corp.

Where the part is to be stored inside and for relatively short periods of time, a lighter oil film rust preventative can be used as follows:

Tectyl 511 M - Valvoline Oil Company
Nox Rust X211 - Daubert Chemical Company
Rust Veto 4214 - E. F. Houghton Company
Cortec VC1-388 - Cortec Corp.

Painted surfaces are to be touched up with original paint or similar paint which will be compatible with the final finish to be used. Unpainted castings should be covered to protect them from direct contact with the elements.

STORAGE OF PARTS

The storage site selected should be on high ground with good drainage and free from standing water and mud. Parts to be stored should be positioned or covered to avoid collection of water which may damage the equipment due to corrosion or freezing.

Provide adequate supervision when unloading parts and when loading for movement prior to installation.

Place machinery parts on cradles, timbers or rails off the ground in a place separated from plant traffic to avoid damage. Block adequately to avoid bending, bowing or sagging of large or non-uniform pieces.

Equipment having machined parts should be covered with tarpaulins or polyethylene sheeting and placed on a suitable vapor barrier.

Special attention should be given to machined surfaces that could be damaged during shipping and handling.

The parts in storage should be inspected periodically for corrosion, especially at contact points of support, cleaned and reprotected, as necessary. The frequency of inspection will be dependent upon the climatic conditions.

Assembled machined components, electrical motors, electrical equipment and items shipped in bulk or cartons such as small castings, bolts, nuts, weld rod, refractories, etc., should be stored inside. The inside storage area should be dry and preferably heated.

Gear reducers and components having assembled anti-friction bearings should be rotated periodically while in storage.

Oil lubricated enclosed bearings and gear reducers should be protected with a vapor emitting rust preventative oil such as Nox-Rust Motorstor #10 (formerly known as Nucle Oil) made by the Daubert Chemical Company. Always follow manufacturer's instruction on use of rust preventative products. All openings should be sealed off tightly to keep the rust preventing vapor from escaping. Remove breathers and plug holes.

Caution: Vapor emitting rust preventative oils may be incompatible with certain nonferrous metals, such as copper, brass, bronze, cadmium, lead, etc., when used undiluted. Follow manufacturer's instructions.

FIELD LIFTING AND HANDLING OF MACHINERY AND EQUIPMENT

The unloading and handling of heavy machinery should be supervised by experienced personnel. Primary considerations are the safety of those working near the machine and the avoidance of damage to the machine itself.

Overhead cranes, derricks or mobile boom rigs are the best means of lifting heavy machinery. Where they are not available, it is necessary to move the machine by such means as jacks, pinch bars and rollers. To avoid strains on any part of the machine, the weight must be evenly distributed over as many points as possible.

Prior to arrival of equipment at the jobsite, lifting and handling should be planned, to assure that properly rated equipment such as cranes, cables, chains and hooks are available and in good condition. This planning will provide maximum human safety, minimum equipment damage during erection and optimum erection procedures and time. Lifting arms or booms, chains, cables, and hooks should be periodically checked for condition and load tested. Approved general lifting practices should be followed at all times.

Skids used in shipping are generally safe for normal handling in field erection, but should be carefully inspected before being depended on to support materials or equipment. It may be necessary to build a skid of heavy timber and place the machinery on it for moving.

It is very important that the lifting lugs which are furnished be used to lift only the part which has the lifting lug attached to it (i.e., the lifting lug on the bearing end cover is for lifting the cover only, the lifting lugs on gear guard sections are to be used to lift one section of guard only).

The installation drawings and general drawings should be reviewed to determine any specific lifting and handling instructions which may apply to the components or sub-assemblies.

In some instances tapped holes are provided for eye-bolts which are to be used for lifting. In all such cases shoulder eye-bolts must be used.

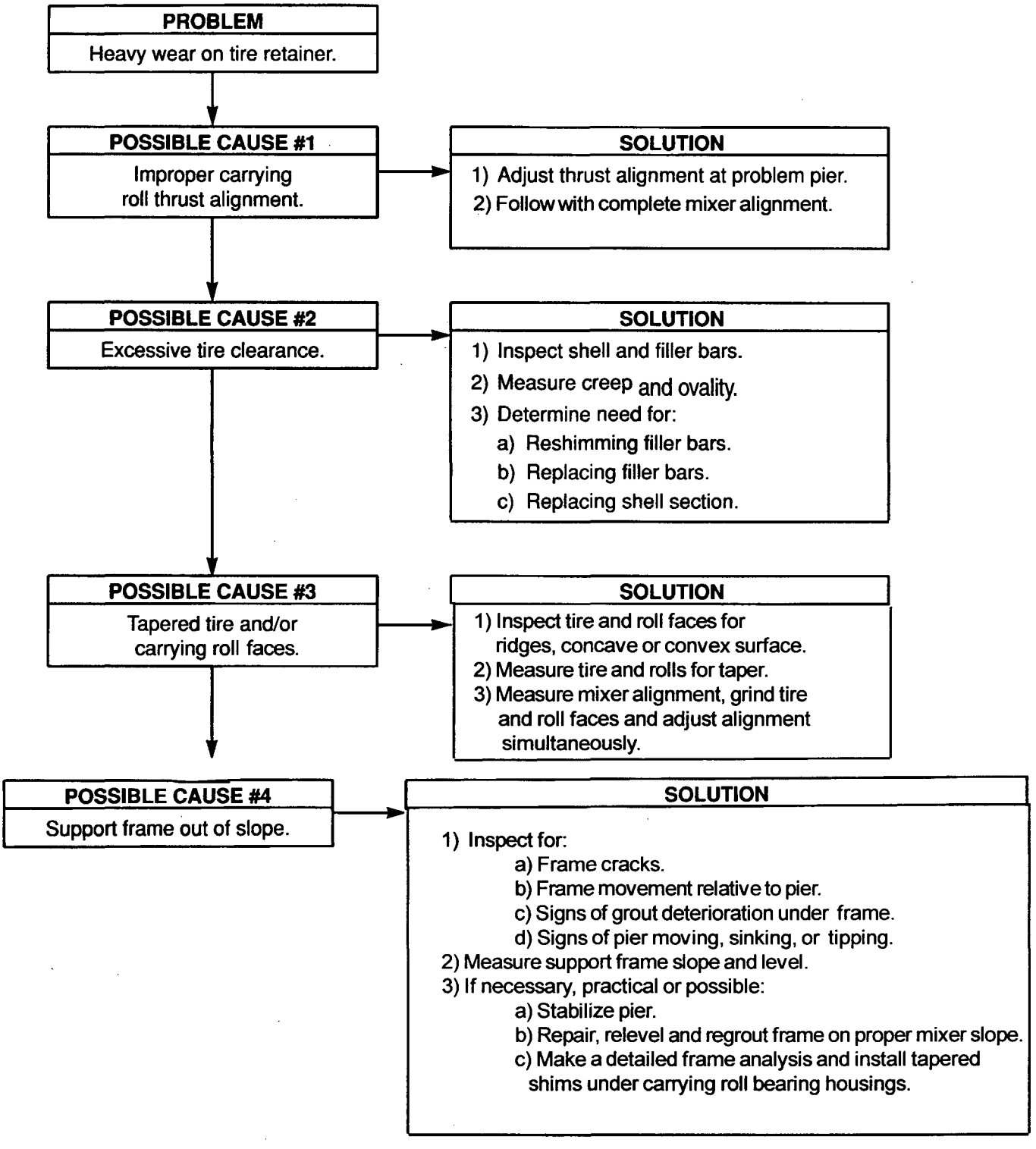
TROUBLESHOOTING

Problem	Cause	Solution
Filler bar chunking or slugging.	1) Embedded contaminants. 2) Plate laminar tearing.	Lubricate tire inside diameter with graphite/water slurry. No oil.
Tire /roll face scaling.	Lack of graphite lubricant.	1) Graphite lube block needs replacing or cleaning. 2) Lube block not moving freely in holder.
Insufficient tire/roll face contact.	1) Mixer misalignment. 2) Tapered or out of round tire or roll faces. 3) Support frame or pier problems.	1) Complete check of horizontal, vertical and thrust alignment. 2) Regrind tire and roll faces. 3) See Tire Retainer Wear possible cause #4, pg. 29.
Thrust roll lifting out of bearing	Roll positioned toward the uprunning side of the mixer centerline.	Position thrust roll 1/4" off mixer centerline toward the downrunning side of the mixer.
Thrust roll face spalling or bearing. hot.	1) Improper thrust adjustment. 2) Mixer shell dogleg (bend) causing changes in thrust. 3) Low oil level. 4) Contamination/wear.	1) Check and adjust carrying roller thrust alignment. 2) Measure shell ovality/run-out to determine extent of problem. 3) Refill oil to correct level. 4) Disassemble, clean and inspect at shutdown.
Carrying roll oil seals leaking.	1) Contamination in seal area. 2) Seal worn or damaged. 3) Shaft worn in seal area.	1) Maintain a clean shaft in area between roller side face and bearing housing. 2) Replace seal. 3) Rebuild and remachine shaft or replace shaft.
Coupling grids/teeth worn, dry and coated with powdery residue.	1) Oil separated from carrier in grease. 2) Coupling misalignment.	1) Relube with grease formulated especially for couplings. 2) Realign coupling. Misalignment should be no more than 25% of coupling manufacturer's recommended maximum misalignment.

TROUBLESHOOTING (CONTINUED)

Problem	Cause	Solution
Large swings in drive motor amps and mixer R.P.H.	1) Uneven buildup in mixer.	1) Requires correction in one of the following areas: a) Operating parameters. b) Raw mix composition.
	2) Shell dogleg (bend).	2) Take shell ovality measurement to locate dogleg. Measure shell run-out in effected area to determine extent of problem.
	3) Mixer misalignment.	3) Check horizontal and vertical alignment.
Excessive wear and/or leakage at feed end seal.	1) Mixer shell run-out.	1) Measure shell run-out at seal. Determine need for: a) Shell replacement or realignment. b) Installation of alternative design seal. c) Modification of sealing surface to correct run-out condition.
	2) Seal component wear.	2) Replace components as needed to renew seal effectiveness.
	3) Seal lubrication.	3) Lubricate seal rollers and check for proper movement.
	4) Seal counterweight.	4) Check counterweight for freedom of movement. Check for proper amount of weight.

TROUBLESHOOTING



TROUBLESHOOTING

PROBLEM

Vibrating or jerky rotational motion of mixer shell.

POSSIBLE CAUSE #1

Improper gear mesh.

REASONS AND REPAIRS FOR IMPROPER GEAR MESH

Loose flange bolts.
a) Check gear run-out.
b) Retorque bolts.

→ **Check for gear flange weld cracks.**
a) Repair as required.

Broken spring plate welds.
a) Repair welds.
b) Check gear run-out.

→ **Inspect spring plate pins and bushings.**
a) Replace with oversized pins if required.

Worn gear/pinion.
a) Reverse or replace gear set.
b) Clean, inspect and measure clearance of pinion bearings.
c) Do a complete axial and radial gear alignment.
d) Align pinion and coupling to new equipment standards.

Trunnion and roller wear.
a) Check mixer horizontal and vertical alignment.
b) Make roller adjustments to correct gear/pinion pitch line relationship (gear mesh).

Shell dogleg (bend).
a) Take shell ovality measurements to identify dogleg condition.
b) Take shell run-out measurement to determine extent of repair required.

Distorted shell in gear area.
a) Replace shell under gear.

TROUBLESHOOTING

PROBLEM

Hot Carrying Roll Bearing.

STEPS TO REDUCE BEARING TEMPERATURE, ESTABLISH LUBRICATION AND MAINTAIN OPERATION.

Check cooling water flow and discharge temperature.

1) Establish sufficient flow.
2) Determine effectiveness of heat transfer. (Is discharge water hot?)
3) Clean water jackets, if necessary.

Check lubricant specification and level.

1) Full to proper level with correct viscosity lubricant.

Check lubricant supply to oiling pan.

If oiling buckets are not working:
1) Flood shaft with lubricant.
2) Install circulating pump or drip cup.
3) Identify cause of lubricant loss and repair at shut down.

Check carrying roller thrust direction.

1) Reduce carrying roll load.
2) Correct thrust adjustment.
3) Apply oil or grease to carrying roller face to reduce thrusting, in emergency situations only.
4) Carefully monitor effect on overall mixer thrust.

If the bearing temperature does not improve, the following suggestions may be useful. The use of these items should be based on plant experience or done with close supervision of a specialist.

Install temporary lubricant circulation pump and heat exchanger to reduce lubricant temperatures.

Move carrying roll (both bearings) away from mixer centerline to reduce the bearing load. Move each bearing in increments of .010" with maximum total movement of .500".

CAUTION: ROLLERS SHOULD NOT BE MOVED OUTWARD ON DRIVE PIER UNLESS GEAR MESH, I.E., ROOT CLEARANGE, HAS BEEN CHECKED.

TROUBLESHOOTING

Hot Carrying Roll Bearing (continued)

Improve lubricant viscosity. Some commonly used methods include:

1) Change to a synthetic lubricant and/or a heavier lubricant.
2) Addition of viscosity improving additive.
3) 50-50 mixture of bearing lube and gear lube.
4) Application of EP2 grease to shaft.

Actual method employed should be determined by plant experience or under the supervision of a specialist.

Apply water cooling to carrying roller, carrying roller shaft, and bearing housing. Care must be taken to cool cast bearing housings gradually and to avoid water contamination of the lubricant. These procedures should be done according to plant experience or under the supervision of a specialist.

If bearing has stabilized and mixer is running:

1) Monitor temperature closely for several weeks or until next shutdown.
2) Check horizontal, vertical and thrust alignment.
   a) If hot bearing was new, check support frame for slope and level.

If mixer is shut down for hot bearing:

1) Check bearing clearance.
2) Check lubricant feed in groove, oiling buckets, oil pan, and bearing housing sump for contamination or buildup.
3) Check shaft and thrust plate or thrust ring condition.
4) Check support frame for slope and level.
5) Check vertical, horizontal and thrust alignment.
6) Change bearings in pairs to maintain equal bearing cross section and promote full contact maximizing the effectiveness of the oil film.

Section 3 – Lubrication Information

Synthetic

Mobil Product Data Sheet

Mobilgear® SHC® Series Oils

Synthetic Extra-Heavy-Duty Gear Lubricants

Description

Mobilgear SHC Series Oils are formulated from PAO synthetic base stocks. These base stocks have exceptional oxidation and thermal properties, naturally high viscosity index, and excellent low-temperature fluidity. Proper additive selection provides foam control, extreme-pressure properties, increased oxidation stability, and protection against rust and corrosion. The base stocks have inherently low traction properties, resulting in reduced fluid friction in the load zone of non-conforming surfaces such as gears and rolling element bearings. The reduction of fluid friction produces lower oil operating temperatures and improved gear efficiency.

Application

Mobilgear SHC Series extra-heavy-duty gear lubricants are recommended for all kinds of enclosed gearing as well as plain and rolling element bearings. Due to the high oil viscosities in this series, elasto-hydrodynamic principals must be applied when selecting the correct fluid. Generally, these gear oils are ideal for heavily loaded, low-speed gears and bearings where boundary lubrication conditions may prevail. They may be used for certain open gear applications, but special engineering consideration may be required to select the most effective method of application. Mobilgear SHC 6800 is exclusively endorsed by EMD for use in DC Traction Motor Drives.

For use in DC traction motor drives, General Electric has given exclusive approval of Mobilgear SHC 6800 against GE Spec D50E25B and Mobilgear SHC 3200 against GE Spec D50E25C.

Benefits

- Extended oil life
- High temperature, high load, slow speed applications
- Can replace grease in some applications due to high viscosity

Typical Characteristics

Physical properties are listed in the table. Those not shown as minimum are typical and may vary slightly.

	Mobilgear SHC			
	1000	1500	3200	6800
Product Number	61094-9	61096-4	61098-0	61093-1
Gravity, API	31.1	29.0	27.5	26.6
Specific Gravity at 20°C, ASTM D 1298	0.871	0.883	0.888	0.897
Pour Point, °C (°F), ASTM D 97	-31 (-24)	-26 (-15)	-20 (-4)	-15 (+5)
Flash Point, °C (°F), ASTM D 92	220 (428)	220 (428)	220 (428)	220 (428)
Viscosity, ASTM D 445				
cSt at 40°C	947.3	1387	3023	8031
cSt at 100°C	80	102	171	357
SUS at 100°F	4500	6775	14,000	36,250
SUS at 210°F	370	475	780	1600
Viscosity Index, ASTM D 2270	160	160	160	180
ISO VG	1000	1500	3200	6800
Color, ASTM D 1500	0.5	0.5	0.5	0.5
Rust Protection, ASTM D 665	Pass	Pass	Pass	Pass
Copper Corrosion, ASTM D 130	1A/1B	1A/1B	1A/1B	1A/1B
Timken OK Load, lb	65	65	65	65
FZG Rating, Fail Stage	13+	13+	13+	13+
Four-Ball EP Test, ASTM D 2783				
Weld Load, kg	250	250	250	250
Load Wear Index	48	48	48	48
Four-Ball Wear Test, ASTM D 2266				
20 kg at 60°C, 1800 rpm, 1 hr				
Scar Diam, mm	0.30	0.30	0.30	0.30

Health and Safety

Based on available toxicological information, it has been determined that these products pose no significant health risk when used and handled properly. Information on use and handling, as well as health and safety information, can be found in the Material Safety Data Sheets which can be obtained from your local distributor; via the Internet on http://www.mobil.com; or by calling 1-800-662-4525 and selecting prompt 2.

For additional technical information or to identify the nearest U.S. Mobil supply source, call 1-800-662-4525.

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Mobilgear SHC Series Oils
PDS I-84 6196098 (12-02-96)

Synthetic

Mobil Product Data Sheet

Mobil SHC® 600 Series

Bearing and Gear Lubricants

Description

Mobil SHC 600 Series oils are formulated using Mobil's synthesized hydrocarbon fluid (SHF) base oil technology and additives that enhance oxidation stability and provide protection against rust, corrosion, and wear. SHF base oils provide better thermal and oxidation stability than conventional mineral oils. Mobil SHC 600 Series oils have naturally high viscosity indexes compared to mineral oils, providing lower viscosity at lower temperatures and higher viscosity at higher temperatures. The SHF base oils also protect against the loss of viscosity as a result of mechanical shearing, even in heavily loaded gear applications.

The low traction coefficient and high viscosity index of the Mobil SHC 600 Series combine to reduce power consumption substantially. Lower operating temperatures of component parts mean that friction has been reduced and, therefore, less power is consumed. This results in extended parts life and allows for more economical equipment design and extended lubricant life.

Application

The Mobil SHC 600 Series are recommended for industrial bearings and gears over the widest range of operating temperatures. They are particularly effective where high oil temperatures result in short oil life or high maintenance costs for parts replacement, system cleaning, and lubricant changes.

These wax-free, high-viscosity-index oils also provide unequalled lubrication of bearings and gears in severe low-temperature applications. The Mobil SHC 600 Series are compatible with the following seal materials: fluorocarbon, polyacrylate, polyurethane ether, silicone, ethylene/acrylic, chlorinated polyethylene, polysulfide, and some Buna N. There is the potential for substantial variations in the elastomers being used today. For best results, consult your equipment supplier, seal supplier, or your local Mobil representative to verify compatibilities.

When changing to the Mobil SHC 600 Series, the system should be cleaned and flushed thoroughly to achieve the maximum performance benefits of the product.

Typical Characteristics

Physical characteristics are listed in the table. Those not shown as maximum or minimum are typical and may vary slightly.

	Mobil SHC								
	624	626	627	629	630	632	634	636	639
Product Number	60292-0	60293-8	60301-9	60294-6	60295-3	60298-7	60291-2	60299-5	60290-4
ISO Viscosity Grade	32	68	100	150	220	320	460	680	1000
Specific Gravity	0.849	0.858	0.861	0.866	0.864	0.861	0.849	0.858	0.861
Gravity, API	35.2	33.4	32.8	31.9	32.3	32.8	35.2	33.4	32.8
Pour Point, °C (°F) max	-54 (-65)	-54 (-65)	-45 (-49)	-45 (-49)	-45 (-49)	-42 (-44)	-37 (-35)	-34 (-29)	-28 (-18)
Flash Point, °C (°F) min	240 (464)	245 (473)	245 (473)	245 (473)	250 (482)	250 (482)	250 (482)	250 (482)	250 (482)
Viscosity									
cSt at 40°C	30.7	65.2	95.0	141.4	217.7	298.2	430.3	650.6	956.7
cSt at 100°C	5.9	10.4	13.8	18.6	25.9	33.1	44.5	62.1	77.6
Viscosity Index	136	147	148	150	152	154	158	165	158
Copper Corrosion 24 Hrs at 212°F, ASTM D 130	1B	1B	1B	1B	1B	1B	1B	1B	1B
Rust Distilled Water ASTM D 665A	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
FZG Spur Gear Test, Typical Fail Stage	9	11	11	12	12	12+	12+	12+	12+
Color, ASTM D 1500, Max	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Advantages

Mobil SHC 600 Series will provide the following advantages over mineral oils:

- Better high-temperature oxidation stability
- Improved low-temperature fluidity
- Lower operating temperatures
- Extended lubricant life
- Reduced power consumption

Health and Safety

Based on available toxicological information, it has been determined that these products pose no significant health risk when used and handled properly. Information on use and handling, as well as health and safety information, can be found in the Material Safety Data Sheets which can be obtained from your local distributor; via the Internet on http://www.mobil.com; or by calling 1-800-662-4525 and selecting prompt 2.

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Mobil SHC 600 Series
PDS I-53 6097030 (02-10-97)

Synthetic

Mobil Product Data Sheet

Mobilith® SHC® 220, 460, 007, 1500

Synthetic Greases

Description

Mobilith SHC 220, 460, 007, and 1500 are high-performance, extreme-pressure greases which combine a synthetic base fluid with a lithium complex soap thickener. The thickener system provides a high dropping point, excellent resistance to water wash, and a tenacious structural stability. The unique physical properties of the synthetic base oil, combined with selective additives, provide outstanding protection against wear, rust, corrosion, and high-temperature degradation. The wax-free feature of the synthetic base oil allows for low-temperature mobility/pumpability and very low starting and running torque values. Also, the traction property of the synthetic base fluid in these greases is considerably lower than mineral oil, allowing for temperature reductions in the load zone of rolling element bearings.

Application

Mobilith SHC 220 is recommended for automotive and industrial applications which need a lubricant that can perform normal functions yet go far beyond in terms of high and low temperatures and long-life performance. It is an NLGI Grade 2 grease having the cold-temperature pumping resistance of most NLGI Grade 0 greases. It is a true wide-temperature, multi-service grease.

Mobilith SHC 460, an NLGI Grade 1 1/2 grease, is recommended for industrial and automotive applications at both high and low temperatures. It will provide outstanding bearing protection under heavy loads at low to moderately high speeds, and where water is a factor. Mobilith SHC 460 has performed extremely well in steel mill and paper mill applications. It also has proven an exceptional severe-service automotive chassis grease.

	Mobilith SHC			
	220	460	007	1500
Product Number	64402-1	64355-1	64356-9	64403-9
NLGI Grade	2	1 1/2	00	1
Soap Type	Lithium Complex	Lithium Complex	Lithium Complex	Lithium Complex
Structure, Visual	Smooth; Slight Tack	Smooth; Slight Tack	Smooth; Tacky	Smooth; Tacky
Color, Visual	Red	Red	Red	Red
Penetration, Worked, ASTM D 217 x 60 strokes	280	305	415	325
x 10,000 strokes	295	322	420	335
x 100,000 strokes	305	334	420	340
Dropping Point, ASTM D 2265, °C (°F)	246 (475)	246 (475)	N/A	246 (475)
Viscosity of Oil, ASTM D 445, cSt at 40°C	220	460	460	1500
cSt at 100°C	23.8	46.5	46.5	110
SUS at 100°F	1100	2400	2400	8000
SUS at 210°F	114	215	215	510
ISO VG	220	460	460	1500
EP and Wear Protection				
Four-Ball Wear Test, ASTM D 2266, Scar dia., mm, max	0.65	0.80	0.70	0.77
Four-Ball EP Weld Load, ASTM D 2596, kg	250	250	250	250
Load Wear Index	45	49	45	50
Corrosion Prevention, ASTM D 1743, Rust Test	Pass	Pass	Pass	Pass
Emcor/SKF Water Wash Test, IP 220 modified	0, 0	0, 0	0, 0	0, 0
Water Washout, ASTM D 1264, 79°C (175°F), wt %	4	3	–	2
US Steel Mobility, g/min, 18°C (64.4°F)	6	5	27	4
Bomb Oxidation, ASTM D 942, psi loss, 100 hr, 210°F	2	2	2	2
500 hr, 210°F	4	4	4	4
NLGI LB - GC	Pass	—	—	—
FAG FE8 - J Cond. 1	—	Pass	N.A.	—
FE8 - K Cond. 2	—	—	N.A.	Pass

Mobilith SHC 007 provides the lubricating qualities of Mobilith SHC 460 in an NLGI Grade 00. Its primary use is for leaky gearcases subjected to high temperatures where conventional semifluid greases will not provide reasonable life. Mobilith SHC 007 has also proven very effective in minimizing leakage in over-the-road truck trailer bearings.

Mobilith SHC 1500 is an NLGI Grade 1 grease with an exceptionally high viscosity synthetic base oil. It is intended for plain and rolling element bearings operating at extremely slow speeds, under heavy loads and high temperatures.

Typical Characteristics

Physical characteristics are listed in the table. Those not shown as maximum are typical and may vary slightly.

Advantages

Mobilith SHC 220, 460, 007, and 1500 synthetic greases provide the following advantages when compared with mineral-oil greases intended for similar service:

- Operating range of -40°C (-40°F) to +177°C (+350°F)
- Excellent resistance to rust, corrosion, and oxidation
- Outstanding structural stability in the presence of water
- Excellent wear protection under heavy loads and high temperatures
- Power-saving capabilities
- Extended relubrication intervals
- Low volatility

Health and Safety

Based on available toxicological information, it has been determined that this product poses no significant health risk when used and handled properly. Information on use and handling, as well as health and safety information, can be found in the Material Safety Data Sheet which can be obtained from your local distributor; via the Internet on http://www.mobil.com; or by calling 1-800-662-4525 and selecting prompt 2.

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INTRODUCTION

The instructions contained in this manual provide guidelines and recommendations for effective lubrication of general purpose parallel shaft gearing. It is essential to determine in advance of actual gear operation what grade of lubricant, quantity, and method of application are proper and adequate for the operating conditions of the particular application. The lubrication, inspection, and maintenance instructions given here are the result of Falk's many years of experience.

SCOPE AND LIMITATIONS—This lubrication data is limited to properly proportioned parallel shaft gears, where the pitch line speed does not exceed 3000 feet per minute, and where the associated bearings are lubricated separately. Consequently, it does not cover self-contained speed reducer drives or any gear applications where the bearings are included in a common lubrication system. It is specifically confined to fully enclosed gear applications (Hoists and Pumps), semi-enclosed gear applications (Ball Mills, Rod Mills, Kilns, Dryers), or other gears operating under similar conditions.

While this type of gearing has been described as "open gearing," implying usage without enclosures, most applications are actually enclosed. Therefore, the term "general gearing" rather than "open gearing" is used in this manual.

ALIGNMENT—Refer to Service Manual 638-110 for trunnion supported equipment.

CLEANING—Before installing the gear enclosure or guard, careful attention should be given to thorough cleaning of all surfaces of the gear, pinion and gear enclosure (when used) to remove all dirt which may have accumulated in transit or storage. Inspect gear set and remove all burrs and bumps which may have occurred in handling. This precaution will provide clean tooth surfaces and prevent contamination of lubricant.

LUBRICATION

General gearing, furnished by the gear manufacturer as individual machine parts, is usually mounted on bearings and within enclosures designed and furnished by the builder of the driven equipment. The nature of the application, the design of the gear enclosure and shaft seals, and the ambient conditions surrounding the installation determine the method of lubrication.

For semi-enclosed gear applications, it is well advised to pressurize the gear guard with clean dry air whenever an abrasive atmosphere is present. This aids in preventing abrasive particles from mixing with the lubricant which can result in significantly increasing the life of the gear set.

The various methods of lubrication are grouped into types as described below. Further details and information pertinent to the driven equipment can be obtained from the supplier.

CONTINUOUS METHODS—These methods of lubrication provide a continuous supply of FLUID OIL to the meshing gear teeth and therefore are not dependent upon a separate system for application. The lubricant is drawn from the reservoir or sump and delivered to the gear mesh either by the partially submerged rotating gear or idler, or by a direct connected or electrically driven oil pump. The methods are generally known as: "splash," "idler immersion" or "pressure." The nature of the application, and the speed and gear arrangement usually determine the most suitable method. The gearing must be fully enclosed and the shafts adequately sealed to prevent oil leakage or contamination of the lubricant.

Typical applications using continuous lubrication methods are Pumps, Hoists, Kilns or similar drives.

INTERMITTENT METHODS—As the name implies, the intermittent methods of lubrication are those in which the lubricant is applied to the working side of the gear teeth at predetermined intervals of time. Systems are available that apply lubricant to the pinion, however, applying lubricant to the gear is preferred to properly flush the gear tooth surface of contaminents. Therefore, an adequate film of lubricant must be maintained on the surfaces of the teeth for the full time interval between applications. The method generally used to apply the lubricant is by "automatic spray."

The "automatic spray" method employs controls for timing the application of lubricant. It is important that the application cycle be carefully controlled to assure adequate lubrication of the teeth.

This method is usually employed on gear applications where it is impractical or difficult to provide oil tight gear enclosures and where it is impossible to prevent abrasive or foreign material from contaminating the lubricant. However, this can be minimized greatly if the gear guard is pressurized properly.

Typical applications using intermittent methods are Autogenous Mills, Semi-Autogenous Mills, Ball Mills, Rod Mills, Kilns, or similar drives.

RECOMMENDED GEAR LUBRICANTS

The selection of the most suitable lubricant for the application depends primarily on the method of application and the ambient conditions. Therefore, specific recommendations are provided for the two basic methods: Continuous and Intermittent. General information on lubrication and lubricants which applies to both methods is given below.

The viscosity of a lubricant is a measure of its resistance to flow. It is generally specified in Saybolt Seconds Universal (SSU). However, there has been some interest in changing to the international standard (ISO-VG). These numbers correspond to a kinimatic viscosity which is measured in centistokes (cSt). For the heavier grades of lubricant, viscosity is sometimes expressed in Saybolt Seconds Furol (SSF) and these values are approximately 1/10 of the SSU viscosity values for a given lubricant.

Viscosity of a lubricant increases (lubricant thickens—becomes less fluid) when the temperature decreases. With an increase in temperature, the viscosity decreases (lubricant thins out—becomes more fluid). These changes in viscosity with temperature require that careful consideration be given to the selection of lubricants in order to obtain the fluidity required for a given method of application at low temperatures and to provide a lubricant of sufficient viscosity and film thickness at the higher operating temperatures.

Viscosity values are a direct index of fluidity, and are used rather than trade names to specify the gear lubricant recommendations given in this manual. AGMA and ISO-VG grade numbers are used for the less viscous lubricants.

The correct grade and type of high quality lubricant is selected on the basis of viscosity for each method of lubrication. Lubricant suppliers should be consulted for the brand or trade name of the lubricant to suit the type and viscosity range.

NOTE: Consult your local Falk Representative for use of lubricants not listed in this manual.

CONTINUOUS METHODS—Continuous methods require that the lubricant remain fluid at the ambient temperature to provide proper lubrication at the start of operation of the gear drive.

Extreme pressure lubricants referred to in this manual do not contain any diluents.

Continued next page

Table 1 VISCOSITIES FOR CONTINUOUS METHODS

Ambient Temperature Range Inside of Guard	Tooth Temperature •	AGMA GRADE NO. — (ISO-VG)		
		Pressure † & Splash Lubrication PLV♦ up to 3000 FPM‡		Idler Immersion
		New Set Min.	Polished Set Min.	PLV♦ Up to 300 FPM
+15°F to +60°F (−9°C to +16°C)	70°F (21°C)	2, 2EP (68)	2, 2EP (68)	8A, 8AEP (1000)
	100°F (38°C)	5, 5EP (200)	3, 3EP (100)	9, 9EP (1500)
+50°F to +125°F (+10°C to +52°C)	130°F (54°C)	7, 7EP (460)	5, 5EP (200)	11, 11EP (4200-5000)
	160°F (71°C)	9, 9EP (1500)	8, 8EP (680)	12, 12EP (6200-7500)

† At lower ambient temperatures, pressure lubrication systems must be equipped with suitable heating units for proper circulation of lubricant. Check with lubricant and pump suppliers.
‡ If PLV exceeds 2000 FPM, 6, 6EP is the max. required.
♦ Pitch line velocity in Ft/Min. = .262 x RPM x pitch diameter in inches.
• Pinion tooth operating temperature measured at pitch line, center of face.

The quantity of lubricant required for continuous methods depends upon the size of the oil reservoir, the lubrication system used, and the location of the oil level as specified by the manufacturer of the gear enclosure. Therefore, quantities cannot be specified in this manual.

The AGMA Grade No. for lubricants applied with continuous methods is shown in Table 1, Page 1.

INTERMITTENT METHODS—Intermittent methods require lubricants which will adhere to the gear teeth at pitch line peripheral speeds up to 1200 ft/min. They must provide a film that will resist being rubbed or squeezed off the tooth profiles during the full interval of time between applications. In general, heavy residual compounds with solvent have been found to provide these characteristics.

Residual compounds as referred to in this bulletin have an asphaltic base and may include extreme pressure additives for extra film strength. Many lubricant suppliers add diluents to these compounds so that they can be applied through lubricant feeders and spray nozzles used for intermittent lubrication.

Minimum allowable viscosity of residual compounds with diluent at 210°F (99°C) is approximately 400SSU.

Experience has shown that compounds with a Timken film strength of 33 lbs. as measured by the United States Steel Retention Test Method have proven to be satisfactory. The lubricant samples to be tested should include diluent in the same proportions as found in the drums which are supplied to the end users.

The lubricant must not be allowed to build up and harden in the tooth roots of the meshing elements.

When necessary, the bulk lubricant and lube lines should be heated, and thermostatically controlled to maintain the pumpability and proper delivery to the gear mesh.

The viscosity of lubricants for the intermittent methods of lubrication is shown in Table 2.

Table 2 VISCOSITIES FOR INTERMITTENT METHODS†

Ambient Temperature	Viscosity (SSU) at 210°F (99°C) Mechanical Spray Systems Without Diluents
+15°F to +60°F (−9°C to +16°C)	3000- 7000
+50°F to +125°F (+10°C to +52°C)	5000-10,000

† Diluents must be used to facilitate flow through applicators.

QUANTITIES OF LUBRICANT—The quantity of lubricant required for a given application depends on the size of the gear, operating speed and the type of intermittent method of lubrication used. However, best results are usually obtained by the application of small quantities of lubricant at frequent intervals rather than larger quantities at prolonged intervals.

Typical values for quantities of lubricant and frequency of application have been established from test results and field performance and are listed in Table 3. Actual operation on a given application may necessitate some modification. For a difference in gear proportions from those shown, the quantities of lubricant can be obtained by interpolation.

Table 3 RECOMMENDED QUANTITIES OF LUBRICANT

Gear Diameter in Feet	Automatic Spray System Application in Ounces				
	Face Width in Inches				
	8	16	24	32	40
10	.2	.3	.4	.5	.6
12	.3	.3	.4	.5	.6
14	.3	.4	.5	.6	.7
16	.4	.5	.6	.7	.8
18	.5	.6	.7	.8	.9
20	.6	.7	.8	.9	1.0
22	.7	.8	.9	1.0	1.1
24	.8	.9	1.0	1.1	1.2
26	.9	1.0	1.1	1.2	1.3
28	1.0	1.1	1.2	1.3	1.4
30	1.1	1.2	1.3	1.4	1.5
34	1.3	1.4	1.5	1.6	1.7

NOTE: The spraying time should be equal to the time for 1 and preferably 2 revolutions of the gear to insure complete coverage.

Intervals between applications:
Single Pinion Drives — 20 min. (max.)
Dual Pinion Drives — 15 min. (max.)

OPERATION, MAINTENANCE & INSPECTION

Controlled operating procedures and proper maintenance are essential to satisfactory gear performance. It is recommended that an accurate running record is maintained showing the length of operation, condition of the teeth, dates of inspection and lubricant application. Important instructions concerning the operation and maintenance of gears and gear drives are listed below.

START-UP PREPARATION—Prior to actual operation, check all lubrication requirements. For the continuous methods of lubrication, see that the oil reservoir or sump is filled to the proper level. If the intermittent system is employed, cover all the teeth on the gear and pinion with lubricant before starting the drive. Where sprays are employed, check to see that they are functioning properly and that they distribute lubricant over the entire face of the gearing.

INSPECTION FOR PROPER LUBRICATION—On new or repaired jobs, make a visual inspection during the first hour of operation to be sure that the lubrication system is functioning properly. During the initial running-in period, a shut down once every hour is recommended to examine the teeth for contact and adequate film of lubricant. Strobe light inspection may assist in the examination of adequate lube film.

Check spray nozzles daily to assure proper actuation. A strobe light inspection at this time will assist to assure that a uniform spray pattern is present. Check alignment periodically using infrared alignment techniques, refer to Service Manual 638-110.

Where spray systems are being used, check air pressures and pump pressure specified by the supplier of this equipment. Make sure that all spray nozzles are open to insure a correct spray pattern and full coverage of the teeth. Where a metering valve is used for measuring the amount of lubricant to be sprayed from each nozzle, make sure that the valve is traveling its full stroke. Keep the lubricant at a uniform temperature above 60°F or higher, if required by the lubricant supplier to avoid a malfunction of the spray system in cold weather.

Once every month a more thorough inspection should be made. Wipe the lubricant off several teeth of the gear and pinion and check the condition of the teeth for evidence of misalignment, abnormal wear or insufficient lubrication. Check the lubricant for possible contamination. If contaminated, the gear and pinion should be thoroughly cleaned and fresh lubricant suppled.

Inspection of backlash, gear splits, and instructions for remounting of ring gears, refer to Service Manual 638-110 for trunnion supported equipment.

HANDLING—If it becomes necessary to dismantle the drive for any reason, care should be exercised in handling the pinion and gear to prevent damage to the teeth. When lifting with a crane, protect the teeth by placing wooden planks between the chain or cable and the ends of the gear teeth. When the gear or pinion is placed on the floor, wooden planks or blocks should be used to avoid damaging the teeth.

PINION REPLACEMENT—When installing a new pinion to mesh with a used gear, it is difficult to align the pinion to suit the wear or contact pattern on the working face of the gear teeth. Therefore, the alignment of a new pinion is usually a "cut and try" procedure.

The important steps in the installation and alignment of a replacement pinion are:

(1) Carefully inspect all the teeth on the gear for possible burrs, ridges or high spots; file or grind these below the normal tooth curvatures to eliminate high load concentration which may cause tooth surface distress, breakage or noisy operation.

(2) Align the pinion to the gear in accordance with procedures in Service Manual 638-110.

SPARE PARTS—When communicating with The Falk Corporation for spare parts, refer to the M.O. (Manufacturing Order) number stamped on the rim face of the gears and on the end of pinion shafts for proper identification of parts to be furnished.

SERVICE—More specific and detailed information on installation, alignment, lubrication and maintenance can be obtained from the builder of the driven equipment or from The Falk Corporation.

SUMTER COUNTY SOLID WASTE
LAKE PANOSOFFKEE, FL

LUBRICATION SUMMARY

4/9/02

COMPONENT	SUPPLIER	MODEL	INITIAL CHARGE (per component)	REQUIRED QTY, (per digester)	RECOMMENDED PRODUCT	SEASON
DRIVE REDUCER	FALK	525A3	96 GAL.	96 GAL.	Mobilgear 634	all
DRIVE GEARSET	FALK	01-076215	100 GAL.	100 GAL.	Mobilgear SHC 3200	all
CARRYING BEARING	A-C	18x22	4.5 GAL.	45 GAL.	Mobilgear 636	all
THRUST BEARING	A-C	12x15	3.3 GAL.	6.6 GAL.	Mobilgear 636	all
PINION BEARING	MIETHER	23148	20 lbs.	40 lbs.	Mobilith SHC 1500	all
L S COUPLING	FALK	1220T10	35 lbs.	35 lbs.	Mobilith SHC 1500	all
H.S.COUPLING	FALK	1100T10	1.0 lbs.	2.0 lbs.	Mobilith SHC 1500	all
C.B. ADJ. SCREW	A-C	4-6 UN	0.1 lbs.	0.8 lbs.	Mobilith SHC 1500	all
ROTARY COUPLING	A-C	D0309	PRE-LUBRICATED	see note	Mobilith SHC 1500	all

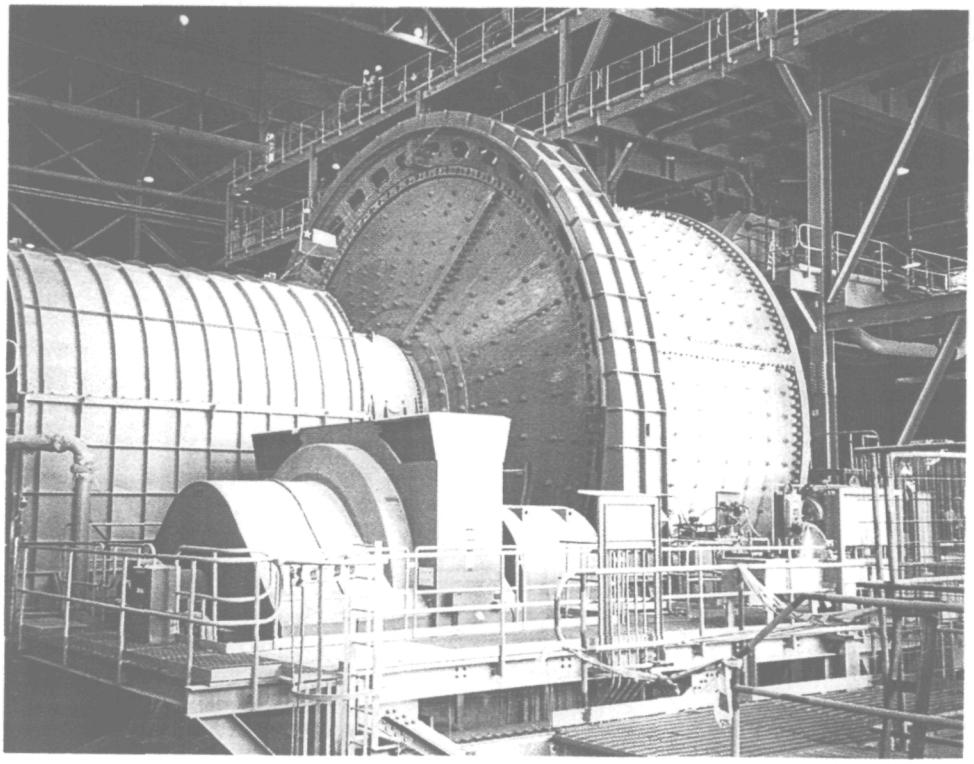
Note:

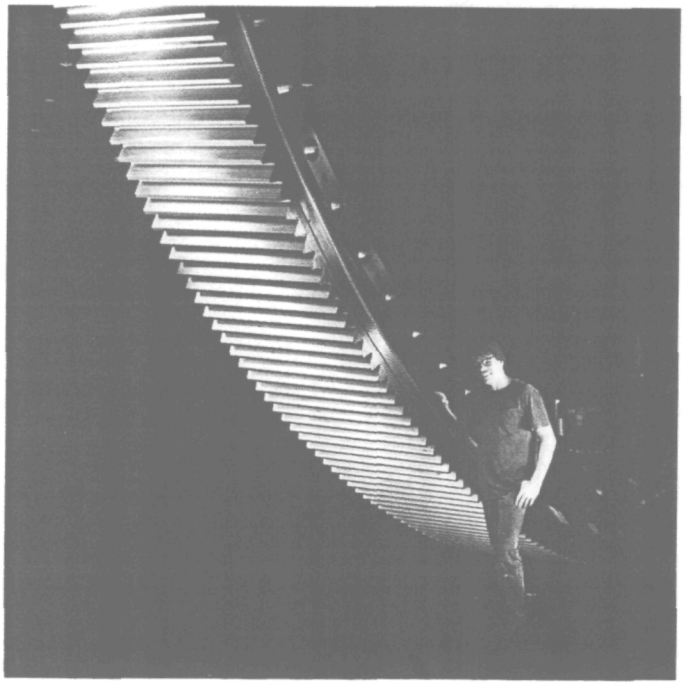
For manual lubrication apply 10 – 15 pumps per month.
For auto-lubrication select system to deliver 2 oz./week.
Check purged grease for cleanliness. If dirty, increase frequency
Check for air leakage through relief port, as grease may be purged by air seal leakage.

Section 4 – Drive Gearset Gear, Pinion, and Bearings

RING GEAR INSTALLATION

Manual





For Trunnion and Spring Mounted Ring Gears

FALK

PN - 2121224

PRICE $2.00

GENERAL INFORMATION

For long life and optimum performance, all gears must be installed properly and aligned accurately. This manual shows how to check alignment and tooth contact during the process of installing ring gears with single helical, double helical, or spur teeth. It is applicable to the installation of both flange mount and spring mount designs and 1, 2 or 4 piece designs. In addition, a section covering the installation of a new pinion with an existing ring gear is included. The steps outlined herein should be studied thoroughly by erectors and mechanics before, and during, the installation of gearing.

It should be understood that the values contained in this instruction manual are acceptable limits and that the conscientious erector will strive to improve on these values whenever possible. This will result in optimum gear performance.

All dimensions in this manual are in standard English units. Corresponding metric units are shown in parentheses after English values, where appropriate.

Personnel performing installation, procedures, and practices which are included or implied in this manual shall observe the following warnings, cautions and notes. Disregard of these warnings and precautionary information can cause serious injury or loss of life. Warnings, cautions, and notes are used to emphasize important and critical instructions and are used for the following conditions:

WARNING: *An installation procedure, practice, etc., which, if not correctly followed, could result in personal injury or loss of life.*

CAUTION: *An installation procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment. Cautions also represent crucial procedures of an installation task which must be performed as prescribed before proceeding to ensure validity of subsequent installation steps.*

NOTE: An installation procedure, condition, etc., which it is essential to highlight. Notes are designated as a Falk recommendation of a specific technique, which may aid the installer in performing an installation task.

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TOOLS FOR INSTALLATION

WRENCHES — Select wrenches to fit all bolts and nuts.

MACHINIST LEVEL — At least 12 in. (300 mm) long, 18 in. (450 mm) preferred.

THICKNESS GAUGES — With leaves ranging from 0.0015 in. to 0.200 in. (0,040 mm to 5 mm) thick.

CONTACT MARKING MEDIUM — A transferable, non-drying medium, typically an oil based dye such as Prussian blue pigment or lamp black.

DIAL INDICATORS — With 0.001 in. (0,025 mm) graduations and at least a 0.050 in. (1.25 mm) range. Be sure to use a button contact point on indicator.

INDICATOR TIP ROCKER SHOES — To be used on dial indicator tip when measuring radial runout of ring gears across the top lands of the teeth.

OUTSIDE MICROMETER — 0 in. to 1 in. (0 mm to 25 mm)

TOOL POST HOLDERS — Check positions for mounting indicators and provide tool post holders, upright spindles, and several clamps to suit. (Magnetic base indicator holders are usually easier to use.)

INDICATOR FIXTURE FOR SHELL AXIAL RUNOUT — To be located across the end of the fixed trunnion bearing at the shell axis. This will read out shell float directly. The fixture used must not be affected by elastic deformation of the shell trunnion (e.g. a rigid fixture bolted across the trunnion may buckle during rotation). This may be replaced by two dial indicators properly located on the thrust face of the trunnion bearing. Figure 1 shows a typical shell runout indicator fixture.

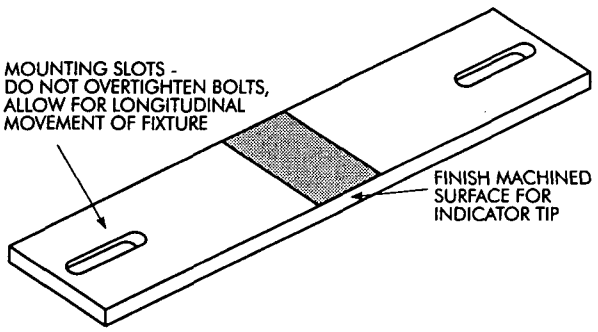

Figure 1 — INDICATOR FIXTURE FOR SHELL AXIAL RUNOUT

SHIMS — Use stainless steel shims starting at 0.003 in. (0,075 mm) thick and upward for adjusting bearing pedestals.

INFRARED THERMOMETER — Pyrometer and temperature crayons.

TORCH WITH HEATING TIP — For clearance bolt pre-stressing.

HIGH TEMPERATURE INSULATING GLOVES — Two pair

DRY LUBRICANT — Molybdenum disulfide type for installation of split hardware.

LEAD HAMMER — For installation of split hardware.

LAYOUT DYE — For dynamic check of ring gear installation.

DRILL BITS — Or a calibrated taper bar with increments from 1/8 in. to 3/8 in. (3 mm to 10 mm) to be used for taking root clearance measurements when setting a new pinion with an existing gear.

MATCH MARKS

Most Falk gears are made in two or more pieces. In these cases, the parts must be assembled with the mating surfaces in the same position as when the teeth were cut. To assure this result, it is necessary to match the identical numbers and letters stamped on one split of each gear section in line with the numbers stamped on its mating section. The location of the match marks is described in Figure 2. The match marks must be aligned for proper assembly of the gear segments. Some gears and pinions are furnished as lapped sets and must operate together. In these cases the pinion will have the same match mark as the gear. Gear identifying numbers are shown in Figure 3. This is a typical example. The sequence and location of the numbers may vary slightly.

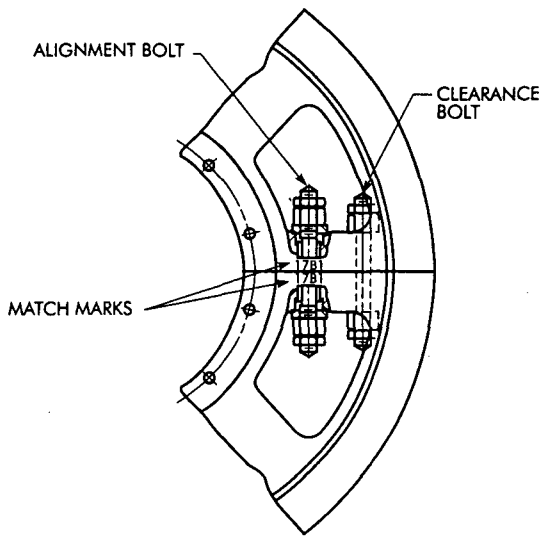

Figure 2 — IDENTIFICATION OF MATCH MARKS ON SPLIT RING GEARS

EXAMPLE: A gear manufactured on February 17, 1997, would be match marked in the following way:

17 B 7

or

17 B 7 A, B, C, D

Day		Month	Year	Supplementary Letter
1	16	A – January	7 – 1997	When a gear consists of more than 2 segments, a supplementary letter will be added to the matchmarks at each split, and each split shall be given a different letter.
2	17	B – February	8 – 1998	
3	18	C – March	9 – 1999	
4	19	D – April	0 – 2000	
5	20	E – May	1 – 2001	
6	21	F – June	2 – 2002	
7	22	G – July	3 – 2003	
8	23	H – August	4 – 2004	
9	24	J – September	5 – 2005	
10	25	K – October	6 – 2006	
11	26	L – November	7 – 2007	
12	27	M – December	8 – 2008	
13	28			
14	29			
15	30			
	31			

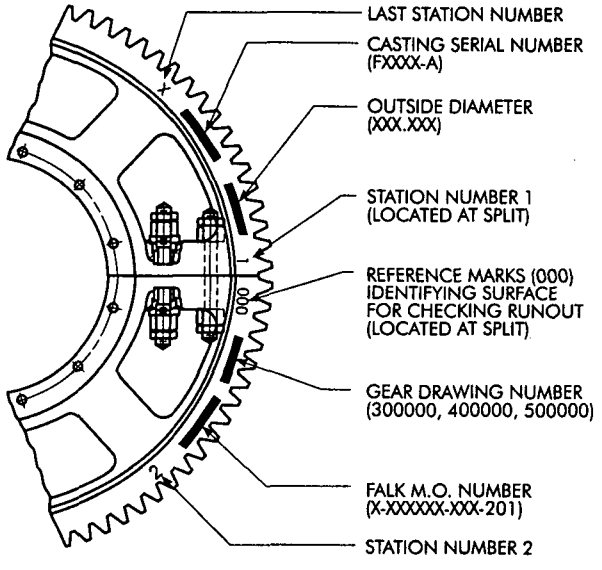

Figure 3 — EXPLANATION OF NUMBERS STAMPED ON RING GEARS

PARTS FURNISHED FOR ASSEMBLY OF GEARS

CLEARANCE BOLTS — A clearance bolt assembly consists of: one stud, two heavy nuts, and two jam nuts as shown in Figure 4.

ALIGNMENT BOLTS — An alignment bolt assembly consists of: one tapered alignment bolt, two jam nuts (one large and one small), one split sleeve (taper bored), two washers (one large and one small), and two standard nuts (one large and one small) as shown in Figure 5.

JACKSCREWS — Typical jackscrew arrangements are shown in Figure 6. They are used for radial adjustment of the gear during erection by bearing against the outer diameter of the mounting flange or the shell. Jackscrews are generally shipped loose and should be inserted in the appropriate position before the gear is initially bolted to the mounting flange.

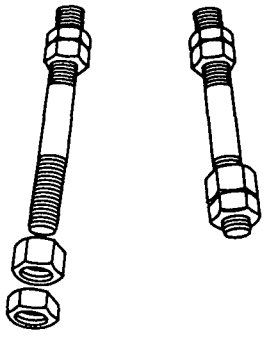

Figure 4 — ONE ASSEMBLY IS FURNISHED FOR EACH CLEARANCE HOLE OF ALL GEAR SPLITS.

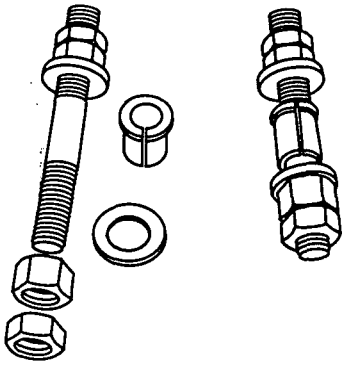

Figure 5 — TWO OF THESE ASSEMBLIES ARE FURNISHED FOR EACH GEAR SPLIT.

STEP 1 — CHECK THE AXIAL RUNOUT OF THE MOUNTING FLANGE

For flange mount applications, the mounting flange must be checked for axial runout prior to gear installation on the shell. For non-flange mount applications, proceed to Step 2.

NOTE: The temperature of the shell should be uniform when checking the mounting flange. For example: a shell with the top surface exposed to the sun for a period of time while the bottom surface is in the shade will give erroneous runout readings.

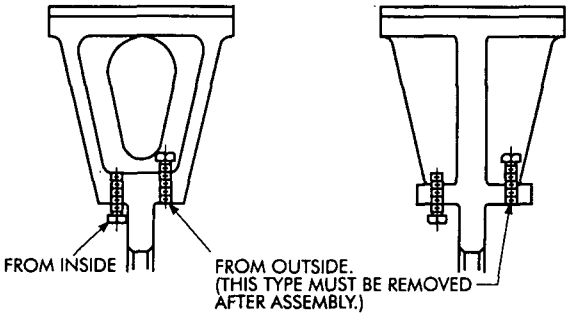

Figure 6 — JACKSCREW ARRANGEMENTS

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1.1 — MARK FLANGE STATIONS

Count the number of stations that are stamped on the gear rim face as shown in Figure 3. Mark off an equal number of spaces on the mounting flange to correspond with the number of stations on the gear.

1.2 — PERFORM AXIAL RUNOUT READINGS

There are four methods available to measure the axial runout of the mounting flange and they are listed below in order of decreasing preference. Select the first method below which is practical to perform at your installation. This will help to achieve the most accurate results possible.

CAUTION: It is imperative to follow proper sign convention (±) when performing the measurements and calculations below. A dropped sign could result in a seriously misaligned gear.

1.2.1 — SHELL AXIAL RUNOUT INDICATOR FIXTURE METHOD

This method may be employed if a shell axial runout indicator fixture (See TOOLS FOR INSTALLATION section of this manual for details) is available.

1.2.1.1 — Position Indicators

Place one indicator on the side of the mounting flange against which the gear will mount, shown at Position A in Figure 7. The other indicator can be positioned against the shell axial runout indicator fixture, shown at Position F in Figure 7.

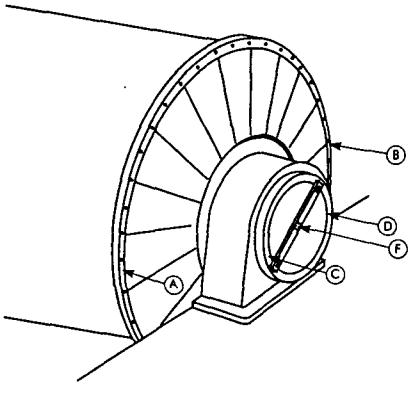

Figure 7 — SHELL INDICATOR POSITION

1.2.1.2 — Collect Runout Data

Rotate the shell one full revolution and record the indicator values for each station on Worksheet 1: Mounting Flange Runout (For One Indicator-, Shell Axial Runout Indicator Fixture-, and Three Indicator-Methods). The values for the mounting flange indicator (at Position A) can be recorded in Column 5 of the worksheet. The values for the shell axial runout indicator fixture indicator (at Position F) can be recorded in Column 4 of the worksheet. **NOTE:** Columns 1 through 3 of the worksheet will not be used for this method.

1.2.1.3 — Perform Runout Calculations

Fill in Column 6 according to the following instructions:

When the stem of Indicator A is pointing in the same direction as Indicator F, subtract the values entered in Column 4 from the values entered in Column 5 and enter the difference in Column 6.

When the stem of Indicator A is pointing in the opposite direction as Indicator F, add the values in Columns 4 and 5 and enter the sum in Column 6.

1.2.1.4 — Determine The Total Axial Runout

The total runout is the difference between the maximum (most positive) value and the minimum (most negative) runout value determined above. Example: Given the following runout values: {+0.004, +0.009, +0.009, +0.004, -0.004, -0.006, +0.004, 0.000}, the maximum value is +0.009 in., and the minimum value is -0.006 in; the runout equals +0.009 -(-0.006) = 0.015 in.

NOTE: With the mounting flange runout data, it is possible to selectively position the gear to the flange and optimize the installed gear rim face runout so that the installed runout duplicates the as-manufactured runout of the ring gear. As-manufactured runouts are included in the inspection documents provided with each ring gear. The mounting flange runout data will also be useful during subsequent steps when analyzing gear rim face runout.

1.2.1.5 — Proceed to Step 2.

1.2.2 — THREE-INDICATOR METHOD

This method may be employed if there is clear access to two positions at 180° apart on the thrust face of the trunnion bearing.

1.2.2.1 — Position Indicators

Place one indicator on the side of the mounting flange against which the gear will mount, shown at Position A in Figure 7. The other two indicators can be positioned against the thrust face internal to the trunnion bearing, shown at Positions C & D in Figure 7. The thrust face indicators must be placed 180° apart with both stems pointing in the same direction.

1.2.2.2 — Collect Runout Data

Rotate the shell one full revolution and record the indicator values for each station on Worksheet 1. The values for the mounting flange indicator (at Position A) can be recorded in Column 5 of the worksheet. The values for the trunnion bearing thrust face indicators (at Positions C & D) can be recorded in Columns 1 & 2 of the worksheet.

1.2.2.3 — Perform Runout Calculations

1.2.2.3.1 — Add the values in Columns 1 and 2 and enter the sum in Column 3.

1.2.2.3.2 — Divide the values in Column 3 by 2.0 and enter in Column 4.

1.2.2.3.3 — Fill in Column 6 according to the instructions given below:

When the stem of Indicator A is pointing in the same direction as Indicators C & D, subtract the values entered in Column 4 from the values entered in Column 5 and enter the difference in Column 6.

When the stem of Indicator A is pointing in the opposite direction as Indicators C & D, add the values in Columns 4 and 5 and enter the sum in Column 6.

1.2.2.4 — Determine The Total Axial Runout

Follow the procedure described in Step 1.2.1.4.

1.2.2.5 — Proceed to Step 2.

1.2.3 — ONE-INDICATOR METHOD

This method may be employed if the shell is pressed firmly against the thrust face on which it will bear during normal operation.

NOTE: This method assumes that there is zero axial runout on the thrust face.

1.2.3.1 — Position Indicator

Place the indicator on the side of the mounting flange against which the gear will mount, shown at Position A in Figure 7.

1.2.3.2 — Collect Runout Data

Rotate the shell one full revolution and record the indicator values at each station in Column 6 of Worksheet 1. Note, Columns 1 through 5 of the worksheet will not be used with this method.

1.2.3.3 — Determine The Total Axial Runout

Follow the procedure described in Step 1.2.1.4.

1.2.3.4 — Proceed to Step 2.

1.2.4 — TWO-INDICATOR METHOD

This method should only be used if it is impractical or impossible to utilize any of the above three methods as there are certain runout patterns which this method cannot detect.

1.2.4.1 — Position Indicators

Place one indicator on the side of the mounting flange against which the gear will mount, shown at Position A in Figure 7. The other indicator will be placed on the same face of the mounting flange, 180° from Position A with both stems pointing in the same direction, shown at Position B in Figure 7.

1.2.4.2 — Collect Runout Data

Rotate the shell one full revolution and record the indicator values for each station on Worksheet 2: Mounting Flange Runout (Two-Indicator Method). The Indicator A values will be entered in Column 1 and the Indicator B values will be entered in Column 2. Note, use Indicator A as the station reference. For example, if you have a gear with 18 stations, when Indicator A is at Station 1, Indicator B will be at Station 10 (180° apart). Therefore, when Indicator A is at Station 1, stop the gear and record both the Indicator A and the Indicator B readings on the same line (for Station 1) of the worksheet.

1.2.4.3 — Perform Runout Calculations

1.2.4.3.1 — Subtract the corresponding Indicator B reading from the Indicator A reading for each station and enter these values in Column 3.

1.2.4.3.2 — Divide the values in Column 3 by 2 to obtain the runout for each station and enter in Column 4.

1.2.4.4 — Determine The Total Axial Runout

Follow the procedure described in Step 1.2.1.4.

1.2.4.5 — Proceed to Step 2.

STEP 2 — ASSEMBLE GEAR TO THE SHELL

2.1 — CLEAN GEAR

All teeth and the mounting and mating surfaces must be thoroughly cleaned before installation. Bumps and burrs that may have occurred in transit and handling must be removed to insure proper assembly and tooth contact. All machined surfaces of the ring gear are protected with a protective film which can be removed at this time with mineral spirits.

2.2 — JACKSCREWS

On ring gears using jackscrews in the bore or counterbore of the mounting flange, place the screws into position BEFORE mounting the gear to the driven equipment, as illustrated in Figure 6. On split gears, determine the correct mating position of the gear halves by observing the stamped match marks previously explained in Figure 2, so that all jackscrews are on the same side of the gear when it is assembled.

Follow the instructions below to determine the correct gear mounting procedure for your application:

If you have a flange mounted, one-piece gear proceed to Step 2.3.

If you have a flange mounted, two-piece gear proceed to Step 2.4.

If you have a spring mounted, two-piece gear proceed to Step 2.5.

If you have a flange mounted, four-piece gear proceed to Step 2.6.

If you have a spring mounted, four-piece gear proceed to Step 2.7.

2.3 — SOLID GEARS, FLANGE MOUNTDESIGNS

Recheck the mounting flanges on the gear and driven equipment to ensure that any bumps or burrs incurred in handling are removed. Secure the gear to the mounting flange with every fourth bolt. Proceed to Step 3.

2.4 — 2-PIECE SPLIT GEARS, FLANGE MOUNT DESIGN

2.4.1 — MOUNT FIRST GEAR HALF

Position half gear on top 180° of shell. Recheck mounting flanges and remove any burrs incurred in handling. Secure the gear half to the mounting flange with every fourth bolt. Any flange bolts located under the jackscrews should only be tightened finger tight. Rotate the shell so that this gear half is positioned on the bottom with the splits in a horizontal position.

WARNING: *Provide a means to control the rotation of the unbalanced shell assembly.*

2.4.2 — CHECK CLEARANCE BOLT ASSEMBLY

Insert a clearance bolt from the top of the split into the clearance holes, located nearest the outside diameter of the gear half. If the bolts will pass completely through the holes, proceed with mounting the other gear half.

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If the bolts will not pass completely through the holes because of interference at the inside rim diameter of the gear, as illustrated in Figure 8, all clearance bolts will have to be inserted into this half as far as they will go before the other gear half can be assembled.

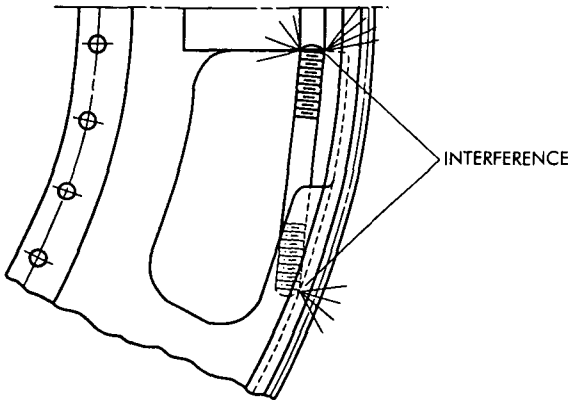

Figure 8 — CLEARANCE BOLT INTERFERENCE

CAUTION: *Do not damage clearance bolt threads during assembly.*

2.4.3 — MOUNT SECOND GEAR HALF

Make a final check for bumps and burrs on the mounting flange and mating surfaces of both gear halves. Bring the second half of the gear into position. Assemble so that the stamped match marks all appear at the same split. Secure the gear half against the mounting flange with every fourth bolt. These bolts should be snug enough to insure metal-to-metal contact, but not so tight that this gear half cannot be shifted slightly. Any bolts located under the jackscrews should only be tightened finger tight. Position the internal bores of the alignment holes in the splits as accurately as possible by shifting the top half of the gear using the jackscrews, screw jacks, or hydraulic jacks.

CAUTION: *Confirm proper alignment of the alignment holes by sight and feel. Improper alignment of the alignment holes before installation of the taper sleeves could result in severe damage to the sleeves and alignment bolts. The alignment bolt assembly is not designed to pull the split into alignment. This must be done manually. The alignment bolts are only designed to maintain proper alignment of the gear split.*

2.4.4 — INSTALL SLEEVES AND ALIGNMENT BOLTS

ALL ALIGNMENT BOLTS MUST BE INSTALLED BEFORE ANY OF THE CLEARANCE BOLTS ARE TORQUED.

2.4.4.1— Coat and Insert Sleeve

Coat the internal and external surfaces of the split sleeve with a dry lubricant such as molybdenum disulfide and insert into an alignment hole (normally located closest to the ring gear bore) with the sleeve flange toward the gear half with the counterbore stamped "TOP". The word "TOP" may not exist if the split is only counterbored from one side. In this case, the alignment sleeve should be inserted with the sleeve flange on the counterbored side. The alignment sleeve splits should be staggered from split to split as shown in Figure 9. Seat the flange portion of the alignment sleeve against this counterbore. Do not force sleeves into hole.

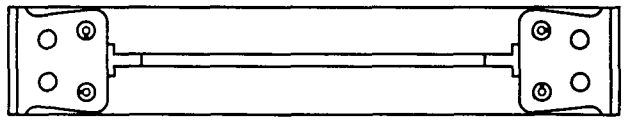

Figure 9 — ALIGNMENT SLEEVE ORIENTATION

2.4.4.2 — Install Alignment Bolts

Insert the small end of the tapered alignment bolt into the flanged end of the sleeve so the large end of the taper is towards the flanged end of the sleeve when the bolt is installed. Tap the alignment bolt down until it seats in the sleeve. Use a lead hammer or block of hard wood to avoid damage to the threads. If the bolt is not driven into the taper, the stud will turn when tightening the nut which could damage the stud or sleeve. Install the remaining sleeves and alignment bolts following the same procedure.

2.4.4.3 — Draw Alignment Bolts Securely Into Sleeves

Place a washer over the smaller end of each alignment bolt and turn on a standard nut. Torque the alignment bolts to 25% of the values listed in Table 1 using the cross bolt tightening technique.

TABLE 1 — Alignment Bolt Torque Values

Thread Size (Small End)	Torque ★	
	(lb-ft)	(Nm)
1	380	515
1-¼	700	950
1-½	1,230	1 670
1-¾	2,000	2 710
2	2,600	3 525
2-¼	3,700	5 015
2-½	5,100	6 915
2-¾	7,100	9 625

★ Lubricate with SAE 20 oil.

2.4.4.4 — Check Split Alignment

With a small parallel and feeler gauge, check the alignment of the rim faces. See Figure 10. They should align themselves within approximately 0.003 in. (0,076 mm). If offset is excessive, remove the sleeves and check for damage or disparities and verify proper alignment hole alignment. When the alignment is acceptable, torque the small nut on the end of the alignment bolts to the full torque values listed in Table 1.

2.4.4.5 — Complete Alignment Bolt Hardware Installation

Install the large end washer and turn on the large end standard nut. Tighten with a wrench to prevent loosening. This nut protects the threads during operation and aids in removal of the alignment bolt in the future.

CAUTION: *Over tightening of this nut will unseat the alignment bolt from the sleeve. Use an indicator to check for longitudinal displacement of the large end of the tapered alignment bolt. If necessary, loosen the standard nut to relieve any displacement of the large end.*

Install jam nuts on both ends and tighten to prevent loosening in operation.

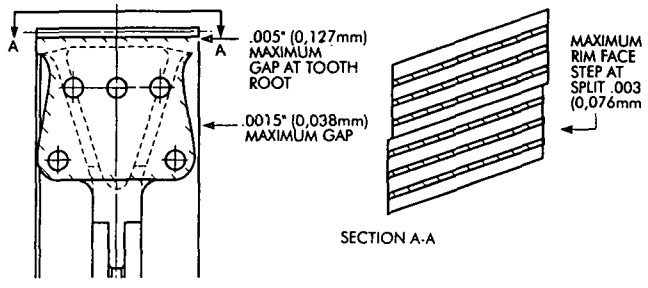

Figure 10 — SPLIT INSPECTION

2.4.5 — INSTALL CLEARANCE BOLTS

After the clearance bolts have been inserted, adjust the top and bottom standard nuts so that equal portions of the bolt extend above and below the split. Using the cross bolt tightening technique, tighten all clearance bolts as high as necessary so that the split joint is tight to the values shown in Figure 10, being careful not to exceed the torque values shown in Table 2. If the split openings exceed the values shown in Figure 10, recheck the splits for bumps, burrs and foreign objects.

TABLE 2 — Clearance Bolt Tightening Torque

Bolt Diameter (Inches)	Torque ★	
	(lb-ft)	(Nm)
2.25	6,200	8 405
2.50	8,500	11 525
2.75	10,500	14 235
3.00	14,000	18 980
3.25	18,000	24 405
3.50	23,000	31 185

★ Lubricate with SAE 20 oil.

2.4.6 — CLEARANCE BOLT TORQUING PROCEDURE

Torque the clearance bolts to the values listed in Table 2. If it is not possible to torque the bolts to these values, perform the bolt prestressing procedure as follows: Remove one bolt completely or withdraw as shown in Figure 11 if it cannot be removed completely. Heat the unthreaded center portion of the bolt with an acetylene or propane torch until the center portion of the bolt is uniformly heated to 400°F (222°C) above the ambient temperature. Use a heating tip on the torch, and hold the tip no closer than 1½ in. (40 mm) from the bolt. Check the temperature every three or four minutes with a surface pyrometer or temperature crayon. Approximately 20 minutes is required for proper heating.

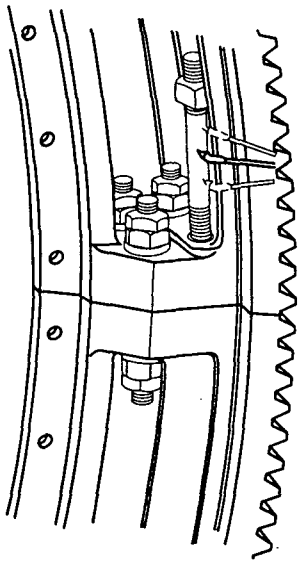

Figure 11 — HEAT CLEARANCE BOLT

CAUTION: *When heating the bolt, care must be taken to HEAT THE BOLT EVENLY. The torch must be moved constantly. Clearance bolts are heat treated and any reduction in hardness caused by overheating will reduce the tensile strength of the bolt. Care must be taken to keep heat away from the gear.*

After proper heating, QUICKLY slip the clearance bolt into the hole and turn a nut on the bottom threads (Figure 12). Seat the nut with a wrench and sledge. Turn on the top and bottom jam nuts and tighten with a wrench and sledge. The time to install the nuts after heating should not exceed one minute. It is recommended that the installer practice this procedure without heat to ensure that the time limit is not exceeded during the installation. Install the remaining clearance bolts in the same manner. After all bolts have been installed, the splits must be feeler tight as shown in Figure 10.

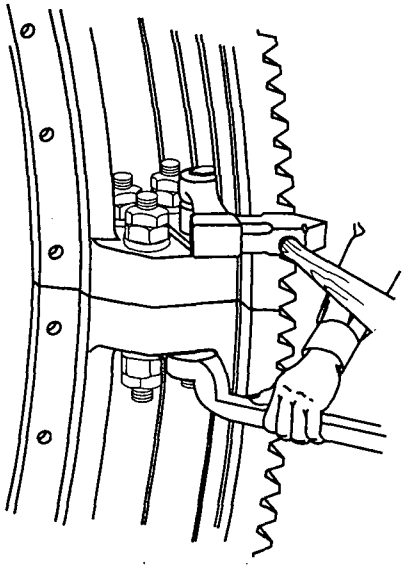

Figure 12 — TIGHTEN NUTS

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NOTE: In some instances, the gear split hardware will utilize alternate tensioning devices. In this case the above instructions should be replaced by the proper tightening technique for the specific product installed on the gear. Refer to the contract instruction manual or gear drawing for details on installation of these products.

2.4.7 — PROCEED TO STEP 3.

2.5 — TWO-PIECE SPLIT GEARS, SPRING MOUNT DESIGN

2.5.1 — PRE-ASSEMBLY OF GEAR SEGMENTS

While the gear segments are on the ground and unassembled, install the springs and support/adjustment chairs per the shell manufacturer's specifications. See Figure 13 for a typical support chair assembly. The chairs should be installed as close to the gear as possible to allow maximum clearance when assembling the gear halves to the shell. Ensure that the springs are installed so that they will be under tension during normal operation of the shell and that the spring ends are oriented properly for attachment to the shell. Also, tie off hinged springs so that they are fully retracted towards the gear.

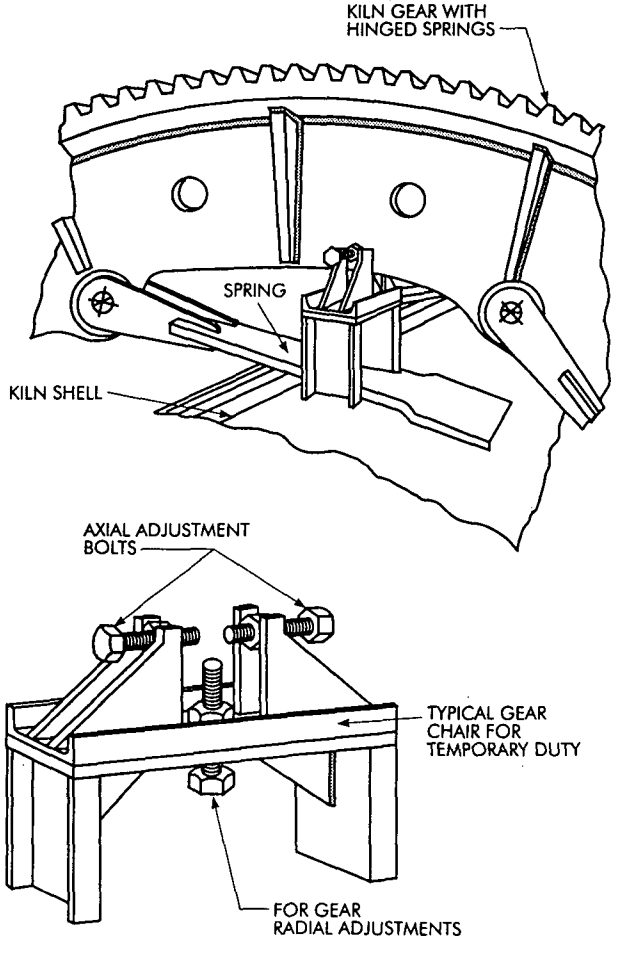

Figure 13 — TYPICAL SUPPORT CHAIR FOR A KILN SPRING GEAR

2.5.2 — LAYOUT GEAR LOCATION ON SHELL

To aid in installation it is typical to scribe layout lines on the shell indicating the location of the ring gear in the cold position. Cold is considered at 70°F (21°C). Allow for expansion or contraction for warmer or cooler temperatures during this process.

2.5.3 — POSITION FIRST GEAR HALF

Maneuver the first gear half under the shell so the split flanges are horizontal and the gear half is as close to the shell as practical. It is important to note that the shell will be on an incline while the gear will be vertical at this stage. Do not attempt to incline the gear so that it is perpendicular to the shell at this time. It should remain vertical during the assembly of the gear halves. Place a support and jack arrangement under the first gear half to support it.

2.5.4 — CHECK CLEARANCE BOLT ASSEMBLY

Insert a clearance bolt from the top of the split into the clearance holes, located nearest the outside diameter of the gear half. If the bolts will pass completely through the holes, proceed with mounting the other gear half. If the bolts will not pass completely through the holes because of interference at the inside rim diameter of the gear, as illustrated in Figure 8, all clearance bolts will have to be inserted into this half as far as they will go before the other gear half can be assembled.

CAUTION: *Do not damage the clearance bolt threads during assembly.*

2.5.5 — POSITION SECOND GEAR HALF

Examine the split flanges at this time and verify that all surfaces are clean and free from defects before proceeding. The second gear half may now be lowered on top of the first gear half.

2.5.6— INSTALL SPLIT HARDWARE

Install the split hardware as described in Steps 2.4.4 through 2.4.6. Once the split hardware is installed, the gear can be lifted slightly by a crane and the supports under the first half can be removed.

2.5.7 — ALIGN GEAR WITH SHELL AXIS

Up to this point the gear has been positioned vertically. It is now necessary to angle the gear so that the gear axis is parallel to the shell axis. Typically this can be accomplished through the use of rigging and/or guide bars. Follow the shell manufacturer's instructions for alignment of the gear with the shell axis.

2.5.8 — ATTACH SUPPORT CHAIRS TO SHELL

The gear can now be positioned so the chairs are aligned axially and in the proper radial position. Once this is verified, the chairs can be lowered and secured to the shell. Firmly adjust all alignment bolts on all chairs to align the gear to the shell as accurately as possible. If the springs include provisions for bolting at the interface to the shell, the bolts may be installed at this time. Once all chairs and alignment bolts are secured, the crane supports can be removed from the gear. See Figure 14 for a typical gear/spring/chair mounting arrangement.

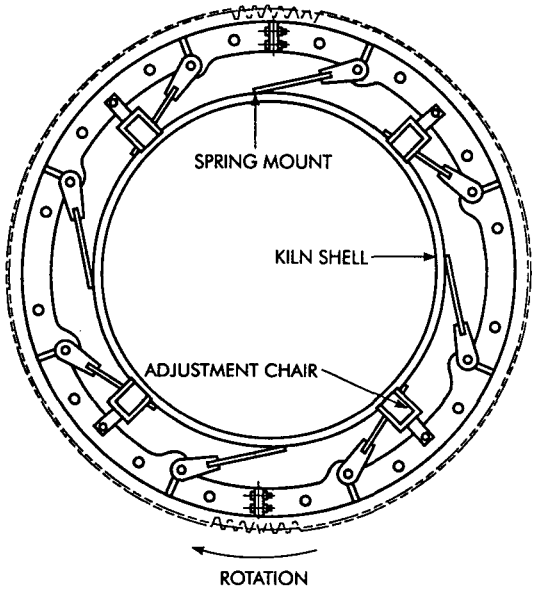

Figure 14 — TYPICAL SPRING MOUNT ARRANGEMENT

2.5.9 — PERFORM RADIAL RUNOUT INSPECTION

Follow the radial runout procedure described in Steps 3.2 through 3.5.

2.5.10 — Perform Axial Runout Inspection

Follow the axial runout inspection procedure described in Steps 4.1 through 4.3.4.

2.5.11 — Adjust Gear Alignment

Based on the axial and radial runout readings obtained above, adjust the chair alignment screws to minimize the installed radial runout (see Column 3 of Worksheet 3) and rim face runout (see Column 8 of Worksheet 4 or Column 6 of Worksheet 5) values. Check the runout values after adjustment and verify that all values are within the acceptable limits. If not, re-adjust the chair alignment screws and repeat.

2.5.12 — Attach Springs to Shell

The springs may now be attached to the shell per the shell manufacturers instructions.

2.5.13 — Check Installation

After the springs are attached to the shell, the alignment bolts on the chairs may be backed off so they are no longer in contact with the gear. Check the axial and radial runout to verify that they are within acceptable limits. If the runout values are acceptable, the support chairs may be removed.

2.5.14 — Proceed to Step 6.

2.6 — FOUR-PIECE SPLIT GEARS, FLANGE MOUNT DESIGN

2.6.1 — PRE-ASSEMBLY OF GEARS FURNISHED IN FOUR SECTIONS

The gear quarter-sections must be pre-assembled to form two half-gear sections prior to mounting on the shell. Before proceeding, check the section match marks to ensure proper assembly of the mating sections. Also, inspect the mating faces to ensure that they are free of any bumps, burrs, etc. incurred in transit and handling.

2.6.2 — CHECK CLEARANCE BOLT ASSEMBLY

Insert a clearance bolt from the top of the split into the clearance holes, located nearest the outside diameter of the gear. If the bolts will pass completely through the holes, proceed with mounting the other gear section. If the bolts will not pass completely through the holes because of interference at the inside rim diameter of the gear, as illustrated in Figure 8, all clearance bolts will have to be inserted into the split as far as they will go before the other gear section can be assembled.

2.6.3 — LIFT QUARTER GEAR SECTION PER FIGURE 15.

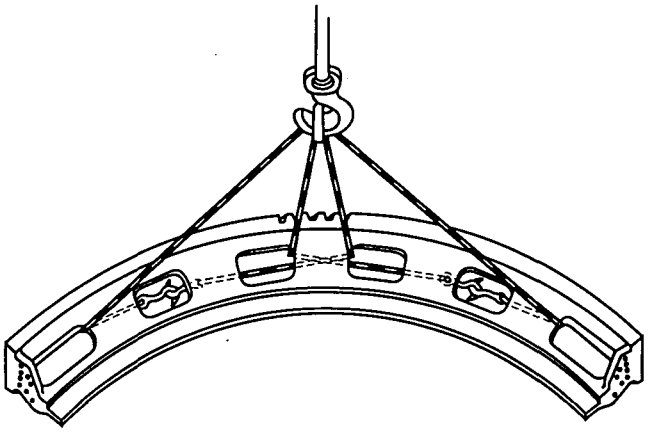

Figure 15 — LIFTING QUARTER SECTION GEAR

Place the two mating gear quarters on rigid parallel supports. Check the match marks to verify proper assembly of mating sections.

NOTE: The difference in the split gap from one edge of the face to the other will indicate the accuracy with which one section is parallel to the other.

Adjust the position of the gear segments on parallels to bring the alignment holes into close proximity to each other.

2.6.4

Insert the clearance bolts at the split if they are not already in place. Use the wrench provided to turn the clearance bolts and bring the two sections of the gear into contact. Pay particular attention to the alignment of the alignment holes. The clearance bolts should not be secured at this time. They should only be used to bring the two sections into contact and tightened enough to insure that the splits will close per Figure 10. Some jacking will be required to align the internal bores of the alignment holes in the splits. Confirm alignment by sight and feel. These alignment holes must be lined up accurately before the split alignment sleeves are inserted.

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2.6.5

Insert the alignment and clearance bolts following the procedure described in Steps 2.4.4 & 2.4.5.

2.6.6

Repeat the above procedure for the other two mating quarter-sections so the result is two mating gear halves.

2.6.7

Proceed with mounting the gear halves on the shell following the procedure described in Steps 2.4.1 through 2.4.5.

2.6.8 — CHECK ALIGNMENT

Rotate the shell 90° so the splits that were preassembled are horizontal. The rim face step at the horizontal split should not exceed 0.003 in. (0,076 mm) as shown in Figure 10.

2.6.9 — CHECK SPLIT TIGHTNESS

If horizontal splits are tight per Figure 10, proceed with the Clearance Bolt Torquing Procedure as described in Step 2.4.6. If the above alignment and split tightness does not meet stated requirements, proceed as follows:

Relax the clearance bolts for the two preassembled splits.

Relax the alignment bolts for the two preassembled splits.

Check the sleeves and alignment studs for damage and for proper hole alignment. Correct the alignment as required.

CAUTION: *Only inspect one alignment bolt at a time. All other clearance and alignment bolts should remain in place to properly support the gear.*

Reassemble and retighten the alignment and clearance bolts as described in Steps 2.4.4 through 2.4.6.

2.6.10

Rotate the shell 90° and tighten the clearance bolts of the remaining two splits using the Clearance Bolt Torquing Procedure as described in Step 2.4.6.

2.6.11 — Proceed to Step 3.

2.7 — FOUR-PIECE SPLIT GEARS, SPRING MOUNT DESIGN

2.7.1

Begin by assembling two of the four gear segments into a half gear segment as described in Steps 2.6.1 through 2.6.4. Verify that the match marks are aligned correctly.

2.7.2

Tighten alignment and clearance bolts as described in Steps 2.4.4 through 2.4.6.

2.7.3

Repeat Sections 2.7.1 & 2.7.2 above so that there are two assembled half gear sections.

2.7.4

Assemble the two gear halves to the shell as described in Step 2.5.1 through 2.5.14.

STEP 3 — CHECK THE RADIAL RUNOUT OF THE GEAR

3.1 — PRELIMINARY RADIAL RUNOUT ALIGNMENT

Measure and record the gap between the mounting flange outside diameter and the counterbore of the gear at each station. Use the jackscrews to adjust and even out the gap for the entire circumference of the gear. In some cases it may be necessary to use steel blocks or wedges to adjust the gap spacing between jackscrew pairs.

3.2 — DETERMINE THE ALLOWABLE INSTALLED RADIAL RUNOUT

There are two considerations when evaluating radial runout of installed ring gears. The first is the total installed radial runout and the second is the change in installed runout from station to station. Allowable total installed radial runout is shown in Table 3. The allowable radial runout between stations is determined by multiplying the allowable installed radial runout by the MF factor given in Table 4. The allowable station-to-station runout applies to a positive or negative difference. That is, if the station-to-station allowable runout is calculated to be .0014 in., station-to-station runout values of -.0014 in. to +.0014 in. would be considered acceptable. It is critical to verify that the installed ring gear satisfies both of these criteria to ensure proper operation of, and maximum life for, the gear set. See Appendix II for an example of a completed radial runout worksheet.

Allowable Runout Calculation Example:

A gear for a trunnion mounted shell has an outside diameter of 288 in. and has 18 stations. The allowable installed rim face runout, from Table 3, is .021 in. The allowable rim face runout between stations is determined by multiplying this value by the MF factor of .171 from Table 4 or .021 in. x .171 = ±.0036 in.

3.3 — PERFORM RADIAL RUNOUT READINGS

Mount a dial indicator so that it can be set against one of the four machined surfaces shown in Figure 16. Place the indicator squarely to the machined surfaces at one of the stations stamped on the gear face. When utilizing the indicator positions shown on sketches A or B, be sure to use the side of the gear that has been stamped (000). Rotate the gear slowly and record the indicator reading for each station at the corresponding station number in Column 1 of Worksheet 3: Radial Runout. After one complete revolution, the indicator must read within +.002 in. (+0,050 mm) of the initial reading at the starting station. If not, repeat this step.

CAUTION: *It is imperative to follow proper sign convention (±) when performing the measurements and calculations below. A dropped sign could result in a seriously misaligned gear.*

3.4 — DETERMINE THE INSTALLED RADIAL RUNOUT

For an ideal installation, the measured ring gear radial runout values should duplicate the values of the gear at the time of manufacture. These as-manufactured values are included in the inspection documents provided for each gear. Enter the as-manufactured values in Column 2 of Worksheet 3. Next, calculate the installed radial runout by subtracting the values in Column 2 from the values in Column 1 and enter the difference in Column 3 of the worksheet.

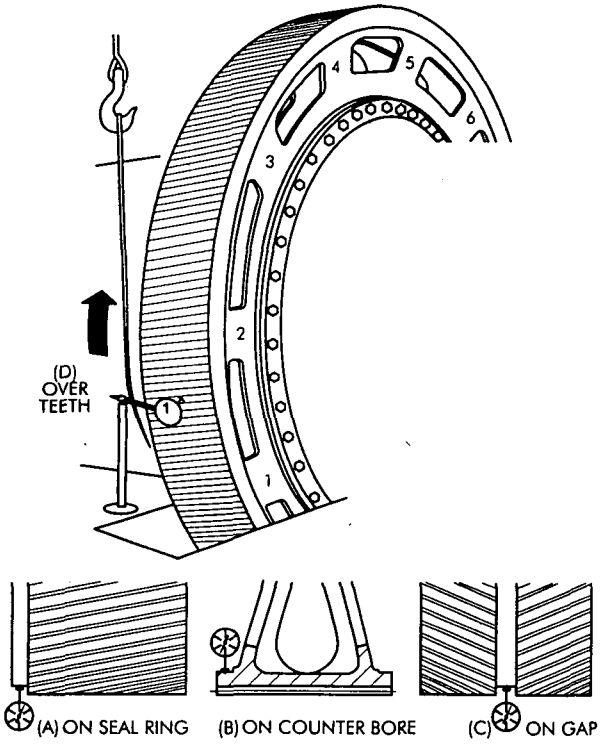

Figure 16 — PLACEMENT OF INDICATORS

NOTE: If this procedure is being used to install an existing gear, the as-manufactured runout values may not be available. Contact Falk to obtain the as-manufactured values if they are not available on site. In the event that Falk no longer has the records for your installation, enter zeros in Column 2 of Worksheet 3.

The total installed radial runout can now be determined by subtracting the lowest installed radial runout value from the highest installed radial runout value. Verify that this value is below the allowable limit.

3.5 — DETERMINE STATION-TO-STATION RUNOUT

The station-to-station runout can be calculated and entered into Column 4 of the worksheet. Starting at Station No. 2 in Column 4, enter the difference between the installed runout of Station No. 1 (shown in Column 3) minus the installed runout of Station No. 2. Repeat this for the remaining stations. Review the station-to-station values in Column 4 and verify that they are all within the allowable station-to-station limit.

3.6 — PERFORM FINAL RADIAL ALIGNMENT

Review the total installed runout values and the station-to-station runout values and verify that they are all within the allowable limits. If either the total installed runout or station-to-station runouts exceed the allowable, correction can be made by recentering the gear. Use jackscrews, hydraulic jacks or screw jacks. Adjust the gear to minimize the installed runout values in Column 3 and repeat the radial runout inspection procedure. If the error cannot be corrected, check for restrictions (e.g. body bound bolts).

TABLE 3 — Ring Gear Allowable Installed Radial Runout

Outside Diameter of Gear (in)	Trunnion Mounted Shells and Roller Mounted Shells with Shell Speed > 6 rpm		Roller Mounted Shells With Shell Speed < 6 rpm	
	(in)	(mm)	(in)	(mm)
108	.008	0,203	.018	0,457
120	.009	0,229	.020	0,508
132	.010	0,254	.022	0,559
144	.011	0,279	.024	0,610
156	.011	0,279	.026	0,660
168	.012	0,305	.028	0,711
180	.013	0,330	.030	0,762
192	.014	0,356	.032	0,813
204	.015	0,381	.034	0,864
216	.016	0,406	.036	0,914
228	.017	0,432	.038	0,965
240	.018	0,457	.040	1,016
252	.018	0,457	.042	1,067
264	.019	0,483	.044	1,118
276	.020	0,508	.046	1,168
288	.021	0,533	.048	1,219
300	.022	0,559	.050	1,270
312	.023	0,584	.052	1,321
324	.024	0,610	.054	1,372
336	.025	0,635	.056	1,422
348	.026	0,660	.058	1,473
360	.026	0,660	.060	1,524
372	.027	0,686	.062	1,575
384	.028	0,711	.064	1,626
396	.029	0,737	.066	1,676
408	.030	0,762	.068	1,727
420	.031	0,787	.070	1,778
432	.032	0,813	.072	1,829
444	.033	0,838	.074	1,880
456	.033	0,838	.076	1,930
468	.034	0,864	.078	1,981
480	.035	0,889	.080	2,032
492	.036	0,914	.082	2,083
504	.037	0,940	.084	2,134
516	.038	0,965	.086	2,184
528	.039	0,991	.088	2,235
540	.040	1,016	.090	2,286
552	.040	1,016	.092	2,337

TABLE 4 — MF Factor

No. of Stations	MF ★	No. of Stations	MF ★
8	.353	24	.129
10	.293	26	.120
12	.250	28	.111
14	.217	30	.104
16	.191	32	.098
18	.171	34	.092
20	.154	36	.087
22	.141	...	...

★ The above values for MF can be calculated by the following equation: MF = $^1/_2$ sin (360/# stations)

3.7 — PRE-TIGHTEN FLANGE BOLTS

When the radial runout values are within the allowable limits, install all remaining flange bolts and torque to 50% of the shell manufacturer's specifications. All jackscrews can be removed at this time. If it is not possible to remove the jackscrews, back-off the jackscrews and stake to prevent movement during operation.

CAUTION: Jackscrews can cause distortion of the gear rim and must be removed (if non-captive) or backed-off (if captive) prior to final runout checks.

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STEP 4 — CHECK THE AXIAL RUNOUT OF THE GEAR RIM FACE

4.1 — ESTABLISH ALLOWABLE RIM FACE RUNOUT

There are two considerations when evaluating rim face runout of installed ring gears. The first is the total installed runout of the rim face and the second is the change in installed runout from station to station. Allowable total installed rim face runout is shown in Table 5. The allowable rim face runout between stations is determined by multiplying the allowable installed rim face runout by the MF factor given in Table 4. The allowable station-to-station runout applies to a positive or negative difference. That is, if the station-to-station allowable runout is calculated to be .0014 in., station-to-station runout values of -0.0014 in. to +.0014 in. would be considered acceptable. It is critical to verify that the installed ring gear is within both of these limits to ensure proper operation of, and maximum life for, the gear set.

Table 5: Allowable Installed Rim Face Runout

Outside Diameter of Gear (in.)	Trunnion Mounted Shells & Roller Mounted Shells with Shell Speed > 6 rpm		Roller Mounted Shells with Shell Speed < 6 rpm	
	(in)	(mm)	(in)	(mm)
108	.005	0,127	.011	0,279
120	.006	0,152	.012	0,305
132	.007	0,178	.013	0,330
144	.007	0,178	.014	0,356
156	.008	0,203	.016	0,406
168	.008	0,203	.017	0,432
180	.009	0,229	.018	0,457
192	.010	0,254	.019	0,483
204	.010	0,254	.020	0,508
216	.011	0,279	.022	0,559
228	.011	0,279	.023	0,584
240	.012	0,305	.024	0,610
252	.013	0,330	.025	0,635
264	.013	0,330	.026	0,660
276	.014	0,356	.028	0,711
288	.014	0,356	.029	0,737
300	.015	0,381	.030	0,762
312	.016	0,406	.031	0,787
324	.016	0,406	.032	0,813
336	.017	0,432	.034	0,864
348	.017	0,432	.035	0,889
360	.018	0,457	.036	0,914
372	.019	0,483	.037	0,940
384	.019	0,483	.038	0,965
396	.020	0,508	.040	1,016
408	.020	0,508	.041	1,041
420	.021	0,533	.042	1,067
432	.022	0,559	.043	1,092
444	.022	0,559	.044	1,118
456	.023	0,584	.046	1,168
468	.023	0,584	.047	1,194
480	.024	0,610	.048	1,219
492	.025	0,635	.049	1,245
504	.025	0,635	.050	1,270
516	.026	0,660	.052	1,321
528	.026	0,660	.053	1,346
540	.027	0,686	.054	1,372
552	.028	0,711	.055	1,397

EXAMPLE: A gear for a trunnion mounted shell has an outside diameter of 288 in. and has 18 stations. The allowable installed rim face runout, from Table 5, is .014 in. The allowable rim face runout between stations is determined by multiplying this value by the MF factor of .171 from Table 4 or .014 in. x .171 = ±.0024 in.

4.2 — PERFORM AXIAL RUNOUT READINGS

Rim face runout of the gear should be checked, recorded, and calculated using the same procedure as used for checking the mounting flange runout given in Step 1. The only difference will be that instead of placing Indicators A or B against the mounting flange, these indicators must be placed against the "000" face of the mounted ring gear. Ideally, the rim face runout should duplicate the values of the gear at the time of manufacture. The as-manufactured values are included in the inspection documents provided for each gear.

There are four methods available to measure the axial runout of the rim face and they are listed below in order of decreasing preference. Select the first method below which is practical to perform at your installation. This will help to achieve the most accurate results possible.

CAUTION: It is imperative to follow proper sign convention (±) when performing the measurements and calculations below. A dropped sign could result in a seriously misaligned gear.

4.2.1 — SHELL AXIAL RUNOUT INDICATOR FIXTURE METHOD

This method may be employed if a shell axial runout indicator fixture (See the TOOLS FOR INSTALLATION section of this manual for details) is available.

4.2.1.1 — Position Indicators

Place one indicator against the "000" rim face, shown at Position A in Figure 17. The other indicator can be positioned against the shell axial runout indicator fixture, shown at Position F in Figure 17.

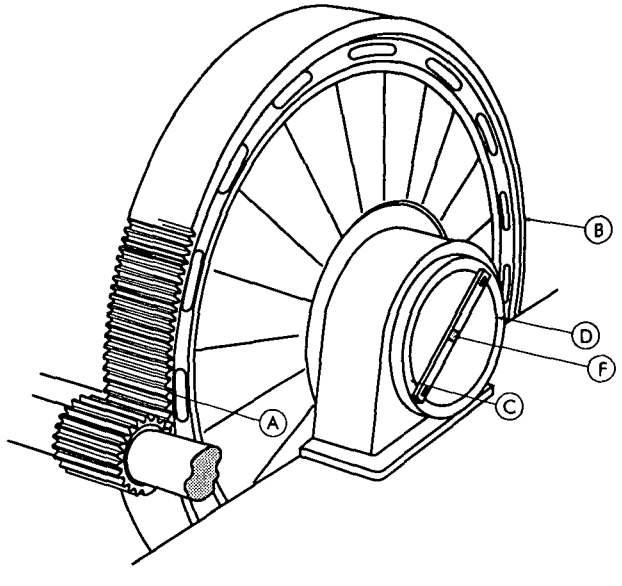

Figure 17 — INDICATOR PLACEMENT

4.2.1.2 — Collect Runout Data

Rotate the shell one full revolution and record the indicator values for each station on Worksheet 4: Rim Face Runout (for One Indicator-, Shell Axial Runout Indicator Fixture-, and Three Indicator-Methods). The values for the mounting flange indicator (at Position A) can be recorded in Column 5 of the worksheet. The values for the shell axial runout indicator fixture indicator (at Position F) can be recorded in Column 4 of the worksheet. **NOTE**: Columns 1 through 3 of the worksheet will not be used for this method.

4.2.1.3 — Compute Runout

Complete the runout computation as described in Step 1.2.1.3.

4.2.1.4 — Proceed to Step 4.3.

4.2.2 — THREE-INDICATOR METHOD

This method may be employed if there is clear access to two positions at 180° apart on the thrust face of the trunnion bearing.

4.2.2.1 — Position Indicators

Place one indicator against the "000" rim face, shown at Position A in Figure 17. The other two indicators can be positioned against the thrust face internal to the trunnion bearing, shown at Positions C & D in Figure 17. The thrust face indicators must be placed 180° apart with both stems pointing in the same direction.

4.2.2.2 — Collect Runout Data

Rotate the shell one full revolution and record the indicator values for each station on Worksheet 4. The values for the mounting flange indicator (at Position A) can be recorded in Column 5 of the worksheet. The values for the trunnion bearing thrust face indicators (at Positions C & D) can be recorded in Columns 1 & 2 of the worksheet.

4.2.2.3 — Compute Runout

Complete the runout computation as described in Step 1.2.2.3.

4.2.2.4 — Proceed to Step 4.3.

4.2.3 — ONE-INDICATOR METHOD

This method may be employed if the shell is pressed firmly against the thrust face on which it will bear during normal operation.

NOTE: This method assumes that there is zero axial runout on the thrust face.

4.2.3.1 — Position Indicator

Place the indicator against the "000" rim face, shown at Position A in Figure 17.

4.2.3.2 — Collect Runout Data

Rotate the shell one full revolution and record the indicator values at each station in Column 6 of Worksheet 4. **NOTE**: Columns 1 through 5 of the worksheet will not be used with this method.

4.2.3.3 — Proceed to Step 4.3.

4.2.4 — TWO-INDICATOR METHOD

This method should only be used if it is impractical or impossible to utilize any of the above three methods as there are certain occurrences of shell float which this method cannot detect.

4.2.4.1 — Position Indicators

Place one indicator against the "000" rim face, shown at Position A in Figure 17. The other indicator will be placed on the same face of the mounting flange, 180° from Position A with both stems pointing in the same direction, shown at Position B in Figure 17.

4.2.4.2 — Collect Runout Data

Rotate the shell one full revolution and record the indicator values for each station on Worksheet 5: Rim Face Runout (Two-Indicator Method). The Indicator A values will be entered in Column 1 and the Indicator B values will be entered in Column 2. Please note, use Indicator A as the station reference. For example, if you have a gear with 18 stations, when Indicator A is at Station 1, Indicator B will be at Station 10 (180° apart). Therefore, when Indicator A is at Station 1, stop the gear and record both the Indicator A and the Indicator B readings on the same line (for Station 1) of the worksheet.

4.2.4.3 — Perform Runout Calculations

To begin, subtract the corresponding Indicator B reading from the Indicator A reading for each station and enter these values in Column 3. Then divide the values in Column 3 by 2 to obtain the runout for each station and enter in Column 4.

4.2.4.4 — Proceed to Step 4.3.

4.3 — ADJUST GEAR FOR OPTIMAL RUNOUT

4.3.1 — ENTER AS-MANUFACTURED VALUES

For an ideal installation, the measured ring gear radial runout values should duplicate the values of the gear at the time of manufacture. These as-manufactured values are included in the inspection documents provided for each gear. Enter the as-manufactured values in the appropriate worksheet column.

NOTE: If this procedure is being used to install an existing gear, the as-manufactured runout values may not be available. Contact Falk to obtain the as-manufactured values if they are not available on site. In the event that Falk no longer has the records for your installation, enter zeros in the as-manufactured values column of the worksheet.

4.3.2 — CALCULATE THE INSTALLED RIM FACE RUNOUT

Next, calculate the installed rim face runout by subtracting the as-manufactured values from the measured axial runout values and entering the difference in the appropriate worksheet column.

4.3.3 — DETERMINE THE TOTAL INSTALLED RIM FACE RUNOUT

The total installed rim face runout can now be determined by subtracting the lowest installed rim face runout value from the highest installed rim face runout value. Verify that this value is below the allowable limit established in Step 4.1.

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4.3.4 — DETERMINE STATION-TO-STATION RUNOUT

The station-to-station runout can be calculated and entered into the appropriate column of the worksheet. Starting at Station No. 2, subtract the installed runout of Station No. 1 from the installed runout of Station No. 2 and enter this value as the station-to-station runout for Station No. 2. Repeat this for the remaining stations.

4.3.5 — PERFORM FINAL RIM FACE ALIGNMENT

Review the total installed runout values and the station-to-station runout values and verify that they are all within the allowable limits. If either the total installed runout or station-to-station runouts exceed the allowable, it will be necessary to shim between the gear and mounting flange. Adjust the gear to minimize the installed runout values (see Column 8 of Worksheet 4 or Column 6 of Worksheet 5) and repeat the above rim face runout inspection procedure.

STEP 5 — FINAL FLANGE BOLT INSTALLATION

When the rim face and radial runout values are within the allowable limits, torque all flange bolts to the shell manufacturer's specifications.

STEP 6 — SET PINION

6.1

Before proceeding, it is necessary to select the proper alignment procedure to match your application. Follow the instructions below to determine the correct pinion setting procedure:

If you are installing a new pinion with a new gear, proceed to Step 6.2, otherwise,

If you are installing a new pinion with a used gear, proceed to Step 6.3.

6.2 — PROCEDURE FOR INSTALLING A NEW PINION WITH A NEW GEAR

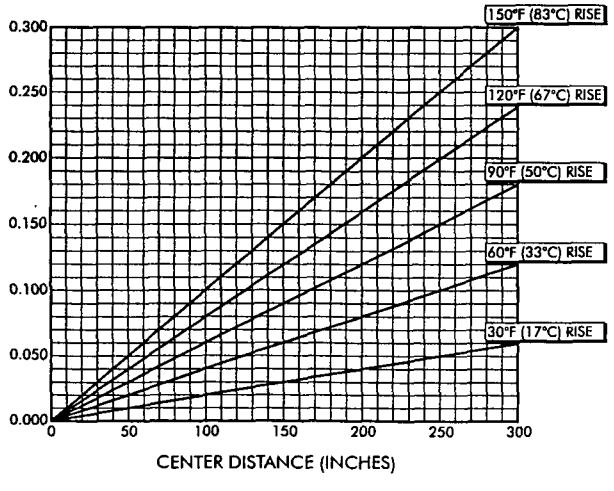

Figure 18 — THERMAL BACKLASH FACTOR

NOTE: See equation Step 6.2.1.1.

6.2.1 — RECOMMENDED BACKLASH

If the shell is roller mounted and the shell temperature during operation will exceed 400°F (200°C), proceed to Step 6.2.1.2, otherwise, proceed to Step 6.2.1.1.

6.2.1.1 — Backlash For Trunnion Mounted Shells and Low Temperature Roller Mounted Shells

The required backlash varies with the diametral pitch, the center distance and the temperature difference between the highest operating temperature of the ring gear and the ambient temperature at time of installation. The diametral pitch, center distance and ambient temperature are known factors. The actual operating temperature of the gear varies with the type of enclosure, type of equipment, lubrication and the product being processed. This value must be established by the shell manufacturer or estimated from similar installations.

The backlash requirement is determined by adding two factors:

(1) Thermal Backlash Factor — allows for the thermal expansion of the gear and pinion during normal operation, and

(2) Diametral Pitch Backlash Factor — includes the recommended operating backlash for a given tooth size.

The backlash requirement can be calculated as:

Backlash Requirement = Thermal Backlash Factor + Diametral Pitch Backlash Factor

The backlash requirement has a tolerance of +.010 in., -.000 in. (+0,25 mm, -0,00 mm).

The Thermal Backlash Factor can be determined from the graph shown in Figure 18. Alternatively, the Thermal Backlash Factor can be calculated with the following equation:

Thermal Backlash Factor (Inches) = Center Distance (Inches) X (Temperature Rise (°F)/150,000)

The Diametral Pitch Backlash Factor can be obtained from Table 6. Note, the diametral pitch is shown on the gear drawing.

TABLE 6 — Diametral Pitch Backlash Factor

Diametral Pitch (See Gear Drawing)	Diametral Pitch Backlash Factor	
	(in)	(mm)
5/8	.055	1,40
3/4	.050	1,27
7/8	.045	1,14
1	.045	1,14
1-1/4	.040	1,02
1-1/2	.040	1,02
1-3/4	.035	0,90
2	.030	0.76
2-1/2	.030	0,76

See Appendix III for a completed backlash calculation example.

Proceed to Step 6.2.2

6.2.1.2 — Backlash For High Temperature Roller Mounted Shell

The backlash requirement is determined by adding two factors:

(1) Diametral Pitch Backlash Factor — includes the recommended operating backlash for a given tooth size, and

(2) Wear Allowance Factor — includes an allowance for wear of the shell riding ring and rollers. As the riding ring and rollers wear, the axis of the shell will drop vertically. As this occurs, the gear and pinion teeth will be forced into a tighter mesh. It is imperative that proper monitoring of the riding ring and rollers is performed to ensure that the gear teeth are not forced into tight mesh which could result in severe damage to the gearset. Therefore, this value should be selected to meet the requirements of each installation and ensure that a proper safety margin is maintained. An initial value of 0.030 in. (0,76 mm) may be used if prior operating data is not available.

The backlash requirement can be calculated as:

Backlash Requirement = Diametral Pitch Backlash Factor + Wear Allowance Factor

The backlash requirement has a tolerance of +0.010 in., -0,000 in. (+0,25 mm, -0,00 mm).

The Diametral Pitch Backlash Factor can be obtained from Table 6. Note, the diametral pitch is shown on the gear drawing.

Proceed to Step 6.2.2

6.2.2 — PRELIMINARY SETTING OF PINION FOR BACKLASH AND TOOTH CONTACT

Place the pinion assembly approximately parallel with the gear axis by leveling and preliminary shimming of the bearing pedestals. It is recommended that a minimum of 0.030 in. (0,76 mm) of shims be used underneath each pillow block. This will allow for future adjustments if they become necessary. Shims should be steel and should support the entire pillow block.

If the gear set is single helical, the bearing caps should be removed to make sure that the stabilizing rings are in the fixed pedestal and that the free bearing is in the center of its axial float.

In the case of a double helical (or herringbone) gear set, the double helical pinion should have 0.092 in. (2,34 mm) minimum axial float and the bearings should be centrally located.

Where locknuts are used to secure the bearing, check for tightness and make sure the lock tab on the washer is secure.

Position the pinion to provide the proper backlash while maintaining the proper tooth contact. The setting of contact and backlash must be done simultaneously. Select the proper backlash requirement as described previously. The backlash must be set where the radial runout of the gear causes the minimum backlash. This would be at the station with the highest positive (+) radial runout. Refer to the Radial Runout readings recorded previously on Worksheet 3 in order to identify the Station where this will occur.

NOTE: An easy method for preliminary alignment of the pinion is to push the pinion into tight mesh with the gear and look at the tooth contact patterns. Adjust the tight mesh of the pinion and gear until you obtain a balanced contact pattern. Then, using dial indicators, each of the pinion bearings can be backed off by the same amount to obtain the initial backlash setting for the set.

6.2.3 — TORQUE PINION TO GEAR

Fix the gear to prevent rotation and torque the pinion to the gear in the actual direction in which it is to operate. For double helical gears, make sure the pinion apex centers on the gear apex. This is done by barring the pinion axially to make sure it is free to float within the bearings. Anti-friction bearings should be free to float and centered in their pedestals when the pinion is centered against apex of gear.

6.2.4 — CONTACT AND BACKLASH MEASUREMENTS

6.2.4.1

Determine the allowable difference between Contact Left and Contact Right.

This is determined with the following formula:

$A = (F \times R)/D$

Where A = Allowable Difference between Contact Left and Contact Right - in/mm

F = Face Width of Gear - in/mm

R = Allowable Gear Rim Face Runout -in/mm (Table 5)

D = Gear Outside Diameter - in/mm

6.2.4.2

With the pinion torqued firmly to the gear, check the contact and backlash side of the teeth at the mesh point at each station. This is done by drawing a feeler gauge between the teeth as shown in Figure 19. Always check contact and backlash close to the pitch diameter line that has been scribed on the side of the gears as illustrated in Figure 20. The scribe lines can also be used to help control running backlash (clearance) by visual inspection. As shown in Figure 20, proper running backlash (clearance) is assured only when scribe lines

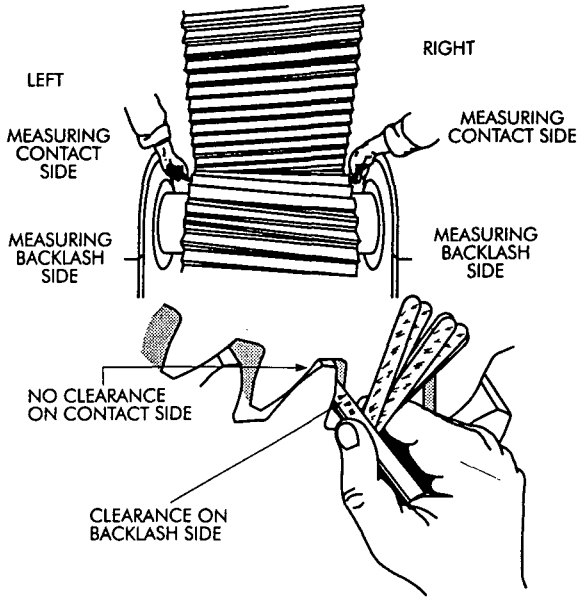

Figure 19 — CHECK BACKLASH

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are tangent or operating apart. If scribe lines overlap, as in case 3, it is necessary to separate the gear and pinion to provide necessary backlash.

Adjust the bearing pedestals until the difference between the Contact Left and Contact Right readings are as close to zero as possible without exceeding the allowable difference (A) calculated above, and you achieve a near equal backlash within the recommended range at Backlash Left and Backlash Right. Measurements should be made at each station of the gear and recorded on Worksheet 6: Contact and Backlash/Root Clearance. See Appendix IV for a contact and backlash feeler gauge measurement example.

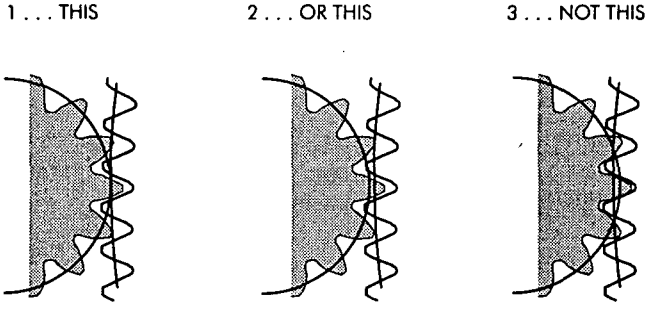

Figure 20 — SCRIBE LINES

6.2.5 — INTERPRETATION OF FEELER GAUGE READINGS

The total of (Contact Left + Backlash Left) should equal the total of (Contact Right + Backlash Right). If these are not equal, the side with the lowest total is in a position that is closer in center distance than the side with the higher total. See Figure 23A, Misalignment in the Plane of Centers.

If Contact Left and Contact Right are not equal, one end of the pinion is at a different elevation than the other. See Figure 23B, Misalignment at Right Angle to the Plane of Centers. The difference between the Contact Left and Contact Right readings should be as close to zero as possible without exceeding the allowable difference (A) calculated above.

Because of radial runout in the gear, the total of (Contact Left + Backlash Left) or (Contact Right + Backlash Right) may vary at each position. This is not detrimental providing the amount of variation falls within the allowable radial runout.

6.2.6 — SECONDARY ADJUSTMENT OF PINION

It is necessary to evaluate all values at each position before making any adjustments. Otherwise, one could create more misalignment at one position by correcting that of another. The best possible pinion move to correct the contact and backlash for all positions must be established.

It is also necessary to take into account the change in shape and deflection of the shell when under full load. The shell deflection will affect alignment of the gear set and must be anticipated to obtain proper contact under running conditions.

After establishing the pinion move which is to be made, place indicators on the pillow block which is to be moved, so that its change in position can be measured. The indicators should be placed before loosening the pillow block bolts. It is then possible to add or subtract shims or to shift the pillow block a known amount. The indicators should be checked again after retightening the bolts.

NOTE: In some cases (e.g. when the drive components are aligned), it may be easier to move the shell as opposed to the pinion pillow blocks. Consult the shell manufacturer before performing any such move.

6.2.7 — CHECK FOR UNIFORM CONTACT PATTERN

After completing the secondary pinion alignment, and with the pedestals firmly secured, check the tooth contact to assure accurate gear alignment. Apply a very thin, smooth coat of contact marking medium to five or six pinion teeth (previously cleaned) as shown in Figure 21. Make sure the entire tooth profiles are covered across the face width. Roll the pinion back and forth through the mesh several times to trace the contact pattern on the gear teeth. If motor power is not available, use a torque arm and "bump" the teeth on both sides as the pinion is rolled back and forth.

Photographs or tape transfers of the as-manufactured contact patterns are provided with the inspection documentation included with every ring gear. The installed pattern should match the as-manufactured pattern as closely as possible. For pinions with un-modified tooth attributes (typically with as-cut teeth) the contact pattern may be scattered but should be present across at least 80% of the gear face width and 50% of the tooth profile height. For pinions with modified tooth attributes (typically with finish ground teeth) the contact pattern should cover about 50% of the face width and 50% of the profile height.

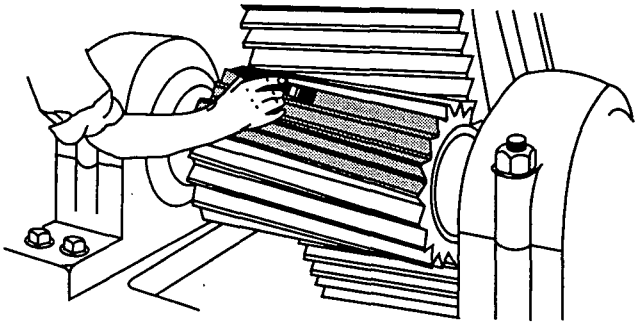

Figure 21— COAT PINION TEETH

After a satisfactory contact pattern is established for the initial position of the gear, the same contact check should be made at a minimum of three more equally spaced locations on the gear. A minor adjustment to the pinion may be necessary to produce the best average contact on the gear.

Permanent records of the installed tooth contact patterns should be taken for future reference. Suggested methods are tape impressions, photographs or sketches.

6.2.8 — PROCEED TO STEP 7.0

6.3 — PROCEDURE FOR INSTALLING A NEW PINION WITH A USED GEAR

6.3.1 — RECOMMENDED BACKLASH

When setting a new pinion with an existing gear, it is important to ensure that the new pinion will mate with undamaged gear teeth. Inspect the contact flanks of the gear to verify that there are no signs of destructive wear such as pitting, spalling, or wear patterns on the tooth profile. Any defects in the gear teeth profiles will be quickly transferred to the pinion and could result in premature pinion failure. If defects are present in the gear teeth, it is recommended that the gear be removed and rotated so that the opposite flanks of the gear teeth will be in contact with the pinion. If the gear has already been rotated and there are no clean tooth flanks available, the gear should be replaced.

Since the new pinion will be mating with a gear whose teeth are worn on at least one flank, the backlash tolerances described in Step 6.2 would not be valid. Therefore, when setting the new pinion, it will be necessary to use the root clearance to verify proper installation. The root clearance is defined as the distance between the tips of the pinion teeth and the roots of the gear teeth when they are in mesh. The distance should be measured at the center of the gear tooth root fillet radius. See Figure 22.

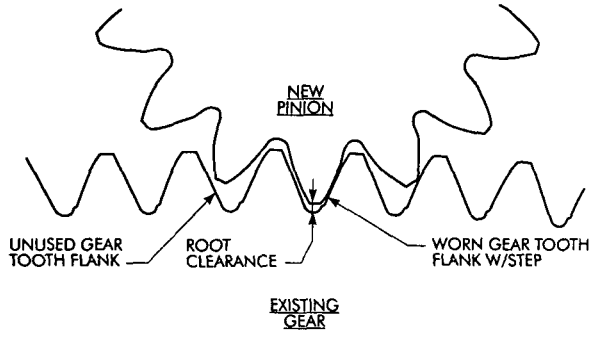

FIGURE 22: NEW PINION MATING WITH EXISTING GEAR

Figure 22 — NEW PINION MATING W/EXISTING GEAR

CAUTION: It is imperative to use the proper reference for root clearance measurements. The values in this manual are based on the clearance between the tips of the pinion teeth and the roots of the gear teeth. Do not measure the root clearance between the tips of the gear teeth and the roots of the pinion teeth as this could give erroneous results.

If the teeth of the new pinion will mate with the worn flanks of the existing gear, proceed to Step 6.3.1.1, otherwise

If the teeth of the new pinion will mate with the unused flanks of the existing gear and the shell is roller mounted and the shell temperature during operation will exceed 400°F (200°C), proceed to Step 6.3.1.3, otherwise, proceed to Step 6.3.1.2.

6.3.1.1 — Root Clearance For A New Pinion Mating With Worn Gear Tooth Flanks

Before removing the existing pinion, measure the root clearance of the existing gear and pinion. This value is the required root clearance for the new installation to ensure that the new pinion will not operate on any steps along the used gear tooth flanks. Figure 22 shows a new pinion mating with the worn face of an existing gear. As the gear has been in service, a slight step has developed at the base of the gear tooth. It is important to ensure that the new pinion tooth flanks do not come into contact with this step or else premature failure could result.

Proceed to Step 6.3.2.

6.3.1.2 — Root Clearance For Pinions Mating With Unused Gear Tooth Flanks On Trunnion Mounted Shells and Low Temperature Roller Mounted Shells

The root clearance requirement is determined by adding two factors:

(1) Thermal Backlash Factor — allows for the thermal expansion of the gear and pinion during normal operation, and

(2) Tooth Form Root Clearance Factor — includes the recommended root clearance for a given tooth form.

The root clearance requirement can be calculated as:

Root Clearance Requirement = Thermal Backlash Factor + Tooth Form Root Clearance Factor

The root clearance requirement has a tolerance of +0.010 in., -0.000 in. (+0,25 mm, -0,00 mm).

The Thermal Backlash Factor can be determined from the graph shown in Figure 18.

The Tooth Form Root Clearance Factor can be obtained from Table 7. Note, the diametral pitch is shown on the gear drawing.

TABLE 7 — Tooth Form Root Clearance Factor

Tooth Form	Approximate Tooth Height		Tooth Form Root Clearance Factor (Excluding Thermal Allowance)	
	(In)	(mm)	(In)	(mm)
1 DP, Mill	1.925	48,9	.222	5,64
1-1/4 DP Mill	1.675	42,5	.204	5,18
1-1/2 DP, Mill	1.395	35,4	.173	4,39
3/4 DP, FHD	3.025	76,8	.356	9,04
7/8 DP, FHD	2.585	65,7	.311	7,90
7/8 DP, FHD-LA	2.710	68,8	.196	4,98
1 DP, FHD	2.270	54,7	.272	6,91
1-1/4 DP, FHD	1.820	42,2	.220	5,59
1-1/2 DP, FHD	1.520	38,6	.186	4,72
1-1/4 DP, UFD	1.590	40,4	.204	5,18
1-1/2 DP, UFD	1.330	33,8	.172	4,37
1-3/4 DP, UFD	1.140	29,0	.150	3,81
2 DP, UFD	1.000	25,4	.129	3,28

For example, if we have a gear with a 1 DP, FHD tooth form, 150 in. center distance, and an anticipated 90°F temperature rise above ambient, the required root clearance would be:

Tooth Form Root Clearance	.272 in. +
Thermal Backlash	.090 in. =
Root Clearance Requirement:	**.362 in.**

Proceed to Step 6.3.2.

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6.3.1.3 — Root Clearance For Pinions Mating With Unused Gear Tooth Flanks on High Temperature Roller Mounted Shells

The root clearance requirement is determined by adding two factors:

(1) Tooth Form Root Clearance Factor — includes the recommended root clearance for a given tooth form.

(2) Wear Allowance Factor — includes an allowance for wear of the shell riding ring and rollers. As the riding ring and rollers wear, the axis of the shell will drop vertically. As this happens, the gear and pinion teeth will be forced into a tighter mesh. It is imperative that proper monitoring of the riding ring and rollers is performed to ensure that the gear teeth are not forced into tight mesh which could result in severe damage to the gearset. Therefore, this value should be selected to meet the requirements of each installation and ensure that a proper safety margin is maintained. An initial value of 0.030 in. (0,76 mm) may be used if prior operating data is lacking.

The root clearance requirement can be calculated as:

Root Clearance Requirement = Tooth Form Root Clearance Factor + Wear Allowance Factor

This root clearance requirement has a tolerance of +0.010 in., -0.000 in. (+0,25 mm, -0,00 mm).

The Tooth Form Root Clearance Factor can be obtained from Table 7. Note, the diametral pitch is shown on the gear drawing.

Proceed to Step 6.3.2.

6.3.2 — PRELIMINARY SETTING OF PINION

Place the pinion assembly approximately parallel with the gear axis by leveling and preliminary shimming of the bearing pedestals. It is recommended that a minimum of 0.030 in. (0,76 mm) of shims be used underneath each pillow block. This will allow for future adjustments if they become necessary. Shims should be steel and should support the entire pillow block.

If the gear set is single helical, the bearing caps should be removed to make sure that the stabilizing rings are in the fixed pedestal and that the free bearing is in the center of its axial float.

In the case of a double helical (or herringbone) gear set, the double helical pinion should have 0.092 in. (2,34 mm) minimum axial float and the bearings should be centrally located.

Where locknuts are used to secure the bearing, check for tightness and make sure the lock tab on the washer is secure.

Position the pinion to provide the proper root clearance while maintaining the proper tooth contact. The setting of contact and root clearance must be done simultaneously. Select the proper root clearance requirement as previously described. The root clearance must be set where the radial runout of the gear causes the minimum root clearance. This would be at the station with the highest positive (+) radial runout. Refer to the Radial Runout readings recorded previously on Worksheet 3 in order to identify the Station where this will occur.

6.3.3 — TORQUE PINION TO GEAR

Fix the gear to prevent rotation and torque the pinion to the gear in the actual direction in which it is to operate. For double helical gears, make sure the pinion apex centers on the gear apex. This is done by barring the pinion axially to make sure it is free to float within the bearings. Anti-friction bearings should be free to float and centered in their pedestals when pinion is centered against apex of gear.

6.3.4 — CONTACT AND CLEARANCE MEASUREMENTS

6.3.4.1

Determine the allowable difference between Contact Left and Contact Right.

This is determined with the following formula:

$A = (F \times R)/D$

Where A = allowable difference between Contact Left and Contact Right - in/mm

F = Face Width of Gear - in/mm

R = Allowable Gear Rim Face Runout -in/mm (Table 5)

D = Gear Outside Diameter - in/mm

6.3.4.2

With the pinion torqued firmly to the gear, check the contact side of the teeth at the mesh point at each station. This is done by drawing a feeler gauge between teeth as shown in Figure 19. Always check contact close to the pitch diameter line that has been scribed on the side of the gears as illustrated in Figure 20. The scribe lines can also be used to help control running clearance by visual inspection. As shown in Figure 20, proper running clearance is assured only when scribe lines are tangent or operating apart. If scribe lines overlap, as in case 3, it is necessary to separate the gear and pinion to provide necessary root clearance.

Adjust pedestals until the difference between the Contact Left and Contact Right readings is as close to zero as possible without exceeding the allowable difference (A) calculated above, and you achieve a near equal root clearance within the recommended range at Root Clearance Left and Root Clearance Right. Measurements should be made at each station of the gear and recorded on Worksheet 6: Contact and Backlash/Root Clearance.

6.3.5 — INTERPRETATION OF CONTACT AND ROOT CLEARANCE MEASUREMENTS

If the Root Clearance Left measurements are consistently above or below the Root Clearance Right measurements, the side with the lowest total is in a position that is closer in center distance than the side with the higher total. See Figure 23A, Misalignment in the Plane of Centers.

If Contact Left and Contact Right are not equal, one end of the pinion is at a different elevation than the other. See Figure 23B, Misalignment at Right Angle to the Plane of Centers.

Because of radial runout in the gear, the Contact Left and Contact Right measurements may vary at each position. This is not detrimental providing the amount of variation falls within the allowable radial runout.

6.3.6 — SECONDARY ADJUSTMENT AND FINAL CHECK OF PINION

Complete the final adjustment and contact check for the pinion as described in Steps 6.2.6 & 6.2.7.

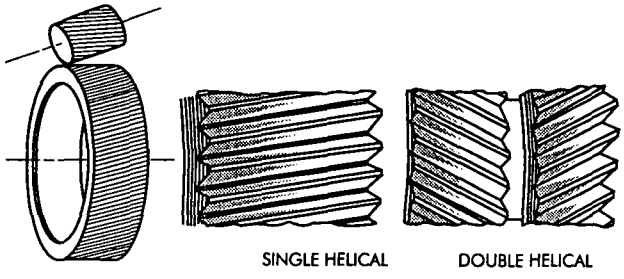

Figure 23A — MISALIGNMENT IN THE PLANE OF CENTERS

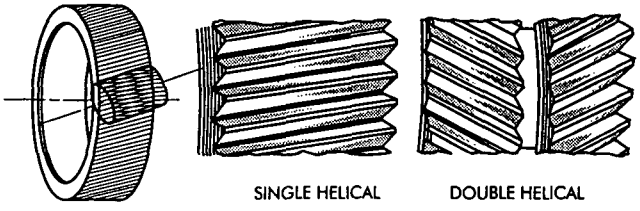

Figure 23B — MISALIGNMENT AT RIGHT ANGLE TO THE PLANE OF CENTERS

STEP 7 — INSPECT FINAL GEAR ASSEMBLY

Inspect the gear teeth and remove all metal upsets and burrs which may have occurred in handling or assembly. Recheck all gear bolts. If the gear is furnished with gear mounted seal accessories (e.g. angle dust guards) refer to the appropriate drawing for assembly. Clean gear teeth and enclosures thoroughly.

STEP 8 — DYNAMIC ALIGNMENT CHECK

The only true measure of contact is under normal running conditions. This is necessary because of the effects of shell temperature, change in deflection of the shell or support structure, pinion shaft motion in the bearing clearance, motion of the foundation, shell shift in trunnion bearing clearance, etc. The initial alignment of the gear and pinion with feeler gauges and indicators is important and a good starting point, but the dynamic contact under normal load determines the load distribution across the face. The dynamic alignment is checked by using both the layout dye and the temperature measurement methods.

8.1 — CHECK THE CONTACT USING LAYOUT DYE

After thoroughly cleaning the gear teeth, paint three teeth at six equally spaced positions around the gear with layout dye. Install the gear guard enclosure around the gearing and lubricate the teeth. See Lubrication and Maintenance Service Manual 638-050 for information and recommendations regarding lubrication. Run the equipment for six to eight hours at a minimum of 50% of full load. After the equipment is stopped, remove the lubricant from the marked teeth without removing the remaining layout dye. The layout dye should wear off of 95% of the face width of the gear teeth at each position which will indicate that the gear and pinion are in good alignment.

If a gear has axial runout, the contact will vary from one side of the gear face to the other in a sinusoidal pattern with each rotation of the gear. The contact pattern on the pinion will migrate accordingly. However, inspection of the pinion teeth would show 100% contact, but in truth, it could be 50% contact on one side of the face during half of the gear rotation, and 50% contact on the other side during the rest of the rotation. A better indication of contact can be obtained by checking more gear locations.

If anything other than 95% face contact at 50% of full load at all locations is found, realignment is required. When determining which direction to move the pinion or the shell, it is necessary to evaluate the contact patterns and relate them to the pinion rotation. Figures 23A and 23B offer some ideas for adjustments based on the contact patterns.

It will be necessary to repeat the above layout dye test after making any alignment adjustments.

8.2 — CHECK THE CONTACT USING A PYROMETER OR INFRARED THERMOMETER

Misalignment in gear sets produces non-uniform load distribution across the face of the gearing and results in higher operating temperatures at the point of highest load. Equal temperatures at both ends of the pinion face indicate a uniform load distribution and optimum alignment. Non-equal temperatures indicate that the gear set is misaligned with heavier load distribution on the side with the higher operating temperature.

The temperature distribution across the face may be determined by the contact pyrometer method or the infrared radiation thermometer method. The basic alignment theory for both methods is the same. The pyrometer method requires the gear set to be shut down and temperature readings to be taken immediately. The short duration of time required to stop the gear set and measure temperatures may be sufficient to allow temperatures to shift and thus give erroneous data. Therefore, when the pyrometer method is used, expedience is of utmost importance.

When taking gear mesh temperature measurements, it is necessary to allow the equipment to operate at least 24 hours before taking readings to insure system temperature stabilization.

8.2.1 — MEASUREMENT PROCEDURES

8.2.1.1 — Surface Contact Pyrometer Equipment Stopped

A pyrometer capable of measuring 400°F (200°C) accurate to within ±3°F (±2°C) is recommended. Pyrometer measurements are taken at the pitchline on the loaded flank of the pinion tooth at the positions shown in Figure 24. The measurements must be taken immediately after shut down and directly through the lubricant film (i.e., the teeth should not be cleaned with solvent). Measurement Position 1 is always on the non-drive end of the pinion.

8.2.1.2 — Infrared Thermometer Equipment Operating

Use an infrared radiation thermometer capable of measuring 400°F (200°C). The infrared thermometer must be calibrated prior to taking data. If the infrared thermometer used requires an emissivity setting, experience has shown that a value of 0.8 typically produces adequate readings.

Position the detector approximately 3 feet (1 m) from the mesh of the gear set. Aim the instrument at five measurement positions across the face of the pinion as shown in Figure 24.

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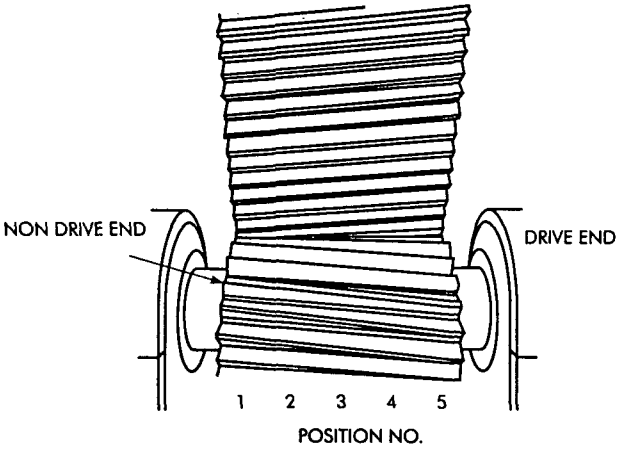

Figure 24 — MEASUREMENT POSITIONS FOR PYROMETER AND INFRARED THERMOMETER

In addition, the infrared instrument should be aimed at the axis of the pinion shaft, not toward the pitch line of the tooth flank. Temperature readings, along with the other required application data, can be recorded on Worksheet 7: Mesh Operating Temperature. Please note, all of the data shown on the worksheet must be supplied in order to determine any required alignment adjustments later. When selecting the measurement positions, Position 1 is always on the non-drive end of the pinion face.

8.2.2 — DATA INTERPRETATION – TEMPERATURE DISTRIBUTIONS

Figure 25, solid black line, illustrates the temperature distribution of a gear set having optimum alignment. The temperature gradient, which is the temperature at Position 1 minus the temperature at Position 5, is zero and this indicates that the load distribution is equal.

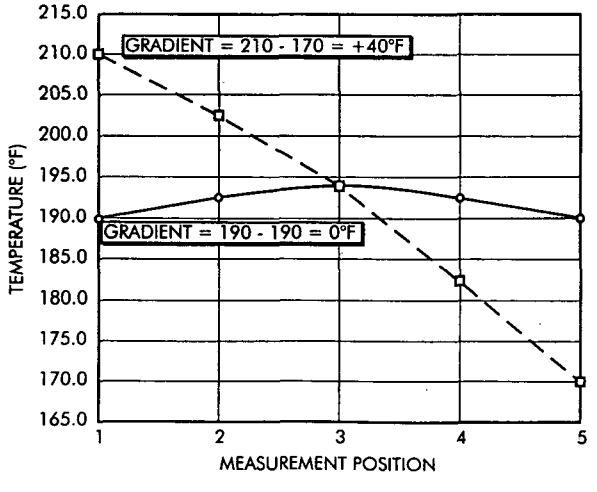

Figure 25 — TEMPERATURE DISTRIBUTION

Figure 25, dashed line, illustrates the distribution of a gear set having poor alignment. The temperature gradient of this set is +40°F which indicates that misalignment is producing unequal load distribution that is higher on the non-drive end of the pinion.

If the temperature gradient is less than 15°F (8°C), the gearset is adequately aligned. If the gradient exceeds this limit, the alignment of the gearset should be adjusted as described in Step 8.2.3.

8.2.3 — ALIGNMENT CORRECTION

It is recommended that the pinion bearing pillow blocks be moved vertically and/or horizontally to improve alignment whenever the magnitude of the gradient exceeds 15°F (8°C). As stated previously, using the data collected on the "Gearing Temperature Worksheet", it is possible to calculate the required pinion adjustments to minimize the operating temperature gradient. There are two ways to perform these calculations:

(1) A computer program is available to Falk customers which will perform the calculations and indicate the required pinion adjustment(s). This program will operate on IBM PC compatible systems utilizing Windows 3.1 or higher. You may contact your local Falk Sales Office or Falk-Milwaukee to obtain a complimentary copy of this software.

(2) The completed "Gearing Temperature Worksheet(s)" may be forwarded to Falk Engineering where the calculations will be performed for you. Falk Engineering will return the required pinion adjustment(s) to you along with any recommendations or concerns regarding the submitted data. This method has the distinct advantage of allowing Falk Engineering to review your application to ensure that the gearset is operating at peak efficiency. Please note that a separate worksheet should be used for each pinion. Also, a separate worksheet should be used for each direction of rotation.

NOTE: For bi-directional rotation applications, it is imperative to provide operation data for both directions of rotation. The equipment should be operated for at least 24 hours in both directions to allow the system temperature to stabilize.

After adjusting the pinion(s), operate the equipment for at least 24 hours, then recheck the temperature gradient and readjust the pinion(s) if necessary.

CAUTION: *Adjusting the pillow blocks could cause misalignment of the couplings and other associated equipment. Recheck and readjust these alignments after any pinion adjustments.*
The final load distribution check should be made in both directions of rotation for reversible equipment.

It is recommended that periodic inspection be made to assure proper tooth contact.

Periodic temperature monitoring should be performed for the first month of operation, under varying load conditions and in both directions of rotation (if applicable). If the temperature readings indicate that the alignment is satisfactory, dowel or permanently affix the location of the pinion shaft bearing support pedestals.

APPENDIX I — RIM FACE RUNOUT EXAMPLE

A typical gear had readings as listed in Table 8. This is a 288 in. outside diameter flange mounted gear with 18 stations, located on a trunnion mounted shell. The procedure given in Step 4 was used to fill in the worksheet columns. The installed rim face runout is shown in Column 8. The rim face runout from station-to-station is shown in Column 9.

The total installed rim face runout is the difference between the maximum value and the minimum value of Column 8. In this case, the maximum values appear at stations 5 and 13. The total installed rim face runout is the difference between the two values or +.0054 in. - (-.0054 in.) = .0108 in. This value is below the allowable maximum value of .0140 in. given in Table 5.

Using an MF factor of .171 (from Table 4 for an 18 station gear), the maximum allowable runout between stations is determined to be .014 in. x .171 = ±.0024 in. Now, it is necessary to compare this allowable against each of the station-to-station runout values listed in Column 9. In this case we see that all of the Column 9 values are below the allowable station-to-station limit.

Since the allowable is greater than the actual runout for both cases, the gear is acceptable as mounted. If the actual runout exceeds the allowable value, it will be necessary to correct the alignment by shimming at the mounting flange bolts.

TABLE 8 — Rim Face Runout

Column	1	2	3	4	5	6	7	8	9
Station No	Indicator C	Indicator D	Column 1 Plus Column 2	Indicator F or Column 3 Divided by 2.0	Indicator A	Axial Runout	As Manufactured Axial Runout Values	Installed Axial Runout (Column 6 Minus Column 7)	Station to Station Runout (Difference Between Successive Stations in Column 8)
1	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
2	.0017	-.0005	.0012	.0006	.0044	.0038	.0022	.0016	.0016
3	.0034	-.0008	.0026	.0013	.0084	.0071	.0034	.0037	.0021
4	.0047	-.0009	.0038	.0019	.0111	.0092	.0044	.0048	.0011
5	.0055	-.0005	.0050	.0025	.0125	.0100	.0046	.0054	.0006
6	.0059	.0003	.0062	.0031	.0123	.0092	.0044	.0048	-.0006
7	.0059	.0017	.0076	.0038	.0109	.0071	.0034	.0037	-.0011
8	.0055	.0033	.0088	.0044	.0082	.0038	.0022	.0016	-.0021
9	.0050	.0050	.0100	.0050	.0050	.0000	.0000	.0000	-.0016
10	.0032	.0054	.0086	.0043	.0005	-.0038	-.0022	-.0016	-.0016
11	.0014	.0056	.0070	.0035	-.0036	-.0071	-.0034	-.0037	-.0021
12	.0000	.0056	.0056	.0028	-.0064	-.0092	-.0044	-.0048	-.0011
13	-.0010	.0050	.0040	.0020	-.0080	-.0100	-.0046	-.0054	-.0006
14	.0000	.0056	.0056	.0028	-.0064	-.0092	-.0044	-.0048	-.0006
15	.0014	.0056	.0070	.0035	-.0036	-.0071	-.0034	-.0037	.0011
16	.0032	.0054	.0086	.0043	.0005	-.0038	-.0022	-.0016	.0021
17	.0050	.0050	.0100	.0050	.0050	.0000	.0000	.0000	.0016

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APPENDIX II — RADIAL RUNOUT EXAMPLE

For a 288 in. outside diameter ring gear with 18 stations, the allowable radial runout is .021 in. (from Table 3). The allowable radial runout from station-to-station is determined by multiplying this value by the MF factor of .171 from Table 4 or .021 in. x .171 = ±.0036 in.

The readings for the gear are listed in the Table 9. The total radial runout is obtained by combining the maximum reading with the minimum reading. In this case, the values are a maximum of +.0019 in. found at Station 17 and a minimum of -.0142 in. found at Station 8. The two combined yield a total radial runout of .0161 inches which is below the allowable limit of .021 in.

Next, by comparing the allowable station-to-station runout of ±.0036 in. against all of the station-to-station runout values listed in Column 4, it can be seen that the station-to-station runout is acceptable. Since both values are within the allowable limits, this installation is acceptable.

TABLE 9 — Radial Runout

Column	1	2	3	4
Station No.	Radial Runout Indicator Reading	As-Manufactured Radial Runout Values	Installed Radial Runout (Column 1 Minus Column 2)	Station-to-Station Runout (Difference Between Successive Stations in Column 3)
1	.0000	.0000	.0000	
2	.0017	.0023	-.0006	-.0006
3	.0017	.0038	-.0021	-.0015
4	.0000	.0044	-.0044	-.0023
5	-.0034	.0043	-.0077	-.0033
6	-.0079	.0031	-.0110	-.0033
7	-.0130	.0000	-.0130	-.0020
8	-.0181	-.0039	-.0142	-.0012
9	-.0226	-.0098	-.0128	.0014
10	-.0260	-.0133	-.0127	.0001
11	-.0277	-.0155	-.0122	.0005
12	-.0277	-.0165	-.0112	.0010
13	-.0260	-.0168	-.0092	.0020
14	-.0226	-.0165	-.0061	.0031
15	-.0181	-.0155	-.0026	.0035
16	-.0130	-.0133	.0003	.0029
17	-.0079	-.0098	.0019	.0016
18	-.0034	-.0039	.0005	-.0014
1	.0000	.0000	.0000	-.0005

APPENDIX III — BACKLASH CALCULATION EXAMPLE

Using a gear set with a diametral pitch of 1 DP and center distance of 150 in. The ambient temperature at the time of installation is 70°F and the expected operating temperature is 130°F.

To begin, determine the Thermal Backlash Factor for this application using Figure 18. It will first be necessary to calculate the temperature rise of this gearset during operation as 130°F - 70°F = 60°F. From Figure 18 we see that the Thermal Backlash Factor is .060 in.

Next, the Diametral Pitch Backlash factor can be obtained from Table 6 which equals .045 in. for this example. The recommended backlash at ambient temperature can now be calculated as .060 in. + .045 in. = .105 in.

APPENDIX IV — CONTACT AND BACKLASH FEELER GAUGE MEASUREMENT EXAMPLE

A gear has an outside diameter of 288 in. and a 30 in. face. From Table 5, the allowable rim face runout is 0.014 in. The allowable difference between Clearance Left and Clearance Right (A) is found with the following formula:

A = (F x R)/D

Where:

A = Allowable Difference between Clearance Left and Clearance Right - (in.)

F = Face Width of Gear - (in.)

R = Allowable Gear Rim Face Runout - (in.)

D = Gear Outside Diameter - (in.)

A = (30 in. x 0.014 in.)/288 in. = 0.0015 in.

The feeler gauge readings for the gear are shown in Table 10 First, verify that the total of Contact Left plus Backlash Left equals the total of Contact Right plus Backlash Right at each station. Looking at the right two columns of the completed table, it can be seen that this is essentially true for all stations. The minor variances in the middle station readings are not a significant concern. Next, determine the maximum difference between Clearance Left and Clearance Right at any given station, which is .0014 in. for this example. This value is less than the allowable value A calculated above, so this is an acceptable preliminary setting.

TABLE 10 — Contact and Backlash/Root Clearance

Station No.	Contact Flank			Backlash Flank or Root Clearance		Total of Contact and Backlash	
	Left	Right	Variance	Left	Right	Left	Right
1	.0014	.0000	.0014	.0499	.0513	.0513	.0513
2	.0014	.0000	.0014	.0493	.0507	.0507	.0507
3	.0011	.0000	.0011	.0501	.0513	.0513	.0513
4	.0006	.0000	.0006	.0524	.0530	.0530	.0530
5	.0000	.0000	.0000	.0558	.0558	.0558	.0558
6	.0000	.0000	.0000	.0592	.0586	.0592	.0586
7	.0000	.0006	.0006	.0625	.0614	.0625	.0620
8	.0000	.0011	.0011	.0659	.0645	.0659	.0656
9	.0000	.0014	.0014	.0670	.0656	.0670	.0670
10	.0000	.0014	.0014	.0676	.0662	.0676	.0676
11	.0000	.0014	.0014	.0670	.0659	.0670	.0673
12	.0000	.0011	.0011	.0654	.0648	.0654	.0659
13	.0000	.0006	.0006	.0625	.0625	.0625	.0631
14	.0006	.0000	.0006	.0586	.0592	.0592	.0592
15	.0011	.0000	.0011	.0546	.0558	.0558	.0558
16	.0014	.0000	.0014	.0516	.0530	.0530	.0530

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WORKSHEET 1: MOUNTING FLANGE RUNOUT (For One Indicator-, Shell Axial Runout Indicator Fixture-, and Three Indicator-Methods)

Project: _____ **Date:** _____

Equipment ID: _____ **Recorded By:** _____

Column	1	2	3	4	5	6
Station No.	Indicator C	Indicator D	Column 1 Plus Column 2	Indicator F or Column 3 Divided by 2.0	Indicator A	Axial Runout
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						

Total Flange Runout (difference between highest and lowest Column 6 value): ☐

WORKSHEET 2: MOUNTING FLANGE RUNOUT (For Two Indicator-, Method)

Project: _____ **Date** _____

Equipment ID: _____ **Recorded By** _____

Column	1	2	3	4
Station No. (Indicator A)	Indicator A	Indicator B	Column 1 Minus Column 2	Axial Runout (Column 3 Divided by 2.0)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				

Total Flange Runout (difference between highest and lowest Column 4 values): ☐

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WORKSHEET 3: RADIAL RUNOUT

Project _____ **Date** _____

Equipment ID: _____ **Recorded By:** _____

Gear Drawing No.: _____ **Gear Serial No.:** _____

Column	1	2	3	4
Station No.	Radial Runout Indicator Reading	As-Manufactured Radial Runout Values	Installed Radial Runout (Column 1 Minus Column 2	Station-to-Station Runout (Difference Between Successive Stations in Column 3)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
28				
30				
31				
32				
33				
34				
35				
36				
1				

Difference Between First and Last Station 1 Readings from Column 1 (must be <.002") _____

Total Radial Runout (difference between highest and lowest Column 3 values): _____

Allowable Radial Runout: _____

Allowable Station-to-Station Runout: _____

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WORKSHEET 4: RIM FACE RUNOUT (For One Indicator-,Shell Axial Runout Indicator Fixture-, and Three Indicator-Methods)

Project: _____ **Date:** _____

Equipment ID: _____ **Recorded By:** _____

Gear Drawing No.: _____ **Gear Serial No.:** _____

Column	1	2	3	4	5	6	7	8	9
Station No.	Indicator C	Indicator D	Column 1 Plus Column 2	Indicator F or Column 3 Divided by 2.0	Indicator A	Axial Runout	As-Manufactured Axial Runout Values	Installed Axial Runout (Column 6 Minus Column 7	Station to-Station Runout (Difference Between Successive Stations in Column 8)
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
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22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									

Total Rim Face Runout (difference between highest and lowest Column 8 values): _____

Allowable Rim Face Runout: _____

Allowable Station-to-Station Runout: _____

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WORKSHEET 5: RIM FACE RUNOUT (For Two Indicator-Method)

Project: _____ **Date:** _____

Equipment ID: _____ **Recorded By:** _____

Gear Drawing No.: _____ **Gear Serial No.:** _____

Column	1	2	3	4	5	6	7
Station No. (Indicator A)	Indicator A	Indicator B	Column 1 Minus Column 2	Axial Runout (Column 3 Divided by 2.0)	As-Manufactured Axial Runout Values	Installed Axial Runout (Column 4 Minus Column 5)	Station-to-Station Runout (Difference Between Successive Stations in Column 6)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							

Total Rim Face Runout (difference between highest and lowest Column 6 values): _____

Allowable Rim Face Runout: _____

Allowable Station-to-Station Runout: _____

FALK

WORKSHEET 6: CONTACT AND BACKLASH/ROOT CLEARANCE

Project: _____ **Date:** _____

Equipment ID: _____ **Recorded By:** _____

Gear Drawing No.: _____ **Gear Serial No.:** _____

Station No.	Contact Flank			Backlash Flank or Root Clearance		Total of Contact and Backlash	
	Left	Right	Variance	Left	Right	Left	Right
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							

Allowable Difference Between Contact Left and Contact Right (A): _____

Backlash/Root Clearance Requirement: _____

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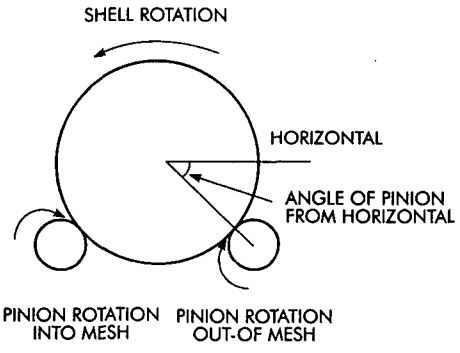
WORKSHEET 7: MESH OPERATING TEMPERATURE

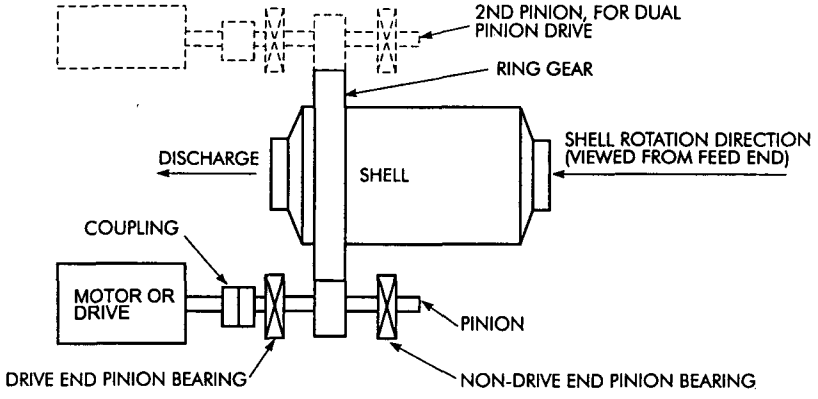
Project _____ **Recorded By:** _____

Equipment ID: _____

Pinion Location ID ‡ _____ **Falk Pinion PN:** _____

Pinion Rotation ‡ _____





Angle of Pinion from Horizontal degrees
[(-) if below horizontal, (+) if above]

Direction of Shell Rotation: CW/CCW
[As viewed from feed end]

Date	Time ★	Actual Motor Power	Temperature at Position †				
			Non-Drive End 1	2	Middle 3	4	Drive End 5

★ The equipment should be operating for at least 24 hours in any given direction before recording temperatures. In addition, it is not necessary to record temperatures more often than every six to eight hours, after temperature has stabilized.

† Position 1 should always be on the non-drive side of the pinion face. Positions 2 through 5 should progress in even increments across the face towards the drive side.

‡ A separate worksheet should be used for each pinion. In addition, a separate worksheet should be used for each direction of rotation. That is, do not record data for more than one pinion or one direction of rotation on the same worksheet.

Introduction

The instructions contained in this manual provide guidelines and recommendations for effective lubrication of general purpose parallel shaft gearing. It is essential to determine in advance of actual gear operation what grade of lubricant, quantity, and method of application are proper and adequate for the operating conditions of the particular application. The lubrication, inspection, and maintenance instructions given here are the result of Falk's many years of experience.

SCOPE AND LIMITATIONS — This lubrication data is limited to properly proportioned parallel shaft gears, where the pitch line speed does not exceed 3000 feet per minute, and where the associated bearings are lubricated separately. Consequently, it does not cover self-contained speed reducer drives or any gear applications where the bearings are included in a common lubrication system. It is specifically confined to fully enclosed gear applications (Hoists and Pumps), semi-enclosed gear applications (Ball Mills, Rod Mills, Kilns, Dryers), or other gears operating under similar conditions.

While this type of gearing has been described as "open gearing," implying usage without enclosures, most applications are actually enclosed. Therefore, the term "general gearing" rather than "open gearing" is used in this manual.

ALIGNMENT — Refer to Service Manual 638-110 for trunnion supported equipment.

CLEANING — Before installing the gear enclosure or guard, careful attention should be given to thorough cleaning of all surfaces of the gear, pinion and gear enclosure (when used) to remove all dirt which may have accumulated in transit or storage. Inspect gear set and remove all burrs and bumps which may have occurred in handling. This precaution will provide clean tooth surfaces and prevent contamination of lubricant.

Lubrication

General gearing, furnished by the gear manufacturer as individual machine parts, is usually mounted on bearings and within enclosures designed and furnished by the builder of the driven equipment. The nature of the application, the design of the gear enclosure and shaft seals, and the ambient conditions surrounding the installation determine the method of lubrication.

For semi-enclosed gear applications, it is well advised to pressurize the gear guard with clean dry air whenever an abrasive atmosphere is present. This aids in preventing abrasive particles from mixing with the lubricant which can result in significantly increasing the life of the gear set.

The various methods of lubrication are grouped into types as described below. Further details and information pertinent to the driven equipment can be obtained, from the supplier.

CONTINUOUS METHODS — These methods of lubrication provide a continuous supply of FLUID OIL to the meshing gear teeth and therefore are not dependent upon a separate system for application. The lubricant is drawn from the reservoir or sump and delivered to the gear mesh either by the partially submerged rotating gear or idler, or by a direct connected or electrically driven oil pump. The methods are generally known as: "splash," "idler immersion" or "pressure." The nature of the application, and the speed and gear arrangement usually determine the most suitable method. The gearing must be fully enclosed and the shafts adequately sealed to prevent oil leakage or contamination of the lubricant.

Typical applications using continuous lubrication methods are Pumps, Hoists, Kilns or similar drives.

INTERMITTENT METHODS — As the name implies, the intermittent methods of lubrication are those in which the lubricant is applied to the working side of the gear teeth at predetermined intervals of time. Systems are available that apply lubricant to the pinion, however, applying lubricant to the gear is preferred to properly flush the gear tooth surface of contaminants. Therefore, an adequate film of lubricant must be maintained on the surfaces of the teeth for the full time interval between applications. The method generally used to apply the lubricant is by "automatic spray."

The "automatic spray" method employs controls for timing the application of lubricant. It is important that the application cycle be carefully controlled to assure adequate lubrication of the teeth.

This method is usually employed on gear applications where it is impractical or difficult to provide oil tight gear enclosures and where it is impossible to prevent abrasive or foreign material from contaminating the lubricant. However, this can be minimized greatly if the gear guard is pressurized properly.

Typical applications using intermittent methods are Autogenous Mills, Semi-Autogenous Mills, Ball Mills, Rod Mills, Kilns, or similar drives.

Recommended Gear Lubricants

The selection of the most suitable lubricant for the application depends primarily on the method of application and the ambient conditions. Therefore, specific recommendations are provided for the two basic methods: Continuous and Intermittent. General information on lubrication and lubricants which applies to both methods is given below.

The viscosity of a lubricant is a measure of its resistance to flow. It is generally specified in Saybolt Seconds Universal (SSU). However, there has been some interest in changing to the international standard (ISO-VG). These numbers correspond to a kinimatic viscosity which is measured in centistokes (cSt). For the heavier grades of lubricant, viscosity is sometimes expressed in Saybolt Seconds Furol (SSF) and these values are approximately 1/10 of the SSU viscosity values for a given lubricant.

Viscosity of a lubricant increases (lubricant thickens – becomes less fluid) when the temperature decreases. With an increase in temperature, the viscosity decreases (lubricant thins out – becomes more fluid). These changes in viscosity with temperature require that careful consideration be given to the selection of lubricants in order to obtain the fluidity required for a given method of application at low temperatures and to provide a lubricant of sufficient viscosity and film thickness at the higher operating temperatures.

Viscosity values are a direct index of fluidity, and are used rather than trade names to specify the gear lubricant recommendations given in this manual. AGMA and ISO-VG grade numbers are used for the less viscous lubricants.

The correct grade and type of high quality lubricant is selected on the basis of viscosity for each method of lubrication. Lubricant suppliers should be consulted for the brand or trade name of the lubricant to suit the type and viscosity range.

NOTE: Contact Falk for use of lubricants not listed in this manual.

CONTINUOUS METHODS — Continuous methods require that the lubricant remain fluid at the ambient temperature to provide proper lubrication at the start of operation of the gear drive.

Extreme pressure lubricants referred to in this manual do not contain any diluents.

The quantity of lubricant required for continuous methods depends upon the size of the oil reservoir, the lubrication system used, and the location of the oil level as specified by the manufacturer of the gear enclosure. Therefore, quantities cannot be specified in this manual.

The AGMA Grade No. for lubricants applied with continuous methods is shown in Table 1.

TABLE 1 — Viscosities for Continuous Methods

Ambient Temperature Range Inside of Guard	Tooth Temperature •	AGMA Grade No. — (ISO-VG)		
		Pressure † & Splash Lubrication PLV ♦ up to 3000 FPM ‡		Idler Immersion
		New Set Min.	Polished Set Min.	PLV ♦ Up to 300 FPM
+15°F to +60°F (–9°C to +16°C)	70°F (21°C)	2, 2EP (68)	2, 2EP (68)	8A, 8AEP (1000)
	100°F (38°C)	5, 5EP (200)	3, 3EP (100)	9, 9EP (1500)
+50°F to +125°F (+10°C to +52°C)	130°F (54°C)	7, 7EP (460)	5, 5EP (200)	11, 11EP (4200-5000)
	160°F (71°)	9, 9EP (1500)	8, 8EP (680)	12, 12EP (6200-7500

† At lower ambient temperatures, pressure lubrication systems must be equipped with suitable heating units for proper circulation of lubrication. Check with lubricant and pump suppliers.
‡ If PLV exceeds 2000 FPM, 6, 6EP is the maximum required.
♦ Pitch line velocity in ft/min = .262 x rpm x pitch diameter in inches.
• Pinion tooth operating temperature measured at pitch line, center of face.

INTERMITTENT METHODS — Intermittent methods require lubricants which will adhere to the gear teeth at pitch line peripheral speeds up to 1200 ft/min. They must provide a film that will resist being rubbed or squeezed off the tooth profiles during the full interval of time between applications. In general, heavy residual compounds with solvent have been found to provide these characteristics.

Residual compounds as referred to in this manual have an asphaltic base and may include extreme pressure additives for extra film strength. Many lubricant suppliers add diluents to these compounds so that they can be applied through lubricant feeders and spray nozzles used for intermittent lubrication.

Minimum allowable viscosity of residual compounds with diluent at 210°F (99°C) is approximately 400 SSU.

Experience has shown that compounds with a Timken film strength of 33 pounds as measured by the United States Steel Retention Test Method have proven to be satisfactory. The lubricant samples to be tested should include diluent in the some proportions as found in the drums which are supplied to the end users.

The lubricant must not be allowed to build up and harden in the tooth roots of the meshing elements.

When necessary, the bulk lubricant and lube lines should be heated, and thermostatically controlled to maintain the pumpability and proper delivery to the gear mesh.

The viscosity of lubricants for the intermittent methods of lubrication is shown in Table 2.

TABLE 2 — Viscosities for Intermittent Methods ★

Ambient Temperature	Viscosity (SSU) at 210°F (99°C) Mechanical Spray Systems Without Diluents
+15°F to +60°F (–9°C to +16°C)	3000-7000
+50°F to +125°F (+10°C to +52°C)	5000-10,000

★ Diluents must be used to facilitate flow through applicators.

QUANTITIES OF LUBRICANT — The quantity of lubricant required for a given application depends on the size of the gear, operating speed and the type of intermittent method of lubrication used. However, best results are usually obtained by the application of small quantities of lubricant at frequent intervals rather than larger quantities at prolonged intervals.

Typical values for quantities of lubricant and frequency of application have been established from test results and field performance and are listed in Table 3. Actual operation on a given application may necessitate some modification. For a difference in gear proportions from those shown, the quantities of lubricant can be obtained by interpolation.

TABLE 3 — Recommended Quantities of Lubricant ■

Gear Diameter (ft)	Automatic Spray System Application (ounces)) Face Width (in)				
	8	16	24	32	40
10	.2	.3	.4	.5	.6
12	.3	.3	.4	.5	.6
14	.3	.4	.5	.6	.7
16	.4	.5	.6	.7	.8
18	.5	.6	.7	.8	.9
20	.6	.7	.8	.9	1.0
22	.7	.8	.9	1.0	1.1
24	.8	.9	1.0	1.1	1.2
26	.9	1.0	1.1	1.2	1.3
28	1.0	1.1	1.2	1.3	1.4
30	1.1	1.2	1.3	1.4	1.5
34	1.3	1.4	1.5	1.6	1.7

■ The spraying time should be equal to the time for one and preferably two revolutions of the gear to ensure complete coverage.
Intervals between applications:
Single Pinion Drives — 20 min. (max.)
Dual Pinion Drives — 15 min. (max.)

Operation, Maintenance & Inspection

Controlled operating procedures and proper maintenance are essential to satisfactory gear performance. It is recommended that an accurate running record is maintained showing the length of operation condition of the teeth, dates of inspection and lubricant application. Important instructions concerning the operation and maintenance of gears and gear drives are listed below.

START-UP PREPARATION — Prior to actual operation, check all lubrication requirements. For the continuous methods of lubrication, see that the oil reservoir or sump is filled to the proper level. If the intermittent system is employed, cover all the teeth on the gear and pinion with lubricant before starting the drive. Where sprays are employed, check to see that they are functioning properly and that they distribute lubricant over the entire face of the gearing.

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Fax: 414-937-4359 e-mail: falkinfo@falkcorp.com web: www.falkcorp.com

INSPECTION FOR PROPER LUBRICATION — On new or repaired jobs, make a visual inspection during the first hour of operation to be sure that the lubrication system is functioning properly. During the initial running-in period, a shut down once every hour is recommended to examine the teeth for contact and adequate film of lubricant. Strobe light inspection may assist in the examination of adequate lube film.

Check spray nozzles daily to assure proper actuation. A strobe light inspection at this time will assist to assure that a uniform spray pattern is present. Check alignment periodically using infrared alignment techniques, refer to Service Manual 638-110.

Where spray systems are being used, check air pressures and pump pressure specified by the supplier of this equipment. Make sure that all spray nozzles are open to insure a correct spray pattern and full coverage of the teeth. Where a metering valve is used for measuring the amount of lubricant to be sprayed from each nozzle, make sure that the valve is traveling its *full* stroke. Keep the lubricant at a uniform temperature above 60°F (16°C) or higher, if required by the lubricant supplier to avoid a malfunction of the spray system in cold weather.

Once every month a more thorough inspection should be made. Wipe the lubricant off several teeth of the gear and pinion and check the condition of the teeth for evidence of misalignment abnormal wear or insufficient lubrication. Check the lubricant for possible contamination. If contaminated, the gear and pinion should be thoroughly cleaned and fresh lubricant supplied.

For inspection of backlash, gear splits, and instructions for remounting of ring gears, refer to Service Manual 638-110 for trunnion supported equipment.

HANDLING — If it becomes necessary to dismantle the drive for any reason, care should be exercised in handling the pinion and gear to prevent damage to the teeth. When lining with a crane, protect the teeth by placing wooden planks between the chain or cable and the ends of the gear teeth. When the gear or pinion is placed on the floor wooden planks or blocks should be used to avoid damaging the teeth.

PINION REPLACEMENT — When installing a new pinion to mesh with a used gear, it is difficult to align the pinion to suit the wear or contact pattern on the working face of the gear teeth. Therefore, the alignment of a new pinion is usually a "cut and try" procedure.

The important steps in the installation and alignment of a replacement pinion are:

1. Carefully inspect all the teeth on the gear for possible burrs ridges or high spots; file or grind these below the normal tooth curvatures to eliminate high load concentration which may cause tooth surface distress, breakage or noisy operation.
2. Align the pinion to the gear in accordance with procedures in Service Manual 638-110.

SPARE PARTS — When communicating with The Falk Corporation for spare parts, refer to the M.O. (Manufacturing Order) number stamped on the rim face of the gears and on the end of pinion shafts for proper identification of parts to be furnished.

SERVICE — More specific and detailed information on installation, alignment, lubrication and maintenance can be obtained from the builder of the driven equipment or from The Falk Corporation.

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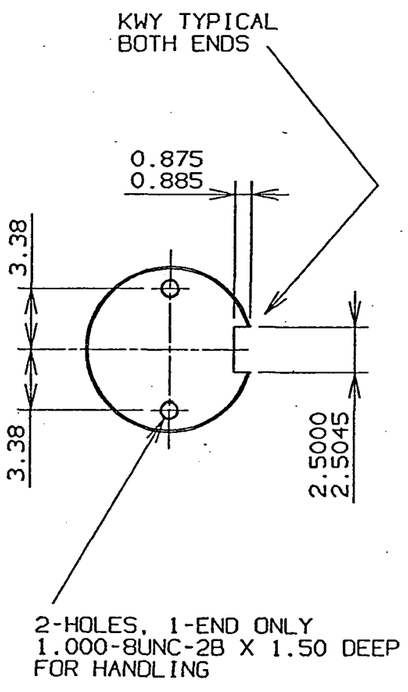
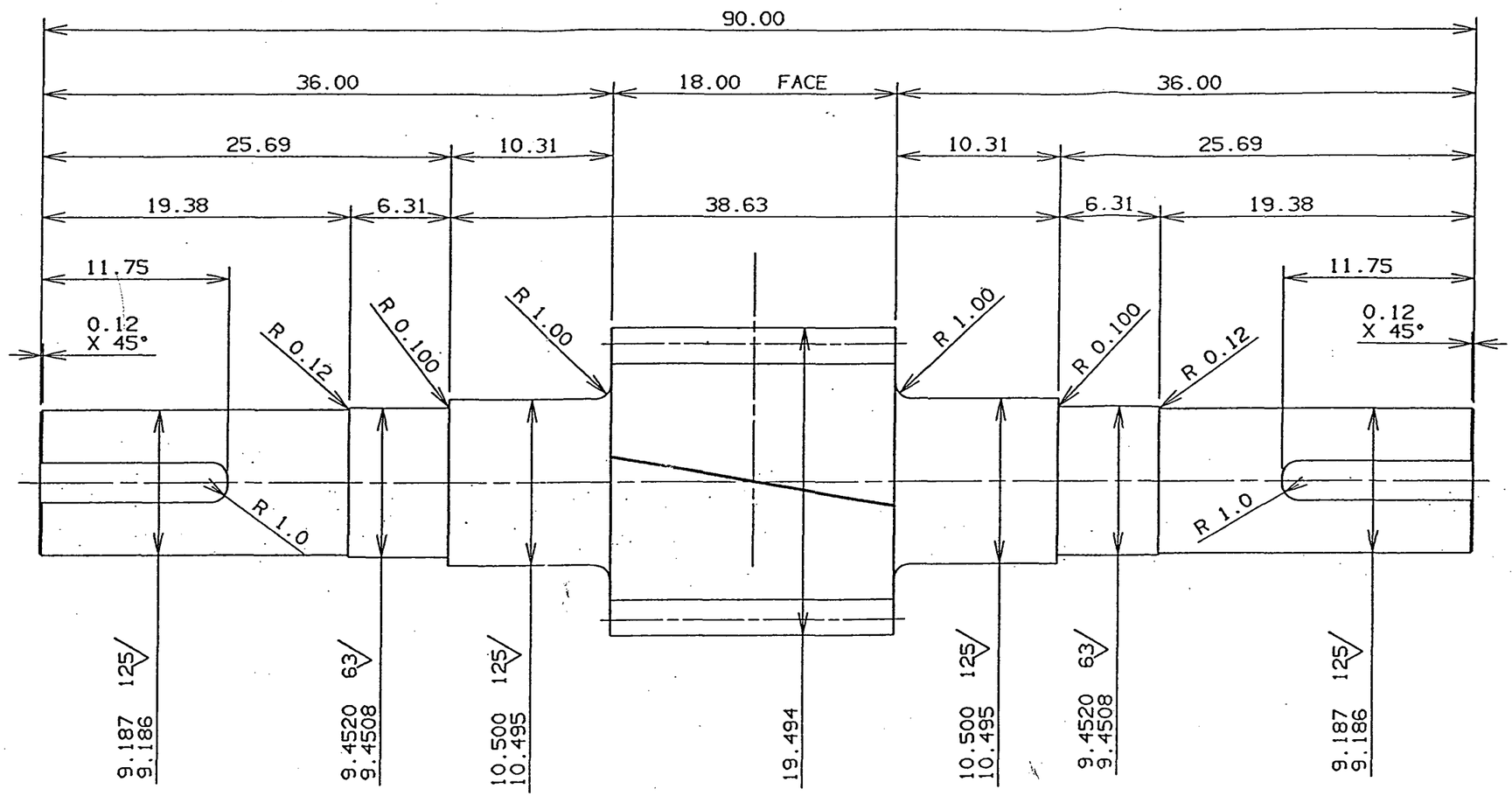
3001 W. Canal St., Zip 53208-4200, Milwaukee, WI USA Telephone : 414-342-3131
Fax: 414-937-4359 e-mail: falkinfo@falkcorp.com web: www.falkcorp.com

638-050
January 1985
Supersedes 6810 3-67

DIRECTION OF THE TEETH SHOWN IS ON THE NEAR SIDE





DATUM (PC) DIAMETER SCRIBED ON BOTH SIDES OF PINION FACE

SPECIAL QUALITY ASSURANCE
REQUIREMENTS PER DRAWING 2125095

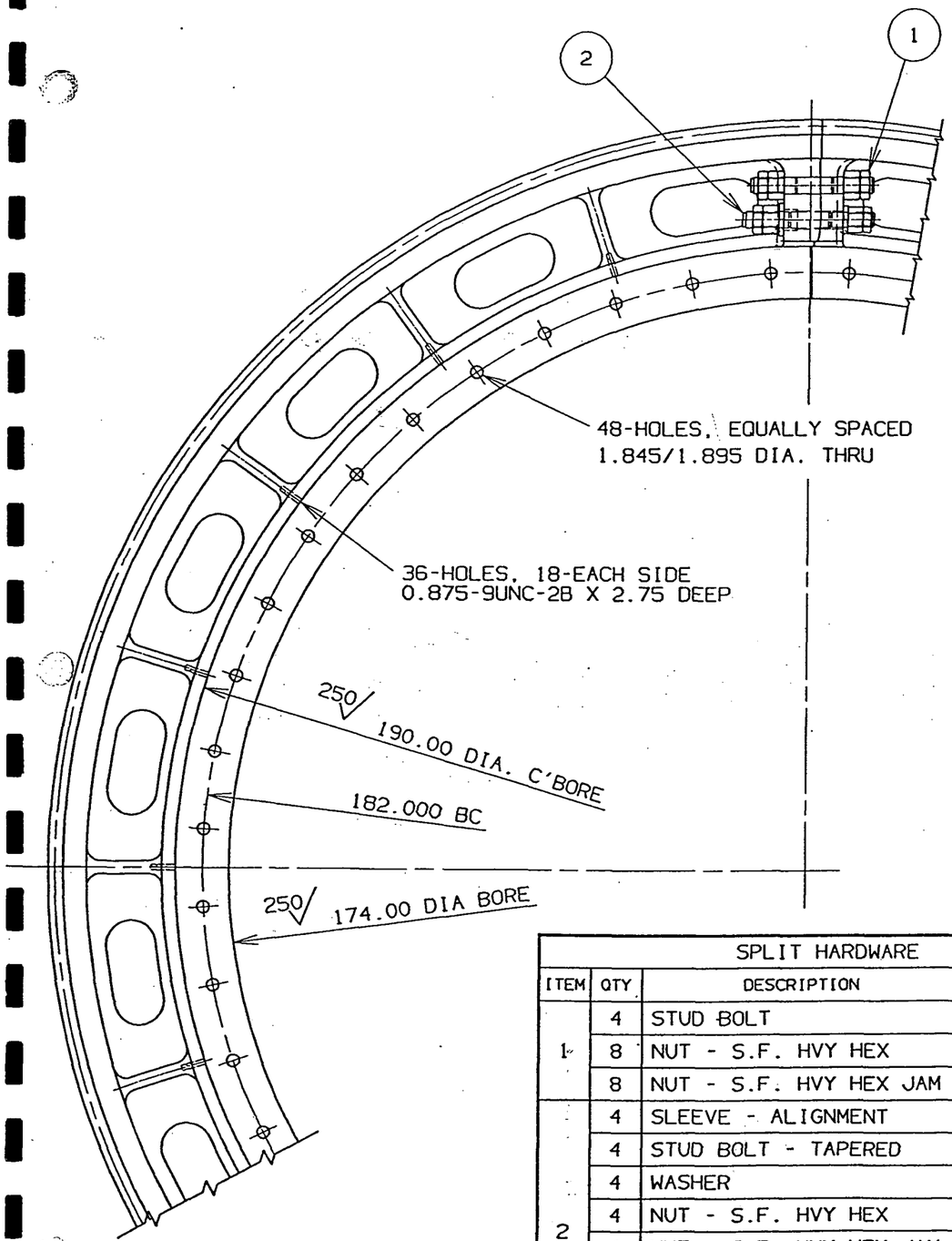
CENTERS: 121.997 RATIO: 13.294:1
NO. TEETH: 17 D.P.: 1.00 NOMINAL
HELIX ANGLE: 10° NOMINAL / HAND: RH
DATUM (PC) DIAMETER: 17.494
HEAT TREAT: 365-415 HB
APPROX. WEIGHT (LBS.): 2,715
MESHES WITH: 520120 / NO. TEETH: 226
PURCHASER'S REF. DRAWING:

*** DO NOT SCALE DRAWING ***

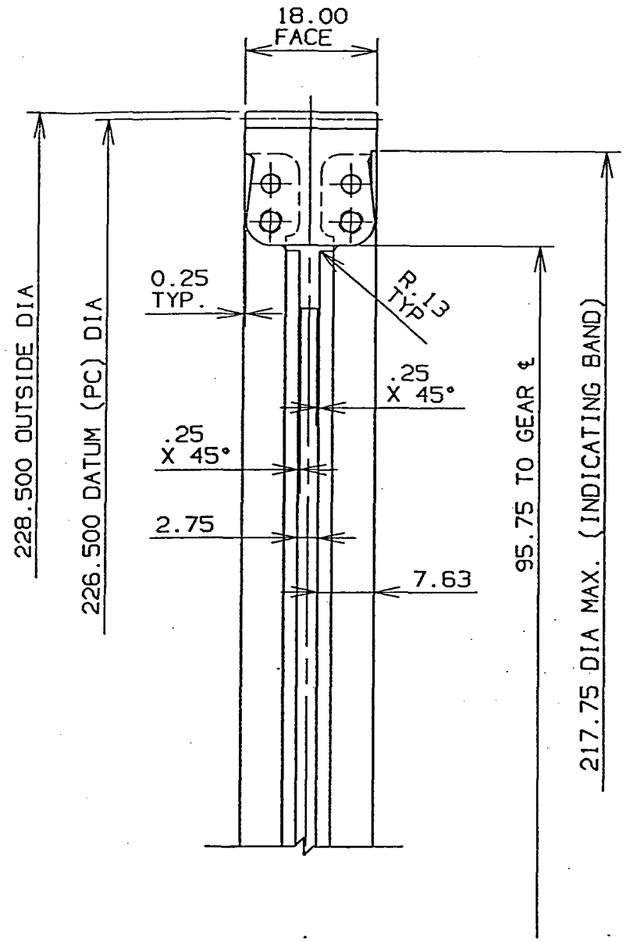
FALK THE FALK CORPORATION
Mill Products Group
MILWAUKEE, WISCONSIN 53201

TITLE: PINION - S.O.S. (358394)
CERTIFIED PRINT FOR:
A-C EQUIPMENT SERVICES

PREPARED BY: RCW	DATE: 10-1-2001
P.O.# 4395DB	REV.DATE: 10-8-2001
M.O.# 01-076215-P	REV. A

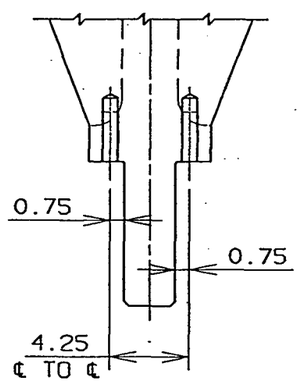


SPECIAL QUALITY ASSURANCE
REQUIREMENTS PER DRAWING 2125031



DATUM (PC) DIAMETER SCRIBED
ON BOTH SIDES OF GEAR FACE

CERTIFIED
RECORD PRINT
OCT 01 2001
PURCHASER



JACKSCREW LOCATION DETAIL

SPLIT HARDWARE			
ITEM	QTY	DESCRIPTION	SIZE
1	4	STUD BOLT	2.500-4UNC
	8	NUT - S.F. HVY HEX	2.500-4UNC
	8	NUT - S.F. HVY HEX JAM	2.500-4UNC
2	4	SLEEVE - ALIGNMENT	----------
	4	STUD BOLT - TAPERED	----------
	4	WASHER	2.62 ID
	4	NUT - S.F. HVY HEX	2.500-4UNC
	4	NUT - S.F. HVY HEX JAM	2.500-4UNC
	4	WASHER	2.38 ID
	4	NUT - S.F. HVY HEX	2.250 4-1/2
	4	NUT - S.F. HVY HEX JAM	2.250 4-1/2

CENTERS: 121.997 RATIO: 13.294:1
NO. TEETH: 226 D.P.: 1.00 NOMINAL
HELIX ANGLE: 10° NOMINAL / HAND: LH
HEAT TREAT: 285-325 HB
NUMBER OF SECTIONS: 2
APPROX. WEIGHT (LBS.): 32,550
MESHES WITH: 358394 / NO. TEETH: 17
NO REQUIRED: 1
DUST GUARD/SEAL BAND: N/A

** DO NOT SCALE DRAWING **

FALK THE FALK CORPORATION
Mill Products Group
MILWAUKEE, WISCONSIN 53201

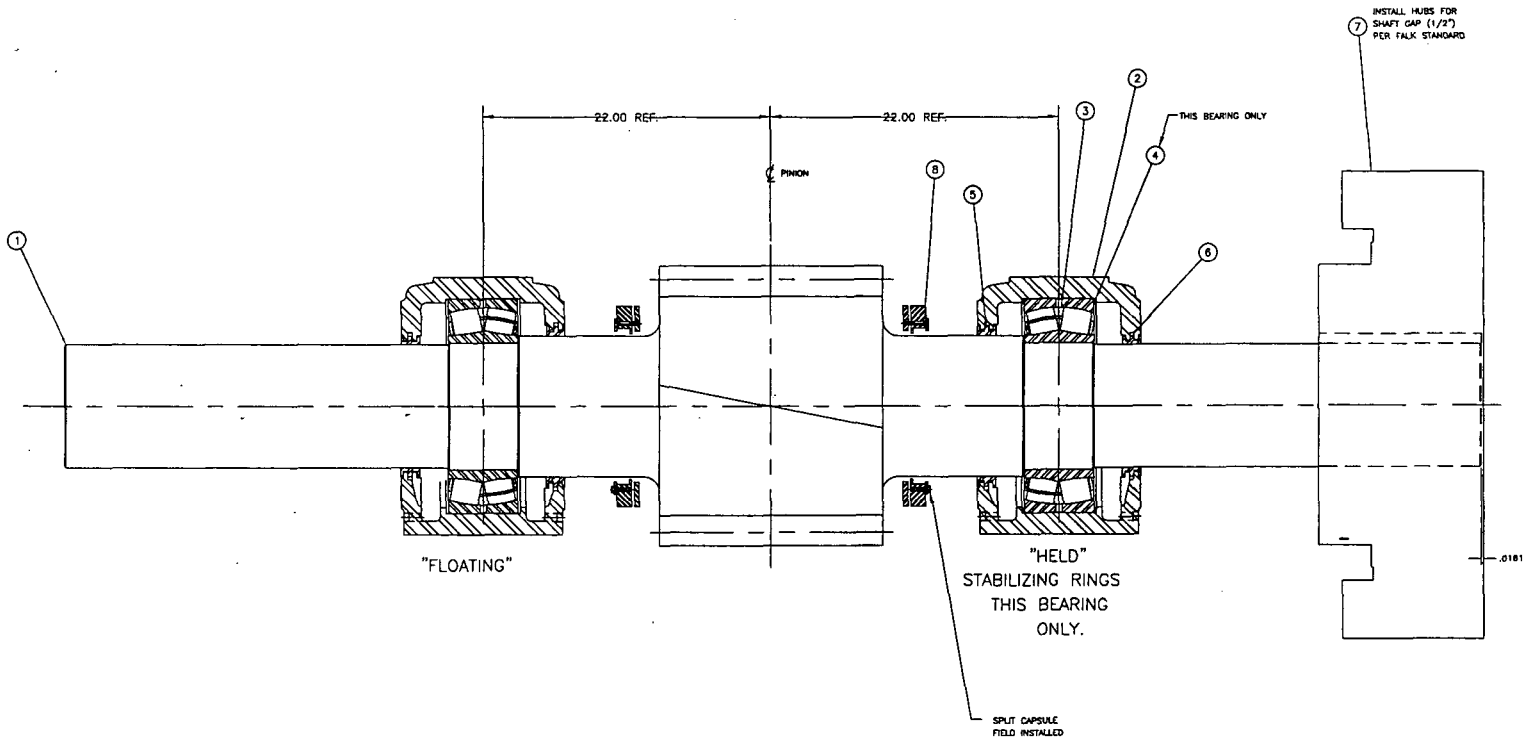
TITLE: GEAR - SPLIT RING (523844)
CERTIFIED PRINT FOR:
A-C EQUIPMENT SERVICES

PREPARED BY: RCW	DATE: 10-1-2001
P.O.# 4395DB	REV. DATE: .
M.O.# 01-076215-G	REV. .

Parts List

ITEM	QTY	DESCRIPTION	MATERIAL SIZE	MATERIAL	NOTE
1	1	PINION SOS	17T., 1.0 NDP, 18° FACE 90° OA	365 -415 BHN	MO 01-076215-P
2	2	PILLOW BLOCK HOUSING	SAF 3148		
3	2	SPHERICAL ROLLER BEARING	23148/W33		
4	2	STABILIZING RING	SR-44-38-1		HELD BEARING ONLY
5	2	TRIPLE SEAL RING	LER 16659		INBOARD
6	2	TRIPLE SEAL RING	LER 16660		OUTBOARD
7	1	LOW SPEED COUPLING HUB	1220T10		DRIVEN
8	2	SEAL RETAINER CAPSULE	69-200-0127	SEAL R1050-13848	INSTALL IN FIELD

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	11/7/2001	
	FOR QUOTE PURPOSES ONLY		



DRAWING NOT TO SCALE

REMOVE ALL BURRS, SHARP EDGES, ETC

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL

CONFIDENTIAL - PROPERTY OF: a-c equipment services, MILWAUKEE, WISCONSIN U.S.A.

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED LINEAR: ANGLES: ±.30° .X ±.06 .XX ±.03 .XXX ±.01

MACHINED SURFACE TEXTURE 125

DR. dwh 11/02/01 CHK. APP.

JOB NO. BM03123

SCALE 1:6

SHEET 1 OF1

NAME: PINION ASSEMBLY 17 T., 1.0 NDP, 18° FACE FOR ø14'-0" x 185'-0" BIO-MIXER

MATL

AUTOCAD FILE: 69-4163

THIRD ANGLE PROJECTION

REFERENCE DWG.

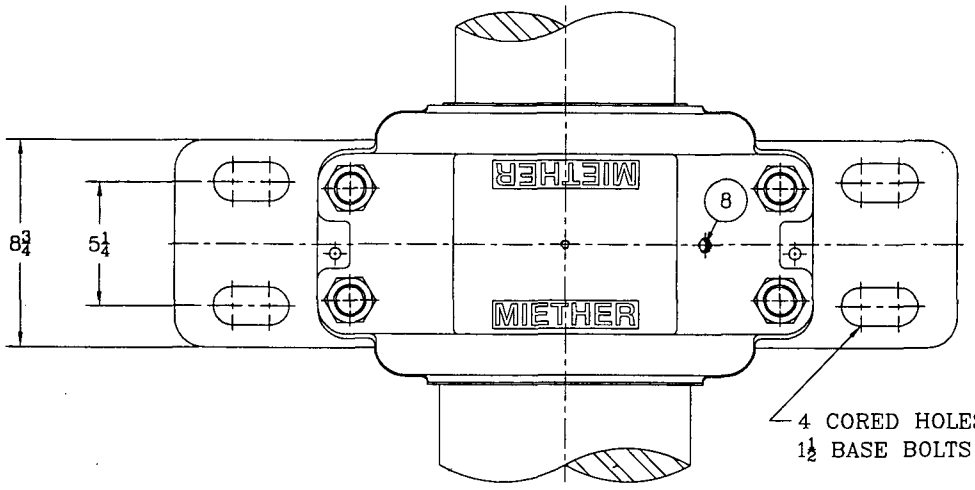
SIZE D

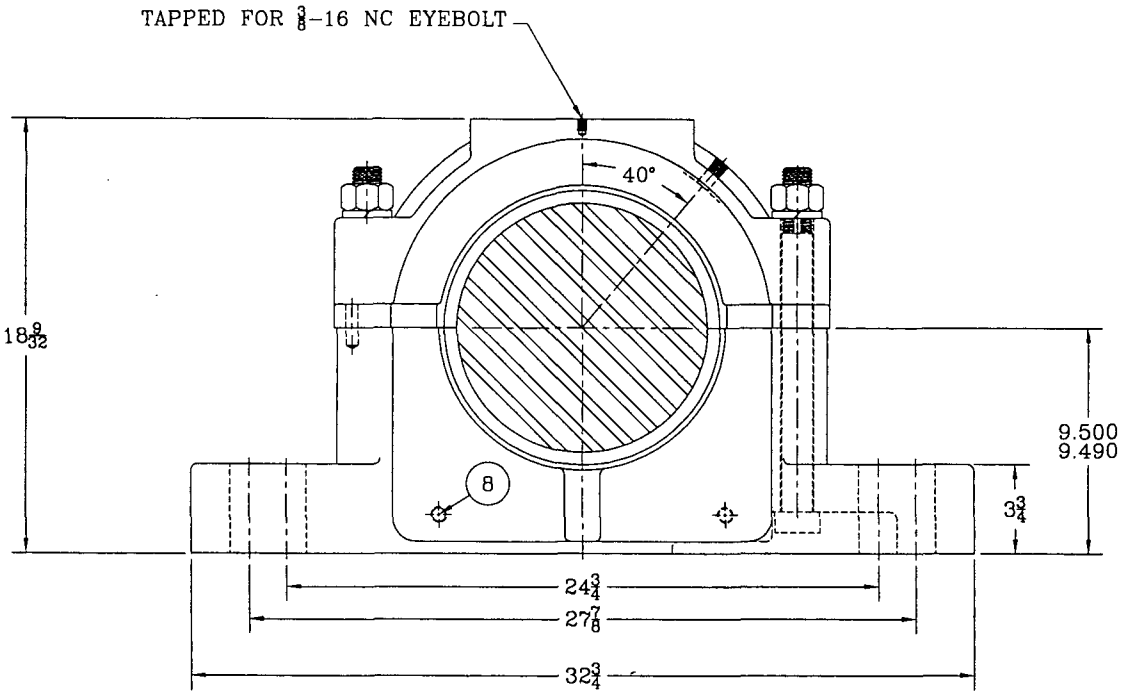
PART NO. 69-400-0163

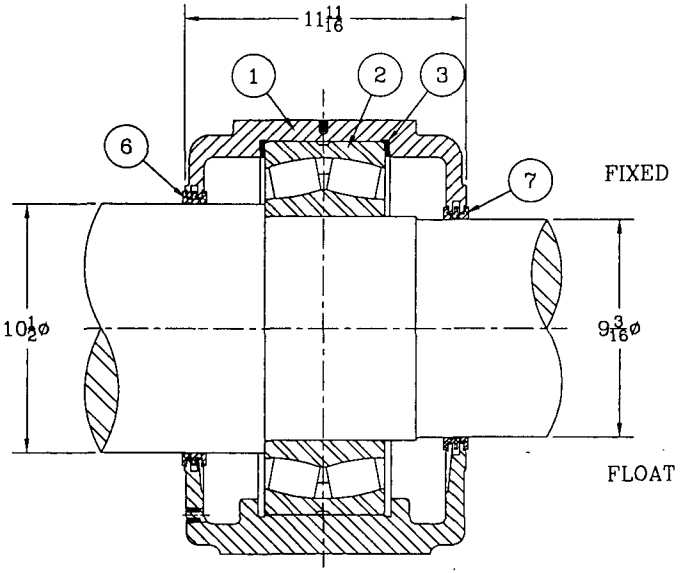
REVISION A

C-25754

ITEM	DESCRIPTION	DETA	PER UNIT FXD.	PER UNIT FLT.
1	HOUSING SAF 3148	C-25752	1	1
2	SPHERICAL ROLLER BEARING	23148/W-33	1	1
3	STABILIZING RING SR-44-38-1	A-11387	2	0
4				
5				
6	TRIPLE SEAL RING LER-16659	A-16659	1	1
7	TRIPLE SEAL RING LER-16660	A-16660	1	1
8	PIPE PLUG	$\frac{3}{8}$-18 NPT	3	3







REVISIONS

TOLERANCE: UNLESS OTHERWISE SPECIFIED
FRACTIONS +- 1/32" ANGLES +- 0° 30'
DECIMALS +- .005" WELD +- 1/16"
CASTING +- 1/16"
A.I.S.I. STANDARD FINISHES

SYMBOL	C	D	E	F	G	J	K
MICRO-INCH VALUE	16	32	63	125	250	500	1000

MIETHER BEARING PRODUCTS, INC.
AN ALCO INDUSTRIES COMPANY
ODESSA, TX. USA

SAF 23148 10-08 X 09-03
ASSEMBLY DRAWING

SCALE 1=4
DRAWN O.M.I.
DATE 10/1/01
CHKD

ASSEMBLY NO.

DRAWING NO. C-25754

Section 5 – Drive Reducer and Couplings

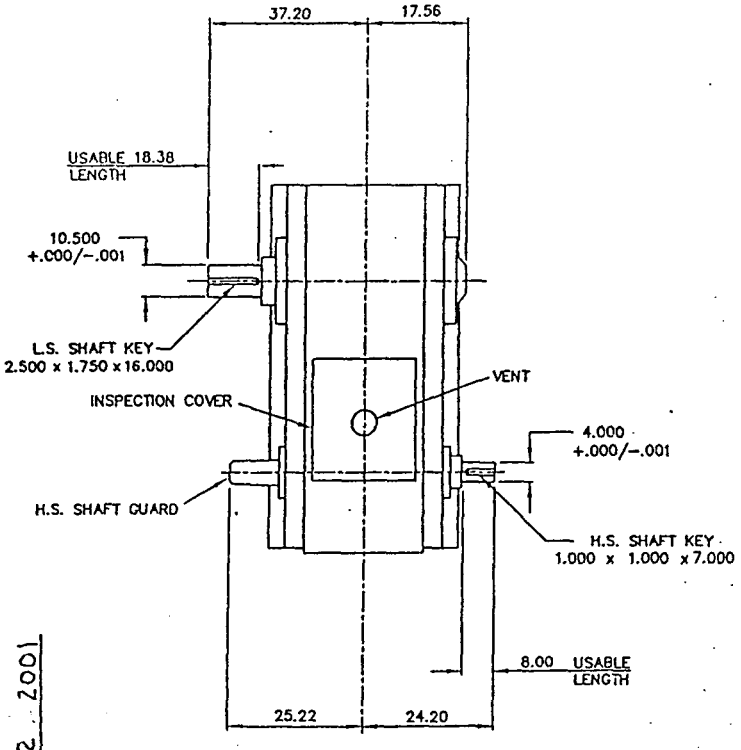
FALK
a good name in industry

GEAR DRIVE
PARALLEL SHAFT
TYPE A * SIZE 525 * TRIPLE REDUC

DWG. NO.: 01067913/01
DIMENSIONS: INCHES
DATE: 09/06/2001

CERTIFIED PRINT FOR: A-C EQUIPMENT SERVICES

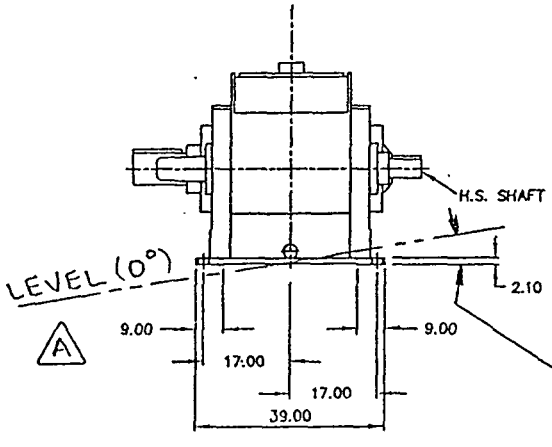
PREPARED BY: Jim LaFond
C.S.

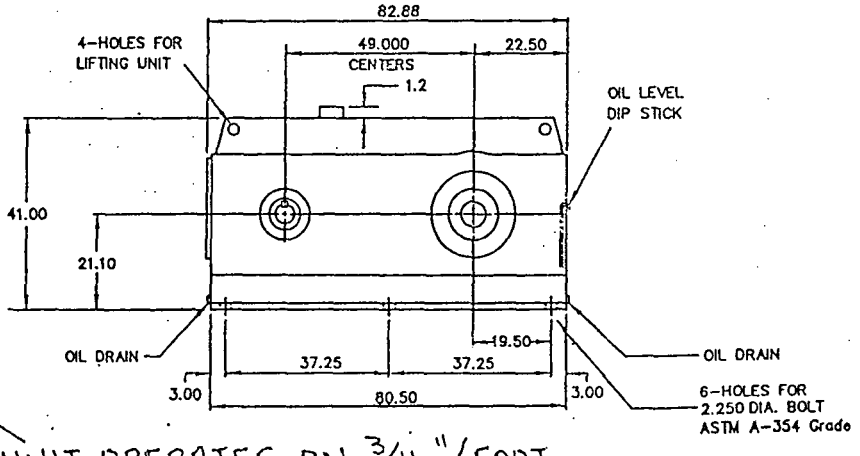


CERTIFIED
RECORD PRINT

FEB 26 2002

PURCHASER





UNIT WEIGHT: 13070 LB

A LOOKING AT H.S. END. SLOPE SHOWN IN FRONT VIEW, C.S. 9-2-2001

UNIT OPERATES ON 3/16"/FOOT (.9°) KILN SLOPE. INPUT EXT. (H.S.S.) BELOW OUTPUT EXT. (L.S.S.)

"2.2KI355 Ld"

Drawings are representative of this series of drives and do not agree in exact detail for all sizes. Gear drives are for horizontal floor mounted operation unless specifically stated otherwise. Consult factory for other mountings.

P.O. NO.: 4494DB		P.O. DATE: 08/22/2001		H.S. SHAFT: 600/1200 RPM
DRIVE SIZE: 525A3-CS	ASSY. NO.: 19	NO. REQ'D.: 1	MOTOR BED: -523908	L.S. SHAFT: 7.0/14.0 RPM
MOTOR: Sever 300 HP	FRAME NO.: C	FURNISHED BY: Purch.	FITTED BY: Purch.	RATIO: 85.94:1
H.S. SHAFT: Coupling 1100T10		FURNISHED BY: Falk	FITTED BY: FALK	SERVICE RATING 300/150 H
L.S. SHAFT: Coupling 1220T10		FURNISHED BY: Falk	FITTED BY: FALK TO UNIT	SERVICE FACTOR: 1.62
REMARKS: -				
ACCESSORY REMARKS: -				

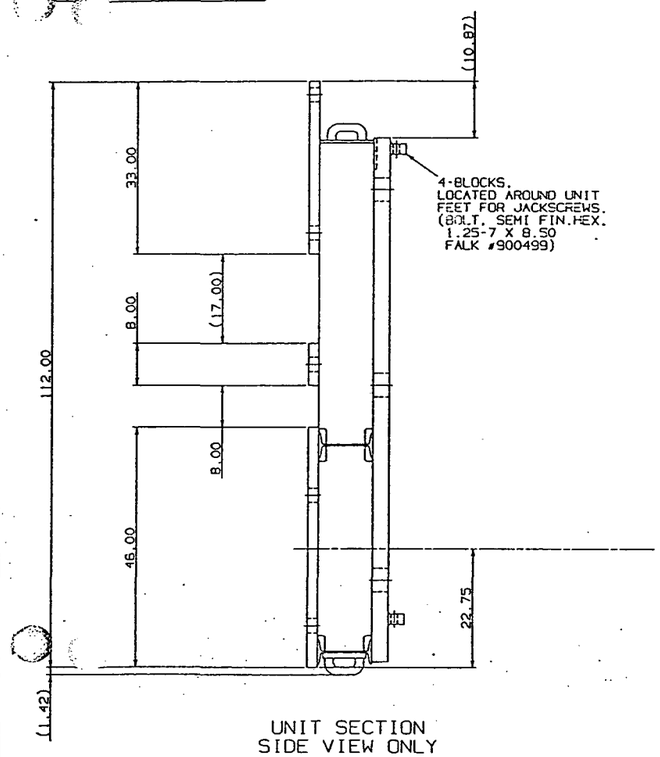
The Falk Corporation, a Sundstrand Company, P.O. Box 492, Zip 53201-0492
3001 W. Canal St., Zip 53208-4222, Milwaukee, WI 53201 USA Telephone: 414-342-3131
FAX: 414-937-4359 e-mail: falkinfo@falkcorp.com web: www.falkcorp.com

REVISED
SEP 27 2001

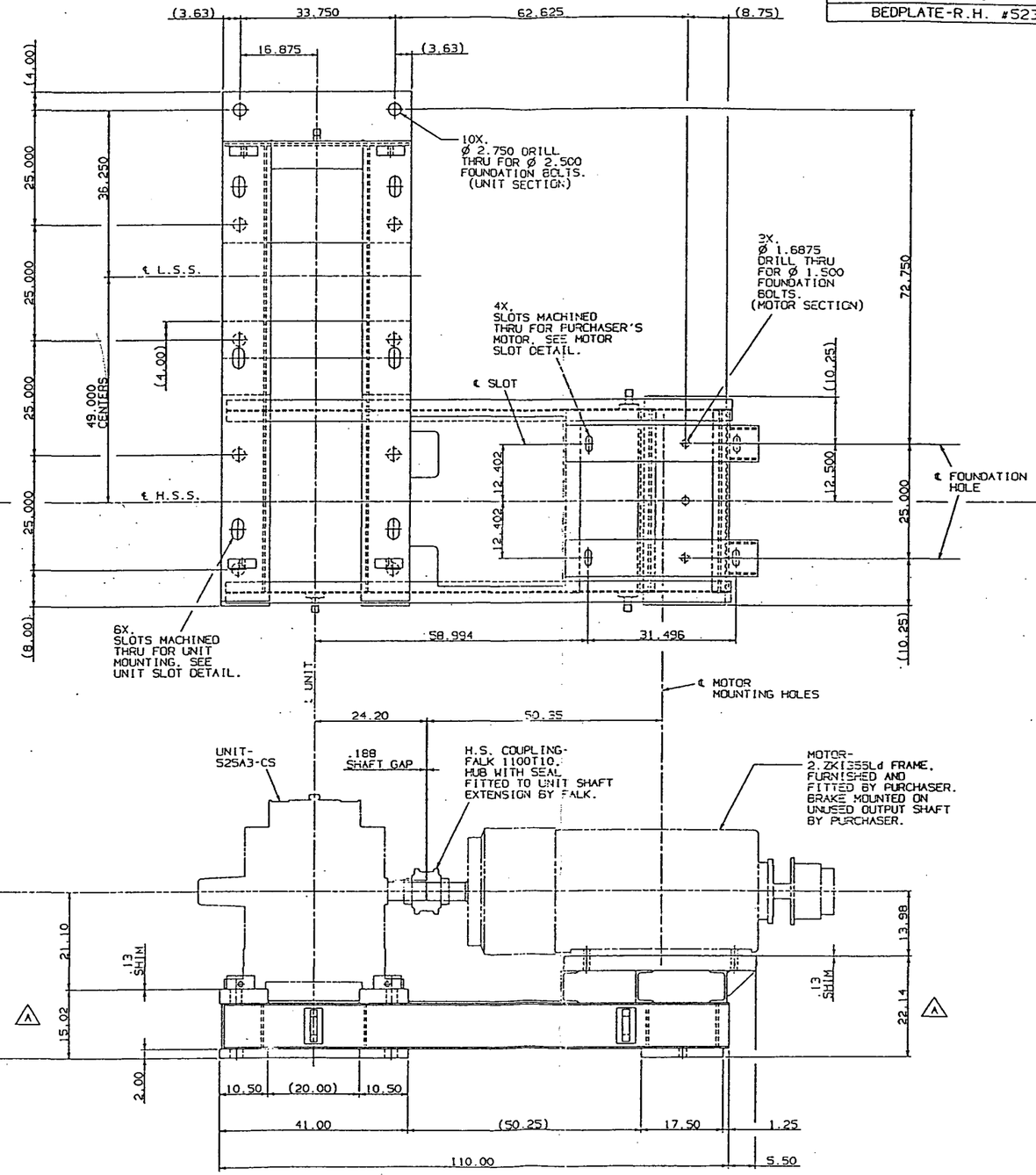
M.O. NO.: 01-067913-0

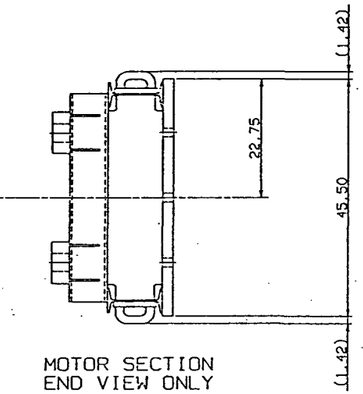
200109-00026994

PART NAME	BOM. PART NO.	MATERIAL	HEAT TREATMENT	BOM. WT.	FIN
BEDPLATE-R.H. #523908	-	-	-	5969#	

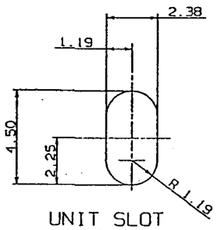


UNIT SECTION
SIDE VIEW ONLY

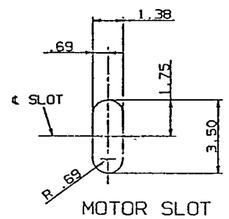




MOTOR SECTION
END VIEW ONLY



UNIT SLOT
DETAIL
(SCALE 1/2)



MOTOR SLOT
DETAIL
(SCALE 1/2)

CERTIFIED
RECORD PRINT

FEB 26 2002

PURCHASER

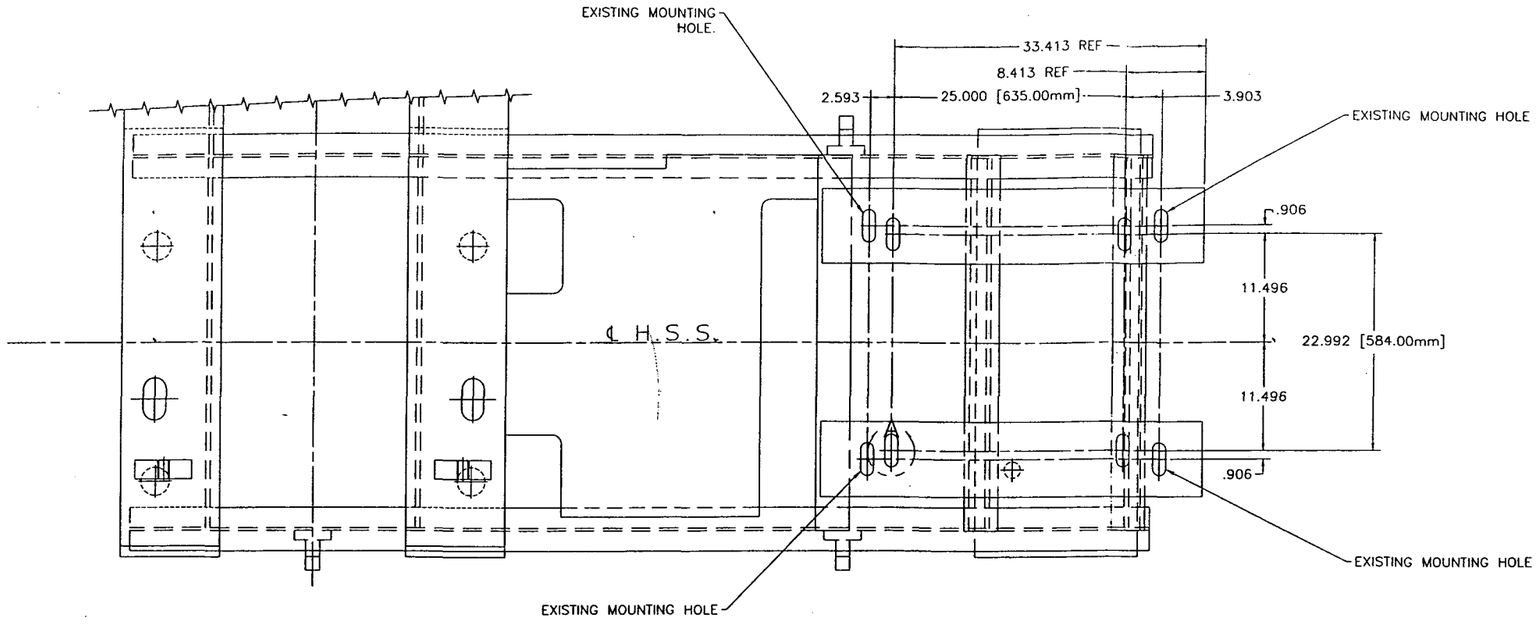
⚠ (LOCATION C-8): 36.25 WAS 35.48, 15.02 WAS 14.25.
⚠ (LOCATION C-20): 22.14 WAS 21.38.

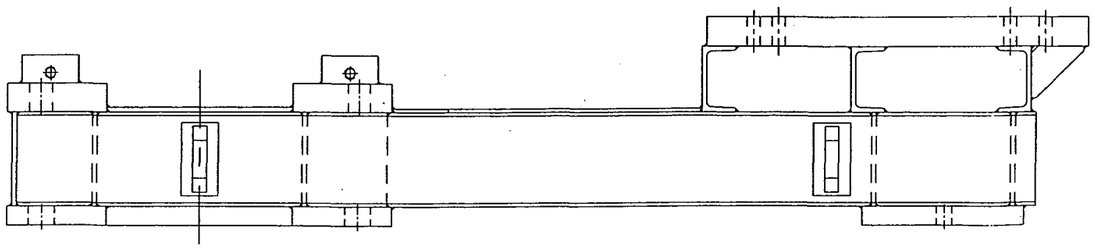
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	DRAWN	C.S.	FALK THE FALK CORPORATION Engineered Products MILWAUKEE, WI 53201, USA
	DATE	9-21-2001	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF THE FALK CORPORATION. NEITHER RECEIPT NOR POSSESSION THEREOF IS A COPYRIGHT TO REPRODUCE, USE, OR DISCLOSE IN WHOLE OR IN PART THE INFORMATION WITHOUT WRITTEN AUTHORITY FROM THE FALK CORPORATION. IT IS SUBJECT TO RETURN UPON D
A CS 9-27-2001	CHECKED	SERAFIN	TITLE: BEDPLATE-R.H. #523908
DIM. CHECKED DATE	DATE	9-21-2001	UNIT: S25A3
CADRA CAD - DRAWING DO NOT CHANGE MANUALLY	DRAWING NO.	523136	SCALE 1/8 BOM. NO. 01-067913-02
			SH. 1 OF 1 REVISION

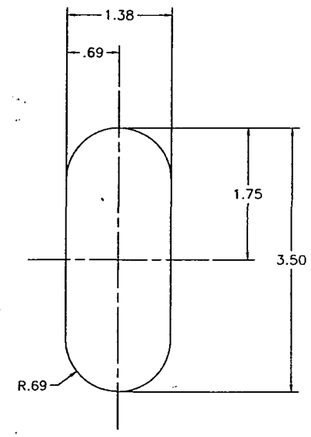
REVISED

SEP 27 2001

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	10/23/2001	SMK
	FOR QUOTE PURPOSES ONLY		
#	DESCRIPTION	DATE	APPROVED
A	RELEASED FOR FIELD	2/12/2002	smk1
	MODIFICATION		







DETAIL A
SCALE 1:1

JOB NAME: SUMTER COUNTY SOLID WASTE – BUSHNELL, FL.

CONFIDENTIAL – PROPERTY OF:
B-C equipment services
MILWAUKEE, WISCONSIN U.S.A.

NAME
REDUCER/MOTOR BEDPLATE
FIELD MODIFICATION
RE-LOCATION OF MOTOR MOUNTING HOLES

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982.
LIMITS UNLESS OTHERWISE NOTED
LINEAR: ANGLES: ±.50°
.X ±.06
.XX ±.03
.XXX ±.01
125 MACHINED SURFACE TEXTURE

MAT'L

AUTOCAD FILE: 69-4166
WT R F

DR. smk 12/12/2002
CH. ---- ----
AP. ---- ----
JOB NO. BM01-3123
SCALE 1:8
SHEET 1 OF1
THIRD ANGLE PROJECTION
REFERENCE DWG:
SIZE D
PART NO. 69-400-0166
REVISION A

REMOVE ALL BURRS, SHARP EDGES, ETC

Jan 14, 2002 – 13:54

F:\Engineer\ACDWGS\BioMixers\SumterCo\BM01-3123\69-4166.dwg, 02/12/2002 04:17:26 PM, SMK1, 11x17, 1:15.9781

Standard Paint Specifications – See Page 2 for Premium Epoxy Paint

Primer — Lead & Chrome Free, Medium Dark Gray, Universal High-Solids, Phenolic Alkyd Primer

For use on such products as drive housings, accessories, bedplates and other steel and gray iron parts.

WEIGHT: 11.5 lb/gal minimum (1,4 Kg/L)

TOTAL SOLIDS: 70% minimum by weight

COMPOSITION OF SOLIDS BY WEIGHT:
Pigment — 70-74% Non-Volatile Vehicle — 26-30%

COMPOSITION OF PIGMENTS BY WEIGHT:
Rust Inhibitive Pigments — 15% min
TiO_2 — 9% min
Others — approximately 76%

APPLICATION: One spray coat of primer shall be applied on thoroughly cleaned surfaces to produce a minimum dry film thickness of 1.0 mil (.001") (25 microns).

AIR DRYING TIME: Primer shall be "set-to-touch" in 20 to 30 minutes and "dry hard" in one hour for handling. It shall be ready to accept the standard finish coat after one hour.

VOC CONTENT: Meets 3.5 lb/gal Maximum (393 g/L)

Finish Coat — Lead & Chrome Free, Medium Dark Gray, High-Solids Alkyd Enamel

For use on such products as Gear Drives (***except 4000J[Quadrive], 1020/1030F & 2000F[Ultramax], Type MD Mixer Drives, see below***), Backstops and Motorbeds.

WEIGHT: 10.9 lb/gal minimum (1,3 Kg/L)

TOTAL SOLIDS: 68.5% minimum by weight.

APPLICATION: One spray coat shall be applied on thoroughly cleaned surfaces to produce a minimum dry film thickness of 1.0 mil (.001") (25 microns).

AIR DRYING TIME: Finish shall be "set-to-touch" in 15 to 20 minutes and "dry hard" overnight. (***4000J[Quadrive], 1020/1030F & 2000F[Ultramax] and Type MD Mixer Drive — Force dry hard: 30 minutes, at 180°F in catalytic oven to handle.***)

COLOR: Medium Dark Gray (No. 33 Gray) as per ANSI Standard Z55.1-1967
Munsell Color Notation — 7.8B 3.30/0.94

VOC CONTENT: Meets 3.5 lb/gal maximum (393 g/L)

4000J(Quadrive), 1020/1030F & 2000F(Ultramax) and Type MD Mixer Drive Paint Specifications

Finish Coat — Medium Dark Gray, Semi-Gloss, Two-Component, Topcoat Urethane Coating

WEIGHT — Mixed: 12.4 lb/gal minimum (1,5 kg/L).

TOTAL SOLIDS: Mixed: 73.5 ±1% by weight.

AIR DRYING TIME: Force dry hard: 30 minutes, at 180°F in catalytic oven to handle.

Falk Paint Specifications

The above specifications apply to products manufactured and painted by Falk. Motors and other non-Falk equipment received at Falk (to be fitted by Falk) will not be repainted unless special arrangements are agreed upon in advance. Without these arrangements, non-Falk components will be fitted and shipped as painted by the original supplier.

Customer Paint Specifications

Consult Falk for a quotation for preparation and painting of Falk products with paints that are not to the above specifications.

Paint Over Prime Coat

After the Falk prime coat has cured a minimum of 30 days, most finish coat paints (including most epoxy base paints) will bond satisfactorily with the Falk primer. See CAUTION notes below.

Paint Over Finish Coat

After the Falk finish coat has cured a minimum of 7 days, most air dried enamels will bond satisfactorily with the Falk finish coat. Epoxy and urethane paints require sand blasting to clean "white metal" before painting. ***4000J[Quadrive], 1020/1030F & 2000F[Ultramax], and Type MD Mixer Drive — Most epoxy, urethane, or alkyd enamel based paints will bond satisfactorily with the Falk finished coat if re-coated within 30 days of the original paint application. Paint compatibility may vary according to solvent and resin make-up***. See CAUTION notes below.

CAUTION — TEST PAINT ADHESION BEFORE RE-COATING: — Test paint adhesion before 100% re-coat application. If previous history is not available, check compatibility by applying coating to a small area and allow to cure for at least 72 hours at normal room temperature. Make crosshatch cuts according to ASTM D3359. If coating remains intact (at least 85% adhesion) and overall appearance is satisfactory, the coatings can assumed to be compatible. Refer any questions or unusual circumstances to the paint manufacturer.

CAUTION — SAND BLASTING: Mask all shafts, shaft seals, air vents, surfaces and accessories subject to damage before sand blasting.

Step by Step Falk Paint Procedures

1. **SURFACE PREPARATION** — Structural members are first flame cut from stock steel plate, spot ground and shot blasted. Next, structural members are deep-flux welded, chipped and again spot ground. After a final hand cleaning, to ensure a good bonding surface, the unitized structure is now ready for the universal primer.
2. **PRIMER APPLICATION** — In the machine shop, another series of planned procedures occur. As excess metal (and the prime coat) is removed in the various machining operations, the raw metal surfaces are simultaneously coated with a rust preventive. The final operation is a cleaning/coating procedure which protects the machined surfaces until ready for assembly.

Continued on Page 2 . . .

3. **FINAL ASSEMBLY** — According to a planned building schedule, stock components are thoroughly cleaned in an automatic washer and kitted with bearings, seals and other hardware. After final assembly, drives are tested with a rust preventive run-in oil.
4. **FINISH COAT APPLICATION** — After hand cleaning, a spraying method produces a paint coat of desired thickness. Shaft extensions and other machined surfaces (which receive mating parts) are not painted but are coated with an easily removed rust preventive.
5. **SHIPMENT PREPARATION** — During shipment, and until filled to the proper level with specified oil, all internal parts and surfaces are protected by the residual coating of rust preventive oil applied during the shop run-in test.
6. **STORAGE** — Drives which are to be stored for periods exceeding four months outdoors or twelve months indoors (in a dry building) from date of shipment, or drives to be exported, should be specified to be protected for long term storage. Such drives are protected for twelve months storage outdoors or twenty-four months indoors.

Premium Epoxy Paint Specifications – See Page 1 and above for Standard Paint

General Description of Premium Epoxy Paint System

A high performance, multipurpose, two-component chemically-cured epoxy semi-gloss coating. Epoxy paint prices include surface preparation in accordance with SSPC-SP10 (abrasive blasted to a near white finish), two coats of Devoe 224 HS High Build Epoxy (8-16 mils [200-400 microns] DFT). Complete paint specifications, available colors, and paint procedures can be found below.

Features

Excellent corrosion protection from salt water, resists spillage of solvents and chemicals.

Surface Preparation

Abrasive cleaning to a near white finish in accordance with SSPC-SP10.

Primer — Devran 224HS High Build Epoxy

Application: One spray coat shall be applied on abrasive cleaned surface to produce a minimum dry film thickness of 4.0-8.0 mils (100-200 microns) d.f.t.

Air Drying Time — At 6.0 mils (150 microns), 70°F, Dry hard 9 Hours.

Finish Coat — Devran 224HS High Build Epoxy

Application: One spray coat shall be applied to produce a minimum dry film thickness of 4.0-8.0 mils d.f.t.

Air Drying Time: At 6.0 mils, 70°F (21°C), Dry Hard, 9 Hours

Color: Medium Dark Gray
Devoe Coatings Color Notation — 6110 Machine Gray. Other Colors available. Contact Falk for a complete color chart or provide a color chip for matching.

Special Paint System/Color — Consult the Falk Corporation.

Weight/gallon: (Mixed) 12.5 lb (1,5 Kg/L)

VOC (epa 24): (Mixed) 1.8 lb/gal (212 g/L)
Varies with color.

Solids By Volume: (Mixed) 75%. Varies with color.

Hardness: (ASTM D 3363) - 7 day
Cure @ 77°F (25°C) -3H

Service Temperature Limits: 250°F (121° C) dry

Falk Paint Specifications

These specifications apply to products manufactured and painted by Falk. Motors and other non-Falk equipment received at Falk (to be fitted by Falk) will not be repainted unless special arrangements are agreed upon in advance. Without these arrangements, non-Falk components will be fitted and shipped as painted by original supplier.

Customer Paint Specifications

Consult Falk for a quotation for preparation and painting of Falk products with paints that are not to the above specifications or listed on Falk's standard paint Specifications on Page 1.

Step by Step Paint Procedures

1. **SURFACE PREPARATION — Structural members** are first flame cut from steel plate, spot ground, and shot blasted. Next, structural members are deep-flux welded, chipped and again spot ground. After gear drive assembly, but before mounting accessories; e.g., fans, bedplates, motor brackets etc., all shafts, seal areas, and air vents are masked. Gear drives and accessory surfaces are then abrasive cleaned to a near white finish in accordance with SSPC-SP10.
2. **PRIME & FINISH COAT** — A spraying method produces a paint coat of desired thickness. Shaft extensions and other machined surfaces (which receive mating parts) are not painted but are coated with an easily removed rust preventive.
3. **SHIPMENT PREPARATION** — During shipment and until filled to the proper level with specified oil, all internal parts and surfaces are protected by a residual coating of rust preventative oil applied during the shop run-in test.
4. **STORAGE** — Drives which are to be stored for periods exceeding four months outdoors or twelve months indoors (in a dry building) from date of shipment, or drives to be exported, should be specified to be protected for long term storage. Such drives are protected for twelve months storage outdoors or twenty-four months indoors.

The Falk Corporation, P.O. Box 492, Zip 53201-0492
3001 W. Canal St., Zip 53208-4200, Milwaukee, WI USA Telephone: 414-342-3131

Falk Enclosed Gear Drives

(See Page 2 for Open Gearing, Spare Parts and Footnotes)

Information provided herein supplements instructions furnished with the drive. These instructions are based on the use of the products shown on Page 2. Refer to the instructions furnished with the product if other supplier's products are used.

FACTORY SHIPPING PREPARATION — Enclosed gear drives are protected against corrosion at The Falk Corporation prior to shipment for the following periods after date of shipment:

	Outdoor Shelter [1]	Dry Building [2]
Domestic Shipment of Standard drives	4 months	12 months
Export Shipment of Standard drives	12 months	24 months
All Shipments of Custom Design, Marine and High Speed Drives	12 months	24 months

INTERMITTENT STORAGE — (6 months maximum) — The following procedure is recommended when a drive is not used for prolonged periods. An example of intermittent storage is *Winter Lay Up* for marine applications.

1. Preparation for Storage
   - A. Drain all moisture from the drive and check for damage if water was present.
   - B. If the drive has been drained of oil, add vapor-phase rust inhibitor [3] at the rate of one ounce per cubic foot of internal drive space. For drives that have not been drained of oil, add vapor-phase rust inhibitor at the rate of 2% of sump capacity.
   - C. Seal the drive completely; tighten all gauges and plugs; seal air vents and the area around the dip stick with pressure sensitive tape [4].
   - D. Drain all water from any attached cooling system.
   - E. Remove all moisture from shaft areas near the oil seals and wrap tape [4] against the seals so that corrosion does not take place near or under the seal area.
   - F. After three months, inspect the drive to assure that it has remained sealed, and add rust inhibitor as indicated in paragraph "B" above; then seal the drive again.
2. Start-Up After Shutdown
   - A. Remove all tape applied in storage preparation.
   - B. If moisture has accumulated in the sump, drain the moisture and thoroughly inspect for damage.
   - C. Fill the cooling system and check for leaks.
   - D. Re-establish the oil level with recommended lubricant.
   - E. Vapor-phase rust inhibitor is soluble in recommended lubricating oils and need not be flushed from the drive.

LONG TERM STORAGE — The following procedure is recommended for drives stored beyond the initial Factory preparation period:

1. Preparation for Storage
   - A. Drain all moisture from the drive and from any attached cooling system; check for damage if water was present in the drive.
   - B. Establish the recommended oil level with the recommended lubricants.
   - C. If the drive has been drained of oil, add vapor-phase rust inhibitor [3] at the rate of one ounce per cubic foot of internal drive space. For drives that have not been drained of oil, add vapor-phase rust inhibitor at the rate of 2% of sump capacity. Then rotate the shafts several times.
   - D. Seal the drive completely by tightening all gauges and plugs; seal air vents and the area around the dip stick with pressure sensitive tape [4].
   - E. Pack grease around the shafts near the contact seals and into the seal retainers; then tape [4] the shaft areas near the oil seals and wrap tape against the seals.
   - F. For external surfaces protected at the Factory, inspect and protect scratched surfaces as required, see *Open Gearing and Spare Parts, Extended Storage*.
   - G. If the drive is stored OUTDOORS, position it on blocks. Build a frame around it if possible and cover it with a tarpaulin. Leave the bottom open for ventilation. DO NOT use a plastic cover.
   - H. Inspect the drive every three months and add vapor-phase rust inhibitor as outlined in paragraph "C" above.
2. Start-Up After Storage
   - A. Remove all tape applied in storage preparation.
   - B. Drain all moisture which may have accumulated in the sump and thoroughly check for damage.
   - C. Vapor-phase rust inhibitor is soluble in recommended lubricating oils and need not be flushed from the drive.
   - D. Refer to individual Manuals furnished with the drive for recommended lubricants and instructions for installation and maintenance. Note: For Type A, AB, Y and YB drives, the oil troughs must be primed as instructed in the installation instructions.

The Falk Corporation, P.O. box 492, Zip 53201-0492
3001 W. Canal St., Zip 53208-4200, Milwaukee, WI USA Telephone: 414-342-3131
Fax: 414-937-4359 e-mail: falkinfo@falkcorp.com web: www.falkcorp.com

128-014
November 1993
Supersedes 5-90

Falk Open Gearing & Spare Parts

FACTORY SHIPPING PREPARATION — Open gearing and spare parts are protected at the Factory prior to shipment for the following periods:

	Outdoor Shelter ★	Dry Building †
Open Gearing	18 months	30 months
Small parts and assemblies in corrugated or paper boxes	0 months	24 months

Small parts and assemblies which are packaged for shipment in corrugated or paper boxes are only protected for shipment in a covered carrier and for indoor storage in a dry building.

EXTENDED STORAGE — For storage beyond the standard periods, the following procedures are recommended:

1. Gearing, Shafts, Metallic Coupling Components, Gear Shaft Assemblies — Thoroughly coat all assemblies and other metallic parts which are not protected by painting, plating, etc. with a firm film forming polar type rust inhibitor compound [5].
2. Gear Shaft Assemblies With Attached Bearings — Grease bearings, cover bearings with Nox-Rust Vapor Paper [6], cover vapor paper with plastic sheeting and tape completely. Coat the gear shaft assembly with a firm film forming polar type rust inhibitor compound. DO NOT coat the plastic sheeting covering the bearings.
3. Small Metallic Components And Hardware — Wrap parts that are not protected by painting, plating, etc. in water repellent vapor-phase rust inhibitor paper and seal with pressure sensitive tape. In lieu of rust inhibitor paper, place the hardware in plastic bags containing vapor-phase rust inhibiting type oil [3] at the rate of 0.3 ounce per cubic foot of space. Seal plastic bags with pressure sensitive tape.
4. Rubber Elements — Keep out of direct sunlight and DO NOT coat the rubber elements of couplings in any way.
5. All Stored Components — On a monthly basis, inspect for corrosion due to scratched coatings or ripped plastic bags.

STORAGE REMOVAL — After storage, remove all applied tape and protective coverings. Remove firm film forming polar type rust inhibitor by swabbing and scrubbing with kerosene, mineral spirits, No. 2 fuel oil aromatic xylol, or Stoddards solvent in a well ventilated area.

1 Drive raised on blocks, a frame built around it if possible, and covered with a tarpaulin. DO NOT use plastic material, and leave the bottom open for ventilation.
2 A shelter closed off from rain and snow, where there is no standing water.
3 Nox-Rust Motorstor VCI-10, Daubert Chemical Company.
4 Permacel Pressure Sensitive Tape, Permacel Corporation.
5 Noccotex 202, National Oil and Chemical Company, X-145, Daubert Chemical Company.
6 Nox-Rust Water Repellent Vapor Paper No. 8OD, Daubert Chemical Company. Listings of other manufacturer's products and prices in Falk literature does not constitute an endorsement or warranty of the product by Falk. Refer to the original manufacturer for application recommendations, service and current prices.

The Falk Corporation, P.O. Box 492, Zip 53201-0492
3001 W. Canal St., Zip 53208-4200, Milwaukee, WI USA Telephone: 414-342-3131
Fax: 414-937-4359 e-mail: falkinfo@falkcorp.com web: www.falkcorp.com

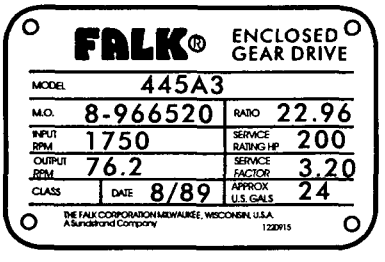
Introduction

This literature applies to Model A, B and C standard gear drives with ratings, speeds, ratios, and dimensions as catalogued in current Falk selection guides. Refer to Falk for all specials and modifications.

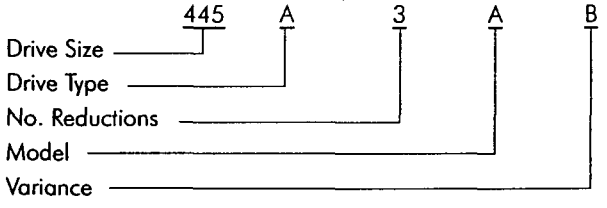
1. **IDENTIFY DRIVE** — Give complete data shown on drive nameplate. Also, give reference numbers, Falk part numbers, and name of parts required. Drawings and reference numbers are representative of all sizes and the actual parts may not agree in exact detail for each drive size. Complete nameplate data and parts reference number will assure receipt of correct parts.

   The numerical designation stamped on the nameplate completely identifies all parts used in the drive. All drives *with exactly the same nameplate markings have* interchangeable rotating elements.

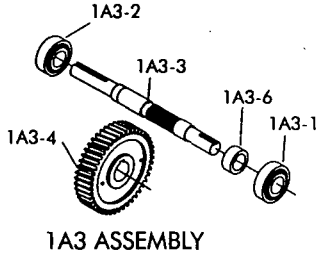
Sample Nameplate



Drive Identification



2. **IDENTIFY INDIVIDUAL PARTS** — Use exploded view on Page 2 to determine Ref. No. of required parts.



1A3 ASSEMBLY

Ref. No.	Part Description
1A3-1	Bearing
1A3-2	Bearing
1A3-3	Pinion & Shaft
1A3-4	Gear
1A3-6	Spacer

NOTE: It is recommended that the shaft seals be replaced whenever it becomes necessary to disturb a seal in the process of disassembling a drive. New Shim-gaskets are recommended to prevent oil leakage and in some cases necessary to adjust internal running clearances. Shim-gaskets are available only in kits; see Ref. No. 100.

PINION–SHAFT–BEARING ASSEMBLIES — With today's production procedures, Falk can normally furnish a total rotating assembly more economically than if a customer purchases individual parts, disassembles the old parts, and reassembles using some new and some old parts. Falk replacement assemblies also reduce down time and always consist of all new parts.

FASTENERS — Fasteners are sold in sets for a specific item, i.e. four for an end cover, eight for a low speed seal cage, etc. Fasteners describe cap screws, bolts, studs, nuts, and lock washers as required.

RATIO CHANGE — Refer complete information to Falk.

SHAFT COUPLINGS — Refer to coupling parts guide and price list.

3. **HOW TO USE THIS GUIDE** — Use the Part Ref. No. (Step 2) and the drive Model No. (Step 1) to determine the part description and use this information to order the required parts.
4. **ORDER REPLACEMENT** — Place your order with your local Falk Representative or Distributor. If you need *assistance call the number below.*

Bearing & Seal Identification

Refer to the exploded views on Page 2 to identify the bearings and oil seals by the parts list Reference Number. Then refer to Tables 2 thru 5, Pages 3 and 4, to determine the Manufacturer and Manufacturer's part number.

Corrosion Protection & Storage

CAUTION: Follow guidelines below to avoid damage to parts.

1. For domestic or indoor storage, Factory provides standard 24 month protection as boxed or optional 24 month protection for individual parts.
2. For export or outdoor storage, Factory provides optional 18 month protection.

CAUTION: This protection does not cover exposure to elements such as standing water, etc.

Parts Diagram

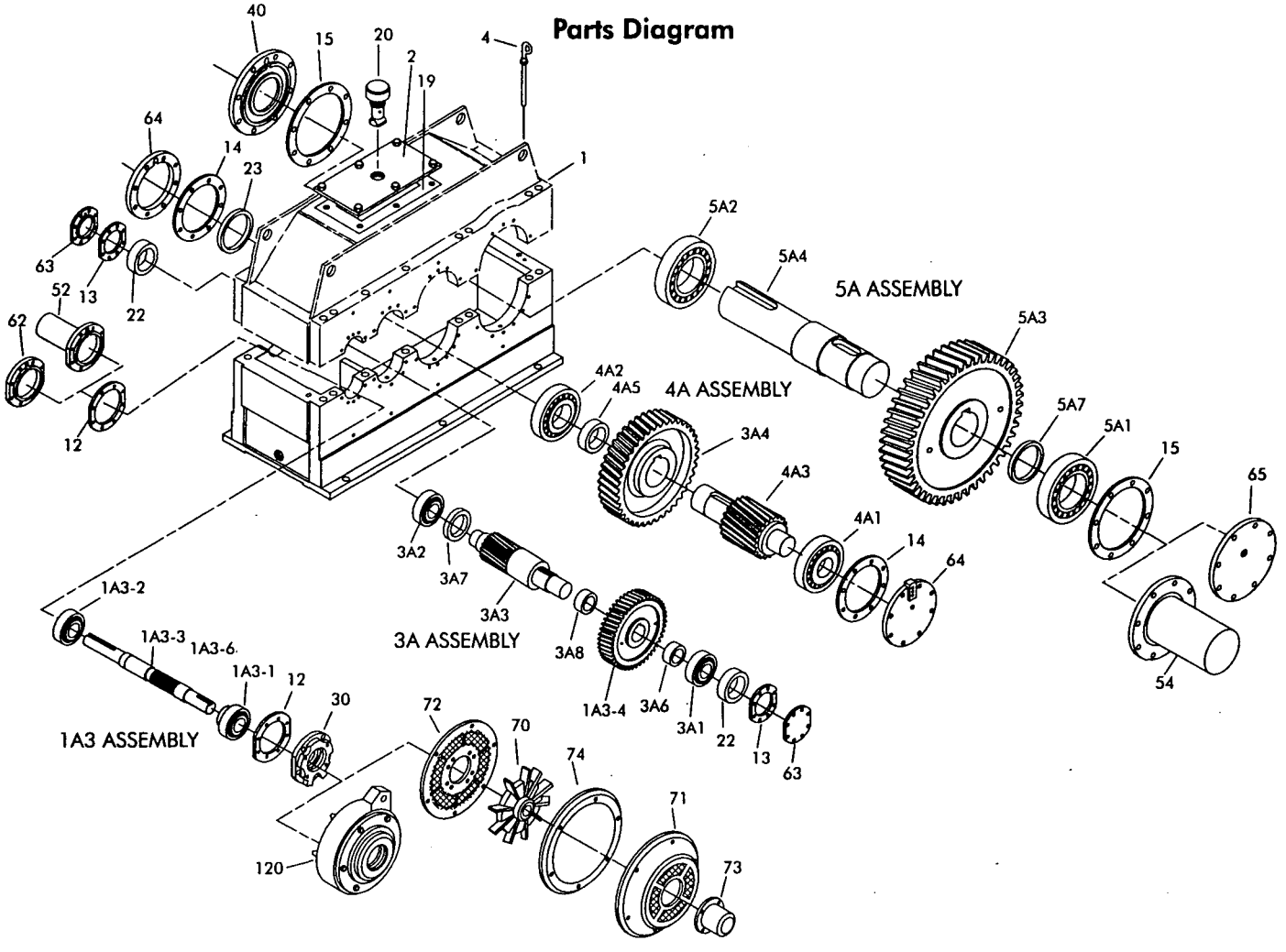


TABLE 1 — Parts List

Ref. No.	Part Description
1	Housing (Consisting of Base & Cover & all Hardware)
2	Inspection Cover
4	Dipstick
12	Shim Gasket, High Speed Shaft
13	Shim Gasket, Intermediate Shaft
14	Shim Gasket, Low Speed Pinion Shaft
15	Shim Gasket, Low Speed Shaft
19	Shim-Gasket, Inspection Cover
20	Air Vent
22	Spacer, Bearing Intermediate
23	Spacer, Bearing, Low Speed Pinion
30	High Speed Seal Cage Assembly — See Figures 4 & 5
31	Cage, Seal, High Speed
32	Seal, Exclusion, High Speed
33	Seal, Bush., High Speed
34	Seal, Oil, High Speed
40	Low Speed Seal Cage Assembly — See Figures 4 & 5
41	Cage, Seal, Low Speed
42	Seal, Exclusion, Low Speed
43	Seal, Bush., Low Speed
44	Seal, Oil, Low Speed
52	Guard, High Speed Shaft
54	Guard, Low Speed Shaft
62	Cover, End, High Speed
63	Cover, End, Intermediate
64	Cover, End, Low Speed Pinion Shaft
65	Cover, End, Low Speed

Ref. No.	Part Description
70	Fan
71	Fan Guard
72	Grill/Backplate
74	Deflector Ring
100	Shim Gasket Kit, Includes Ref. Nos.:11, 12, 13, 14, 15 & 19
120	Backstop
1A3-1	Bearing, High Speed Shaft
1A3-2	Bearing, High Speed Shaft
1A3-3	Pinion & Shaft, High Speed
1A3-4	Gear, High Speed
1A3-6	Spacer
3A1	Bearing, Intermediate
3A2	Bearing, Intermediate
3A3	Pinion & Shaft, Intermediate
3A4	Gear, Intermediate
3A6	Spacer, Intermediate
3A7	Spacer, Intermediate
3A8	Spacer, High Speed Gear
4A1	Bearing, Low Speed Pinion Shaft
4A2	Bearing, Low Speed Pinion Shaft
4A3	Pinion & Shaft, Low Speed
4A5	Spacer, Low Speed Pinion Bearing
5A1	Bearing, Low Speed Shaft
5A2	Bearing, Low Speed Shaft
5A3	Gear, Low Speed
5A4	Shaft, Low Speed
5A7	Spacer, Bearing/Gear

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NOTE: Figures 1-3 are not used for this size range or reduction.

Figure 4

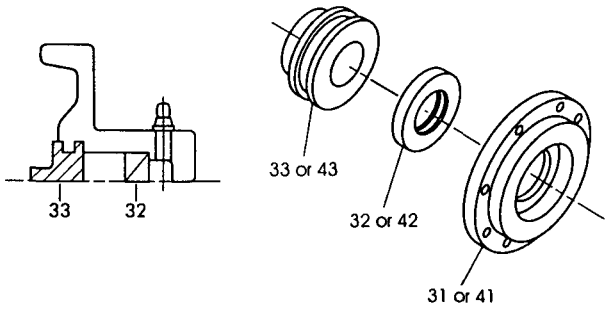

Figure 5

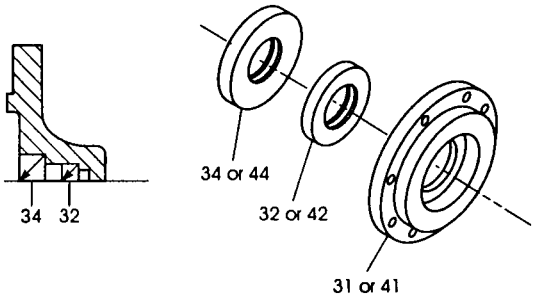

TABLE 2 — Bearings/Falk Part Numbers

DRIVE SIZE	Reference No.							
	1A3-1	1A3-2	3A1	3A2	4A1	4A2	5A1	5A2
385	921892	921892	921856	921856	921893	921893	921414	921414
405	921629	921629	921809	921809	921899	921899	921674	921674
425	921878	921878	921895 †	921895 †	921552	921552	921881	921881
445	921301	921301	921678	921899 ‡	921443	921443	921439	921439
465	921855	921855	921443	921443 ●	921541	921541	920570	920570
485	921895	921895	921541	921541 ♦	921470	921470	915524	2915524
505	921678	921678	921541	921459 ✱	921481	921481	919284	919284
525	921443 ★	921443 ★	921470	921470	921901	921901	919096	919096
545	921541	921541	921481	921481	919680	919680	920704	920704
565	921646	921646	921481	921481	919118	919118	919945	919945
585	921646	921646	921481	921481	919319	919319	919119	919119

★ Use 921741 for ratios 85.94 thru 105.6.
† Use 921494 for ratio 85.24, Models A & C.
‡ Use 921678 for ratios 22.96 thru 33.34 & 41.07.
● Use 921551 for ratios 51.2 thru 105.6.
♦ Use 921459 for ratios 57.96 thru 102.0.
✱ Use 921541 for ratios 70.8 &91.83, Model C.

TABLE 3 — Oil Seals/Falk Part Numbers

DRIVE SIZE	Reference No.				
	32	33	34	42	44
385	913018	5741073	912946	913014	913015
405	912948	5741340	912949	913000	913001
425	912948	5741340	912949	913016	913017
445	912991	5741072	912992	913004	913005
465	912993	5741339	912994	913023	913024
485	913012	5741596	913013	912827	912554
505	912995	5741071	912996	913025	912769
525	912997	5741338	912998	912901	912626
545	913014	5741076	913015	912550	913034
565	913002	5742158	913003	2909092	2909091
585	913002	...	913003	2911930	912808

TABLE 4 — Seal Manufacturers' Part Numbers

Falk Part No.	Manufacturers' No.
912550	CRWH85015
912554	CRWH107551
912626	CRWHA92536
912769	CRWH85009
912808	HSD1-1075230
912827	CRW17558(V)
912901	CRW19823(V)
912946	CRWH20002(V)
912948	CRW22363(V)
912949	CRWH22449(V)
912991	CRWH24914(V)
912992	CRWH24984(V)
912993	CRWH34892(V)
912994	JM/8821LPD-H5/L16(V)
912995	CRWH39932(V)
912996	CRWH39996(V)
912997	CRWH52447(V)
912998	CRWH52489(V)
913000	CRWH64998(V)
913001	JM/8950LUP-H5/L16(V)
913002	CRWH29958(V)
913003	CRWH44973(V)
913004	CRWH57552(V)
913005	CRWH57523(V)
913012	CRW17379(V)
913013	JM/12094LUP
913014	NATIONAL416257
913015	JM11709LUPH5L16(V)
913016	CR57522(V)
913017	CR57523(V)
913018	CR17379(V)
913023	JM12094LUP
913024	JM8951LUP
913025	NAT416257
913034	JM10509H5L1LUP
2909091	CRWHA1122590
2909092	CR1225239HDS3
2911930	CR1300290

TABLE 5 — Bearing Manufacturers' Part Numbers

Falk Part No.	Manufacturers' No.
919096	SKF23156-W33/C3
919284	SKF23148-W33/C3
920570	SKF23138-W33/C3
921301	TIM623/612
921414	TIM938/932
921439	TIMHM237535/HM237510
921443	TIMHH221449/HH221410
921459	TIMHH224335/HH224310
921470	TIMHH228349/HH228310
921481	TIMHH234048/HH234010
921494	TIMH715336/H715311
921541	TIMHH224346/HH224310
921551	TIMHH221430/HH221410
921552	TIMHH421246C/HH421210
921629	TIM3780/3720
921674	TIM95528/95925
921678	TIM850/832
921741	TIMHH221449A/HH221410
921809	TIM5583/5535
921855	TIM5584/5535
921856	TIM5578/5535
921878	TIM529X/522
921881	TIM99575/99100
921892	TIM3586/3520
921893	TIM6386/6320
921895	TIMH715346/H715311
921899	TIM843/832
921901	TIMHH437549/HH437510
2915524	SKF23144-W33/C3

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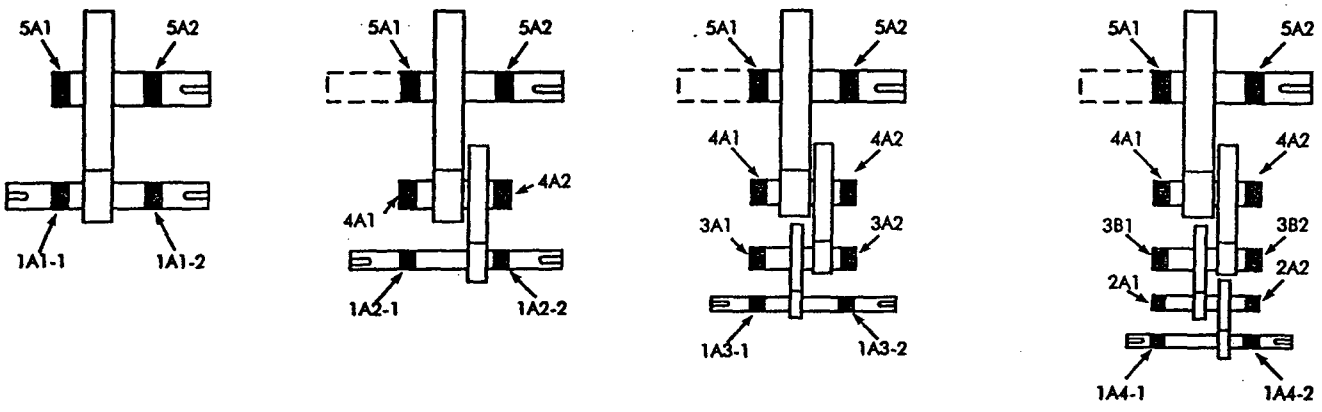
Bearing Data for Single, Double, Triple & Quadruple Reduction Drives



Single Reduction **Double Reduction** **Triple Reduction** **Quadruple Reduction**

TABLE 1 — Bearing Reference & Part Numbers

DRIVE SIZE	Type A, AXV, AXVQ, AR & ARJ										
	1A1-1 1A1-2	1A2-1 1A2-2	1A3-1 1A3-2	1A4-1 1A4-2	2A1	2A2	3A1	3A2	3B1	3B2	4A1 4A2
305	921526	921533	921537	...	...	...	921343	921343	...	...	921492
325	921434	921534	921537	...	...	...	921493	921493	...	...	921492 [33]
345	921490	921492	921533	...	...	...	921442	921442	...	...	921447
365	921879	921526	921533	...	...	...	921442	921442	...	...	921494 [34]
385	921352 [2]	921809 [1]	921892	921896	921892	921892	921856	921856	921856	921856	921893 [34]
395	921877	921490 [32]	921534	...	...	...	921526	921526	...	...	[35]
405	921885 [36]	921874 [37]	921898 [3]	921896	921629 [7]	921629	921875 [13]	921875 [13]	921809	921809	921899 [25]
425	921882	921877 [38]	921878	921892	921878	921878	921877 [14]	921877 [14]	921895 [19]	921895 [19]	921552 [26]
445	921882	921883 [39]	921884 [40]	921629	921301 [8]	921301	921678	921678 [15]	921678	921899 [20]	921885 [27]
465	921646	921885 [41]	921874 [4]	921878	921855 [9]	921855 [12]	921443	921443 [16]	921443	921551 [21]	921882 [42]
485	921905	921882 [43]	921877 [44]	921301	921895 [10]	921895	921882 [46]	921882 [17]	921541	921459 [22]	921904 [28]
505	921887	921470	921883 [5]	921895	921678 [11]	921678	921882 [47]	921882 [18]	921541	921541 [23]	921905 [29]
525	921906	921646	921885 [6]	921895	921552	921552	921904 [45]	921904 [45]	921470	921470	921887 [30]
535	...	921646	921885 [51]	921895	921552	921552	921904 [52]	921904 [52]	921470	921470	921887 [53]
545	...	921481	921541	...	...	...	921905 [48]	921905 [48]	...	...	919680
555	...	921481	921541	921895	921541 [54]	921541	921905	921905	921481	921481	921906 [55]
565	...	921901	921646	...	...	...	921905 [49]	921905 [49]	...	...	919118
585	...	921887	921646	...	...	...	921905 [50]	921905 [50]	...	...	919319

1 Use 921874 for 5.861 ratio and 921855 for 6.177 thru 15.52 ratios.
2 Use 921902 for ratios 1.882 thru 4.467.
3 Use 921629 for ratios 56.87 thru 105.9.
4 Use 921855 for ratios 59.08 thru 105.6.
5 Use 921678 for ratios 48.34 thru 100.0.
6 Use 921741 for ratios 85.94 thru 105.6 use 921443 for ratios 38.82 thru 75.71.
7 Use 921888 for ratios 396.0 and 431.1.
8 Use 921319 for ratios 401.5 and 429.8.
9 Use 921874 for ratios 105 thru 112.1; use 921856 for ratios 365.8 thru 428.6.
10 Use 921734 for ratios 391.7 and 426.3.
11 Use 921899 for ratios 407.2.
12 Use 921874 for ratios 105 and 112.1.
13 Use 921809 for ratios 47.12 thru 105.9.
14 Use 921895 for ratios 58.6 thru 76.06 and 94.39 thru 103.4; use 921494 for ratio 85.24.
15 Use 921899 for ratios 37.96, and 45.39 thru 104.6.
16 Use 921551 for ratios 51.20 thru 105.6.
17 Use 921459 for ratios 57.96 thru 102.0; use 921541 for ratio 50.07.
18 Use 921903 for ratios 34.12 thru 51.88; use 921541 for ratios 70.8 and 91.8; use 921459 for 61.7, 77.1, 84.4 and 100.
19 Use 921494 for ratios 229.8 and 340.9.
20 Use 921678 for ratios 105.0 thru 123.0.
21 Use 921443 for ratios 105.0 thru 129.4.
22 Use 921541 for ratios 106.5 thru 135.5.
23 Use 921459 for ratios 113.4, 145.0, 216.1, 251.1, and 313.9 thru 431.5.
24 Use 921891 for double reductions drives, ratios 5.861 thru 18.13.
25 Use 921876 for double reduction drives ratios 5.59 thru 18.48, and triple reduction drives, ratios 24.37 thru 39.10.
26 Use 921880 for double reduction drives, ratios 5.591 thru 18.74.
27 Use 921443 for quadruple reduction drives, all ratios, and triple reduction ratios 70.45 thru 104.6. 8
28 Use 921470 for quadruple reduction drives, all ratios, and triple reduction drives, ratios 63.09 thru 102.0.
29 Use 921481 for quadruple reduction drives, all ratios, and triple reduction drives, ratios 61.68 thru 100.0.
30 Use 921901 quadruple reduction drives, all ratios, and triple reduction drives ratios, and triple reduction drives ratios 72.19 thru 105.6.
31 Use 921882 for single reduction drives, ratios 1.882 thru 2.529; use 921541 for single reduction drives, ratios 2.812 thru 4.857.
32 Use 921918 for ratios 31.15 thru 34.02.
33 Use 921623 for 4A1.
34 Use 921529 for 4A2.
35 Use 921922 for double reduction units and 921529 for triple reduction units.
36 Use 921443 for 4.812 ratio.
37 Use 921855 for 20.21 thru 24.86 ratios.
38 Use 921895 for 22.86 thru 25.00 ratios.
39 Use 921678 for ratios 18.27 thru 24.93.
40 Use 921301 for ratios 45.39 thru 104.6.
41 Use 921443 for ratios 17.19 thru 25.09.
42 Use 921541 for triple reduction drives, ratios 79.39 thru 105.60, and quadruple reduction drives, all ratios.
43 Use 921541 for ratios 14.0 thru 21.0.
44 Use 921895 for ratios 50.07 thru 102.0.
45 Use 921470 for ratios 63.97 thru 105.6.
46 Use 921541 for ratios 50.07 thru 102.0.
47 Use 921541 for ratios 61.68 thru 100.0.
48 Use 921481 for ratios 45.94 thru 107.1.
49 Use 921481 for ratios 46.48 thru 102.1.
50 Use 921481 for ratios 85.8 thru 103.2.22
51 Use 921443 for ratios 44.05 thru 75.79 Use 921741 for ratios 86.03 thru 101.2.
52 Use 921470 ratios 65.52 thru 101.2.
53 Use 921901 for ratios 65.52 thru 445.8.
54 Use 921486 for ratios 403.6 thru 439.3.
55 Use 2918894 for ratios 120.6 thru 439.3.

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TABLE 1 — Bearing Reference & Part Numbers - Continued

DRIVE SIZE	A	AXV & AR		ARJ		AXVQ	
	SA1 & SA2	SA1	SA2	SA1	SA2	SA1	SA2
305	921530	...	...	...	...	...	...
325	921309	...	...	...	...	...	...
345	921352	...	...	...	...	...	...
365	921310	...	...	...	...	...	...
385	921414 [3]	...	...	...	...	...	...
395	921414	...	...	...	...	...	...
405	921674	921674	...	921331	...	...	...
425	921881	921881	...	921759	...	...	...
445	921439	921439	...	2912892	...	...	...
465	920570	2912611	...	2912802	...	...	...
485	2915524	921788	...	2913166	...	...	...
505	919284	921791	921791	2917472	2917472	2917124	2917124
525	919096	...	...	...	...	...	...
535	...	2918718	921794	2918635	2918635	2918385	2918385
545	920704	...	...	...	...	...	...
555	...	2918739	2918739	2918743	2918743	2918740	2918741
565	919945	...	...	...	...	...	...
585	919119	...	...	...	...	...	...

TABLE 2 — Bearing Cross Reference Numbers [1]

Falk Part No.	Manufacturer's Number
	SPHERICAL ROLLER BEARINGS
919096	23156-W33/C3
919118	22344-W33/C3
919119	23168-W33/C3
919284	23148-W33/C3
919319	22352-W33/C3
919680	22340-W33/C3
919945	23164-W33/C3
920570	23138-W33/C3
920704	23160-W33/C3
2915524	23144-CC
	TAPERED ROLLER BEARINGS
921301	623/612
921309	755/752
921310	861/854
921319	619/612
921331	HM237545/HM237510
921343	3659/3620
921352	6580/6535
921414	938/932
921434	HM807049/HM807010
921439	HM237535/HM237510
921442	3877/3820
921443	HH221449/HH221410
921447	65212/65500
921459	HH224335/HH224310
921470	HH228349/HH228310
921481	HH234048/HH234010
921486	HH224332/HH224310
921490	65237/65500
921492	HM807040/HM807010
921493	HM88542/HM88510
921494	H715336/H715311
921526	HM807046/HM807010
921529	H715345/H715311
921530	H414249/H414210
921533	3872/3820
921534	3876/3820
	TAPERED ROLLER BEARINGS
921537	3198/3120
921541	HH224346/HH224310
921551	HH221430/HH221410
921552	HH421246C/HH421210
921623	4559/4535
921629	3780/3720
921646	HH231649/HH231610
921674	95528/95925
921678	850/832
921734	H715341/H715311
921741	HH221749A/HH221410
921759	JHM840449/JHM840410
921788	H242649/H242610
921791	H247549/H247510
921794	H852849/H852810
921809	5583/5535
921855	5584/5535
921856	5578/5535
921874 [2]	5584V/5535V
921875 [2]	5583V/5535V
921876 [2]	843V/832V
921877 [2]	H715346XX/H715311XX
921878	529X/522
921879	H715344/H715311
921880 [2]	HH421246CV/HH421210V
921881	99575/99100
921882 [2]	HH224346V/HH224310V
921883 [2]	850V/832V
921884 [2]	623V/612V
921885 [2]	HH221449XX/HH221410XX
921887 [2]	HH437549XX/HH437510XX
921888	3782/3720
921891 [2]	6386V/6320V
921892	3586/3520
921893	6386/6320
921895	H715346/H715311
921896	M802048/M802011
921898 [2]	3780V/3720V
921899	843/832
921901	HH437549/HH437510
921902 [2]	6580V/6536V
921903 [2]	HH224335V/HH224310V
921904 [2]	HH228349V/HH228310V
921905 [2]	HH234048V/HH234010V
921918	65500/65225
921922	H715345XX/H715311XX
2912611	H239649/H239610
2912802	EE275100/275155
2912892	EE130902/131400
2913166	EE722115/722185
2917124	H859049/H859010
2917472	HM261049/HM261010
2918635	HM262749/HM262710
2918718	EE295110/295193
2918739	HH258248/HH258210
2918740	M268730/M268710
2918743	HM266446/HM266410
2918894	H247535/H247510

1 Falk suppliers of bearings are:
Tapered Roller Bearings — Timken, Bower and Tyson.
Spherical Roller Bearings — Torrington, SKF, FAG and PTC (Link Belt).

2 Tapered roller bearing numbers with an "XX" or "V" suffix are made of premium quality "Consumable-Electrode-Vacuum-Melted" steel (CEVM) and must be replaced with bearings of identical quality.

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Use the following steps to determine high and low speed shaft seal type and part numbers:

1. Determine drive size, type, reduction and approximate oil capacity from drive nameplate.
2. For 385 & 405 thru 585 type "A" drives, locate drive size and reduction in Table 1 and read across to find approximate oil capacity under high or low speed shaft. Determine type of seal (lip or bush) at the top of the column. For all other A, AR & AXV drives, go to step 3.
3. Refer to Tables 2 thru 7, Pages 1 and 2, for Falk part number and Tables 6 thru 8, Pages 2 thru 4, for manufacturer's part number and dimensions.

TABLE 1 — Seal Type (Lip or Bush) – Type A

Based on Approx. Oil Capacity — Gallons ★
Sizes 385 & 405 thru 585

DRIVE SIZE	No. of Red.	Approximate Oil Capacity			
		H.S. Shaft		L.S. Shaft	
		Lip	Bush	Lip	Bush
385	A1	10	6-8	10	6-8
	A2	10	5-8	10	5-8
	A3	10	9	9-10	...
	A4	10	...	10	...
405	A1	13	8-12	12-13	8-10
	A2	15	8-12	15	8-12
	A3	15	12	12-15	...
	A4	14	...	14	...
425	A1	17	11-16	17	11-16
	A2	20	10-16	20	10-16
	A3	21	18	18-21	...
	A4	20	...	20	...
445	A1	29	18-22	29	18-22
	A2	28	14-22	28	14-22
	A3	29	24	24-29	...
	A4	28	...	28	...
465	A1	34	22-29	22-34	...
	A2	37	18-30	18-37	...
	A3	39	33	33-39	...
	A4	38	...	38	...
485	A1	38	24-32	24-38	...
	A2	48	23-38	23-48	...
	A3	57	48	48-57	...
	A4	47-56	...	47-56	...
505	A1	51	32-42	32-51	...
	A2	64	32-50	32-64	...
	A3	78	64	64-78	...
	A4	64-77	...	64-77	...
525	A1	64	40-53	40-64	...
	A2	78	38-59	38-78	...
	A3	95	79	79-95	...
	A4	78-93	...	78-93	...
545	A2	Refer to Factory			
	A3				
565	A2	Refer to Factory			
	A3				
585	A2	Refer to Factory			
	A3				

★ Approximated gallons as listed on drive nameplate.

TABLE 2 — Falk Oil Seal Part Numbers – Type A

Sizes 385 & 405 thru 585

DRIVE SIZE	Location & Seal Type	H.S. Shaft				L.S. Shaft All Red.
		A1	A2	A3	A4	
385	OUTER-LIP	912995	912991	913018	913010	913014
	INNER-LIP	912996	912992	912946	913011	913015
	INNER-BUSH &	3200213	3200210	3200208	...	3200215
	"O" RING	927112	927100	926957	...	927121
405	OUTER-LIP	912997	912993	912948	913010	913000
	INNER-LIP	912998	912994	912949	913011	913001
	INNER-BUSH &	3200214	3200211	3200209	...	3200216
	"O" RING	927116	926968	926988	...	927125
425	OUTER-LIP	913014	913012	912948	913018	913016
	INNER-LIP	913015	913013	912949	912946	913017
	INNER-BUSH &	3200215	3200212	3200209	...	3200218
	"O" RING	927121	926962	926988	...	927128
445	OUTER-LIP	913014	912995	912991	912948	913004
	INNER-LIP	913015	912996	912992	912949	913005
	INNER-BUSH &	3200215	3200213	3200210	...	3200220
	"O" RING	927121	927112	927100	...	926965
465	OUTER-LIP	913002	912997	912993	912948	913023
	INNER-LIP	913003	912998	912994	912949	913024
	INNER-BUSH &	3200217	3200214	3200211	...	...
	"O" RING	927126	927116	926968	...	...
485	OUTER-LIP	913021	913014	913012	912991	912827
	INNER-LIP	913022	913015	913013	912992	912554
	INNER-BUSH &	3200219	3200215	3200212	...	...
	"O" RING	927129	927121	926962	...	...
505	OUTER-LIP	913004	912999	912995	913012	913025
	INNER-LIP	913005	912310	912996	913013	912769
	INNER-BUSH &	3200220	9200266	3200213	...	...
	"O" RING	926965	927125	927112	...	...
525	OUTER-LIP	913026	913002	912997	913012	912901
	INNER-LIP	913027	913003	912998	913013	912626
	INNER-BUSH &	3200327	3200217	3200214	...	...
	"O" RING	926966	927126	927116	...	...
545	OUTER-LIP	...	913021	913014	...	912550
	INNER-LIP	...	913022	913015	...	913034
	INNER-BUSH &	...	...	3200215	...	...
	"O" RING	...	...	927121	...	...
565	OUTER-LIP	...	913004	913002	...	2909092
	INNER-LIP	...	913005	913003	...	2909091
	INNER-BUSH &	...	...	3200217	...	...
	"O" RING	...	...	927126	...	...
585	OUTER-LIP	...	913004	913002	...	2911930
	INNER-LIP	...	913005	913003	...	912808
	INNER-BUSH &	...	...	...	...	...
	"O" RING	...	...	...	...	...

TABLE 3 — Falk Oil Seal Part Numbers – Type A

Sizes 305 thru 365 & 395

DRIVE SIZE	H.S. Shaft			L.S. Shaft All Red.
	A1	A2	A3	
305	2907851	912928	912927	912934
325	912780	912929	912927	912935
345	912805	912930	912928	912936
365	912934	912931	912928	912838
395	912935	912932	912929	912818

TABLE 4 — Falk Oil Seal Part Numbers – Type AXV Sizes 405 thru 485

DRIVE SIZE	Location & Seal Type	H.S. Shaft			L.S. Shaft (All Red.)			
		A2	A3	A4	AXVU	AXVD	AXVQ Upper	AXVQ Lower
405	OUTER-LIP	912993	912948	913010	913000	913000	912816	912816
	INNER-LIP	912994	912949	913011	913001	913001	912833	912767
	DRYWELL "O" RING	...	...	...	...	2912848	...	2912848
425	OUTER-LIP	913012	912948	913018	913016	913016	2913531	912767
	INNER-LIP	913013	912949	912946	913017	913017	912767	912827
	DRYWELL "O" RING	...	...	...	...	927080	...	927080
445	OUTER-LIP	912995	912991	912948	913004	913004	912672	912578
	INNER-LIP	912996	912992	912949	913005	913005	912578	912580
	DRYWELL "O" RING	...	...	...	...	927084	...	927084
465	OUTER-LIP	912997	912993	912948	913023	913023	912580	912580
	INNER-LIP	912998	912994	912949	913024	913024	912940	912550
	DRYWELL "O" RING	...	...	...	...	926996	...	926996
485	OUTER-LIP	913014	913012	912991	2913170	2913170	912550	912550
	INNER-LIP	913015	913013	912992	2913169	2913169	2913168	912808
	DRYWELL "O" RING	...	...	...	...	2913171	...	2913171

TABLE 5 — Falk Oil Seal Part Numbers – Types AR & ARJ Sizes 405 thru 485

DRIVE SIZE	Location & Seal Type	H.S. Shaft — AR & ARJ			L.S. Shaft	
		A2	A3	A4	AR	ARJ (Shrink Disc)
405	OUTER-LIP	912993	912948	913010	913000	(2)912816
	INNER-LIP	912994	912949	913011	913001	(2)912833
425	OUTER-LIP	913012	912948	913018	913016	(2)2913531
	INNER-LIP	913013	912949	912946	913017	(2)912767
445	OUTER-LIP	912995	912991	912948	913004	(2)912672
	INNER-LIP	912996	912992	912949	913005	(2)912578
465	OUTER-LIP	912997	912993	912948	913023	(2)912580
	INNER-LIP	912998	912994	912949	913024	(2)912940
485	OUTER-LIP	913014	913012	912991	2913170	(2)912550
	INNER-LIP	913015	913013	912992	2913169	(2)2913168

TABLE 6 — Drive Drywell – Types AXVD & AXVQ V-Ring Seal Part Nos. & Dimensions Sizes 405 thru 485

DRIVE SIZE	Falk Part Number	Manufacturer's Part Number Chicago Rawhide	Basic Dimensions — Inches	
			Inside Dia.	Width
405	2912858	402202	7.800	.410
425	2913534	402500	8.860	.980
445	2912448	402750	9.720	.980
465	2912803	403250	11.500	.980
485	2913172	403500	12.400	.980

TABLE 7 — "O" Ring – Type A Part Numbers & Dimensions

Falk Part Number	Industry Part Number	Basic Dimensions — Inches		
		Inside Dia.	Outside Dia.	Width
926957	144	2.500	2.688	.0937
926962	240	3.750	4.000	.1250
926965	367	7.500	7.875	.1875
926966	371	8.500	8.875	.1875
926968	152	3.250	3.438	.0937
926988	147	2.688	2.875	.0937
926996	458	14.500	15.000	.2500
927080	451	11.000	11.500	.2500
927084	455	13.000	13.500	.2500
927100	233	2.875	3.125	.1250
927112	245	4.375	4.625	.1250
927116	249	4.875	5.125	.1250
927121	254	5.500	5.750	.1250
927125	258	6.000	6.250	.1250
927126	259	6.250	6.500	.1250
927128	261	6.750	7.000	.1250
927129	262	7.000	7.250	.1250
2912848	378	10.500	10.875	.1875
2913171	464	17.500	18.000	.2500

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TABLE 8 — Oil Seal Part Numbers & Dimensions – All Types (Continued on Page 4)

Falk Part Number	Manufacturer's Part Number ★			Basic Dimensions — Inches		
	Chicago Rawhide	Johns-Manville	National	Shaft Dia.	Outside Dia.	Width t
912310	CRWH 49991 (V)	6325LUP H5/L16 (V)	...	5.000	6.250	.562
912550	CRWH1-115021	9019LUP	...	11.500	13.000	.750
912554	CRWH 85015	8954LUP	455126	8.500	10.500	.750
912578	HDS5-91135	16554LUP	455476	9.000	10.260	.750
912580	...	9830LPD	455270	10.000	11.010	.750
912626	CRWH 107551	16570LUP	...	10.750	12.750	1.000
912672	CPR 90006	11552LPD	...	9.000	10.008	.750
912767	CRWH 77540	...	...	7.750	9.250	.625
912769	CRWHA 92536	...	...	9.250	11.250	.625
912780	CRW 21163	...	...	2.125	3.005	.375
912805	CRW 23701	...	...	2.375	3.355	.375
912808	HDS1-1300570	10093LUP	...	13.000	15.000	.938
912816	CRWH 70016	10063LPD	455517	7.000	8.009	.750
912818	CRWH 44967	4519LUP	456888	4.500	5.506	.562
912827	CRWH 85009	10371LUP	455489	8.500	10.000	.750
912828	CRWH 39933	9866LUP	...	4.000	5.004	.438
912833	CRWH 70052	11577LPD	455084	7.000	8.509	.750
912901	HSDI 1075230	16569LUP	...	10.750	12.250	.625
912927	CRW 11123	9625LUP	481100	1.125	1.628	.313
912928	CRW 12545	...	481795	1.250	2.129	.375
912929	CRW 15141	9952LUP	481837	1.500	2.506	.375
912930	CRW 17284	9799LPD	481122	1.750	2.441	.375
912931	CRW 19992	11018LUP	482009	2.000	3.005	.375
912932	CRWH 22446	10418LUP	452636	2.250	3.256	.500
912934	CRWH 27368	6257LPD	457316	2.750	3.756	.438
912935	CRWH 29951	6423LUP	...	3.000	4.008	.438
912936	CRWH 34888	11197LUP	456414	3.500	4.505	.500
912940	...	17846LDS	417020	10.000	12.008	.625
912946	CRW 17558 (V)	4465LUP H5/L16 (V)	...	1.750	2.750	.375
912948	CRW 19823 (V)	10755LPD H5/L16 (V)	...	2.000	2.750	.313
912949	CRWH 20002 (V)	1075LPD H5/L16 (V)	...	2.000	3.000	.375
912991	CRW 22363 (V)	10289LUP H5/L16 (V)	483323V	2.250	3.000	.468
912992	CRWH 22449 (V)	6336LUP H5/L16 (V)	...	2.250	3.250	.438
912993	CRWH 24914 (V)	9790LUP H5/L16 (V)	450519V	2.500	3.250	.500
912994	CRWH 24984 (V)	10208LUP H5/L16 (V)	...	2.500	3.500	.438
912995	CRWH 34892 (V)	11197LUP H5/L16 (V)	...	3.500	4.500	.500
912996	...	8821LPD H5/L16 (V)	...	3.500	4.750	.625
912997	CRWH 39932 (V)	7199LUP H5/L16 (V)	456967V	4.000	5.000	.500
912998	CRWH 39996 (V)	5489LPD H5/L16 (V)	...	4.000	5.250	.468
912999	...	9629LUP H5L/16 (V)	455271V	5.000	6.000	.625
913000	CRWH 52447 (V)	7042LUP H5/L16 (V)	455448V	5.250	6.250	.562
913001	CRWH 52489 (V)	7112LPD H5/L16 (V)	...	5.250	6.500	.625
913002	CRWH 54934 (V)	5926LUP H5/L16 (V)	...	5.500	6.500	.500
913003	CRWH 54974 (V)	7186LUP H5/L16 (V)	...	5.500	6.750	.500
913004	CRWH 64998 (V)	10267LUP H5/L16 (V)	...	6.500	7.500	.562
913005	...	8950LUP H5/L16 (V)	...	6.500	8.000	.750
913010	CRW 14861 (V)	11654LUP H5/L16 (V)	...	1.500	2.000	.313
913011	CRW 14940 (V)	12184LUP H5/L16 (V)	481507V	1.500	2.250	.375
913012	...	5961LUP H5/L16 (V)	455281V	3.000	3.750	.500
913013	CRWH 29958 (V)	6423LUP H5/L16 (V)	455013V	3.000	4.000	.468
913014	CRWH 44973 (V)	9170LUP H5/L16 (V)	455200V	4.500	5.500	.562
913015	...	11709LUP H5/L16 (V)	...	4.500	5.750	.562
913016	CRWH 57552 (V)	9548LUP H5/L16 (V)	455363V	5.750	6.750	.625
913017	CRWH 57523 (V)	14915LPD H5/L16 (V)	455107V	5.750	7.000	.625
913018	CRW 17379 (V)	14849LPD H5/L16 (V)	...	1.750	2.500	.313
913021	...	9514LUP H5/L16 (V)	...	6.000	7.000	.438
913022	...	8947LUP H5/L16 (V)	...	6.000	7.500	.562
913023	...	12094LUP	...	7.250	8.250	.438
913024	...	8951LUP	...	7.250	8.750	.750
913025	...	...	416257	9.250	11.000	.750
913026	...	9595LUP H5/L16 (V)	...	7.750	8.750	.438
913027	...	8941LUP H5/L16 (V)	...	7.750	9.000	.625
913034	HDS1-1150540	10509LUP	...	11.500	13.500	.750

★ Subject to substitution of equivalent seals without notice. Manufacturer's part numbers ending in V or (V) denote high temperature seals.

† Seal listed may be slightly narrower than the width listed.

TABLE 8 — Oil Seal Part Numbers & Dimensions – All Types (Continued from Page 3)

Falk Part Number	Manufacturer's Part Number ★			Basic Dimensions — Inches		
	Chicago Rawhide	Johns-Manville	National	Shaft Dia.	Outside Dia.	Width †
2907851	CRW 19760	...	...	2.000	2.627	.313
2909091	CRWHA1-122590	5891LPD	...	12.250	14.250	1.000
2909092	HDS3-1225239	11318LPD	...	12.250	13.750	.625
2911930	HDS1-1300290	13811LUP	...	13.000	14.500	1.000
2913168	CRWH 115041	...	...	11.500	13.500	.750
2913169	CRWH 80010	...	455300	8.000	9.500	.625
2913170	CRWH1 80037	...	455122	8.000	10.000	.625
2913531	CRSH 77530	...	...	7.750	9.010	.625

★ Subject to substitution of equivalent seals without notice.
† Seal listed may be slightly narrower than the width listed.

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How to Use This Manual

This manual provides detailed instructions on installation and maintenance of parallel shaft Types A, AR, AXV and right angle Types AB, ABR, ABX, and ABRC gear drives. Use the table of contents below to locate required information.

CAREFULLY FOLLOW THE INSTRUCTIONS IN THIS MANUAL FOR OPTIMUM PERFORMANCE AND TROUBLE FREE SERVICE OF YOUR FALK GEAR DRIVE.

Table of Contents

Installation Instructions . . . . . Pages 1-3
Shaft Connections . . . . . Pages 3-4
Tightening Torques . . . . . Page 5
Lubrication Recommendations . . . . . Pages 5-8
Preventive Maintenance . . . . . Page 9
Stored and Inactive Gear Drives . . . . . Page 11

Introduction

Credit for long service and dependable operation of a gear drive is often given to the engineers who designed it, or the craftsmen who constructed it, or the sales engineer who recommended the type and size. Ultimate credit belongs to the mechanic on the job who worked to make the foundation rigid and level, who accurately aligned the shafts and carefully installed the accessories, and who made sure that the drive received regular lubrication. The details of this important job are the subject of this manual.

NAMEPLATE — Operate Falk gear drives only at power, speed and ratio shown on the nameplate. Before changing any one of these, submit complete nameplate data and new application conditions to the Falk for correct oil level, parts, and application approval.

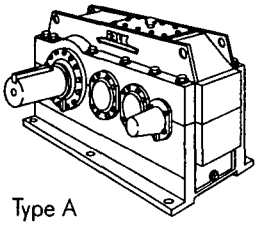
DISASSEMBLY AND ASSEMBLY — Disassembly & assembly instructions and parts guides are available from the Factory or Falk Representatives. When requesting information, please give complete data from the nameplate on the gear drive; Model, M.O.Number, Date, RPM, and Ratio.

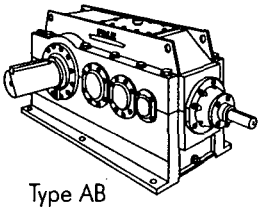
WARNING: Consult applicable local and national safety codes for proper guarding of rotating members. Lock out power source and remove all external loads from drive before servicing drive or accessories.

Warranty

The Falk Corporation (the "Company") warrants that its products (i) conform to Company's published specifications, and (ii) are free from defects in material or workmanship. The duration of this warranty is three years from the date of shipment.

Company does not warrant any purchased, non-Falk branded products or components (manufacturer's warranty applies) or any defects in, damage to, or failure of products caused by: (i) dynamic vibrations imposed by the drive system in which such products are installed unless the nature of such vibrations has been defined and accepted in writing by Company as a condition of operation; (ii) failure to provide suitable installation environment; (iii) use for purposes other than those for which designed, or other abuse or misuse; (iv) unauthorized attachments, modifications or disassembly, or (v) mishandling during shipping.


Type A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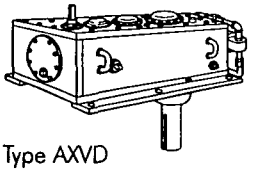
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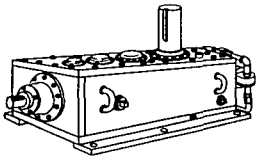
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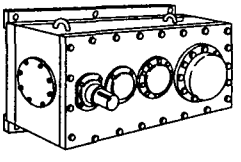
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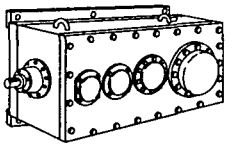
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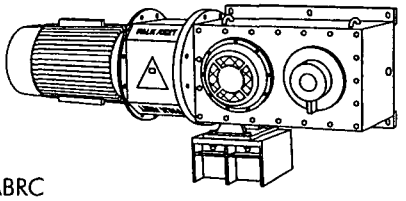

Type ABRC

Installation Instructions

The following instructions apply to standard Falk Type A, AB, AXV, ABX, AR, ABR, & ABRC (Alignment Free) drives. If a drive is furnished with special features, refer to the supplementary instructions shipped with the drive.

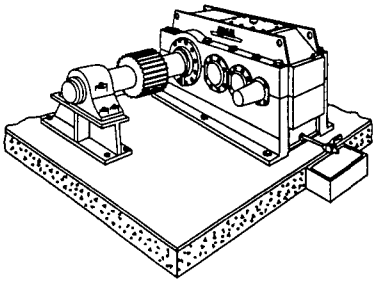
NOTE: Quadruple Reduction Type "A" Gear Drives: Removal of backstop and mounting bracket may be required for adequate clearance when installing foundation fasteners. Removal of fan assemblies may be required for adequate clearance when installing foundation fasteners.

WELDING — Do not weld on the gear drive or accessories without prior approval from The Falk Corporation. Welding on the drive may cause distortion of the housing or damage to the bearings and gear teeth. Welding without prior approval could void the warranty.

EFFECTS OF SOLAR ENERGY — If the gear drive operates in the sun at ambient temperatures over 100°F(38°C), then special measures should be taken to protect the drive from solar energy. This protection can consist of a canopy over the drive or reflective paint on the drive. If neither is possible, a heat exchanger or other cooling device may be required to prevent the sump temperature from exceeding the allowable maximum.

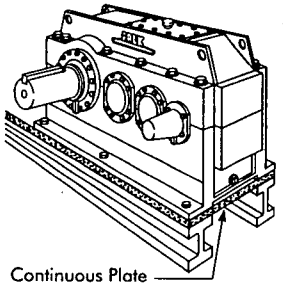
MOUNTING POSITION — Standard mounting positions for types A, AB, AXV, and ABX are with the base horizontal, and for types AR, ABR, and ABRC with the input and output shafts horizontal. If a gear drive is ordered for non-standard mounting positions, refer to the instructions provided with the drive for oil levels and bearing lubrication. If it is necessary to mount the gear drive in a different position from which it was ordered, refer to Falk for required changes to provide proper lubrication.

FOUNDATION, GENERAL — To facilitate oil drainage, elevate the gear drive foundation above the surrounding floor level. If desired, replace the drive oil drain plug with a valve, but provide a guard to protect the valve from accidental opening or breakage.

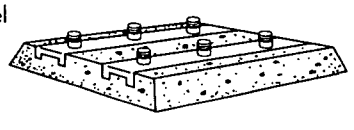


When an outboard bearing is used, mount drive and outboard bearing on a continuous foundation or bedplate, and dowel both in place.

FOUNDATION, STEEL — When mounting gear drive on structural steel, it is recommended that an engineered design be utilized for a pedestal, adapter base or bed to provide sufficient rigidity, to prevent induced loads from distorting the housing and causing gear misalignment. In the absence of an engineered design, it is recommended that a base plate, with thickness equal to or greater than the thickness of the drive feet, be securely bolted to steel supports and extend under the entire drive as illustrated.



FOUNDATION, CONCRETE — If a concrete foundation is used, allow the concrete to set firmly before bolting down the gear drive. For the best type of mounting, grout structural steel mounting pads into the mounting base, as illustrated, rather than grouting the drive directly into the concrete.



Motors and other components mounted on motor plates or motor brackets may become misaligned during shipment. ALWAYS check alignment after installation. Refer to Page 4 for coupling alignment instructions.

MOTOR BRACKETS — Falk motor brackets provide an economical "soft mounting" for standard NEMA and IEC foot mounted AC induction electric motors. The weight, location, and starting torque of the motor will cause cantilevered motor brackets to deflect downward or to twist to varying degrees.

The motor bracket/motor selections are engineered to be within acceptable deflection limits as determined by the Falk Corporation. Because the bracket is a "soft motor support", deflection and vibration magnitude of the bracket may exceed levels normally considered acceptable for rigidly mounted machinery.

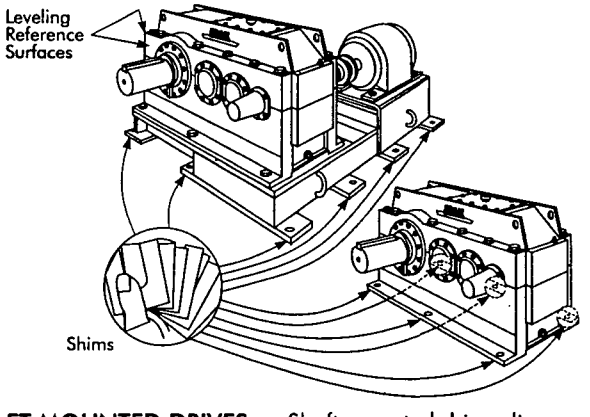
For applications using other than standard selections, use of a motor plate is recommended. If a motor bracket is to be used, it becomes the customer's responsibility to support the rear of the motor bracket to limit deflection and vibration to within satisfactory levels as determined by the customer.

Gear Drive Alignment

FOOT MOUNTED DRIVES – Align drive with driven equipment by placing broad, flat shims under all mounting pads. Start at the low speed shaft end and level across the length and then the width of the drive. Check with a feeler gauge to make certain that all pads are supported to prevent distortion of housing when drive is bolted down. After drive is aligned with driven equipment and bolted down, align prime mover to drive input shaft. Refer to Page 4 for coupling alignment.

If equipment is received from Falk mounted on a bedplate, the components were accurately aligned at Falk with the bedplate mounted on a large, flat assembly plate. Shim under the bedplate foot pads until the gear drive is level and all feet are in the same plane.

Check high speed shaft coupling alignment. If the coupling is misaligned, the bedplate is shimmed incorrectly. Re-shim bedplate and recheck high speed coupling alignment. If necessary, realign motor.



SHAFT MOUNTED DRIVES — Shaft mounted drive alignment occurs when the gear drive is attached to the driven shaft. The standard hollow low speed shaft is connected to the driven shaft with a shrink disc connection. Solid low speed shafts are typically connected with an MCF moment type coupling. Refer to the Shaft Connection section for coupling installation.

There may be some visible movement of the drive while operating due to shaft and coupling runouts. Torque arm assemblies must be aligned such that the gear drive movement is not restricted during operation. Refer to torque arm instructions on Page 3.

The Alignment Free drive flange motor adapter provides registration for the motor which eliminates the adjustments normally required for high speed coupling alignment.

Torque Arms

The torque arm connects a shaft mounted gearbox to the foundation. In static condition, it helps to support the weight of the gearbox/motor assembly. In the dynamic condition, it supports the weight and also transmits the torque reaction to

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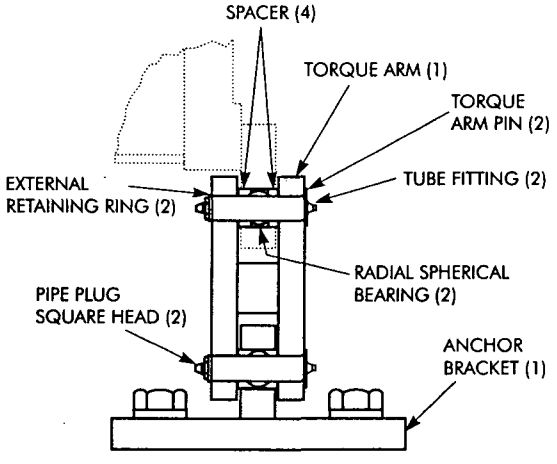
the foundation. The torque arm may be loaded in compression or tension. Maximum torque arm loads should be considered when designing the foundation for the torque arm anchor.

TORQUE ARM ASSEMBLY — The torque arm components are to be assembled according to the following illustration. A plain spherical bearing is fitted into the gearbox housing or bedplate. A pin engages the spherical bearing and connects it to the torque arm. Spacers center the bearing on the pin. The pin is retained by a snap ring. A similar connection is made between the torque arm and anchor bracket. In operation, the torque arm is to be perpendicular to the edge of the gear drive.

Warning: *Angular misalignment of the torque arm may restrict gear drive gear drive movement and cause excessive loading on the low speed shaft and driven equipment.*



TORQUE ARM MOVEMENT — Movement of the gear drive while operating is natural. The movement is due to shaft and coupling runouts. The standard torque arm is designed to accommodate this movement. It allows the gearbox to move slightly with the driven shaft. This prevents transmitting unnecessary additional loads to the driven shaft through the gearbox. DO NOT restrain free movement of the gear drive, to do so will adversely load the low speed shaft and driven shaft and may result in shaft or hub failure. Recheck torque arm movement during regular maintenance intervals.

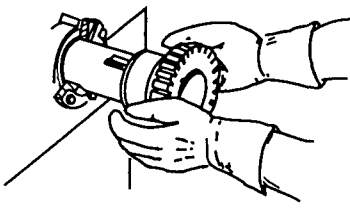
Shaft Connections

WARNING: *Provide suitable guards in accordance with local and national standards.*

SHRINK DISC CONNECTIONS — Shrink disc assemblies used on hollow low speed shafts and on some MCF coupling hubs require special installation procedures. Refer to the following Falk bulletins for detailed instructions:

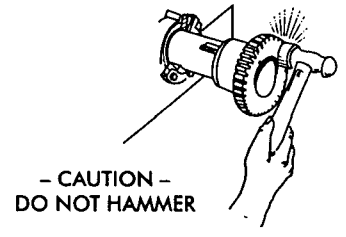
Shrink Discs 138-850
MCF couplings 458-862

COUPLING CONNECTIONS — The performance and life of any coupling depends largely upon how well the coupling is installed and serviced. Refer to the coupling manufacturer's manual for specific instructions.



CORRECT METHOD

Heat interference fitted hubs, pinions, sprockets or pulleys to a maximum of 275°F (135°C) and slide onto gear drive shaft.



INCORRECT METHOD

DO NOT drive coupling hub, pinion, sprocket or pulley onto the shaft. An endwise blow on the shaft/coupling may damage gears and bearings.

FLANGED MOTOR

ADAPTERS — Accurate axial positioning of the coupling hub on the motor shaft is required to ensure proper coupling gap. To establish the correct overhang on the motor shaft, measurements are required. Refer to Figure 1 below. First measure the distance from the motor mounting face of the motor to the end of the motor shaft (A). Then measure the distance from the motor mounting face of the motor adapter to the face of the gear drive hub (B). Refer to the coupling installation and maintenance instructions to determine the desired coupling gap. The coupling overhang is determined from the following equation:

Overhang = A + Gap - B

If the calculated overhang is a positive value, the motor shaft extends beyond the hub by that amount.

NOTE: For couplings where the coupling gap does not occur at the end of the motor hub, an additional adjustment must be made. See dimension C in Figure 1 below.

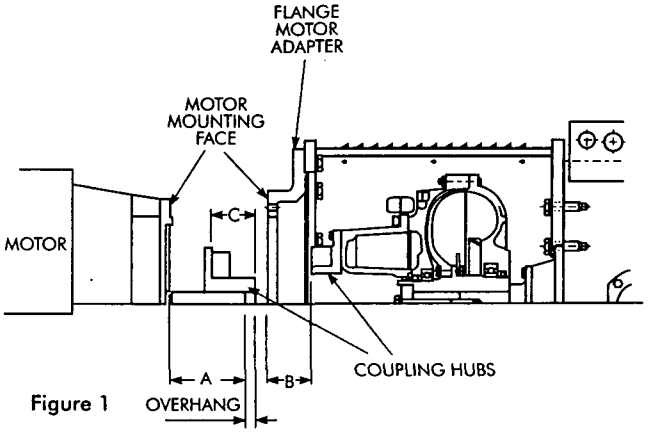


Figure 1

FALK COUPLINGS — (Except fluid type) Detailed installation manuals are available from Falk, your local Falk Representative or Distributor—just provide size and type designations stamped on the coupling. For lubricant requirements and a list of typical lubricants meeting Falk specifications, refer to appropriate coupling service manual.

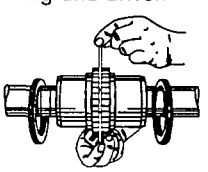
Flanged Type Rigid Couplings are typically used on drives with vertical output shafts. The low speed shaft extension ends of the solid vertical shaft drives are drilled and tapped to accommodate coupling keeper plates. Tightening torques for fasteners, including keeper plate fasteners are listed in Table 1, Page 5.

FALK FLUID COUPLINGS — Refer to the installation manual furnished with the Falk fluid coupling for installation and startup instructions.

Type ABRC — The Alignment Free flange motor adapter has two side inspection openings. On solid shaft gear drives, the opening opposite the low speed shaft extension has been marked to indicate the vertical midpoint of the adapter. On hollow shaft gear drives, the opening on the shrink disk side of the gear drive has been marked to indicate the vertical midpoint of the adapter. These marks are used to establish the proper fill angle for the fluid coupling.

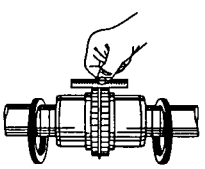
The fluid coupling outside diameter has been marked with two separate match marks. The recommended fill can be obtained by lining up the correct match mark on the fluid coupling with the mark in the inspection opening and filling the fluid coupling until fluid appears at the lip of the fill hole. To determine the correct mark on the fluid coupling begin by aligning the fill hole with the match mark in the inspection opening. For fill angles less than 90°, rotate the fill plug upward till the match marks line up. For fill angles greater than 90°, rotate the fill plug downward till the match marks line up.

GAP AND ANGULAR ALIGNMENT — If possible, after mounting coupling hubs, position the driving and driven equipment so that the distance between shaft ends is equal to the coupling gap. Align the shafts by placing a spacer block, equal in thickness to required gap, between hub faces, as shown at right, and also at 90° intervals around the hub. Check with feelers.



STEELFLEX® ILLUSTRATED

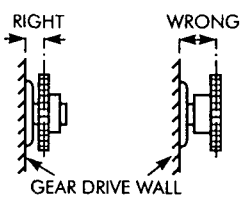
OFFSET ALIGNMENT — Align driving and driven shafts so that a straight edge will rest squarely on both couplings hubs as shown to the right and also at 90° intervals. Tighten foundation bolts of the connected equipment and recheck alignment and gap.

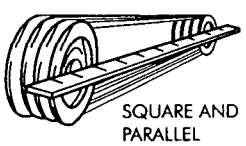


STEELFLEX ILLUSTRATED

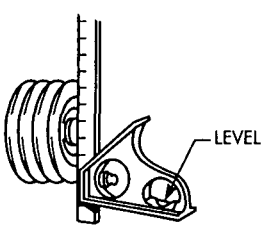
SPROCKETS, PULLEYS OR SHEAVES — Mount power take-offs as close to the gear drive housing as possible to avoid undue bearing load and shaft deflection.

Align the output shaft of the gear drive square and parallel with the driven shaft by placing a straightedge across the face of the sprockets or sheaves as illustrated.Check horizontal shaft alignment by placing one leg of a square against the face of the sheave or sprocket with the spirit level on the horizontal leg of the square.





SQUARE AND PARALLEL



DO NOT over tighten belts or chains. Adjust chains to manufacturers' specifications. Adjust belts as follows:

The ideal tension is the lowest tension at which the belt will not slip under peak load conditions. Check the belt tension frequently during the first 24 to 48 hours of run-in operation. Over tightening belts shortens belt and bearing life. Keep belts free from foreign material which may cause slippage. Inspect the V–belt periodically; tighten the belts if they are slipping.

OUTBOARD BEARING — Mount the outboard bearing and gear drive on a common foundation so that they will shift as an assembly if settling should occur. Bring the outboard bearing to the correct horizontal position with broad flat shims under the mounting pad. Align accurately so that the load is equally divided between the two drive bearings and the outboard bearing. Mount a stop bar against the pillow block foot on the load side when large horizontal load components are exerted on the pillow block.

PINION MOUNTING — Mount pinion as close to the drive as possible to avoid undue bearing load and shaft deflection. Refer to Falk for pinion alignment instructions.

Non Falk Couplings — Refer to manufacturers' installation and maintenance instructions.

BACKSTOPS — To prevent damage to backstops due to incorrect motor shaft rotation at start up, couplings are NOT assembled when gear drives are furnished with backstops for all types except ABRC. For type ABRC drives, remove the backstop before electrically connecting the motor. AB, ABR, and ABRC backstops are held in place by a retaining ring on the intermediate shaft.

After completing electrical connections, check motor and gear drive shaft rotations. If rotations are correct, complete alignment and assembly of coupling or re-install the backstop.

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Fastener Tightening Torques

Use the tightening torque values specified in Table 1 for fastening Falk gear drives, motors and accessories to their mounting surfaces with un-lubricated fasteners. DO NOT use these values for "torque locking" fasteners or for fastening components with aluminum feet or soft gaskets or vibration dampeners on the mounting surface. If the tightening torque exceeds the capacity of the torque wrench, use a torque multiplier. For inch fasteners, use Grade 5 for diameters though 1.500 inch and ASTM A 354 grade BC for larger diameter fasteners. Use ISO property class 8.8 for metric fasteners.

TABLE 1 — Tightening Torques: +/-5%
DO NOT Lubricate Fasteners

Inch Fasteners – Grade 5				
Fastener Size	Metal to Metal		Metal to Concrete	
	lb-ft	Nm	lb-ft	Nm
.250-20	7	10	6	8
.3125-18	15	21	12	16
.375-16	27	37	22	30
.500-13	67	91	54	73
.625-11	134	184	108	146
.750-10	242	330	194	265
.875-9	395	530	315	425
1.000-8	590	800	475	640
1.125-7	740	1000	590	800
1.250-7	1060	1420	840	1140
1.375-6	1360	1860	1100	1480
1.500-6	1840	2480	1460	1980
1.750-5	3900	5300	2700	4240
2.000-4.5	5900	7900	4100	6300
2.250-4.5	8600	11800	6000	9400
2.500-4	11800	16000	8300	12800
2.750-4	14600	19800	10200	15800
3.000-4	19400	26400	13600	21100

TABLE 1A — Tightening Torques: +/-5%
DO NOT Lubricate Fasteners

Metric Fasteners – Property Class 8.8				
Fastener Size	Metal to Metal		Metal to Concrete	
	lb-ft	Nm	lb-ft	Nm
M4 x .7	2	3	1.5	2
M5 x .8	4.5	6	3.5	5
M6 x 1.0	7.5	10	6	8
M8 x 1.25	18	24	14	19
M10 x 1.5	36	50	29	39
M12 x 1.75	62	84	50	68
M16 x 2	56	210	126	170
M20 x 2.5	305	415	246	330
M30 x 3.5	1060	1 440	850	1 150
M36 x 4	1680	2 520	1500	2 030
M42 x 4.5	3000	4 050	2400	3 250
M48 x 5	4500	6 100	3600	4 880
M56 x 5.5	7300	9 850	5800	7 860

Water Cooling

WATER COOLED HEAT EXCHANGERS — Install a shut-off or control valve in the water line to the heat exchanger to regulate the water flow through the exchanger. Also install a water flow gauge between the control valve and the exchanger to determine actual flow rate. Discharge water to an OPEN DRAIN to prevent back pressure.

INTERNAL COOLING TUBES — Refer to Manual 138-310 for installation, operation, and maintenance of internal cooling tubes.

Lubrication Systems

SPLASH LUBRICATED DRIVES — Standard type A, AR, AB, ABR, and ABRC drives are splash lubricated. The lubricant is picked up by the revolving elements and distributed to the bearings and gear meshes.

OIL PUMP LUBRICATED DRIVES — Types AXV and ABX are equipped with an external oil pump to provide oil to the upper bearings and gear meshes. The system is composed of an electric motor driven gear pump, oil filter, flow indicator with switch, and an internal distribution network with relief valve (set at 30 psi). The pump system may be furnished with a 50 or 60Hz, 3 phase electrical motors based on the selection. Refer to the pump motor nameplate and Table 2 for electrical requirements. Wire the motor for correct rotation as indicated by the rotation arrow. The flow indicator has a single pole, double throw switch rated at 15A, 125V/7A, 250V maximum. Connect the flow indicator switch with the prime mover control circuitry to prevent drive operation without the lubrication system.

Other types of gear drives may also be equipped with oil pumps for special lubrication considerations or external cooling.

TABLE 2 — Oil Pump Electrical Specifications

DRIVE SIZE	405 & 425		445-485		505-535	
HP	1		2		3	
Cycles, Hz	50	60	50	60	50	60
RPM	1425	1725	1425	1725	1425	1725
Voltage	220/380/440	208-230/460	220/380/440	208-230/460	220/380/440	208-230/460

Caution: Refer to Falk for drives that use pumps to distribute lubricants with temperatures below 30°F (-1°C).

Lubrication Recommendations

Carefully follow lubrication instructions on the gear drive nameplate, warning tags, and installation manuals furnished with the gear drive.

Lubricants listed in this manual are typical ONLY and should not be construed as exclusive recommendations. Industrial type petroleum based rust and oxidation inhibited (R & O) gear lubricants or industrial type sulfur-phosphorus extreme pressure (EP) gear lubricants are the recommended lubricants for ambient temperatures of 15°F to 125°F(-9°C to +50°C).

For drives operating outside the above temperature range refer to "Synthetic Lubricants" paragraphs, Page 7. Synthetic lubricants can also be used in normal climates.

VISCOSITY (IMPORTANT) — The proper grade for R & O and EP lubricants is found in Table 3. For cold climate conditions refer to Table 6, Page 7 and the "Synthetic Lubricant" paragraphs.

If a gear drive operates in a typical indoor environment where the ambient temperature is within 70°F to 125°F (21°C to 52°C), the oil viscosity should be increased one AGMA grade above that shown for the 50°F to 125°F(10°C to 52°C) range. That is, an AGMA Number 6 or 7 should be substituted for a 5 or 6 respectively, under these ambient conditions.

OIL PUMPS — When selecting a lubricant for a gear drive equipped with an oil pump, cold temperature oil viscosity is important. Lubricant viscosity at start-up generally should not exceed 1725 cSt (8,000 SSU). When exceeding this viscosity, pump cavitation is possible, reducing oil circulation and possibly damaging the pump. A sump heater may be required or it may be possible to use a lower viscosity oil to minimize pump cavitation, refer to Falk.

TABLE 3 — Viscosity Grade Recommendations for Petroleum Based R & O or EP Lubricants

Output RPM	Normal Climates			
	15° to 60°F (-9° to +16°C)		50° to 125°F (10° to 52°C)	
	ISO-VG	AGMA	ISO-VG	AGMA
Output RPM Below 80	150	4	320	6
Output RPM 80 & Above	150	4	220	5

Petroleum Based Lubricants

R & O GEAR LUBRICANTS (Table 4) — Industrial type petroleum based rust and oxidation inhibited (R & O) gear lubricants are the most common and readily available general purpose gear lubricants.

EXTREME PRESSURE (EP) LUBRICANTS (Table 5) — For highly loaded gear drives or drives loaded in excess of original estimates, industrial type petroleum extreme pressure lubricants are preferred. The EP lubricants currently recommended are of the sulfur-phosphorus type.

TABLE 5 — Extreme Pressure Lubricants †

Maximum Operating Temperature 200°F(93°C)

Manufacturer	Lubricant
Amoco Oil Co. BP Oil Co. Chevron U.S.A. Inc. Citgo Petroleum Corp.	Permagear/Amogear EP Energear EP Gear Compounds EP Citgo EP Compound
Conoco Inc. Exxon Co. U.S.A. E.F. Houghton & Co. Imperial Oil Ltd.	Gear Oil Spartan EP MP Gear Oil Spartan EP
Kendall Refining Co. Keystone Div. Pennwalt Corp. Lyondell Petrochemical (ARCO) Mobil Oil Corp. Petro-Canada Products	Kendall NS-MP Keygear Pennant NL Mobilgear Ultima EP
Phillips 66 Co. Shell Oil Co. Shell Canada Limited Sun Oil Co. Texaco Lubricants	Philgear Omala Oil Omala Oil Sunep Meropa
Valvoline Oil Co.	AGMA EP

† Minimum viscosity index of 90.

TABLE 4 — Petroleum Based R & O Gear Oils † Maximum operating temperature of lubricants 200°F (93°C)

AGMA Viscosity Grade	4	5	6	7
ISO Viscosity Grade	150	220	320	460
Viscosity SSU @ 100°F	626-765	918-1122	1335-1632	1919-2346
Viscosity cSt @ 40°C	135-165	198-242	288-352	414-506
Manufacturer	**Lubricant**	**Lubricant**	**Lubricant**	**Lubricant**
Amoco Oil Co. BP Oil Co. Chevron U.S.A., Inc. Citgo Petroleum Corp.	Amer.Ind. Oil 150 . . . . . Machine Oil AW 150 Citgo Pacemaker 150	Amer.Ind. Oil 220 Energol HLP-HD 220 Machine Oil AW 220 Citgo Pacemaker 220	Amer. Ind. Oil 320 . . . . . Machine Oil AW 320 Citgo Pacemaker 320	Amer. Ind. Oil 460 . . . . Citgo Pacemaker 460
Conoco Inc. Exxon Company, U.S.A. Houghton International, Inc. Imperial Oil Ltd.	Dectol R&O Oil 150 Teresstic 150 Hydro-Drive HP 750 Teresso 150	Dectol R&O Oil 220 Teresstic 220 Hydro-Drive HP 1000 Teresso 220	Dectol R&O Oil 320 Teresstic 320 . . . . . Teresso 320	Dectol R&O Oil 460 Teresstic 460 . . . .
Kendall Refining Co. Keystone Lubricants Lyondell Petrochemical (ARCO) Mobil Oil Corp. Pennzoil Products company Petro-Canada Products	Four Seasons AW 150 KLC-40 Duro 150 DTE Oil Extra Heavy Pennzbell AW Oil 150 Premium R & O 150	. . . . . KLC-50 Duro 220 DTE Oil BB Pennzbell AW Oil 220 Premium R & O 220	. . . . Duro 32 DTE Oil AA Pennzbell AW Oil 320 Premium R & O 320	. . . . DTE Oil HH Pennzbell AW Oil 460 . . . . .
Phillips 66 Co. Shell Oil Co. Shell Canada Limited Sun Oil Co. Texaco Lubricants	Magnus Oil 150 Morlina 150 Tellus 150 Sunvis 9150 Regal Oil R&O 150	Magnus Oil 220 Morlina 220 Tellus 220 Sunvis 9220 Regal Oil R&O 220	Magnus Oil 320 Morlina 320 Tellus 320 . . . . . Regal Oil R&O 320	. . . . . Morlina 460 . . . . Regal Oil R&O 460
Unocal 76 (East) Unocal 76 (West) Valvoline Oil Co	Unax RX 150 Turbine Oil 150 Valvoline AW ISO 150	Unax RX 220 Turbine Oil 220 Valvoline AW ISO 220	Unax AW 320 Turbine Oil 320 Valvoline AW ISO 320	Turbine Oil 460 Turbine Oil 460 . . . . .

† Minimum viscosity index of 90.

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WARNING: EP LUBRICANTS IN FOOD PROCESSING INDUSTRY — EP lubricants may contain toxic substances and should not be used in the food processing industry without the lubricant manufacturers' approval. Lubricants which meet USDA "H1" classification are suitable for food processing applications.

Synthetic Lubricants

Synthetic lubricants of the polyalphaolefin type are recommended for cold climate operation, high temperature applications, extended temperature range (all season) operation, and/or extended lubricant change intervals. The proper viscosity grade of synthetic lubricant is given in Table 6 Refer to Table 7 for Synthetic lubricants.

TABLE 6 — Viscosity Grade Recommendations for Synthetic Lubricants ★

Output RPM	Cold Climates				Normal Climates					
	−30° to +10°F (−34° to −12°C)		−15° to +50°F (−26° to +10°C)		0° to +80°F (−18° to +27°C)		+10° to +125°F (−12° to +52°C)		+20° to +125°F (−7° to +52°C)	
	ISO-VG	AGMA	ISO-VG	AGMA	ISO-VG	AGMA	ISO-VG	AGMA	ISO-VG	AGMA
Below 80	32	0S	68	2S	150	4S	320	6S	320	6S
80 & Above	32	0S	68	2S	150	4S	220	5S	320	6S

★ Refer to Falk for viscosity recommendations when ambient temperatures are below −30°F (−34°C) or above 125°F (52°C).

TABLE 7 — Synthetic Lubricants – Polyalphaolefin Type ★

AGMA Viscosity Grade	0S	2S	4S	5S	6S
ISO Viscosity Grade	32	68	150	220	320
Viscosity SSU @ 100°F	134–164	284–347	626–765	918–1122	1335–1632
Viscosity cSt @ 40°C	28.8–35.2	61.2–74.8	135–165	198–242	288–352
Manufacturer	Lubricant				
Chevron U.S.A., Inc.	...	...	...	Clarity Synthetic PM Oil 220	...
	...	...	...	Syn. Gear Lube Tegra 220 ‡	...
Conoco, Inc.	Syncon 32	Syncon 68	...	...	...
	...	Syncon EP 68 ‡	...	Syncon EP 220 ‡	...
Dryden Oil Co.	Drydene SHL Lubricant 32	Drydene SHL Lubricant 68	Drydene SHL Lubricant 150	Drydene SHL Lubricant 220	Drydene SHL Lubricant 320
Exxon Co. U.S.A.	Teresstic SHP 32	Teresstic SHP 68	Teresstic SHP 150	Teresstic SHP 220	Teresstic SHP 320
	...	...	Spartan Synthetic EP 150 ‡	Spartan Synthetic EP 220 ‡	Spartan Synthetic EP 320 ‡
Mobil Oil Corp.	SHC 624	SHC 626	SHC 629	SHC 630	SHC 632
	...	...	Mobilgear SHC 150 ‡	Mobilgear SHC 220 ‡	Mobilgear SHC 320 ‡
Pennzoil Products Co.	Pennzgear SHD 32	Pennzgear SHD 68	Pennzgear SHD 150	Pennzgear SHD 220	Pennzgear SHD 320
	...	Super Maxol "S" 68 ‡	Super Maxol "S" 150 ‡	Super Maxol "S" 220 ‡	Super Maxol "S" 320 ‡
Petro-Canada Products	...	...	Super Gear Fluid 150EP ‡	Super Gear Fluid 220EP ‡	Super Gear Fluid 320EP ‡
Shell Oil Co.	...	...	...	Hyperia 220	Hyperia 320
	...	...	...	Hyperia S220 ‡	Hyperia S320 ‡
Sun Co.	...	...	...	Sunoco Challenge 220	Sunoco Challenge 320
	...	...	...	Sunoco Challenge EP 220 ‡	Sunoco Challenge EP 220 ‡
Texaco Lubricants Co.	Pinnacle 32	Pinnacle 68	Pinnacle 150	Pinnacle 220	Pinnacle 320
	...	...	Pinnacle EP 150 ‡	Pinnacle EP 220 ‡	...
Whitmore Mfg. Co.	...	...	Decathlon 4EP ‡	Decathlon 5EP ‡	Decathlon 6EP ‡

★ Minimum viscosity index of 130. Consult lubricant supplier/manufacturer for maximum operating temperature.

‡ Extreme Pressure EP lubricant (contains sulphur phosphorus).

WARNING: SYNTHETIC LUBRICANTS IN FOOD PROCESSING INDUSTRY — Synthetic lubricants may contain toxic substances and should not be used in the food processing industry without the lubricant manufacturers' approval. Lubricants which meet USDA "H1" classification are suitable for food processing applications.

Bearing and Seal Greases

All drives and some backstops have grease lubricated seals. Some vertical shaft and specially mounted drives have grease lubricated bearings. Drives are shipped with NLG1 or #2 grease in the seal housing cavities unless otherwise specified. Refer to Table 8 for grease recommendations.

TABLE 8 — Greases for Bearings and Seals

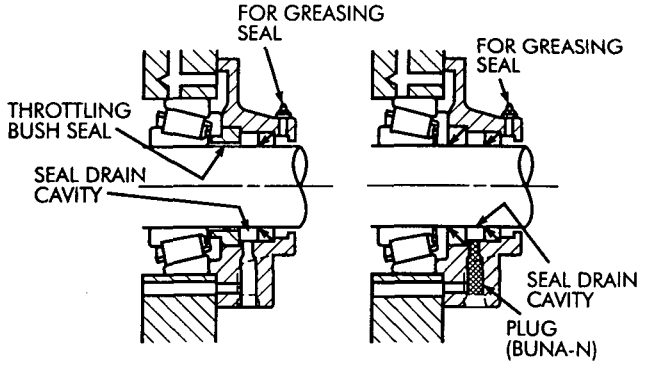
(0° to 200°F(-18° to +93°C)

Manufacturer	Lubricant
Amoco Oil Co. BP Oil Co. Chevron U.S.A., Inc. Citgo Petroleum Corp.	Amolith Grease No. 2 Energrease LS–EP2 Industrial Grease Medium Premium Lithium Grease No. 2
Conoco Inc. Exxon Company, U.S.A. E.F. Houghton & Co. Imperial Oil Ltd.	EP Conolith Grease No. 2 Unirex N2 Cosmolube 2 Unirex N2L
Kendall Refining Co. Keystone Div. Pennwalt Corp. Lyondell Petrochemical (ARCO) Mobil Oil Corp. Mobil Oil Corp Petro–Canada Products	Multi–Purpose Lithium Grease L421 Zeniplex 2 Litholine H EP 2 Grease Mobilith 22 Mobilith SHC 460 ★ Multipurpose EP2
Phillips 66 Co. Shell Oil Co. Shell Canada Limited Sun Oil Co. Texaco Lubricants	Philube Blue EP Alvania Grease 2 Alvania Grease 2 Ultra Prestige EP2 Premium RB Grease
Unocal 76 (East & West) Valvoline Oil Co.	Unoba EP2 Multilube Lithium EP Grease

★ High performance synthetic alternate.

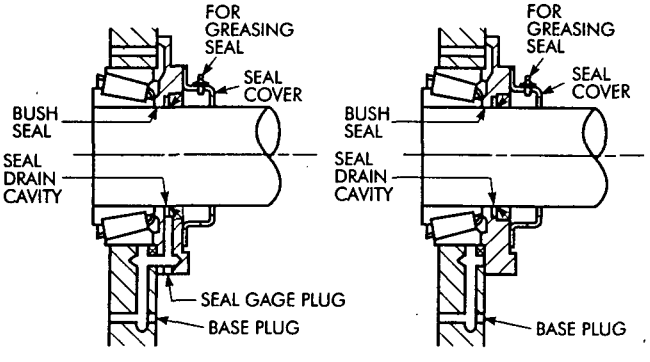
GREASE LUBRICATED SEALS — Most gear drives and backstops are furnished with grease purged seals which minimize the entry of contaminants into the drive or backstop. Gear drives and backstops are shipped with NLGI #2 grease in the seal housing cavities unless otherwise specified. If grease could contaminate the product, as in the food and drug industries, it should be removed. A grease that meets USDA "H1" classification is suitable for food processing applications.

TYPICAL SEAL ASSEMBLIES



LOW OIL LEVEL
Sizes 385 & 405 thru 585
Inner Bush Seal and Outer Lip Type Seal

HIGH OIL LEVEL
Sizes 385 & 405 thru 585
Two Lip Type Oil Seals



LOW OIL LEVEL
Sizes 305 thru 365 & 395
Inner Bush Seal and Outer Lip Type Seal

HIGH OIL LEVEL
Sizes 305 thru 365 & 395
Inner Bush Seal and Outer Lip Type Seal

GREASE LUBRICATED BEARINGS — Vertical shaft drives with hollow shafts or with drywells have grease lubricated lower low speed bearings. These bearings are lubricated at the Factory with an NLGI#2 grease. Refer to the preventive maintenance instructions for greasing instructions.

BACKSTOPS — For types AB, ABR, and ABX model C and later, backstops are furnished filled with oil. Remove plug from top of backstop and replace with vent wired to torque arm. Earlier models had backstops that are grease lubricated, do not use greases with molybdenum disulfide or other EP additives.

Type "A" and "AR" drives may have a Falk pawl type backstop or a **Falk PRT** wedge ramp type backstop. Falk pawl backstops are prelubricated and sealed at assembly and require no future lubrication. These backstops also contain grease purgeable seals (see paragraph above for grease lubricated seals).

Falk PRT backstops are shipped filled with oil. Remove plug from top of backstop and replace with vent wired to torque arm.

Oil Levels

Types A & B Prior to filling gear drive, remove the inspection cover and flood the oil troughs with oil. This will provide oil to the bearings. Fill the drive with oil to the level indicated on the oil dipstick. Approximate oil capacities are given on the drive nameplate and in Table 9.

Types ABR, ABRC, and AR Fill the drive with oil to the level indicted on the oil dipstick. Approximate oil capacities are given on the nameplate and in Table 10.

Drives with Oil Pumps Types ABX, AXV, and occasionally other types of gear drives will be equipped with oil pumps for cooling or special lubrication considerations. If a drive is equipped with an oil pump, fill the drive to the level marked on the dipstick. Run the lubrication system for several minutes to fill the system components. Verify that the pump is circulating oil properly, then recheck oil level. If necessary, add oil to compensate for filter and/or cooler.

Before starting the gear drive, rotate the input shaft to check for obstructions. Then start the drive and allow it to run without load for several minutes. Shut down and recheck oil level. If everything is satisfactory, the drive is ready for operation.

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Preventive Maintenance

AFTER FIRST WEEK — Check alignment of total system and realign where necessary. Also tighten all external bolts and plugs where necessary. DO NOT readjust the internal gear or bearing settings in the drive, these were permanently set at Falk.

AFTER FIRST MONTH — Proceed as follows:

1. Operate drive until old sump oil reaches normal operating temperature. Shut down drive and drain immediately.
2. Immediately flush drive with an oil of the same type and viscosity grade as the original charge (warmed to approximately 100°F (38°C) in cold weather) by rapidly pouring or pumping a charge equal to 25 - 100% of the initial fill volume or until clean oil flows through the drain.
3. Close the drain and refill the drive to the correct level with new oil of the correct type and viscosity.

PERIODICALLY —

1. Check the oil level of the drive when it is stopped and at ambient temperature. Add oil if needed. If the oil level is ABOVE the high oil level mark on the dipstick, have the oil analyzed for water content. Moisture in the oil may indicate that a seal or the heat exchanger is leaking. If so, replace the defective part immediately and change the oil. DO NOT fill above the mark indicated as leakage or undue heating may result.
2. Check coupling alignment to make certain that foundation settling has not caused excessive misalignment.
3. If drive is equipped with a fan, periodically clean accumulated foreign matter from the fan, guard, and deflector.
4. If drive is equipped with a torque arm, check for free movement.

Lubricant Changes

OIL ANALYSIS REPORT— Checking oil condition at regular intervals is recommended. In the absence of more specific limits, the guidelines listed below may be used to indicate when to change oil:

1. Water content is greater than 0.05% (500 ppm).
2. Iron content exceeds 150 ppm.
3. Silicon (dust/dirt) exceeds 25 ppm.
4. Viscosity changes more than 15%.

PETROLEUM LUBRICANTS — For normal operating conditions, change gear oils every 6 months or 2500 operating hours, whichever occurs first. Change oil more frequently when gear drives operate in extremely humid, chemical or dust laden atmospheres. In these cases, R & O and EP lubricants should be changed every 3 to 4 months or 1500 to 2000 hours. If the drive is operated in an area where the temperatures vary with seasons, change oil viscosity grade to suit temperature. Lubricant suppliers can test oil periodically and recommend economical change intervals.

SYNTHETIC LUBRICANTS — Synthetic lube change intervals can be extended to 8000 - 10,000 hours depending upon operating temperatures and lubricant contamination. Change oil more frequently when gear drives operate in extremely humid, chemical or dust laden atmospheres. In these cases, synthetic lubricants should be changed every 4 to 6 months or 4000 to 6000 hours. Laboratory analysis is recommended for optimum lubricant life and gear drive performance. Change lube with change in ambient temperature, if required. Refer to Table 6 for synthetic lubricant viscosity recommendations.

GREASE LUBRICATED SEALS — Depending on the frequency and degree of contamination (at least every six months), purge contaminated grease from seals by slowly pumping fresh bearing grease , WITH A HAND GREASE GUN, through the seal until fresh grease flows out along the shaft. Wipe off purged grease. Refer to Table 8 for NLGI #2 greases. Some of these greases are of the EP type and may contain toxic substances not allowed in the food processing industry. A grease that meets the USDA "H1" classification is suitable for food processing applications.

CAUTION: Rapid greasing with a power grease gun can force grease inward past the seals and plug the oil drainback system causing seal leaks.

GREASE LUBRICATED BEARINGS (TYPES AXV AND ABX) — All hollow and most solid vertical low speed shaft drives have a grease lubricated lower low speed bearing. Grease bearings during oil changes or at intervals of every 6 months or 2500 hours of operation whichever is less. Table 11 contains low speed bearing grease capacities.

HOLLOW SHAFT DRIVES — Remove the pressure relief plug before greasing. Pump grease into bearing cage until fresh grease appears at the plug. Replace the pressure relief plug when finished. See Figure 2 below.

Refer to Table 8 for NLGI #2 greases. Some of these greases are of the EP type and may contain toxic substances not allowed in the food processing industry. A grease that meets the USDA "H1" classification is suitable for food processing applications.

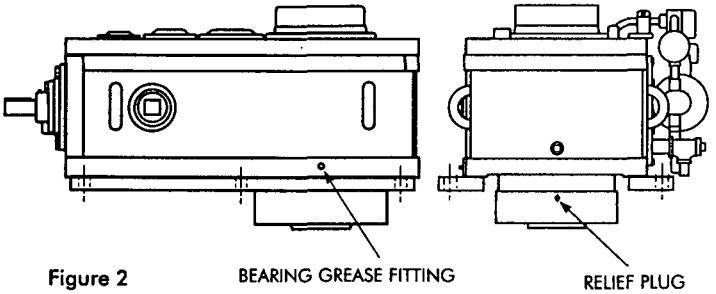

Figure 2

BACKSTOPS — For types AB, ABR, and ABX refer to the supplemental backstop installation and maintenance instructions provided with the drive for recommended lubricants. It is recommended to lubricate backstops during regular drive lubrication intervals. If backstops are grease lubricated, do not use greases with molybdenum disulfide or other EP additives.

Type "A" and "AR" drives may have a Falk pawl type backstop or a **Falk PRT** wedge ramp type backstop. Falk pawl backstops are prelubricated and sealed at assembly and require no future lubrication. These backstops also contain grease purgeable seals (see paragraph above for grease lubricated seals).

Falk PRT backstops are a wedge ramp type and are oil lubricated. Follow lubrication recommendations as outlined in the supplemental backstop instructions furnished with the drive.

TABLE 9 — Types A & B Approximate Oil Capacities

DRIVE SIZE	Type A								Type AB						DRIVE SIZE
	A1		A2		A3		A4		AB2		AB3		AB4		
	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	
305	3	11	4	15	4	15									305
325	5	19	6	23	6	23									325
345	6	23	8	30	9	34									345
365	10	38	13	49	13	49									365
385	10	38	10	38	10	38	10	38	11	42	11	42	11	42	385
395	12	45	16	61	17	64									395
405	10	38	15	57	15	57	14	53	11	42	15	57	15	57	425
425	14	53	20	76	21	79	20	76	14	53	20	76	22	83	405
445	22	83	22	83	29	110	28	106	22	83	29	110	30	114	445
465	29	110	30	114	39	148	38	144	30	114	39	148	39	148	465
485	32	121	38	144	57	216	56	212	31	117	52	197	58	220	485
505	42	159	50	189	78	295	77	291	39	148	70	265	80	303	505
525	53	201	59	223	95	360	93	352	48	182	87	329	100	379	525
545	...	...	115	435	135	511	...	...	...	...	111	420	138	522	545
565	...	...	130	492	160	606	...	...	...	...	142	538	170	644	565
585	...	...	215	814	250	946	...	...	...	...	220	833	275	1 041	585

TABLE 10 — Types AR, AVX, ABR, and ABX Approximate Oil Capacities

DRIVE SIZE	Vertical Output				Horizontal Output				DRIVE SIZE
	ABX3 & AXV2		ABX4, AXV3, & AXV4		ABR3 & AR2		ABR4, AR3, & AR4 ★		
	Gallons	Liters	Gallons	Liters	Gallons	Liters	Gallons	Liters	
405	10	38	10	38	14	53	14/18	53/68	405
425	15	57	15	57	19	72	19/27	72/102	425
445	25	95	25	95	35	132	35/50	132/189	445
465	30	114	30	114	40	151	40/55	151/208	465
485	40	151	45	170	50	189	60/80	227/303	485
505	50	189	60	227	65	246	80/100	303/379	505
535	70	265	80	303	95	360	110/140	416/530	535
555	100	379	120	454	130	492	160/220	606/833	555

★ Values to right of slash mark are for type AR4 drives when HS Shaft is above drive center line.

TABLE 11 — Types AXV and ABX – LS Shaft Lower Bearing Grease Capacity

DRIVE SIZE	Solid Shaft				Hollow Shaft		DRIVE SIZE
	Down		Up		oz	mL	
	oz	mL	oz	mL			
405	8	237	12	355	12	355	405
425	12	355	18	532	12	355	425
445	12	355	18	532	24	710	445
465	30	890	40	1180	30	890	465
485	30	890	40	1180	60	1770	485
505	40	1180	50	1480	60	1770	505
535	50	1480	50	1480	80	2370	535
555	50	1480	60	1770	80	2370	555

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Stored & Inactive Gear Drives

Each gear drive is protected with a rust preventative that will protect parts against rust for a period of 4 months in an outdoor shelter or 12 months in a dry building after shipment from Falk.

If a gear drive is to be stored, or in inactive after installation beyond the above periods, drain oil from housing and spray all internal parts with a rust preventative oil that is soluble in lubricating oil or add "Motorstor"™ vapor phase rust inhibitor at the rate of one ounce per cubic foot (1.05 liters per cubic meter) of internal drive space (5% of sump capacity). Refer to Table 12 for Motorstor quantities. Rotate the shafts several times by hand. Before operating, drives which have been stored or inactive must be filled to the proper level with oil meeting the specifications given in this manual. Refer to Manual 128-014 for "Start-up after Storage" instructions.

Periodically inspect stored or inactive gear drives and spray or add rust inhibitor every six months, or more often if necessary. Indoor dry storage is recommended.

Gear drives ordered for extended storage can be treated at Falk with a special preservative and sealed to rust-proof parts for periods longer than those cited previously.

The vented dipstick should be replaced with a plug (vented dipstick should be attached to gear drive for future use) so that the protective rust inhibiting atmosphere is sealed inside the drive. Install vented dipstick when preparing drive for operation.

TABLE 12 — Motorstor/VCI–10★

(Add to stored or inactive drives)

DRIVE SIZE	Motorstor	
	Ounces Per Drive	Milliliters Per Drive
305 thru 425	2	60
445 thru 485	6	180
505 thru 535	10	300
545 thru 585	30	890

★ Product of Daubert Chemical Company, Chicago, IL.

This manual provides detailed instructions on disassembly, parts replacement and reassembly of Type AB right angle and Type A parallel shaft enclosed gear drives.

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General Tightening & Loosening Procedures . . . . . Page 10

Introduction

The following instructions apply to standard Type AB horizontal-right angle and Type A horizontal-parallel shaft enclosed gear drives.

Drawings are representative of this series of enclosed gear drives and may not agree in exact detail with all drive sizes. When ordering parts or requesting information, specify M.O. number, drive size, model number, rpm, ratio and date stamped on the drive nameplate.

CONSULT FALK BEFORE CHANGING SPEED. OPERATE ONLY AT SPEED SHOWN ON NAMEPLATE.

WARNING: Consult applicable local and national safety codes for proper guarding of rotating members. Lock out power source and remove external loads from drive before servicing drive or accessories.

Recommendations

INPUT SPEED, RATIO, AND GEARING ASSEMBLY CHANGES — When either the input speed or ratio is changed, contact Falk to determine whether an oil pan or oil catchers must be relocated or added. When turning shafts end for end on drives with offset gearing, the oil catchers and oil pans must be relocated. Shaft assemblies can not be turned end for end on drives with both cooling tubes and offset gears.

REPLACEMENT GEARING — Bevel gearing is manufactured in matched sets and must be replaced as sets. Replacement of both helical pinions and gears is recommended although they may not be manufactured as matched sets. Depending on the cause of replacement, failure or damage to one element of a gearset may have caused inconspicuous damage to the mating element. When replacing gearing, it is recommended that the bearings, seals, and shim-gaskets on both shafts be replaced.

SERVICE — It is recommended that the drive be removed from its operating area for service. Service can be performed in the drive's operating area provided the shaft connections can be removed from the shaft extensions.

Lifting Instructions

Disconnect all attached equipment and drain oil. Lift drive from its foundation by slinging from the four lifting holes in the housing cover.

Required Equipment

In addition to standard mechanics tools, the following equipment is required: hoist, sling, eyebolts, arbor press, wheel puller, feeler gauges, dial indicator with stand, inside and outside micrometers, heavy duty "C" clamp, and heating oven.

General Instructions

1. **PRE-DISASSEMBLY** — To prevent dirt from falling into the drive, clean all external surfaces before disassembling. Record mounting dimensions of couplings and accessories for reference when reassembling. Record direction of backstop rotation, if so equipped, before removing.

   SHIM-GASKETS — During disassembly, wire tie all shim-gaskets to their respective seal cages or end covers for reference when reassembling.

   For complete drive disassembly, start with Step 4.

3. **SEAL REPLACEMENT ONLY** — Seal replacement requires that seal cages be removed from the drive and the shim-gaskets replaced. Bearing adjustment is required when replacing all helical high speed shaft oil seals and all low speed shaft oil seals. Type AB high speed shaft bearing settings are not affected by high seal cage removal and replacement and adjustments are not required when just replacing seals. It is recommended that new oil seals are installed in the seal cages after bearing settings (when required) have been determined, during final assembly of the seal cages.

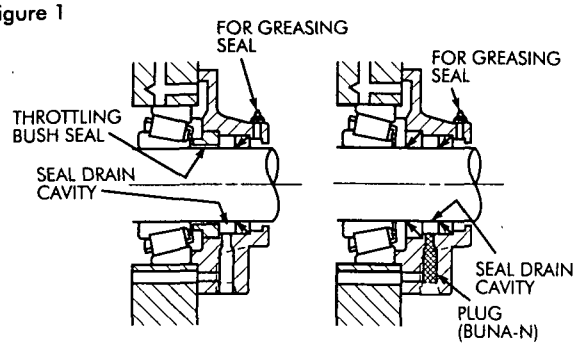
   A. Clean the shaft extensions and remove all sharp edges. DO NOT allow abrasive cleaning material on the rubbing surface polished by the seal. New seals will leak if the seal rubbing surface on the shaft is damaged.

   B. **SHAFT FAN COOLED DRIVES** — Note orientation of fan guard components and fan axial location for reference when reassembling.

      1. Remove fan guard mounting locknuts and remove fan guard.
      2. Record fan mounting dimensions (back of fan blade to fan guard backplate clearance) for reference when reassembling.
      3. Loosen fan hub setscrew over key and loosen fan hub clamping fasteners. Remove fan.
      4. For Type AB, remove the housing shroud fasteners and remove the housing shroud. The housing shroud is partially supported by the fan guard mounting fasteners in the fan guard backplate.
      5. Remove fan guard backplate. NOTE: Fan guard backplate on Type AB and double and triple reduction Type A drives is mounted using four longer seal cage fasteners with spacers between the seal cage and backplate.

   C. Remove the seal cages when required and save the shim-gaskets for reference when reassembling. Note the type of inner seal (throttling bush or lip) in the seal cage, Figure 1. All lip type seals are installed with the lips facing inward.

Figure 1



D. Drive inner and outer seals out of seal cage. Do not damage the throttling bush seal (when used) as it will be reused.

E. Remove old sealing compound, grease, and shim-gasket material from seal cage and housing seal cage face. Do not install new seals at this time. For right angle drive high speed seal cages, proceed to Step 3K.

F. **BEARING ADJUSTMENT** — All shafts have tapered roller or spherical roller bearings that require axial float or settings as indicated in Tables 1 and 2, Pages 11 & 12.

Exception: Sizes 545-585 Types A and AB drive low speed pinion shafts. Place only a .015" (0,38 mm) shim gasket between the housing and end cover on each side. Shaft float need not be checked. Type AB high speed shaft floats do not need to be adjusted when seals are replaced.

Replace shim-gaskets with new ones of the same total thickness and add a .007" (0,18 mm) and .009" (0,23 mm) shim to insure shaft axial float on initial check. Use only one .015" (0,38 mm) shim-gasket per shim pack.

Table 3, Page 12, lists shim-gaskets available from Falk. Always place the .015" (0,38 mm) thick shim-gasket next to the housing for positive sealing.

CAUTION: *During assembly, position seal cages with the word "TOP" in the upright position (except Type A quadruple reduction high speed seal cages and quadruple reduction Type AB Sizes 385AB4 and 405AB4) to permit oil flow to the bearings.*

For quadruple reduction Type A high speed shaft seal cages, position seal grease purge fitting towards the high speed end. Sizes 385 and 405A4 will only fit one way.

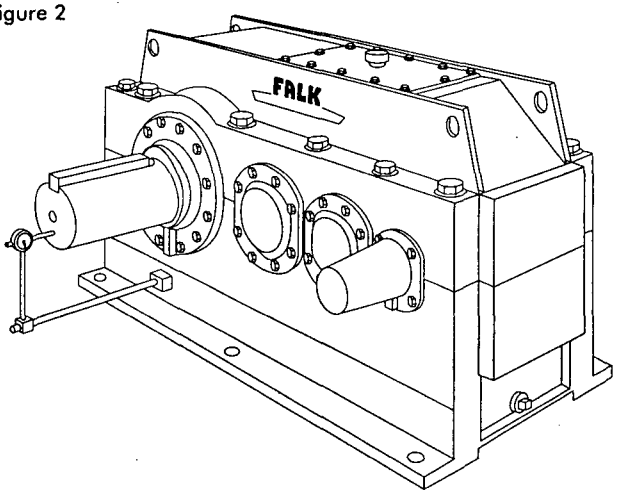
Type AB Sizes 385 and 405AB4, position flat up.

G. Install seal cages (without seals) with new shim-gaskets. Install fasteners with lock washers and tighten to torque specified in Table 6, Page 13.

Type A high speed shaft seal cages of double and triple reduction drives with fans utilize the fan guard backplate spacers and .25" (6,4 mm) of extra washers on the longer fasteners for proper thread engagement.

H. Check shaft axial float with a dial indicator, Figure 2, and adjust to limits specified in Tables 1 or 2, Pages 11 & 12. Rock the shaft back and forth with thrust applied to obtain an accurate float check. Pry the low speed or intermediate gear back and forth through the inspection cover to apply thrust. Do not pry on oil troughs. For Type A high speed shafts, attach a "C" clamp to the extension to apply axial force, if required. Refer to Step 19 for bearing setting examples.

Figure 2



J. Remove seal cages from drive. DO NOT interchange shim-gaskets after bearing adjustment has been completed.

K. **LIP TYPE SEALS** — Coat seal seat area of seal cage with Permatex #3 or equivalent sealant and drive seals (with lips facing toward bearing) into seal cage with a square faced cylindrical tool. Install outer seal first.

L. **THROTTLING BUSH SEAL (when used)** — Clean throttling bush seal element and coat "O" ring and groove with a #2 bearing grease and install in cage. Seal cage bore must be clean, no sealant is used.

M. **SHAFTS WITH FANS** — If desired, fill outer cavity in seal cage with a #2 bearing grease before installing seal cage.

CAUTION: *Protect seal lips from the sharp edges of the shaft keyway and stepped diameters by wrapping thin strong paper (.003" (0,08 mm) thick mylar film is recommended) around the shaft and coating with grease before sliding the seal on or off the shaft.*

N. Grease seal lips and install seal cages. Install seal cage fasteners and tighten to torque specified in Table 6, Page 13. Recheck shaft axial floats.

O. **SHAFT FAN COOLED DRIVES** —

Type AB — Assemble fan guard backplate to drive with one pair of fan guard mounting fasteners in the vertical plane. Install backplate with the long seal cage fasteners with spacers between the backplate and seal cage and tighten to torque specified in Table 6, Page 13. Install housing shroud and tighten fasteners to torque specified in Table 5, Page 13. Install fan in same axial position, Step 3B, as removed and tighten fan hub clamping fasteners and setscrew. Do not overtighten or fan hub will distort. Assemble fan guard onto backplate and install fan guard mounting locknuts, tighten to torque specified in Table 5, Page 13.

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Type A — Assemble fan guard backplate to drive with one pair of fan guard mounting fasteners in the vertical plane. Install backplate mounting fasteners with spacers between backplate and drive. On double and triple reduction drives, remove the .25" (6,4 mm) of extra washers added in Step 3G and install backplates with the long seal cage fasteners and spacers. Tighten fasteners to torque specified in Table 6, Page 13. Recheck shaft axial float. Install fan in same axial position, Step 3B, as removed and tighten fan hub clamping fasteners and setscrew. Do not overtighten or fan hub will distort. Assemble fan guard onto backplate and install fan guard mounting locknuts, tighten to torque specified in Table 5, Page 13.

P. Hand pump grease (user option) into seal cage grease purge cavity (except shaft extensions with fans) until grease appears at the shaft adjacent to the grease fitting. Do not over grease.

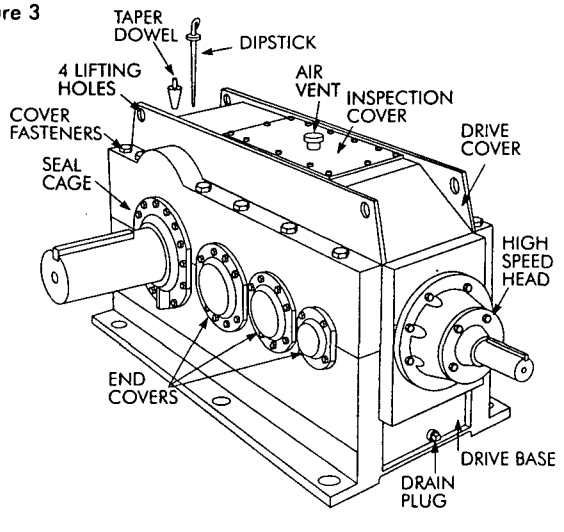
Drive Disassembly

4. **PRELIMINARY**
   A. Drain oil from drive and remove dipstick.
   B. **SHAFT FAN ASSEMBLIES** — Refer to Step 3B and remove.
   C. Remove housing cover fasteners. Some later models of Size 585 drives, may use multi-jackbolt tensioners. See Page 10 for loosening procedure.

   NOTE: Certain accessories including backstops and top mounted motors may use longer sidebar fasteners. Upon removal, note their position and reinstall in the same position during assembly.

   D. Remove all fasteners above the housing split that hold seal cages, end covers, shaft guards and high speed heads to the housing cover. Loosen fasteners below housing split three or four turns. Do not remove, they hold the bearing outer races in position.
   E. Sizes 485 through 585, tighten nut on taper dowel and remove. Refer to Figure 3. Type A drives have a taper dowel at each end of the housing.

Figure 3



   F. Hitch drive cover to a hoist and lift it *STRAIGHT UP. DO NOT DAMAGE GEAR TEETH.*
5. **REMOVAL OF SHAFT ASSEMBLIES** — Complete the following procedures for each shaft assembly. Start with the high speed head or shaft (except on quadruple reduction Type A gear drives where the high speed shaft is removed last) and work through to the low speed shaft. Intermediate shafts typically have spacers between the bearing outer race and the end cover. Note spacer locations for reference when reassembling.
   A. **HIGH SPEED HEAD** — Place a sling around the high speed head as shown in Figure 4 and take up slack. Remove the remaining high speed head mounting fasteners and lift the shaft assembly out. Do not damage gear teeth.

Figure 4

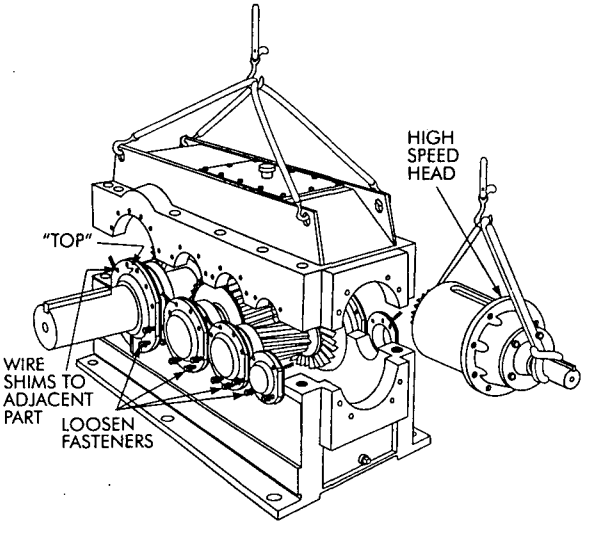
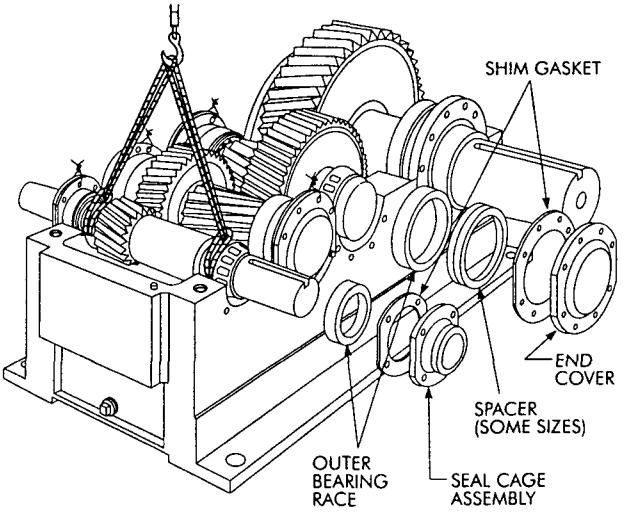


Figure 5



B. **HELICAL HIGH SPEED, INTERMEDIATE, AND LOW SPEED SHAFT ASSEMBLIES** — Place a sling around the first shaft assembly to be removed, as shown in Figure 5, and take up enough slack to take weight off of the bearings. Do not lift shaft assemblies out of housing at this time. The low speed pinion shaft may be lifted by slinging from a heavy duty "C" clamp attached to the recessed gear face when necessary.

Remove the seal cage, end cover or shaft guard, outer bearing races, and shaft spacers. Lift shaft assembly out of base. ***CAUTION:*** *DO NOT DAMAGE GEAR TEETH.*

C. **QUADRUPLE REDUCTION HIGH SPEED SHAFT** — Sling shaft at center, remove seal cages, bearing outer races and feed shaft out of housing through either bearing bore. Sling will require repositioning to outside of housing when shaft is half way out of housing.

Cleaning, Inspection, and Parts Replacement

6. **HOUSING BASE AND COVER** — Remove old sealing compound from housing base/cover joint and old shim-gasket material from sealing faces. Clean oil troughs, oil passages, seal drain passages, cooling tube fins (if so equipped), and oil sump with kerosene or solvent and then dry.
7. **AIR VENT** — Wash in kerosene or solvent and squeeze filter element dry. Replace filter if necessary.
8. **OIL SEALS** — Remove throttling bush seal element (when used) and old seals from seal cage. Remove sealing compound from seal cages. DO NOT install new seals at this time.
9. **BEARINGS**
   A. Wash all bearings in clean kerosene or solvent and then dry. Do not spin bearings to dry as they may score due to lack of lubricant.
   B. Inspect bearings carefully and replace those that are worn or questionable. Replacement tapered roller bearings must be identical to the original equipment.
   C. If bearings need replacement, use a wheel puller or press to remove them. Apply force to the inner race only.
   D. To mount new bearings, heat in an oil bath or an oven to a maximum of 275°F (135°C). Slide or press bearing onto shaft tight against shaft shoulder or spacer.

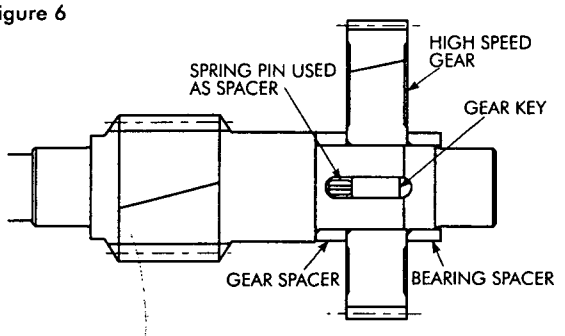
   CAUTION: *DO NOT APPLY FLAME DIRECTLY TO BEARINGS OR REST THEM ON THE BOTTOM OF THE HEATED CONTAINER.*

   E. Thoroughly coat all bearings with lubricating oil.
10. **HELICAL PINIONS, GEARS, AND SHAFTS** — All helical pinions are solid on shaft. Note number and location of shaft spacers before disassembly for reference when reassembling. Pinions and gears which are discolored have been softened from excessive heat and must be replaced.
    A. Wash the pinions and gears in clean kerosene or solvent and inspect for damaged or worn teeth.
    B. Remove gear from shaft with a press if required.
    C. Assemble replacement gear to shaft with large chamfer toward shaft shoulder or adjacent spacer. To aid assembly, heat gear to 325°-350°F (163°-177°C) in an oil bath or oven and cool shaft to -90°F (-68°C). DO NOT exceed 350°F (177°C) or heat softening will occur. Use a press for final seating of gear hub against shaft shoulder or spacer.

SPECIAL INSTRUCTIONS — Model "C" or later drives only

Size 405 — The 405A3 1st intermediate, 405A4 2nd intermediate, and 405AB4 2nd intermediate pinions require a spacer in the keyway under the gear (see Figure 6). This spacer is a spring pin. Locate the spring pin at the pinion end of the keyway and place the spacer on the shaft over the spring pin. Place the key into the other end of the keyway.

Figure 6



Sizes 405 through 465A2 23:1 and 25:1 — Assemble retaining ring to the high speed shaft and install spacer to the outboard end so that the large chamfer in the spacer (if any) faces away from the retaining ring.

Sizes 545 through 585 — The Size 545A & AB low speed pinion shaft requires a keeper plate on the gear end of the shaft to retain the bearing. Sizes 565 and 585A & AB have keeper plates on both sides of the low speed pinion. Wire tie the heads of the cap screws together to prevent loosening.

11. **BEVEL GEARS** — Solid hub or bolted rim type bevel gears are used depending on bevel gear size. Refer to Steps 10A thru 10C for solid hub gear cleaning, inspection and replacement. Proceed as follows for bolted rim bevel gears.
    A. Wash the gear in clean kerosene or solvent and inspect for damaged or worn teeth.
    B. If helical pinion, shaft, or bevel gear spider are damaged, remove gear rim from spider and then remove gear spider from shaft.
    C. Spider must be installed on shaft before gear rim is reinstalled. Refer to Step 10C for gear spider to shaft reassembly procedure.
    D. Assemble bevel gear rim onto spider. Assembly may be aided by heating the gear rim to 150°F (66°C). Lower shaft assembly onto the bevel gear mounting flange, use guide pins or long fasteners to align fastener holes. Install fasteners (with threads coated with Loctite #262 high strength thread locking compound on gear rims with tapped holes) and tighten to torque specified in Table 7, Page 14.
12. **BEVEL PINIONS — Figures 7, 8 and 9**

CAUTION: *The components of the inner bearing in Figures 7 and 8 are NOT interchangeable. Each part is matched marked with a serial number and must be assembled accordingly.*

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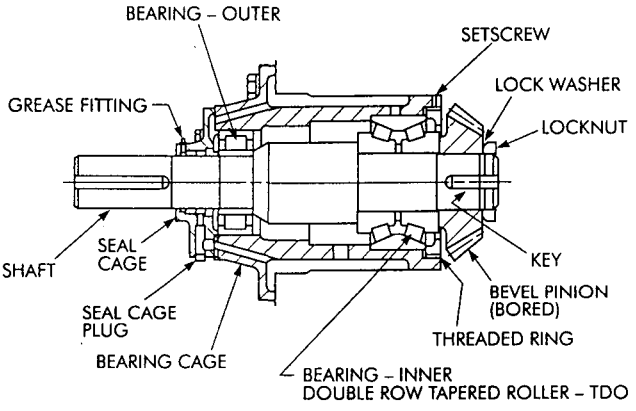
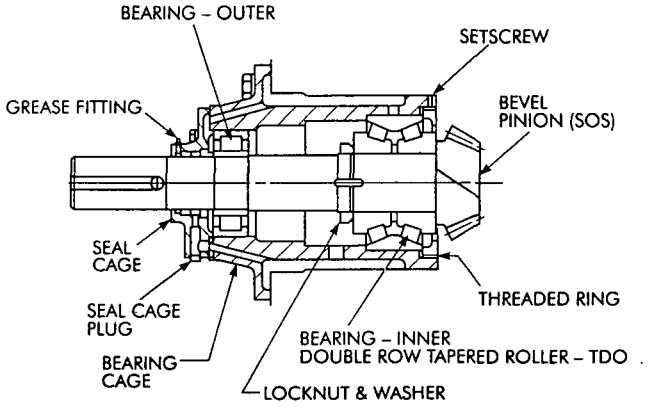
Figure 7



A. **BORED PINIONS** — Figure 7; All sizes except 545-585AB3

1. Remove seal cage fasteners and seal cage.
2. Remove pinion locknut and lock washer.
3. Remove bevel pinion with a wheel puller (heat may be applied to pinion if pinion is not to be reused). Table 8, Page 14, lists approximate removal forces to determine the correct size wheel puller.
4. Remove pinion key.
5. Remove threaded ring locking setscrew and threaded ring.
6. Slide shaft assembly out of bearing cage and remove bearings with a press or wheel puller.
7. Wash pinion in clean kerosene or solvent and inspect for damaged or worn teeth. Replace if worn or damaged.
8. Refer to Step 9 for bearing cleaning, inspection and reassembly.
9. Assemble inner bearing to shaft in the following order: one cone, cone spacer, double cup, and other cone. Seat cones against shaft shoulder.
10. Position shaft assembly vertical with pinion end down. Install outer bearing on shaft and seat against shaft shoulder.
11. Sling bearing cage from eyebolts in seal cage fastener holes and lower onto shaft. Spherical roller bearing outer rings will require guidance when assembling bearing cage onto shaft.
12. Position assembly on its side. ***CAUTION:*** *Shaft assembly can slide out of pinion end of bearing cage during repositioning.*
13. Install threaded ring and tighten against bearing cup. Install locking setscrew and stake.
14. Install pinion key. Heat pinion to 325°-350°F (163°-176°C) maximum and assemble to shaft. Seat with a press.
15. Install and lock washer and locknut. Tighten locknut against pinion and lock with lock washer tang.

Figure 8

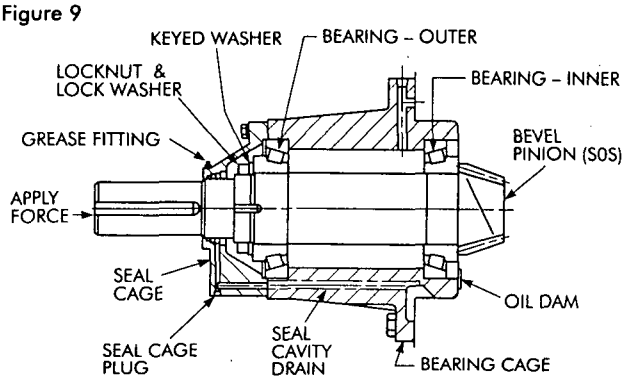


B. **SOLID ON SHAFT PINIONS** — Figure 8; All sizes except 485-525AB2 and 545-585AB3

1. Remove seal cage fasteners and seal cage.
2. Remove threaded ring setscrew and threaded ring.
3. Slide bevel pinion assembly out of bearing cage from pinion end.
4. Remove outer bearing with a bearing puller, apply force to bearing inner ring only.
5. Remove inner bearing locknut and lock washer.
6. Remove inner bearing assembly with a bearing puller or press.
7. Wash the pinion in clean kerosene or solvent and inspect for worn or damaged teeth. Replace pinion or shaft if worn or damaged.
8. Refer to Step 9 for bearing cleaning, inspection, and reassembly.
9. Assemble inner bearing to shaft in the following order: one cone, cone spacer, double cup and other cone, seat cones and cone spacer against shaft shoulder.
10. Install bearing and locknut, tighten against bearing cone. Lock locknut.
11. Install outer bearing, position next to shaft shoulder.
12. Position shaft assembly vertical with pinion end down.
13. Sling bearing cage from in seal cage fastener holes and lower onto shaft. Spherical roller bearing outer rings will require guidance when entering bearing cage outer bore.
14. Position assembly on its side. ***CAUTION:*** *Bevel pinion shaft is free to slide out of bearing cage during repositioning.*
15. Install and tighten threaded ring against inner bearing double cup. Install locking setscrew, tighten and stake.

C. **BORED OR SOLID ON SHAFT PINIONS** — Figure 9;

Figure 9



Sizes 485-525AB2 & 545-585AB3

1. Remove seal cage fasteners and seal cage.
2. **BORED PINION ONLY** — Remove pinion locknut and lock washer. Remove bevel pinion with a wheel puller (heat may be applied to pinion if pinion is not to be reused) and remove pinion key. Approximate pinion removal forces are found in Table 8, Page 14. Pinion may be removed from shaft after shaft assembly is removed from bearing cage.
3. Remove outer bearing locknut, lock washer and keyed washer.
4. Press shaft out of outer bearing and bearing cage after providing protection for pinion teeth and inner bearing when shaft falls free from outer bearing.
5. Remove inner bearing cone from shaft and bearing cups from bearing cage.
6. Wash pinion and shaft in clean kerosene or solvent and inspect pinion for damaged or worn teeth and shaft for damage. Replace if pinion or shaft is worn or damaged.
7. Refer to Step 9 for bearing cleaning, inspection and assembly.
8. Install bearing cups in bearing cage. Install inner bearing cup first, outer bearing cup may be used as a spacer when installing inner bearing cup.
9. **BORED PINION ONLY** — Assemble pinion key to shaft. Heat pinion to 325-350°F (163-176°C) maximum and assemble to shaft, seat with press. Install keyed lock washer and locknut and tighten against pinion, lock locknut.
10. Heat inner bearing cone as instructed in Step 9D, install on shaft and seat against shaft or pinion shoulder.
11. Position shaft assembly vertical with extension end up.
12. Sling bearing cage from eyebolts in seal cage fastener holes and lower onto bevel pinion shaft.
13. Heat outer bearing cone as instructed in Step 9D, install and allow to cool.
14. Install keyed washer, bearing lock washer and bearing locknut. Tighten locknut until .003" (0,08 mm) to .005" (0,13 mm) shaft axial float is obtained. Check outer bearing cone back face runout (must be .0015" (0,038 mm)or less, tap high side to adjust) and recheck axial float. Locknut may be loosened and shaft bumped to loosen overly tightened bearings. Lock locknut.
13. **FASTENERS** — All fasteners may be reused. If replacement is required, replace with identical grade, length and type. All housing sidebar fasteners are Grade 8 or ASTM A354 Grade BD.

Drive Assembly

14. **PRELIMINARY**
    A. Check to see that all spacers and worn parts have been replaced, all shaft spacers are tight (not free to rotate) and all gears and bearings tight (less than .0015" [0,038 mm] clearance) against their respective shaft shoulders.
    B. Remove all foreign matter from housing base and cover and clean magnetic drain plug(s). Make certain all bearing cages, seal cages, end covers, shaft guards, and oil dams are clean. Housing and component surfaces in contact with Loctite thread locking compounds require degreasing before assembly for maximum effectiveness.
    C. Replace old shim-gaskets on input side of drive (Type A) or side opposite bevel gear (Type AB) with new shim-gaskets of equal thickness. Replace old shim-gaskets on opposite side of drive with new shim-gaskets of equal thickness and add .007" (0,18 mm) to .009" (0,23 mm) shim to ensure shaft axial float on first float check. Use only one .015" (0,38 mm) thick shim-gasket per located next to housing for positive sealing. Use a .015" (0,38 mm) shim-gasket to seal end covers at unused bores. If the inspection cover has been removed, replace the gasket if it has been torn or damaged. Use only Falk shim-gaskets. Table 3, Page 12, lists shim-gaskets with minimum compressibility that are available from Falk.

CAUTION: During assembly, position all high speed shaft and intermediate shaft bearing cages, seal cages and end covers with the word "TOP" in the upright position.

Sizes 385 & 405A4: Seal cage will only fit in one position.

Sizes 425 - 525A4: Position the high speed seal cage with the seal grease purge fitting toward the high speed end of drive.

Sizes 385 & 405AB4: Position the flat up.

    D. Coat all pipe plugs with Permatex #3 or equivalent sealant before installing.
    E. Refer to Tables 5 and 6, Page 13, for fastener tightening torques.

15. **INSTALL SHAFT ASSEMBLIES** — Install shaft assemblies into the housing in the following order: low speed shaft, low speed pinion, intermediate pinions, and high speed head or helical high speed pinion. For quadruple reduction "A" drives, install high speed pinion first.
    A. **TYPE "A" QUADRUPLE REDUCTION HIGH SPEED PINION** — Install high speed pinion before other assemblies are installed. Insert shaft assembly through either high speed shaft bore. Install bearing outer races. Install seal cages with shim gaskets as instructed in Step

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14C. Install seal cage fasteners with lock washers and tighten to torque specified in Table 6, Page 13.

B. **ALL OTHER SHAFT ASSEMBLIES**

1. Sling shaft assemblies and gently lower into housing. Do not unload sling or damage housing internal accessories (oil pans, cooling tubes, etc.) or gear teeth. The low speed pinion shaft may be lifted by slinging from a heavy duty "C" clamp attached to the recessed gear faces when necessary.
2. Install bearing outer races on shaft and spacers (where used) in housing bores. Install seal cages, end covers, and shaft guards with shim gaskets as instructed in Step 14C. Loosely install cage and cover fasteners with lock washers in housing base. Wire tie the shim gaskets to the tops of cages.
3. Lower shaft assembly into housing and remove sling.
4. Repeat Steps 1 through 3 until all shaft assemblies have been installed.

16. **BEVEL GEARSET ADJUSTMENT** — Figure 10

A. Tighten bevel gear shaft end cover and high speed head mounting fasteners to the torque specified in Table 6, Page 13. Make certain bevel pinion teeth are free in mesh.

B. Measure bevel gear shaft axial float with a dial indicator. Remove shims from bevel gear side end cover to obtain .001" (0,03 mm) to .004" (0,10 mm) shaft axial float. Reinstall end cover and tighten end cover fasteners to torque specified in Table 6, Page 13.

C. Obtain bevel pinion setting distance (SD) and bevel gear backlash (BL) by referring to values etched on the bevel gear. The setting distance is from the bevel pinion front face to the center line of the bevel gear shaft.

D. With a micrometer, measure the outside diameter "A" of the helical pinion having an even number of teeth. To measure the outside diameter "A" of a helical pinion with an odd number of teeth, wrap a wire approximately .062" (1,5 mm) diameter around the periphery of the pinion teeth and at right angle to the pinion centerline. Twist the wire ends together to insure a tight fit over the pinion teeth. Measure the diameter over the wire and subtract two wire diameters from the measured diameter to obtain pinion diameter "A". Remove the wire after the measurement is taken. Subtract half the dimension "A" (A ÷ 2) from the recorded setting distance (SD) to get the "Required B" dimension, Figure 10.

E. Position the helical pinion so that one of the teeth is exactly opposite the vertical center of the bevel pinion. Measure the "Actual B" dimension with an inside micrometer. The required thickness of shims for the bevel pinion head assembly is "Required B" minus "Actual B".

F. Remove the bevel pinion head and add or subtract head shims equal to the required thickness determined in the previous Step. Reinstall the bevel pinion head and tighten the flange fasteners to specified torque. Recheck setting distance (SD). Repeat adjustment procedure until the "Actual B" dimension is equal to the "Required B". Tolerance range for setting distance is located in Table 9, Page 14

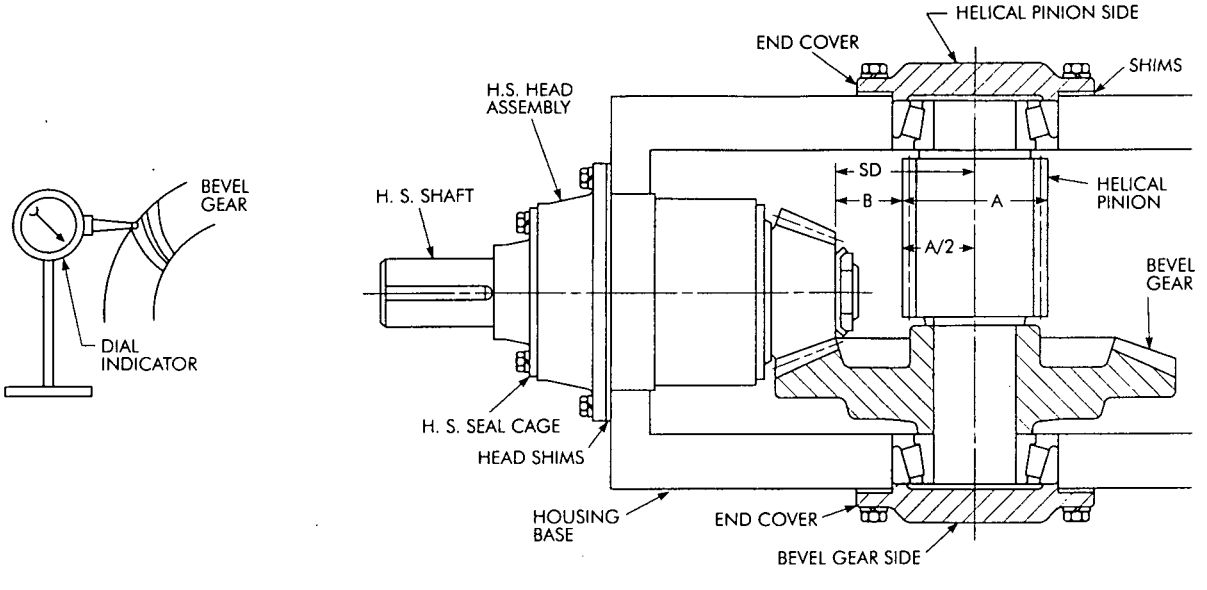
G. Place a dial indicator on a bevel gear tooth with tip perpendicular to the tooth surface as shown in Figure 10.

H. Lock bevel pinion and rotate bevel gear back and forth while reading backlash on dial indicator. If pinion can not be locked, the indicator may be located on the pinion and lock the gear. The tolerance range for backlash should be determined from Table 9, Page 14.

I. To adjust backlash, transfer end cover shims from one side to the other. A .003" (0,08 mm) shimpack thickness change is approximately .002" (0,05 mm) change in backlash. Do not add shims. Increase backlash by transferring shims from the helical pinion side end cover to the bevel gear side cover. Backlash is reduced by transferring shims from the bevel gear side to the helical pinion side end cover.

17. **BEVEL GEARSET TOOTH CONTACT**

Figure 10

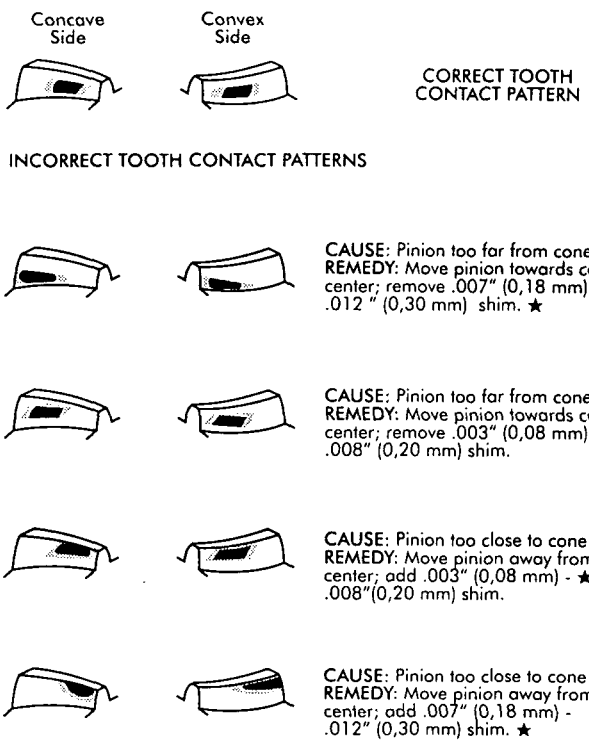


CHECK-PRELIMINARY & FINAL — Figure 11

Preliminary bevel gearset contact check is performed with housing cover off, final contact check is performed through inspection opening with drive completely assembled and bearing adjustments completed.

A. Make certain that the bevel pinion head and bevel gear shaft bearings are properly seated in the housing bores. Coat several bevel pinion teeth with bluing and rotate the coated pinion teeth back and forth through mesh several times to trace a contact pattern on the teeth of both elements.

Figure 11



★ Use the smaller tolerances for gear diameters in the 6"-8" (152,4 mm) - (203,2 mm) range. Use the larger tolerances for gear diameters over 20" (508 mm). If correct tooth contact pattern cannot be achieved, consult Falk.

B. Correct (and incorrect) bevel pinion tooth contact patterns are shown in Figure 11. Cone distance adjustment is used to obtain correct tooth contact patterns, remove shims at the bevel pinion head flange to move pinion toward cone center (gear shaft) or add shims to move pinion away from cone center. If the bevel pinion head is reshimmed to obtain correct tooth contact, realign marks on bevel teeth and recheck backlash (Steps 16E - 16H).

18. **HOUSING COVER TO BASE ASSEMBLY**

A. Loosen fasteners holding seal cages, end covers shaft guards, and high speed head to provide clearance for housing cover when it is lowered into place. Wire tie the upper portion of shims to their respective cages.

B. Coat housing split surface of base with #3 or equivalent sealant. Keep sealing compound away from bearing bores.

C. Sling housing cover from hoist and position over housing base. Pull back cages and slowly lower cover over gears. Do not bump gears or catch shim gaskets.

D. For Sizes 485 - 585A, drive taper dowels in low and high speed ends. For Sizes 485 - 585AB, drive taper dowel in low speed end.

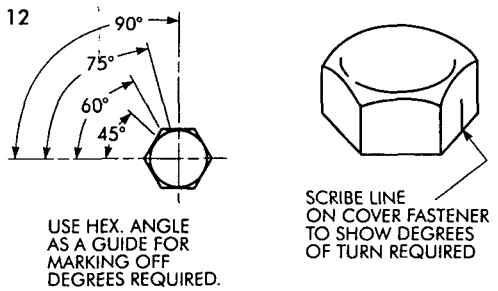
E. Remove shim gasket wire ties. Tighten seal cage, end cover, shaft guard, and high speed bevel head fasteners in housing base to center housing cover on base. Loosely install remaining cage fasteners.

F. Install backstop anchor bracket if required.

G. Coat threads and heads of housing cover sidebar fasteners with 20 or heavier mineral oil and install with hardened flat washers. Pre-tighten fasteners to torque specified in Table 4, Page 13. Scribe a line on fastener head and housing cover (Figure 12) to indicate additional degrees of head rotation required. Complete tightening of fasteners with an impact, slugging, or hydraulic wrench. Tighten fasteners at center of housing sidebar first and work toward the end bar fasteners. Housing end bar fasteners are assembled and in the "shop dry" condition per Table 6, Page 13.

NOTE: On later models of Size 585, the large housing cover fasteners on either side of the low speed shaft are studs with multi-jackbolt tensioners. See Page 10 for tightening procedure.

Figure 12



Example: Size 425A2, pre-tighten the 1.250" (31,8 mm) diameter fasteners to 196 lb-ft (266 Nm) with a torque wrench. Mark the fastener heads and housing for the additional 60° head rotation specified in Table 4 and complete tightening of fasteners.

19. **BEARING ADJUSTMENT** — All bearing settings are axial float except the low speed shafts of Sizes 385 - 445 which are preloaded. Bearing preload is shim removal from a zero float/ zero preload condition. Adjust the low speed shaft bearings first and work through to the high speed shaft on Type A or bevel gear shaft on Type AB. The high speed bearings on Type AB are non-adjustable or previously adjusted. The bevel gear shaft bearings are to be adjusted by adding shims to the bevel gear side end cover only.

EXCEPTION: Size 545 - 585 drives have spherical roller bearings on the low speed pinion shaft. Place only a .015" (0,38 mm) shim-gasket between the housing and end cover on each side.

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A. Tighten all seal cage, end cover, bevel head, and shaft guard fasteners to torque specified in Table 6, Page 13. High speed shaft seal cages on double and triple Type "A" drives with fans utilize the fan guard backstop spacers and .25" (6,4 mm) of extra shim washers on the longer than standard fasteners for proper thread engagement at bearing adjustment.

B. Position dial indicator probe on shaft end (Figure 2) and apply axial force on shaft (in both directions) to measure shaft axial float. Holes are provided in the intermediate shaft end covers for taking indicator readings. Oscillate shaft (with force applied) through gear train to obtain accurate axial float measurements. Pry shafts with gears back and forth through the inspection cover opening. Do not pry on oil troughs.

C. To adjust bearings, remove shim-gaskets from the cages and covers where the extra shims were installed, Step 14C, so that the float or preload values will be within limits specified in Table 1 or 2, Pages 11 & 12.

1. Make all shim pack adjustments for the bevel gear shaft at the bevel gear side end cover.

2. Tighten cage and cover fasteners to specified torque before rechecking bearing settings after shimpack adjustments.

Preload example — The measured axial float on a Size 505A3 low speed shaft is .004" (0,10 mm). The specified preload range in Table 1, Page 11, is .007" to .010" (0,18 to 0,25 mm). Add the measured axial float to the specified preload range (.004"+.007" (0,10 + 0,18 mm) to .004"+.010" (0,10 + 0,25 mm) = .011" to .014") [0,28 to 0,35 mm]) to determine shim-gasket removal. Remove (2) .007" (0,18 mm) shim-gaskets (.012") (0,30 mm) compressed thickness) to be within limits specified in Table 1, Page 11.

Float example — The measured axial float on a Size 445A2 high speed pinion shaft is .015" (0,38 mm). The specified axial float range in Table 1, Page 11, is .008" (0,20 mm) to .011" (0,28 mm). Subtract the specified axial float from the measured float (.015"-.011" (0,38 mm) - (0,28 mm) to .015"-.008" (0,38mm-0,20 mm)= .004" to .007") (0,10 mm to 0,18 mm) to determine shim-gasket removal. Remove (1) .007" (0,18 mm) shim-gaskets (.006" [0,15 mm] compressed thickness) to be within limits specified in Table 1, Page 11.

D. Bevel gear shaft bearing adjustment is to be combined with final bevel gear backlash adjustment, refer to Steps 16 & 17.

E. **FINAL BEVEL GEARSET TOOTH CONTACT CHECK** — Figure 11

Refer to Steps 16 & 17. To adjust backlash after bevel gear shaft bearings are properly set, transfer shims from one end cover to the other — DO NOT ADD SHIMS.

20. **INSTALL SEALS** — Remove seal cages, install seals and re-install seal cages, refer to Step 3.

Installation

21. **DRIVE INSTALLATION**

A. Coat threads of magnetic drain plugs and air vent with Permatex #3 or equivalent sealant and install. Reinstall accessories. Coat shaft extension for backstops with anti-seize lubricant before installing backstop. Tighten fasteners to specified torque. Reinstall dipstick.

B. Turn gear train over by hand as a final check for internal or accessory interference. Readjust if necessary.

CAUTION: If lubricant was not applied to bearings (Step 9E), pour a small amount of lubricant into oil troughs through inspection cover prior to rotating gear train by hand.

C. Reinstall drive. Refer to Manual 138-050 for installation instructions.

D. Fill drive with oil to level indicated on dipstick. Refer to Manual 138-050 for recommended lubricants and approximate oil quantities.

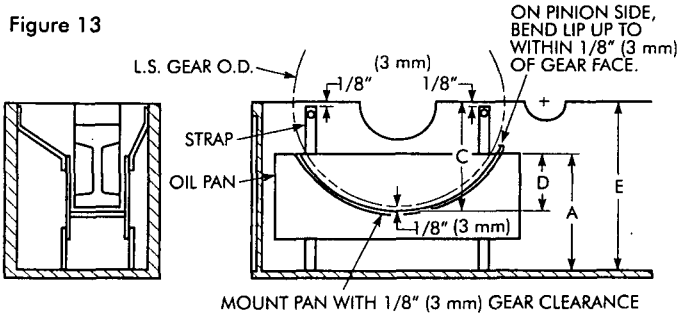
IMPORTANT — PRIME OIL TROUGHS. When filling drive with oil, remove inspection cover and pour enough oil into troughs so a generous supply flows to bearings. This will lubricate bearings until oil is circulated by the rotating gears.

E. Run drive without load to verify satisfactory operation of drive and its lubrication system (including electrical cutouts).

F. After drive runs satisfactorily, apply load. Inspect periodically until operation is deemed satisfactory. Follow preventive maintenance instructions in Manual 138-050.

Oil Pan & Oil Catcher Relocation or Addition

Figure 13



(See Introduction and Input Speed, Ratio, or Gearing Assembly Changes paragraphs on Page 1)

22. **SINGLE REDUCTION** — Figure 13.

Sizes 385, 405, 425 & 525 have centrally located gears and do not require relocation of oil pans or catchers when turning shafts end for end.

Sizes 445, 465, 485 & 505 turn oil pan and oil catchers end for end and reinstall using same fasteners when turning shafts end for end.

Proceed as follows when adding an oil pan or catcher:

A. Determine C as follows:

$$C = \frac{\text{Gear O.D.}}{2} + \frac{1}{8}\text{" (3 mm)}$$

B. Determine A as follows: A = E - C + D. D is inside depth of pan. E is inside depth of housing.

C. Cut legs of oil pan to obtain height A. Place oil pan into base and recheck D. Place low speed shaft assembly into base and center pan under the low speed gear. Mark strap hole locations on housing wall. Remove low speed shaft assembly and oil pan. If available, use self tapping fasteners. If not available, drill and tap four holes into base. ***CAUTION:*** *Drilled holes in the housing must not exceed 5/8" (15,9 mm) deep. Refer to Table 10, Page 14, for drill, tap, and fastener sizes.*

D. Clean out base and install oil pan to base with four fasteners specified in Table 10, Page 14. Apply Loctite 242 Threadlocker to fastener threads.

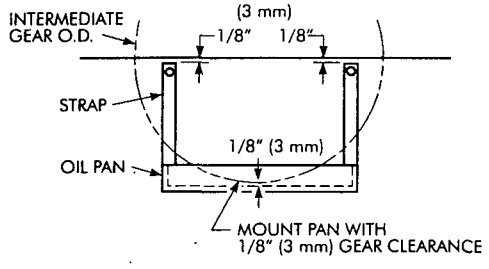
E. Lower gear assembly into drive and bend lip of pan to within 1/8" (3 mm) of gear face on pinion side as shown in Figure 13.

F. Install oil catchers on housing cover tie bar with notch of oil catchers over gear mesh. Use fasteners and locknuts provided.

23. **DOUBLE REDUCTION** — Figure 14

All Sizes turn oil pan and oil catchers end for end when turning shaft assemblies end for end.

Figure 14



Proceed as follows when adding an oil pan or catchers:

A. Place oil pan and intermediate shaft assembly into base.

B. Center oil pan under gear and level with bottom of pan 1/8" (3 mm) below gear O.D. Mark strap hole locations on housing wall. Remove shaft assembly and oil pan. Drill and tap four holes into base. Refer to Table 10, Page 14, for drill and tap sizes.

C. Clean out base and install oil pan to base with fasteners with fasteners specified in Table 10, Page 14. Apply Loctite 242 Threadlocker to fastener threads.

D. Lower shaft assembly into base and recheck clearance.

E. Install oil catchers on housing cover tie bar with notch of oil catchers over gear mesh. Use fasteners and locknuts provided.

24. **TRIPLE & QUADRUPLE REDUCTION**

All Sizes turn oil catchers end for end when turning shaft assemblies end for end. Oil pans are not used.

Proceed as follows when adding oil catchers: Install oil catchers on housing cover tie bar with notch of oil catchers over gear mesh. Use fasteners and locknuts provided.

General Tightening & Loosening Procedures for Multi-Jackbolt Tensioners on Size 585

25. **LOOSENING PROCEDURE.**

Jackbolts should be loosened with care. For longer fasteners, this procedure is even more important. The intent is to slowly *release the preload force - DO NOT rush to completely loosen* individual jackbolts. All jackbolts should be loosened uniformly.

A. Loosen first jackbolt until it feels loose (no more than one half turn).

B. Move in circular pattern to next jackbolt and repeat Step A.

C. Continue repeating until all jackbolts have been unloaded.

D. Usually after 2 or 3 passes, the tensioner can be spun off the stud by hand. Long fasteners will stretch more and may require extra passes.

E. Before reusing any tensioner, the body and jackbolts should be cleaned and relubricated to insure proper jackbolt torque vs. preload performance on reinstallation.

26. **TIGHTENING PROCEDURE.**

A. Slide hardened washer provided onto stud.

B. Check base of tensioner and verify that all jackbolts are flush with the bottom of the tensioner body.

C. Clear any dirt or chips from the threads of the stud and from the main internal thread of the tensioner.

D. Spin the tensioner body down on the main thread of the stud by hand. The tensioner should be in light contact with the hardened washer.

E. Tightening is accomplished by tightening in multiple passes to the torques and patterns specified in Table 11, Page 14. Tightening patterns are shown in Figure 15 and Figure 16.

F. For the final tightening pass, set the torque wrench for the specified torque and continue to repeat the circular pattern until all jackbolts are torqued to the same value.

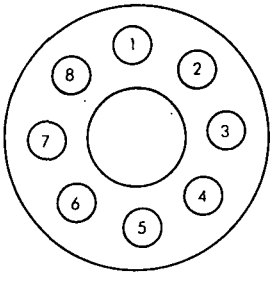


Figure 15
CIRCULAR PATTERN FOR ALL LOOSENING AND LATER TIGHTENING.

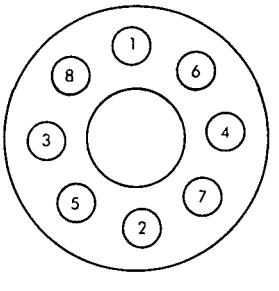


Figure 16
STAR PATTERN FOR INITIAL TIGHTENING ONLY

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TABLE 1 — Type A Shaft Axial Float – Inches (mm) – Figure 18

DRIVE SIZE	Bore-L.S.		Bore-1			Bore-2		Bore-3		Bore-4
	L.S. A1	L.S. A2, A3, A4	H.S. A1	L.S. PIN A2	L.S. PIN A3, A4	H.S. A2	INT. A3, A4	H.S. A3	INT. A4	H.S. A4
385	.003-.006 (0,08-0,15)	★	.007-.010 (0,18-0,25)	.002-.005 (0,05-0,13)	.001-.004 (0,03-0,10)	.006-.009 (0,15-0,23)	.002-.005 (0,05-0,13)	.005-.008 (0,13-0,20)	.002-.005 (0,05-0,13)	.005-.008 (0,13-0,20)
405	.003-.006 (0,08-0,15)	★	.008-.011 (0,20-0,28)	.001-.004 (0,03-0,10)	.000-.003 (0,00-0,08)	.006-.009 (0,15-0,23)	.001-.004 (0,03-0,10)	.005-.008 (0,13-0,20)	.002-.005 (0,05-0,13)	.005-.008 (0,13-0,20)
425	.004-.007 (0,10-0,18)	★	.010-.013 (0,25-0,33)	.002-.005 (0,05-0,13)	.000-.003 (0,00-0,08)	.006-.009 (0,15-0,23)	.001-.004 (0,03-0,10)	.005-.008 (0,13-0,20)	.002-.005 (0,05-0,13)	.005-.008 (0,13-0,20)
445	.006-.009 (0,15-0,23)	★	.010-.013 (0,25-0,33)	.002-.005 (0,05-0,13)	.000-.003 (0,00-0,08)	.008-.011 (0,20-0,28)	.001-.004 (0,03-0,10)	.006-.009 (0,15-0,23)	.002-.005 (0,05-0,13)	.005-.008 (0,13-0,20)
465	.055-.060 (1,40-1,52)	.055-.060 (1,40-1,52) †	.014-.017 (0,36-0,43)	.002-.005 (0,05-0,13)	.000-.003 (0,00-0,08)	.009-.012 (0,23-0,30)	.001-.004 (0,03-0,10)	.006-.009 (0,15-0,23)	.002-.005 (0,05-0,13)	.005-.008 (0,13-0,20)
485	.060-.065 (1,52-1,65)	.060-.065 † (1,52-1,65)	.015-.018 (0,38-0,46)	.003-.006 (0,08-0,15)	.000-.003 (0,00-0,08)	.010-.013 (0,25-0,33)	.001-.004 (0,03-0,10)	.007-.010 0,18-0,25)	.002-.005 (0,05-0,13)	.005-.008 (0,13-0,20)
505	.065-.070 (1,65-1,78)	.065-.070 (1,65-1,78) †	.016-.020 (0,41-0,51)	.004-.007 (0,10-0,18)	.001-.004 (0,03-0,10)	.012-.016 (0,30-0,41)	.002-.005 (0,05-0,13)	.008-.011 (0,20-0,28)	.003-.006 (0,08-0,15)	.006-.009 (0,15-0,23)
525	.075-.080 (1,91-2,03)	.075-.080 (1,91-2,03) †	.020-.024 (0,51-0,61)	.004-.007 (0,10-0,18)	.001-.004 (0,03-0,10)	.014-.018 (0,36-0,46)	.002-.005 (0,05-0,13)	.010-.013 (0,25-0,33)	.003-.006 (0,08-0,15)	.006-.009 (0,15-0,23)
545	....	.075-.085 (1,91-2,16)	....	‡	‡	.017-.021 (0,43-0,53) • .012-.016 (0,30-0,41) •	.005-.009 (0,13-0,23)	.012-.016 (0,30-0,41) • .009-.013 (0,23-0,33) •	....	....
565	....	.075-.085 (1,91-2,16)	....	‡	‡	.019-.023 (0,48-0,58) • .013-.017 (0,33-0,43) •	.005-.009 (0,13-0,23)	.017-.021 (0,43-0,53) • .012-.016 (0,30-0,41) •	....	....
585	....	.075-.085 (1,91-2,16)	....	‡	‡	.022-.026 (0,56-0,66) • .018-.022 (0,46-0,56) •	.005-.009 (0,13-0,23)	.017-.021 (0,43-0,53) • .012-.016 (0,30-0,41) •	....	....

★ Preload .007"-.010" (0,18-0,25 mm). Preload is shim removal from a zero float condition.
† Values shown are for spherical roller bearings.
‡ No adjustment required.
• Upper float range for 1820-1050 rpm input.
Lower float range for 1049-0 rpm input.

Figure 17 — Multi-Jackbolt Tensioner

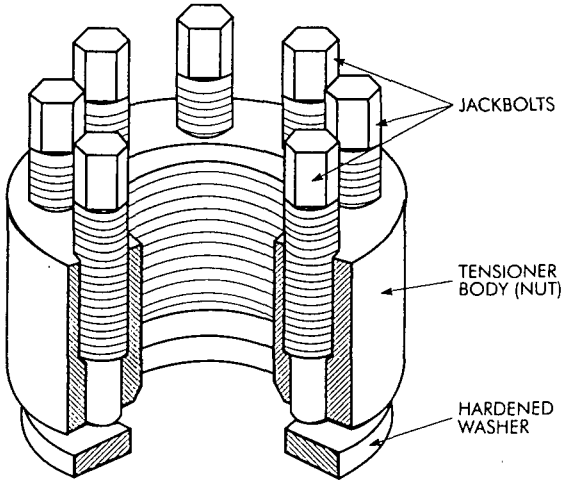

Figure 18

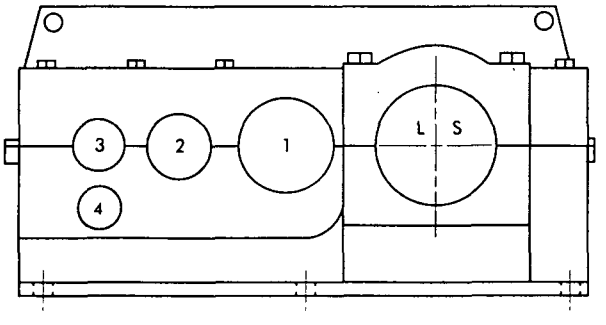

Figure 19

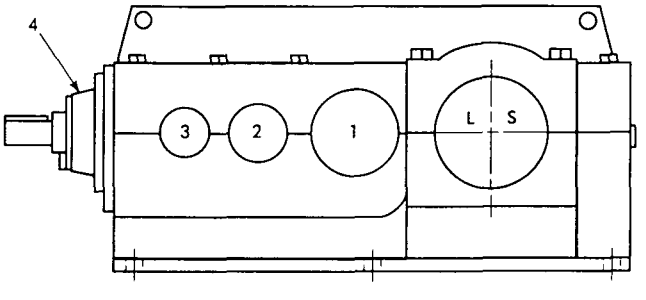

TABLE 2 — Type AB Shaft Axial Float – Inches (mm) – Figure 19

DRIVE SIZE	Shaft – L.S.		Shaft 1		Shaft 2		Shaft 3
	L.S. AB2	L.S. AB3 & AB4	L.S. Pin. AB2	L.S. Pin. AB3 & AB4	1st Int. AB3	2nd Int. AB4	1st Int. AB4
385	.004-.007 (0,10-0,18) Preload ‡	.007-.010 (0,18-0,25) Preload ‡	.004-.007 (0,10-0,18)	.001-.004 (0,03-0,10)	.002-.005 (0,05-0,13)	.001-.004 (0,03-0,10)	.002-.005 (0,05-0,13)
405	.004-.007 (0,10-0,18) Preload ‡	.007-.010 (0,18-0,25) Preload ‡	.005-.008 (0,13-0,20)	.001-.004 (0,03-0,10)	.002-.005 (0,05-0,13)	.001-.004 (0,03-0,10)	.002-.005 (0,05-0,13)
425	.004-.007 (0,10-0,18) Preload ‡	.007-.010 (0,10-0,18 Preload ‡	.006-.009 (0,15-0,23)	.001-.004 (0,03-0,10)	.002-.005 (0,05-0,13)	.001-.004 (0,03-0,10)	.002-.005 (0,05-0,13)
445	.004-.007 (0,10-0,18) Preload ‡	.007-.010 (0,10-0,18) Preload ‡	.006-.009 (0,15-0,23)	.001-.004 (0,03-0,10)	.002-.005 (0,05-0,13)	.001-.004 (0,03-0,10)	.002-.005 (0,05-0,13)
465	.055-.060 † (1,40-1,52)	.055-.060 † (1,40-1,52)	.009-.012 (0,23-0,30) .006-.009 (0,15-0,23) ■	.002-.005 (0,05-0,13)	.003-.006 (0,08-0,15)	.002-.005 (0,05-0,13)	.003-.006 (0,08-0,15)
485	.060-.065 † (1,52-1,65)	.060-.065 † (1,52-1,65)	.007-.010 (0,18-0,25)	.002-.005 (0,05-0,13)	.004-.007 (0,10-0,18)	.002-.005 (0,05-0,13)	.003-.006 (0,08-0,15)
505	.065-.070 † (1,65-1,78)	.065-.070 † (1,65-1,78)	.007-.010 (0,18-0,25)	.003-.006 (0,08-0,15)	.006-.009 (0,15-0,23)	.002-.005 (0,05-0,13)	.004-.007 (0,10-0,18)
525	.075-.080 † (1,91-2,03)	.075-.080 † (1,91-2,03)	.007-.010 (0,18-0,25)	.003-.006 (0,08-0,15)	.006-.009 (0,15-0,23)	.002-.005 (0,05-0,13)	.004-.007 (0,10-0,18)
545	...	.075-.085 † (1,91-2,16)	...	•	.009-.013 (0,23-0,33) .006-.010 (0,15-0,25) ■	.002-.006 (0,05-0,15)	.005-.009 (0,13-0,23)
565	...	.075-.085 † (1,91-2,16)	...	•	.007-.011 (0,18-0,28) .005-.009 (0,13-0,23) ■	.002-.006 (0,05-0,15)	.006-.010 (0,15-0,25)
585	...	.075-.085 † (1,91-2,16)	...	•	.007-.011 (0,18-0,28) .005-.009 (0,13-0,23) ■	.002-.006 (0,05-0,15)	.006-.010 (0,15-0,25)

★ BEP — Bench End Play, unassembled TDO bearing, MEP — Mounted End Plat, TDO bearing assembled to shaft.
† Spherical Roller Bearing
‡ Preload is shim removal from zero float condition.
• Spherical roller bearing — not adjustable
■ Upper float range for 1.50 (38,1 mm) bevel ratio. Lower float range for 2.25 (57,2 mm) & 3.38 (85,9) bevel ratios.
♦ 1520 RPM max

TABLE 3 — Falk Shim-Gasket Compressibility

Thickness in Inches and (millimeters)					
	New	.007	.009	.015	.031
		(0,18)	(0,23)	(0,38)	(0,79)
	Compressed	.006	.008	.013	.028
		(0,15)	(0,20)	(0,33)	(0,71)

TABLE 2 — Type AB Shaft Axial Float – Inches (mm) Con't.

DRIVE SIZE	Shaft 4		
	H.S. AB2 ★	H.S. AB3 ★	H.S. AB ★4
385	BEA .005-.007 (0,13-0,18) MEP .0021-.0055 (0,05-0,14)	BEP .005-.007 (0,13-0,18) MEP .0017-.0054 (0,04-0,14)	BEP .003-.005 (0,08-0,13 MEP .0011-.0014 (0,03-0,04)
405	BEP .005-.007 (0,13-0,18) MEP .0018-.0057 (0,05-0,14)	BEP .005-.007 (0,13-0,18) MEP .0017-.0054 (0,04-0,14)	BEP .003-.005 (0,08-0,13 MEP .0011-.0014 (0,03-0,04)
425	BEP .009-.011 (0,23-0,28) MEP .0022-.0079 (0,06-0,20)	BEP .005-.007 (0,13-0,18) MEP .0015-.0053 (0,04-0,13)	BEP .005-.007 (0,13-0,18) MEP .0017-.0054 (0,04-0,14)
445	BEP .009-.011 (0,23-0,28) MEP .0028-.0082 (0,07-0,21)	BEP .005-.007 (0,13-0,18) MEP .0021-.0055 (0,05-0,14)	BEP .005-.007 (0,13-0,18) MEP .0017-.0054 (0,04-0,14)
465	BEP .009-.011(0,23-0,28) MEP .0028-.0082 (0,07-0,21)	BEP .005-.007 (0,13-0,18) MEP .0018-.0057 (0,05-0,14)	BEP .005-.007 (0,13-0,18) MEP .0015-.0053 (0,04-0,13)
485	.003-.005 (0,08-0,13)	BEP .009-.011 (0,23-0,28) MEP .0022-.0079 (0,06-0,20)	BEP .005-.007 (0,13-0,18) MEP .0021-.0055 (0,05-0,14)
505	.003-.005 ♦ (0,08-0,13)	BEP .009-.011 (0,23-0,28) MEP .0028-.0082 (0,07-0,21)	BEP .005-.007 (0,13-0,18) MEP .0018-.0057 (0,05-0,14)
525	.003-.005 ♦ (0,08-0,13)	BEP .009-.011 (0,23-0,28) MEP .0028-.0082 (0,07-0,21)	BEP .005-.007 (0,13-0,18) MEP .0018-.0057 (0,05-0,14)
545	...	.003-.005 (0,08-0,13)	BEP .009-.011 (0,23-0,28) MEP .0028-.0082 (0,07-0,21)
565	...	.003-.005 ♦ (0,08-0,13)	BEP .009-.011 (0,23-0,28) MEP .0028-.0082 (0,07-0,21)
585	...	.003-.005 ♦ (0,08-0,13)	BEP .009-.011 (0,23-0,28) MEP .0028-.0082 (0,07-0,21)

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TABLE 4 — Housing Cover Fastener Tightening Torques A & AB Side Bar Fasteners ★

	FASTENER PRE-TORQUE AND TURN OF THE NUT (LB-FT (Nm)/DEGREES) †‡												
DRIVE SIZE & REDUCTION	**.750**	**.875**	**1.000**	**1.125**	**1.250**	**1.375**	**1.500**	**1.750**	**2.000**	**2.250**	**2.500**	**2.750**	**3.000**
385A1 & AB2			99 (134) 60°	99 (134) 50-60°									
385A2-A4 & AB3-4	38 (52) 60°			99 (134) 45°									
& 405A1 & AB2			146 (198) 60°	196 (266) 60°									
405A2-A4 & AB3-4	54 (73) 80°			99 (134) 45-55°									
425A1 & AB2					340 (460) 60°								
425A2-A4 & AB3-4		99 (134) 60°	99 (134) 60°		196 (266) 60°								
445A1 & AB2					340 (460) 60°	340 (460) 60°							
445A2-A4 & AB3-4	73 (94) 60°			146 (198) 60°		196 (266) 50-60°							
465A1 & AB2					340 (480) 60°		560 (760) 60°						
465A2-A4 & AB3-4			146 (198) 60°		340 (480) 60°		560 (760) 50-60°						
485AB1 & AB2								560 (760) 60°					
485A2-A4 & AB3-4				262(355) 60°		420 (570) 60°		560 (760) 60°					
505A1 & AB2									420 (570) 75°				
505A2-A4 & AB3-4							560 (760) 60°		560 (760) 60°				
525A1 & AB2										560 (760) 75°			
525A2-A4 & AB3-4					340 (460) 75°			560 (760) 60°		560 (760) 75°			
545A2 & A3 545AB3 & A4									560 (760) 75°		560 (760) 75°		
565A2 & A3 565AB3 & A4										560 (760) 75°		560 (760) 75°	
585A2 & A3 585AB3 & A4										560 (760) 90°			560 (760) 90°

★ Torque values are for Grade 8 or ASTM A354 Grade BD fasteners coated with SAE 20 or heavier mineral oil.

† Tighten fasteners to top value, then apply additional rotation per bottom value.

‡ Tolerance for degrees additional head rotation is ±5° except where degree range is listed.

TABLE 5 — Fan Assembly, Inspection Cover, Oil Catcher, & Oil Pan Fastener Tightening Torque lb-ft (Nm) ±5% *

With Locknuts		Without Locknuts	
Size	**Torque**	**Size**	**Torque**
.250	6 (8,5)	.250	4.5 (6)
.3125	13 (17)	.3125	9.5 (13)
.375	21 (29)	.375	17 (23)
.500	50 (68)	.500	42 (57)

* Fan assembly and oil pan fasteners are Grade 2, inspection cover and oil catcher fasteners are Grade 5.

TABLE 6 — Bevel Head, End Cover, Seal Cage, & Shaft Guard Fastener Tightening Torques (See Note ■ for Size 445 Drives)

Fastener Diameter	**.375**	**.500 †**	**.625**	**.750**	**.875**	**1.000**	**1.250**
Torque lb-ft ♦ (Nm)	27 (37)	67 (91)	134 (184)	242 (330)	395 (530)	590 (800)	1060 (1420)

Except where noted, all fasteners are Grade 5 UNC. Torques are for shop dry conditions.

■ Low speed pinion end cover fasteners for 445A2, A3, A4, AB3 & AB4 are Grade 8. Tightening torque is 95 lb-ft (130 Nm.)

♦ Tolerance is ±5%

TABLE 7 — Bevel Gear Rim Fastener Tightening Torques ★

Fastener Diameter	0.625	0.750	0.875	1.000
Torque lb-ft (Nm)	190 (260)	345 (465)	590 (800)	880 (1200)

★ All fasteners are Grade 8 UNC.

TABLE 8 — Bored Bevel Pinion Removal Force

DRIVE SIZE & REDUCTION	Approximate Removal Force — lbs (kN)
385 & 405AB3, 425 & 445AB4 425AB3, 465AB4	22000 (98) 30000 (133)
385AB2, 445AB3, 485AB4	34000 (151)
405AB2, 465AB3, 505 & 525AB4	50000 (222)
425B2, 485AB3	56000 (249)
445 & 465AB2, 505 & 525AB3, 545AB3, 565 & 585AB4	90000 (400)
565 & 585AB3	133000 (592)

TABLE 9 — Bevel Pinion Mounting Distance (SD) Tolerance – Inches Bevel Gear Set Backlash (BL) Tolerance – Inches

Bevel Gear Outside Diameter	Setting Distance Tolerance	Backllash Tolerance
Less Than 15"	–0.000 +0.002	–0.001 +0.001
Greater than 15"	–0.000 +0.005	–0.002 +0.002

TABLE 10 — Oil Pan Data – Inches

DRIVE SIZE	Strap Hole Diameter	Drive Base Hole	Fastener Size Grade 5
All	7/16	5/16 drill, 5/8 deep 3/8-16UNC-2B tap †	3/8-16UNC x 1/2

† If possible, use self tapping fasteners.

TABLE 11 — Multi-Jackbolt Tightening Torques – lb-ft. (Nm)

Tightening Pass	Torque	Tightening Pattern
1	22-27 (30-37)	Star
2	110-135 (150-183)	Star
3	165-200 (225-270)	Circular
4	240-290 (325-390)	Circular
5	220-270 (300-370)	Circular

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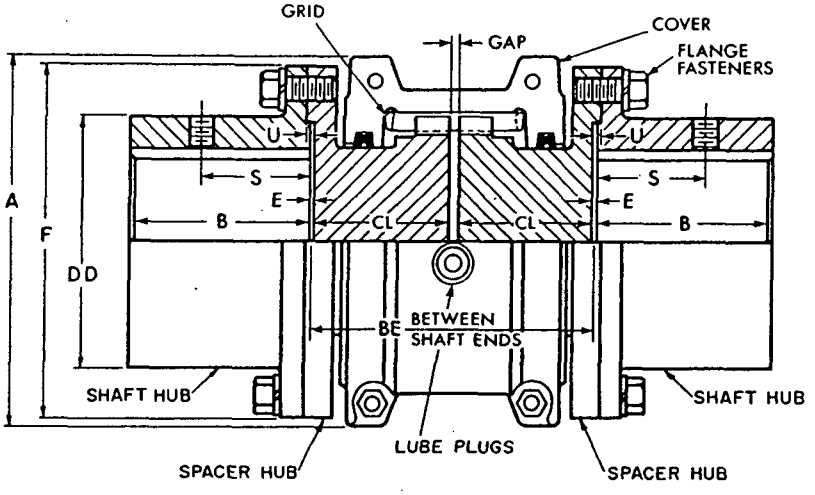
Both Shaft Hubs with Straight Bores



SIZE ★	Torque Rating (lb-in.)	Allow. Speed rpm	Shaft Hub Bores		Cplg. Wt. With No Bore & Min BE-lb	Lube Wt. lb	DIMENSIONS – Inches											
			Max† Bore (Sq. Key)	Min Bore •			A	B	BE Min	BE Max	DD	E	F	S	U	Gap	Flange Fasteners No. per Flange & Grade	Flange Fasteners Dia.
1020T	422	3600	1.375	.500	8.5	.06	4.00	1.38	3.50	8.00	2.06	.03	3.38	1.08	.08	.188	4, Gr 8	.250
1030T	1,200	3600	1.625	.500	11.6	.09	4.38	1.62	3.50	8.50	2.34	.03	3.69	1.24	.08	.188	8, Gr 8	.250
1040T	2,000	3600	2.125	.500	18.6	.12	4.62	2.12	3.50	8.50	3.09	.03	4.44	1.08	.08	.188	8, Gr 8	.250
1050T	3,500	3600	2.375	.500	27.6	.15	5.44	2.38	4.38	8.50	3.44	.03	4.94	1.60	.08	.188	8, Gr 8	.312
1060T	5,500	3600	2.875	.750	43.2	.19	5.94	2.88	5.00	13.00	4.06	.06	5.69	1.70	.11	.188	8, Gr 8	.375
1070T	8,000	3600	3.125	.750	54.3	.25	6.38	3.12	5.00	13.00	4.31	.06	6.00	1.84	.11	.188	12, Gr 8	.375
~~1080T~~	~~16,500~~	~~3600~~	~~3.500~~	~~1.062~~	~~86.8~~	~~.38~~	~~7.62~~	~~3.50~~	~~7.25~~	~~16.00~~	~~4.81~~	~~.06~~	~~7.00~~	~~1.96~~	~~.11~~	~~.188~~	~~12, Gr 5~~	~~.500~~
1090T	30,000	3600	4.000	1.062	133	.56	8.38	4.00	7.25	16.00	5.62	.06	8.25	2.24	.11	.188	12, Gr 5	.625
~~1100T~~	~~50,500~~	~~2440~~	~~4.750~~	~~1.500~~	~~218~~	~~.94~~	~~9.88~~	~~3.56~~	~~8.00~~	~~16.00~~	~~6.75~~	~~.06~~	~~9.88~~	....	~~.12~~	~~.250~~	~~12, Gr 5~~	~~.750~~
1110T	75,000	2250	5.500	2.000	303	1.12	10.62	4.10	8.25	16.00	7.75	.06	10.88	....	.12	.250	12, Gr 5	.750
1120T	110,000	2025	6.250	2.500	433	1.62	12.12	4.70	9.69	16.00	8.88	.06	12.56	....	.16	.375	12, Gr 5	.875
1130T	160,000	1800	7.000‡	3.000	572	2.00	13.62	5.30	10.12	16.00	9.38	.06	13.62	....	.16	.375	12, Gr 5	1.000
1140T	230,000	1650	8.000‡	3.500	750	2.50	15.12	6.00	10.50	16.00	10.50	.06	15.19	....	.16	.375	12, Gr 5	1.125

★ Dimensions are for reference only and are subject to change without notice unless certified.

† *Maximum bores are LESS than shown above for hubs with an INTERFERENCE FIT and a set screw OVER the keyway; Refer to Manual 427-105 for details.* For the above Max Bores, Sizes 1020 thru 1090 will be furnished for CLEARANCE FIT with a set screw OVER the keyway. Sizes 1100 and larger will be furnished for INTERFERENCE FIT without set screw. Falk standards apply unless otherwise specified.

‡ Maximum bore is for hub with keyway for rectangular key.

• Minimum bore is the smallest bore to which a RSB (rough stock bore) hub can be bored. Depending upon coupling size, rough stock bore hubs have only a blind centering hole or a small through hole that will permit remachining of the hubs to the minimum bores specified. RSB hubs are not drilled and tapped for set screws.

SIZE & TYPE	ONE SHAFT HUB				OTHER SHAFT HUB				SPACER HUBS	
	Bore	Keyway	Fitted To	Fitted By	Bore	Keyway	Fitted To	Fitted By	BE	CL
1090 T31	3.9975 3.9985	1 x 1/2	HSS	PURCH.	3.9356 3.9370	28 x 6.4 mm	MOTOR	PURCH	9.750	3.4690" 5.9690"
	Overhang This Hub ..... —				Overhang This Hub ..... —					

PRELIMINARY CERTIFIEDPRINT OF FALK COUPLING FOR.... A-C EQUIPMENT SERVICES ..... ~~CO~~

DRAWN DWB	DATE	07-16-2002	
CHECKED	NO. REQ'D.	(1) ONE	
DRAWING NO.	FOR UNIT ON M.O.	01-067913-01	
425-312J	P.O.	4888 DB	
	COUPLING M.O.	02-006804	

How to Use This Manual

This manual provides detailed instructions on maintenance, lubrication, installation, and parts identification. Use the table of contents below to locate required information.

Table of Contents

Introduction . . . . . Page 1
Lube Fittings . . . . . Page 1
Limited End Float . . . . . Page 1
Lubrication . . . . . Pages 1-2
Installation & Alignment Instructions . . . . . Pages 2-4
Annual Maintenance, Relube & Disassembly . . . . . Page 4
Installation & Alignment Data . . . . . Page 5
Parts Identification & Parts Interchangeability . . . . . Page 6

CAREFULLY FOLLOW THE INSTRUCTIONS IN THIS MANUAL FOR OPTIMUM PERFORMANCE AND TROUBLE FREE SERVICE.

INTRODUCTION

This manual applies to Sizes 1020T thru 1140T and 20T thru 140T31 standard Falk Steelflex Pre-assembled Spacer Couplings. Unless otherwise stated, information for Sizes 1020T thru 1140T applies to Sizes 20T thru 140T respectively, e.g. 1020T = 20T, 1100T = 100T, etc. For couplings furnished with special features, refer to assembly drawing furnished with coupling for proper assembly arrangement and any additional installation or maintenance requirements. The Pre-Assembled Spacer Assembly permits installation (or removal, as shown on Page 3) without disturbing coupling cover, grid or grease. These couplings are designed to operate in either the horizontal or vertical position without modification. However, for vertical applications, the match mark shown on Page 4 must be up. Beginning in 1994, these couplings may be supplied with either inch series cover fasteners or metric cover fasteners depending on domestic or foreign shipping destinations. Refer to Page 6 for part interchangeability.

The performance and life of the couplings depend largely upon how you install and service them.

WARNING: Consult applicable local and national safety codes for proper guarding of rotating members. Lockout starting switch of prime mover and remove all external loads from drive before installing or servicing couplings. Observe all safety rules when installing or servicing couplings.

LUBE FITTINGS

Cover halves have ⅛ NPT lube holes. Use a standard grease gun and lube fitting as instructed on Page 4.

LIMITED END FLOAT

When electric motors, generators, and other machines are fitted with sleeve or straight roller bearings, limited axial end float kits are recommended for protecting the bearings. Falk Steelflex couplings are easily modified to limit end float; refer to Manual 428-820 for instructions.

NOTE: To drop-in a pre-assembled spacer fitted with limited end float, the sleeve bearing shaft must have enough axial movement to separate and clear the shaft hub registers.

LUBRICATION

Adequate lubrication is essential for satisfactory operation. Page 2 provides a list of typical lubricants and specifications for general purpose greases. Because of its superior lubricating characteristics and low centrifuge properties, Falk Long Term Grease (LTG) is highly recommended. LTG is provided in all pre-assembled spacer couplings.

The use of general purpose grease requires re-lubrication of the coupling at least annually.

Long Term Grease (LTG)

The high centrifugal forces encountered in couplings separate the base oil and thickener of general purpose greases. Heavy thickener, which has no lubrication qualities, accumulates in the grid-groove area of Steelflex couplings resulting in premature hub or grid failure unless periodic lubrication cycles are maintained.

Falk Long Term Grease (LTG) was developed specifically for couplings. It resists separation of the oil and thickener. The consistency of Falk LTG changes with operating conditions. As manufactured it is an NLGI #1/2 grade. Working of the lubricant under actual service conditions causes it to become semifluid while the grease near the seals will set to a heavier grade, helping to prevent leakage.

LTG is highly resistant to separation, easily out performing all other lubricants tested. The resistance to separation allows the lubricant to be used for relatively long periods of time.

Steelflex couplings initially lubricated with LTG will not require re-lubrication until the connected equipment is stopped for servicing. If a coupling leaks grease, is exposed to extreme temperatures, excessive moisture, or experiences frequent reversals, more frequent lubrication may be required.

Although LTG grease is compatible with most other coupling greases, the mixing of greases may dilute the benefits of LTG.

USDA Approval

LTG has the United States Department of Agriculture Food Safety & Inspection Service approval for applications where there is no possibility of contact with edible products. (H-2 ratings).

CAUTION: *Do not use LTG in bearings.*

Specifications — Falk LTG

The values shown are typical and slight variations are permissible.

AMBIENT TEMPERATURE RANGE — -20°F (-29°C) to 250°F (121°C). Min. Pump = 20° F (-7° C).

MINIMUM BASE OIL VISCOSITY — 3300SSU (715cST) @ 100°F (38°C).

THICKENER — Lithium & soap/polymer.

CENTRIFUGE SEPARATION CHARACTERISTICS — ASTM #D4425 (Centrifuge Test) — K36 = 2/24 max., very high resistance to centrifuging.

NLGI GRADE (ASTM D-217) — 1/2

MINIMUM DROPPING POINT — with 60 stroke worked penetration value in the range of 320 to 365 — 350°F (177°C) min.

MINIMUM TIMKEN O.K. LOAD — 40 lbs.

ADDITIVES — Rust and oxidation inhibitors that do not corrode steel or swell or deteriorate synthetic seals.

Packaging

14 oz. (0,4 kg) CARTRIDGES — Individual or case lots of 10 or 60

35 lb. (16 kg) PAIL, 120 lb. (54 kg) KEG & 400 lb. (181 kg) DRUMS.

General Purpose Grease

ANNUAL LUBRICATION — The following specifications and lubricants for general purpose grease apply to Falk Steelflex couplings that are lubricated annually and operate within ambient temperatures of 0°F to 150°F (–18°C to 66°C). For temperatures beyond this range (see Table 1), consult Falk.

If a coupling leaks grease, is exposed to extreme temperatures, excessive moisture or experiences frequent reversals, more frequent lubrication may be required.

General Purpose Greases Meeting Falk Specifications

Lubricants listed below are typical products only and should not be construed as exclusive recommendations.

TABLE 1 — General Purpose Greases ★

Ambient Temperature Range	0°F to 150°F (-18°C to 66°C)	-30°F to 100°F (-34°C to 38°C)
Manufacturer	**Lubricant †**	**Lubricant †**
Amoco Oil Co. BP Oil Co. Chevron U.S.A. Inc. Citgo Petroleum Corp.	Amolith Grease #2 Energrease LS-EP2 Dura-Lith EP2 Prem. Lithium Grease EP2	Amolith Grease #2 Energrease LS-EP1 Dura-Lith EP1 Prem. Lithium Grease EP1
Conoco Inc. Exxon Company, USA E.F. Houghton & Co. Imperial Oil Ltd.	EP Conolith Grease #2 Unirex N2 Cosmolube 2 Unirex N2L	EP Conolith Grease #2 Unirex N2 Cosmolube 1 Unirex N2L
Kendall Refining Co. Keystone Div. (Pennwalt) Lyondell Petrochemical (ARCO) Mobil Oil Corp.	Lithium Grease L421 81 EP-2 Litholine H EP 2 Grease Mobilux EP111	Lithium Grease L421 81 EP-1 Litholine H EP 2 Grease Mobilith AW1
Petro-Canada Products Phillips 66 Co. Shell Oil Co. Shell Canada Ltd.	Multipurpose EP2 Philube Blue EP Alvania Grease 2 Alvania Grease 2	Multipurpose EP1 Philube Blue EP Alvania Grease 2 Alvania Grease 2
Sun Oil Co. Texaco Lubricants Unocal 76 (East & West) Valvoline Oil Co.	Ultra Prestige 2EP Starplex HD2 Unoba EP2 Multilube Lithium EP Grease	Ultra Prestige 2EP Multifak EP2 Unoba EP2 . . .

★ Grease application or re-lubrication should be done at temperatures above 20°F (-7°C). If grease must be applied below 20°F (-7°C), consult Falk.

† Lubricants listed may not be suitable for use in the food processing industry; check with lube manufacturer for approved lubricants.

Specifications – General Purpose Coupling Lubricants

The values shown are typical and slight variations are permissible.

DROPPING POINT — 300°F (149°C) or higher.

CONSISTENCY — NLGI No. 2 with 60 stroke worked penetration value in the range of 250 to 300.

SEPARATION & RESISTANCE — Low oil separation rate and high resistance to separation from centrifuging.

LIQUID CONSTITUENT — Possess good lubricating properties ... equivalent to a high quality, well refined petroleum oil.

INACTIVE — Must not corrode steel or cause swelling or deterioration of synthetic seals.

CLEAN — Free from foreign inclusions.

INSTALLATION OF TYPE T31 STEELFLEX TAPERED GRID COUPLINGS

Installation

Only standard mechanics tools, wrenches, a straight edge and feeler gauges are required to install Falk Steelflex couplings. Clean all parts using a non-flammable solvent. Check hubs, shafts and keyways for burrs. Coupling Sizes 1020T thru 1090T are generally furnished for CLEARANCE FIT with setscrew over the keyway. Sizes 1100T and larger are furnished for an INTERFERENCE FIT without a setscrew.

CLEARANCE FIT HUBS — Clean all parts using a non-flammable solvent. Check hubs, shafts and keyways for burrs. Do not heat clearance fit hubs. Install keys, mount hubs with flange face flush with shaft ends or as otherwise specified and tighten setscrews.

INTERFERENCE FIT HUBS — Furnished without setscrews. Heat hubs to a maximum of 275°F (135°C) using an oven, torch, induction heater or an oil bath. To prevent damage DO NOT heat hubs beyond a maximum temperature of 400°F(205°C).

When an oxy-acetylene or blow torch is used, use an excess acetylene mixture. Mark hubs near the center of their length in several places on hub body with a temperature sensitive crayon, 275°F (135°C) melt temperature. Direct flame towards hub bore using constant motion to avoid overheating an area.

WARNING: If an oil bath is used, the oil must have a flash point of 350°F (177°C) or higher. Do not rest hubs on the bottom of the container. Do not use an open flame in a combustible atmosphere or near combustible materials.

Heat hubs as instructed above. Mount hubs as quickly as possible with hub flange face flush with shaft end. Allow hubs to cool before proceeding. Insert setscrews (if required) and tighten.

Maximize Performance & Life

The performance and life of couplings depend largely upon how you install and maintain them. Before installing couplings, make certain that foundations of equipment to be connected meet manufacturers' requirements. Check for soft foot. The use of stainless steel shims is recommended. Measuring misalignment and positioning equipment within alignment tolerances is simplified with an alignment computer. These calculations can also be done graphically or mathematically.

Alignment is shown using spacer bar and straight edge. This practice has proven to be adequate for many industrial applications. However, for superior final alignment, the use of dial indicators (see Manual 458-834 for instructions), lasers, alignment computers or graphical analysis is recommended.

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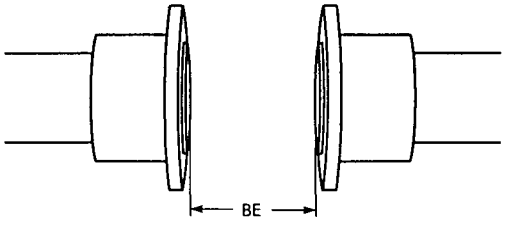
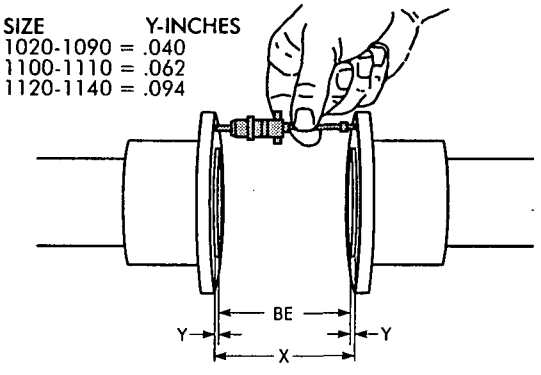
Installation of Spacer Assembly

1— Mount Shaft Hubs

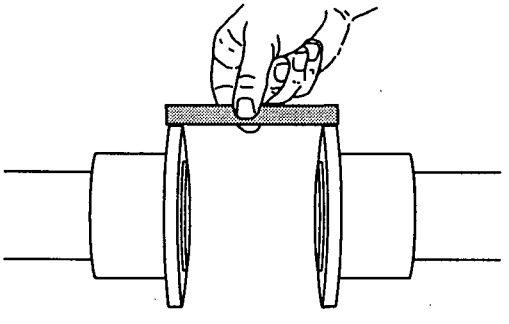


Lock out starting switch of prime mover. Heat interference fit hubs as previously instructed. Mount shaft hubs on their respective shafts so that hub face is flush with the end of the shaft unless otherwise indicated. Position drives for approximate distance between shaft ends with minimum angular and offset misalignment.



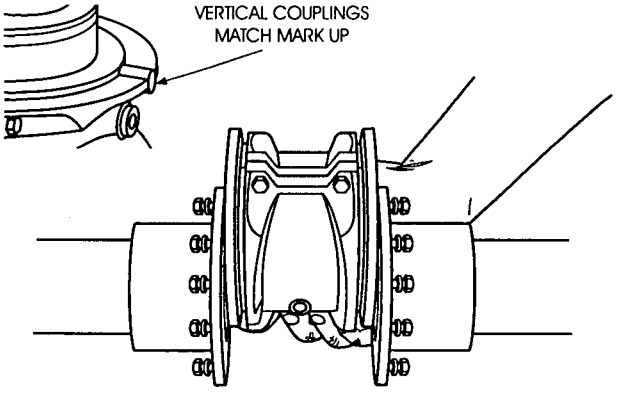
2 — Angular Alignment

Determine Dimension (X = BE + 2Y) and then take micrometer readings between flange faces at 90° intervals. Refer to Table 2 on page 5 for "BE" dimension tolerance. If a dial indicator is used, place the indicator on one shaft hub and rotate that hub 360° while taking readings from the other hub face. The difference in minimum and maximum measurements must not exceed the ANGULAR installation limits specified in Table 2 on Page 5.



3 — Offset Alignment

Align so that a straight edge rests squarely (or within the limits specified in Table 2) on both hubs as shown above and also at 90° intervals. Check with feelers. The clearance must not exceed the PARALLEL OFFSET installation limits specified in Table 2 on Page 5. If a dial indicator is used, place it on one shaft hub and rotate that hub through 360° while taking readings from the flange outside diameter of the other hub. The TIR reading must not exceed two times the installation limits specified in Table 2. Tighten all foundation bolts and repeat Steps 2 and 3. Realign coupling if necessary.

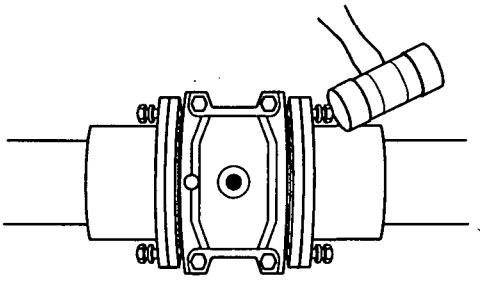


4 — Insert Steelflex Spacer

Insert fasteners as shown – do not allow them to protrude beyond flange face. Remove pipe plugs to vent and compress spacer to eliminate its gap. Then insert between shaft hubs. Carefully engage the hub registers and then alternately tighten fasteners. Torque to specifications in Table 2 on Page 5. Replace pipe plugs.

Removal of Spacer Assembly

Remove Spacer Assembly



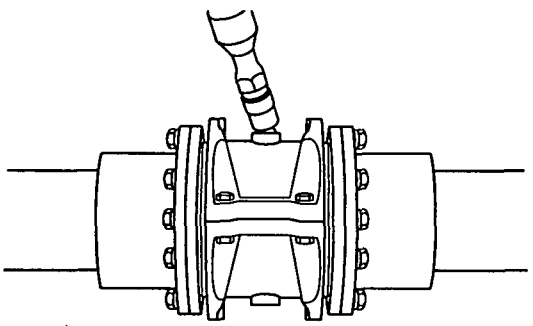
Remove pipe plugs and all but two fasteners opposite each other in each hub. Loosen these about one-quarter inch and tap them with a mallet to disengage Steelflex spacer from the shaft hubs. Remove fasteners and spacer.

ANNUAL MAINTENANCE

For extreme or unusual operating conditions, check coupling more frequently.

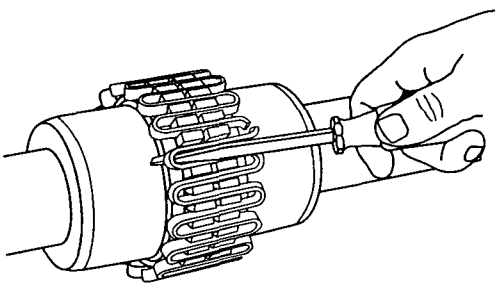
1. Check alignment per steps on Page 3. If the maximum operating misalignment limits are exceeded, realign the coupling to the recommended installation limits. See Table 2 on Page 5 for installation and operating alignment limits.
2. Check tightening torques of all fasteners.
3. Inspect seal ring and gasket to determine if replacement is required. If leaking grease, replace.
4. When connected equipment is serviced, disassemble the coupling and inspect for wear. Replace worn parts. Clean grease from coupling and repack with new grease. Install coupling using new gasket as instructed in this manual.

Periodic Lubrication



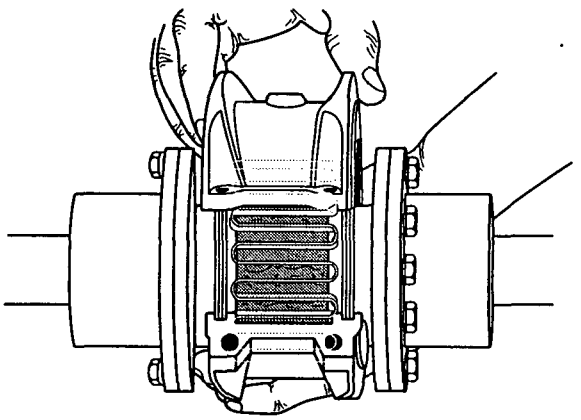
The required frequency of lubrication is directly related to the type of lubricant chosen, and the operating conditions. Steelflex couplings lubricated with common industrial lubricants, such as those shown in Table 1, should be relube annually. The use of Falk Long Term Grease (LTG) will allow relube intervals to be extended to beyond five years. When relubing, remove both lube plugs and insert lube fitting. Fill with recommended lubricant until an excess appears at the opposite hole. **CAUTION:** *Make certain all plugs have been inserted after lubricating.*

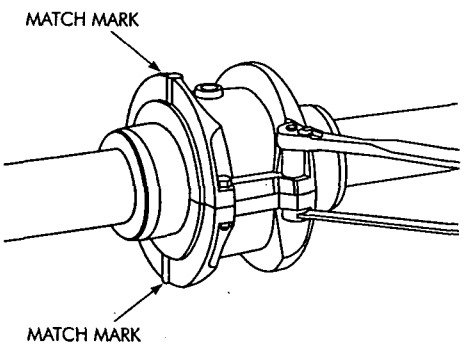
Coupling Disassembly & Grid Removal



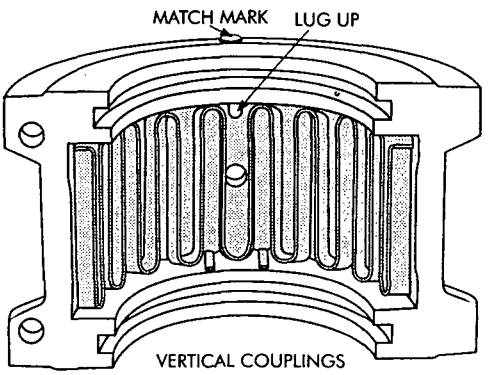
Whenever it is necessary to disconnect the coupling, remove the cover halves and grid. A round rod or screwdriver that will conveniently fit into the open loop ends of the grid is required. Begin at the open end of the grid section and insert the rod or screwdriver into the loop ends. Use the teeth adjacent to each loop as a fulcrum and pry the grid out radially in even, gradual stages, proceeding alternately from side to side.

Pack with Grease & Assemble Covers





Pack the spaces between and around the grid with as much lubricant as possible and wipe off excess flush with top of grid. Position seals on hubs to line up with grooves in cover. Position gaskets on flange of lower cover half and assemble covers so that the match marks are on the same side (see above). If shafts are not level (horizontal) or coupling is to be used vertically, assemble cover halves with the lug and match mark UP or on



the high side. Push gaskets in until they stop against the seals and secure cover halves with fasteners, tighten to torque specified in Table 2 on Page 5. Make sure gaskets stay in position during tightening of fasteners. **CAUTION:** *Make certain lube plugs are installed before operating.*

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INSTALLATION & ALIGNMENT DATA

Maximum life and minimum maintenance for the coupling and connected machinery will result if couplings are accurately aligned. Coupling life expectancy between initial alignment and maximum operating limits is a function of load, speed and lubrication. Maximum operating values listed in Table 2 are based on cataloged allowable rpm.

Values listed are based upon the use of standard coupling components, standard assemblies and cataloged allowable speeds. Values may be combined for an installation or operating condition.

Example: 1060T max. operating misalignment is .016" parallel plus .018" angular.

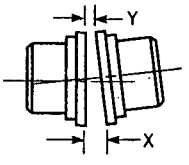
NOTE: For applications requiring greater misalignment, refer application details to the Factory.

Angular misalignment is dimension X minus Y as illustrated below.

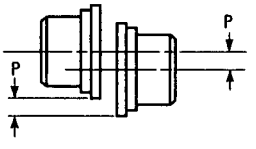
Parallel misalignment is distance P between the hub center lines as illustrated below.

End float (with zero angular and parallel misalignment) is the axial movement of the hubs(s) within the cover(s) measured from "O" gap.

ANGULAR MISALIGNMENT



PARALLEL OFFSET MISALIGNMENT



END FLOAT

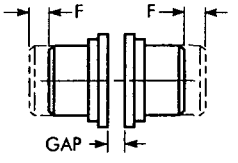


TABLE 2 — Misalignment & End Float

SIZE	Installation Limits						Operating Limits						Fastener Tightening Torque Values			Allow Speed (rpm)	Lube Wt	
	Parallel Offset-P		Angular (x-y)		Hub Gap ★ ± 10%		Parallel Offset-P		Angular (x-y)		End Float Physical Limit (Min) 2 x F		Cover		Flange			
	Max Inches	Max mm	Max Inches	Max mm	Inches	mm	Max Inches	Max mm	Max Inches	Max mm	Inches	mm	Inch Series Fasteners (lb-in)	Metric Fasteners (Nm)	Inch Series Fasteners (lb-in)		lb	kg
1020T	.006	.15	.003	.08	.188	5	.012	.30	.010	.25	.210	5.33	100	11.3	120	3600	.06	.03
1030T	.006	.15	.003	.08	.188	5	.012	.30	.012	.30	.198	5.03	100	11.3	120	3600	.09	.04
1040T	.006	.15	.003	.08	.188	5	.012	.30	.013	.33	.211	5.36	100	11.3	120	3600	.12	.05
1050T	.008	.20	.004	.10	.188	5	.016	.41	.016	.41	.212	5.38	200	23.6	250	3600	.15	.07
1060T	.008	.20	.005	.13	.188	5	.016	.41	.018	.46	.258	6.55	200	23.6	440	3600	.19	.09
1070T	.008	.20	.005	.13	.188	5	.016	.41	.020	.51	.259	6.58	200	23.6	440	3600	.25	.11
1080T	.008	.20	.006	.15	.188	5	.016	.41	.024	.61	.288	7.32	200	23.6	825	3600	.38	.17
1090T	.008	.20	.007	.18	.188	5	.016	.41	.028	.71	.286	7.26	200	23.6	1640	3600	.56	.25
1100T	.010	.25	.008	.20	.250	6	.020	.51	.033	.84	.429	10.90	312	35	2940	2440	.94	.43
1110T	.010	.25	.009	.23	.250	6	.020	.51	.036	.91	.429	10.90	312	35	2940	2250	1.1	.51
1120T	.011	.28	.010	.25	.375	10	.022	.56	.040	1.02	.556	14.12	650	73	4560	2025	1.6	.74
1130T	.011	.28	.012	.30	.375	10	.022	.56	.047	1.19	.551	14.00	650	73	6800	1800	2.0	.91
1140T	.011	.28	.013	.33	.375	10	.022	.56	.053	1.35	.571	14.50	650	73	8900	1650	2.5	1.14

★ "BE" dimension tolerance is ±10% of hub gap listed.

TABLE 3 — Coupling Cover Fastener Identification

SIZE	Inch Series Fasteners				Metric Fasteners	
	Old Style		New Style			
1020-1070T10		SAE Grade 8 †		SAE Grade 8		Property Class 10.9
1080-1090T10		SAE Grade 8		SAE Grade 8		Property Class 10.9
1100-1140T10		SAE Grade 5		SAE Grade 5		Property Class 8.8

† Older style covers, Sizes 1020T10 thru 1070T10 must utilize socket head cap screws and locknuts held by the cover.

PARTS IDENTIFICATION

All coupling parts have identifying part numbers as shown below. Parts are interchangeable between the 10 series and 1000 series spacer couplings. However, to utilize the higher 1000 series ratings, the 1000T – Blue Grid, Spacer Hubs, Shaft Hubs and Hardware must be used. When ordering parts, always SPECIFY SIZE and TYPE. Sizes 80 through 140T10 covers have been manufactured with two and three ribs; DO NOT mix these cover halves.

PARTS INTERCHANGEABILITY

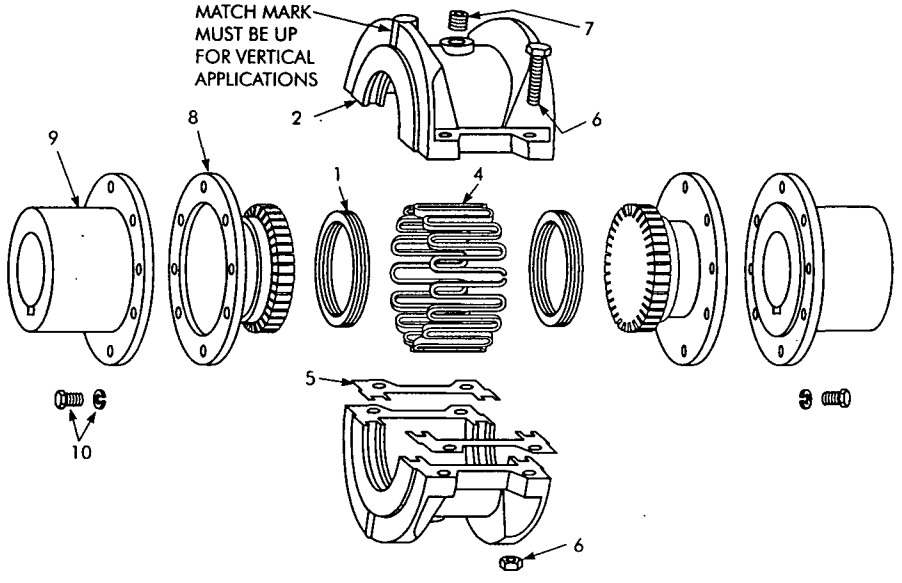
Parts are interchangeable between Sizes 20T and 1020T, 30T and 1030T, etc. except as noted.

GRIDS — Size 1020T thru 1140T Steelflex couplings use blue grids. Older models, 20T thru 140T, use orange grids.

CAUTION: *Blue grids may be used in all applications, but DO NOT substitute orange grids for blue.*

COVERS — ***CAUTION:*** DO NOT mix cover halves of different designs. Sizes 1020T thru 1070T10 covers have been manufactured in several different two-rib designs and 80T thru 140T covers have been manufactured with two and three ribs.

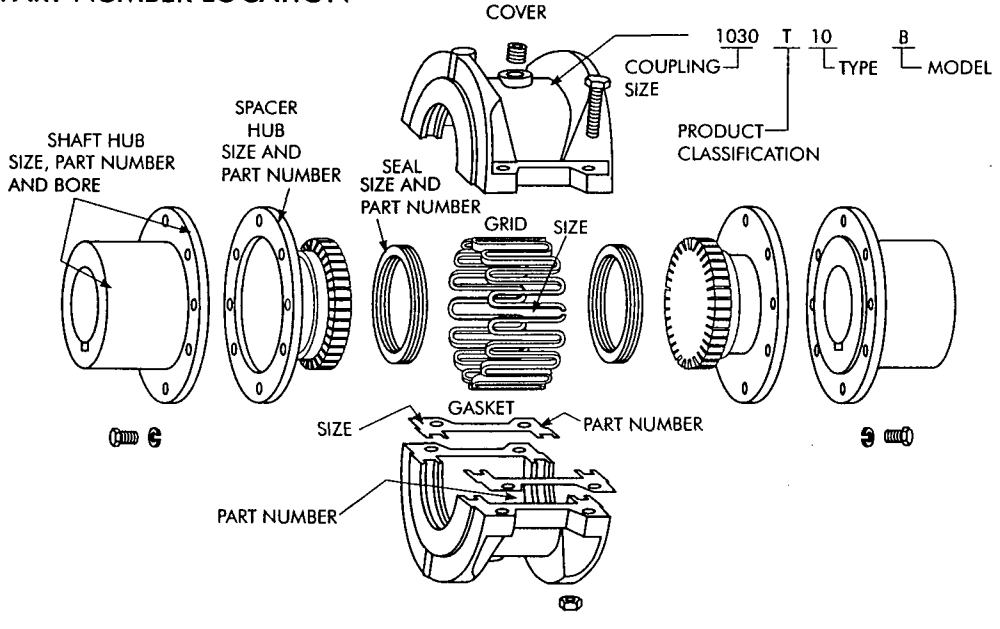
HARDWARE — Older style covers, Sizes 1020T10 thru 1070T10, utilized socket head cap screws with captured locknuts. The new style covers use hex head cap screws (either inch or metric) and unrestrained locknuts. Specify either inch series SOCKET head or inch or metric series HEX head cap screws when ordering replacement parts.



PART NUMBERS

1. Seal (T10)
2. Cover (T10)
4. Grid
5. Gasket (T10)
6. Fasteners (T10) — Coupling may be supplied with one set each of inch series fasteners and metric fasteners.
7. Lube Plug
8. T31 Spacer Hub (Specify Length)
9. Shaft Hub
10. Flange Fastener

PART NUMBER LOCATION



ORDER INFORMATION

1. Identify part(s) required by name above.
2. Furnish the following information.

   EXAMPLE:
   Coupling Size: 1030
   Coupling Type: T31
   Model: B
   Bore: 1.375
   Keyway: .375 x .187
   Distance Between Shaft Ends (BE): 5.0
3. Price parts from appropriate Price List and discount sheet.

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MILWAUKEE

Application with Straight Bores

SIZES 1210 thru 1260

STEELFLEX COUPLINGS

Tapered Grid

Type T10

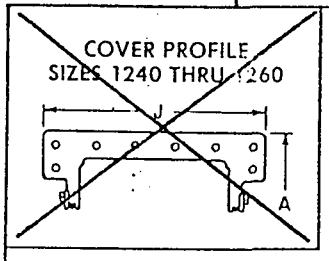
Subject to change without notice

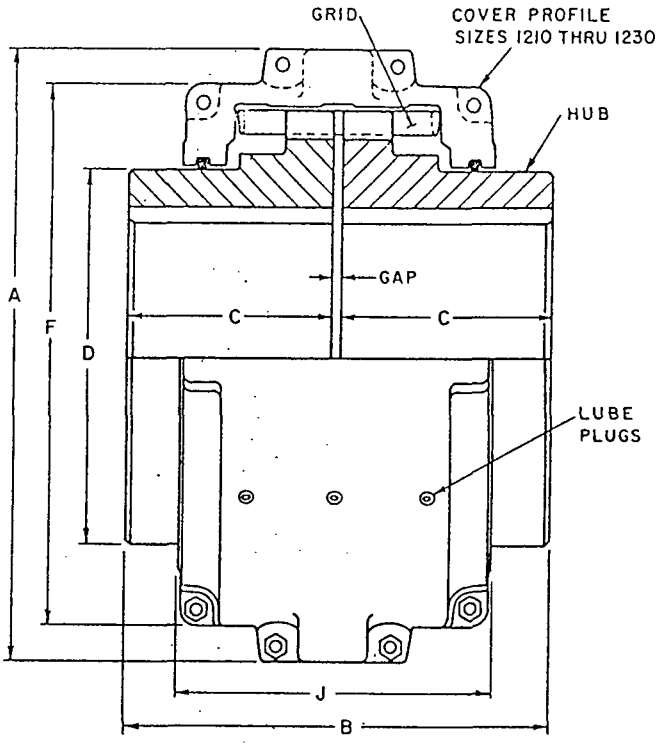
425-115A

DIMENSIONS

January 1984

Supersedes 425-115





SIZE ★	HP per 100 rpm	Allow. Speed rpm	Max* Bore (Rect. Key)	Min Bore‡	Cplg Wt With No Bore-lb	Lube Wt lb	DIMENSIONS—INCHES A	B	C	D	F	J	Gap	SIZE ★
~~1210T~~	~~3175~~	~~820~~	~~14.000~~	~~7.000~~	~~3140~~	~~23.2~~	~~33.25~~	~~24.50~~	~~12.00~~	~~21.00~~	~~29.56~~	~~17.00~~	~~.500~~	~~1210T~~
1220T	4290	730	15.000	8.000	3935	35.4	36.25	26.10	12.80	22.50	32.37	19.30	.500	1220T
~~1230T~~	~~5555~~	~~680~~	~~16.000~~	~~8.000~~	~~4997~~	~~53.0~~	~~39.50~~	~~27.70~~	~~13.60~~	~~24.00~~	~~35.62~~	~~21.50~~	~~.500~~	~~1230T~~
1240T	7140	630	17.000	10.000	6504	74.5	42.80	29.50	14.50	25.50	...	25.50	.500	1240T
1250T	9520	580	18.500	10.000	8450	110.5	46.50	32.10	15.80	28.00	...	27.50	.500	1250T
1260T	11900	540	20.000	10.000	10322	148.1	49.64	34.50	17.00	30.00	...	30.00	.500	1260T

★ Dimensions are for reference only and are subject to change without notice unless certified. Size 1210 thru 1230T10 covers are cast aluminum alloy; 1240 thru 1260T10 are fabricated steel.

* Maximum bores are LESS than shown above for hubs with an INTERFERENCE FIT and a set screw OVER the keyway; refer to Factory for details. Couplings for the above Max Bores are furnished for INTERFERENCE FIT without a set screw. Falk standards apply unless otherwise specified.

‡ Minimum bore is the smallest bore to which a RSB (rough stock bore) hub can be bored. Rough stock bore hubs have a through hole that will permit remachining of the hubs to the minimum bores specified.

SIZE & TYPE	ONE HUB Bore	Keyway	Overhang	Fitted To	Fitted By	OTHER HUB Bore	Keyway	Overhang	Fitted To	Fitted By
1220T10	10.4935 10.4955	2½ x ⅞	—	LSS	FALK	9.1815 9.1835	2½ x ⅞	—	FALK SOS PINION	FALK

~~PRELIMINARY~~ CERTIFIED PRINT OF FALK COUPLING FOR ..A-C EQUIPMENT SERVICES..... ~~CO.~~

DRAWN J. LAFOND	DATE	9-6-01	
CHECKED C.S.	NO. REQ'D.	(1) ONE	
DRAWING NO. 425-115A	FOR UNIT ON M.O.	01-067913-01	
	P.O.	44940B	
	COUPLING M.O.	01-067913-04	

How To Use This Manual

This manual provides detailed instructions on maintenance, lubrication, installation, and parts identification. Use the table of contents below to locate required information.

Table of Contents

Introduction . . . . . Page 1
Lube Fittings . . . . . Page 1
Limited End Float. . . . . Page 1
Lubrication . . . . . Pages 1-2
Installation & Alignment Instructions . . . . . Pages 2-4
Annual Maintenance, Relube & Disassembly . . . . . Page 4
Installation & Alignment Data . . . . . Page 5
Parts Identification & Parts Interchangeability. . . . . Page 6

CAREFULLY FOLLOW THE INSTRUCTIONS IN THIS MANUAL FOR OPTIMUM PERFORMANCE AND TROUBLE FREE SERVICE.

INTRODUCTION

This manual applies to Sizes 1150T thru 1260T and 150T thru 260T Falk Steelflex Tapered Grid Couplings. Unless otherwise stated, information for Sizes 1020T thru 1140T applies to Sizes 150T thru 260T respectively, e.g. 1150T = 150T, 1260T = 260T, etc. These couplings are designed to operate in either the horizontal or vertical position without modification.

The performance and life of the couplings depend largely upon how you install and service them. Carefully follow the instructions in this manual for optimum performance and trouble free service.

CAUTION: Consult applicable local and national safety codes for proper guarding of rotating members. Observe all safety rules when installing or servicing couplings.

WARNING: Lockout starting switch of prime mover and remove all external loads from drive before installing or servicing couplings.

LUBE FITTINGS

Cover halves have $^3/_8$ NPT lube holes. Use a standard grease gun and lube fitting as instructed on Page 4.

LIMITED END FLOAT

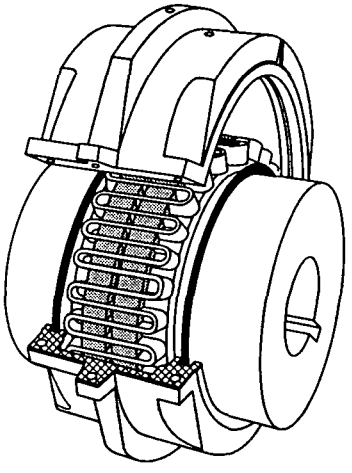
When electric motors, generators, engines, compressors and other machines are fitted with sleeve or straight roller bearings, limited axial end float kits are recommended for protecting the bearings. Falk Steelflex couplings are easily modified to limit end float; refer to Manual 428-820 for instructions.

LUBRICATION

Adequate lubrication is essential for satisfactory operation. Page 2 provides a list of typical lubricants and specifications for general purpose and long term greases. Because of its superior lubricating characteristics and low centrifuge properties, Falk Long Term Grease (LTG) is highly recommended.

The use of general purpose grease requires re-lubrication of the coupling at least annually.

TYPE T10 STEELFLEX COUPLING



Long Term Grease (LTG)

The high centrifugal forces encountered in couplings separate the base oil and thickener of general purpose greases. Heavy thickener, which has no lubrication qualities, accumulates in the grid-groove area of Steelflex couplings resulting in premature hub or grid failure unless periodic lubrication cycles are maintained.

Falk Long Term Grease (LTG) was developed specifically for couplings. It resists separation of the oil and thickener. The consistency of Falk LTG changes with operating conditions. As manufactured it is an NLGI #1/2 grade. Working of the lubricant under actual service conditions causes it to become semifluid while the grease near the seals will set to a heavier grade, helping to prevent leakage.

LTG is highly resistant to separation, easily out performing all other lubricants tested. The resistance to separation allows the lubricant to be used for relatively long periods of time.

Steelflex couplings initially lubricated with LTG will not require re-lubrication until the connected equipment is stopped for servicing. If a coupling leaks grease, is exposed to extreme temperatures, excessive moisture, or experiences frequent reversals, more frequent lubrication may be required.

Although LTG grease is compatible with most other coupling greases, the mixing of greases may dilute the benefits of LTG.

USDA Approval

LTG has the United States Department of Agriculture Food Safety & Inspection Service approval for applications where there is no possibility of contact with edible products. (H-2 ratings).

CAUTION: Do not use LTG in bearings.

Specifications — Falk LTG

The values shown are typical and slight variations are permissible.

AMBIENT TEMPERATURE RANGE — –20°F (–29°C) to 250°F (121°C). Min. Pump = 20°F (–7°C).

MINIMUM BASE OIL VISCOSITY — 3300SSU (715cST) @ 100°F (38°C).

THICKENER — Lithium & soap/polymer.

CENTRIFUGE SEPARATION CHARACTERISTICS — ASTM #D4425 (Centrifuge Test) — K36 = 2/24 max., very high resistance to centrifuging.

NLGI GRADE (ASTM D-217) — $^1/_2$

MINIMUM DROPPING POINT — with 60 stroke worked penetration value in the range of 320 to 365 — 350°F (177°C) min.

MINIMUM TIMKEN O.K. LOAD — 40 lbs.

ADDITIVES — Rust and oxidation inhibitors that do not corrode steel or swell or deteriorate synthetic seals.

Packaging

14 oz. (0,4 kg) CARTRIDGES — Individual or case lots of 10 or 60.

35 lb. (16 kg)PAIL, 120 lb. (54 kg) KEG & 400 lb. (181 kg) DRUMS.

General Purpose Grease

Annual Lubrication — The following specifications and lubricants for general purpose grease apply to Falk Steelflex couplings that are lubricated annually and operate within ambient temperatures of 0°F to 150°F (–18°C to 66°C). For temperatures beyond this range (see Table 1), consult the Factory.

If a coupling leaks grease, is exposed to extreme temperatures, excessive moisture or experiences frequent reversals, more frequent lubrication may be required.

Specifications — General Purpose Coupling Lubricants

The values shown are typical and slight variations are permissible.

DROPPING POINT — 300°F (149°C) or higher.

CONSISTENCY — NLGI No. 2 with 60 stroke worked penetration value in the range of 250 to 300.

SEPARATION AND RESISTANCE — Low oil separation rate and high resistance to separation from centrifuging.

LIQUID CONSTITUENT — Possess good lubricating properties ... equivalent to a high quality, well refined petroleum oil.

INACTIVE — Must not corrode steel or cause swelling or deterioration of synthetic seals.

CLEAN — Free from foreign inclusions.

General Purpose Greases Meeting Falk Specifications

Lubricants listed below are typical products only and should not be construed as exclusive recommendations.

TABLE 1 — General Purpose Greases ★

Ambient Temperature Range	0°F to 150°F (-18°C to 66°C)	-30°F to 100°F (-34°C to 38°C)
Manufacturer	**Lubricant †**	**Lubricant †**
Amoco Oil Co.	Amolith Grease #2	Amolith Grease #2
BP Oil Co.	Energrease LS-EP2	Energrease LS-EP1
Chevron U.S.A. Inc.	Dura-Lith EP2	Dura-Lith EP1
Citgo Petroleum Corp.	Premium Lithium Grease EP2	Premium Lithium Grease EP1
Conoco Inc.	EP Conolith Grease #2	EP Conolith Grease #2
Exxon Company, USA	Unirex N2	Unirex N2
E.F. Houghton & Co.	Cosmolube 2	Cosmolube 1
Imperial Oil Ltd.	Unirex N2L	Unirex N2L
Kendall Refining Co.	Lithium Grease L421	Lithium Grease L421
Keystone Div. (Pennwalt)	81 EP-2	81 EP-1
Lyondell Petrochemical (ARCO)	Litholine H EP 2 Grease	Litholine H EP 2 Grease
Mobil Oil Corp.	Mobilux EP111	Mobilith AW1
Petro-Canada Products	Multipurpose EP2	Multipurpose EP1
Phillips 66 Co.	Philube Blue EP	Philube Blue EP
Shell Oil Co.	Alvania Grease 2	Alvania Grease 2
Shell Canada Ltd.	Alvania Grease 2	Alvania Grease 2
Sun Oil Co.	Ultra Prestige 2EP	Ultra Prestige 2EP
Texaco Lubricants	Starplex HD2	Multifak EP2
Unocal 76 (East & West)	Unoba EP2	Unoba EP2
Valvoline Oil Co.	Multilube Lithium EP Grease	...

★ Grease application or re-lubrication should be done at temperatures above 20°F (–7°C). If grease must be applied below 20°F (–7°C), consult The Falk Corporation.

† Lubricants listed may not be suitable for use in the food processing industry; check with lube manufacturer for approved lubricants.

INSTALLATION OF TYPE T10 STEELFLEX TAPERED GRID COUPLINGS

Installation

Only standard mechanics tools, wrenches, a straight edge and feeler gauges are required to install Falk Steelflex couplings. Clean all parts using a non-flammable solvent. Check hubs, shafts and keyways for burrs.

INTERFERENCE FIT HUBS — Furnished without setscrews. Heat hubs to a maximum of 275°F (135°C) using an oven, torch, induction heater or an oil bath. To prevent damage DO NOT heat hubs beyond a maximum temperature of 400°F (205°C).

When an oxy-acetylene or blow torch is used, use an excess acetylene mixture. Mark hubs near the center of their length in several places on hub body with a temperature sensitive crayon, 275°F (135°C) melt temperature. Direct flame towards hub bore using constant motion to avoid overheating an area.

WARNING: If an oil bath is used, the oil must have a flash point of 350°F (177°C) or higher. Do not rest hubs on the bottom of the container. Do not use an open flame in a combustible atmosphere or near combustible materials.

Heat hubs as instructed above. Mount hubs as quickly as possible with hub flange face flush with shaft end. Allow hubs to cool before proceeding. Insert setscrews (if required) and tighten.

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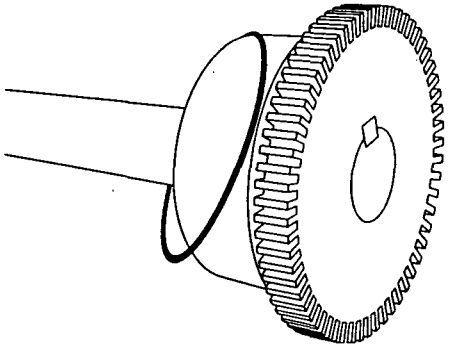
Maximize Performance And Life

The performance and life of couplings depend largely upon how you install and maintain them. Before installing couplings, make certain that foundations of equipment to be connected meet manufacturers' requirements. Check for soft foot. The use of stainless steel shims is recommended. Measuring misalignment and positioning equipment within alignment tolerances is simplified with an alignment computer. These calculations can also be done graphically or mathematically.

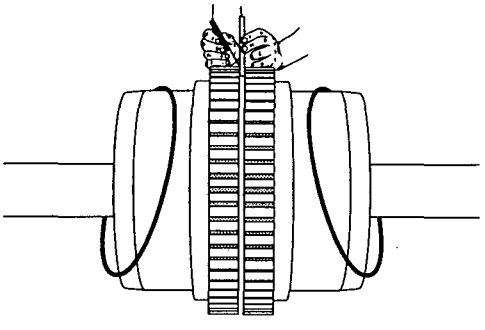
Alignment is shown using spacer bar and straight edge. This practice has proven to be adequate for many industrial applications. However, for superior final alignment, the use of dial indicators (see Manual 458-834 for instructions), lasers, alignment computers or graphical analysis is recommended.

1— Mount Seals And Hubs



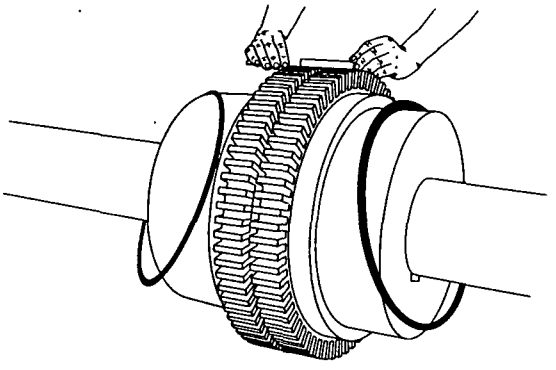
Lock out starting switch of prime mover. Clean all metal parts using a non-flammable solvent. Lightly coat seals with grease and place on shafts BEFORE mounting hubs. Heat hubs as previously instructed. Seal keyways to prevent leakage. Mount hubs on their respective shafts so the hub face is flush with the end of its shaft unless otherwise indicated.

2 — Gap and Angular Alignment



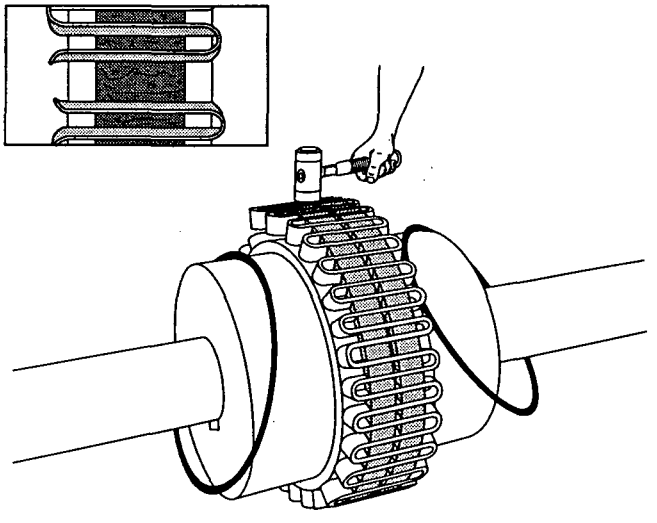
Use a spacer bar equal in thickness to the gap specified in Table 2, Page 5. Insert bar as shown above, to same depth at 90° intervals and measure clearance between bar and hub face with feelers. The difference in minimum and maximum measurements must not exceed the ANGULAR INSTALLATION limits specified in Table 2.

3 — Offset Alignment



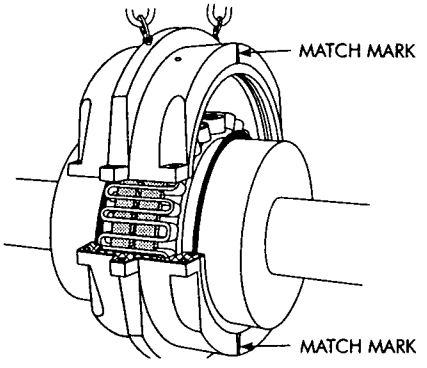
Align so that a straight edge rests squarely (or within the limits specified in Table 2) on both hubs as shown above and also at 90° intervals. Check with feelers. The clearance must not exceed the PARALLEL OFFSET installation limits specified in Table 2. Tighten all foundation bolts and repeat Steps 2 and 3. Realign coupling if necessary. NOTE: Use a dial indicator for more accurate alignment.

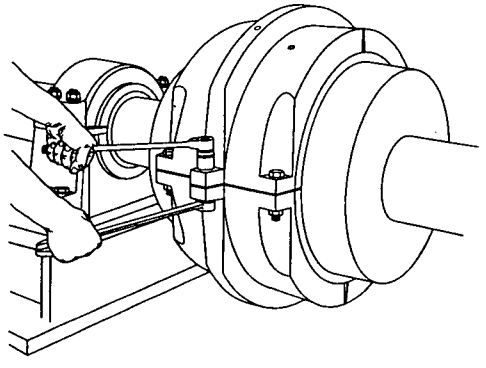
4 — Insert Grid



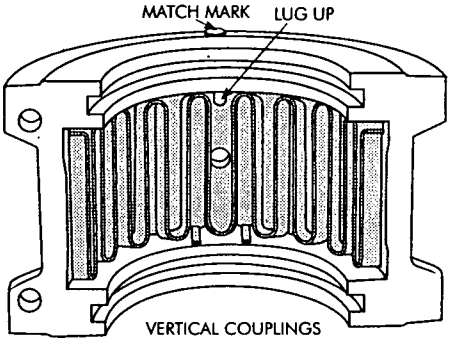
Pack gap and grooves with specified lubricant before inserting grid. When grids are furnished in two or more segments, install them so that all cut ends extend in the same direction (as detailed in the exploded view picture above); this will assure correct grid *contact with non-rotating pin in cover halves. Spread the grid* slightly to pass over the coupling teeth and seat with a soft mallet.

5 — Pack With Grease And Assemble Covers





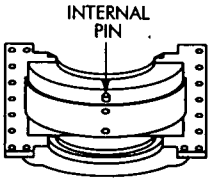
Pack the spaces between and around the grid with as much lubricant as possible and wipe off excess flush with top of grid. Position seals on hubs to line up with grooves in cover. Move lower cover half into position and block-up in place.



Sizes 1150 thru 1230 — Position gaskets on flange split and assemble upper cover half with the match mark on the same side as the lower half (see above). If shafts are not level (horizontal) or coupling is to be used vertically, assemble cover halves with the lug and match mark UP or on the high side.

Push gaskets in until they stop against the seals and secure cover halves with fasteners, tighten to torque specified in Table 2. Make sure gaskets stay in position during tightening of fasteners. ***CAUTION:*** *Make certain lube plugs are installed before operating.*

Sizes 1240 thru 1260 — Check all flange faces for burrs and coat either half with Permatex #2 or equivalent. Assemble cover half with the internal pin (see drawing at right) on the same side as the lower half. Secure cover with fasteners and tighten to torque specified in Table 2. Assemble split seal retainers so the split is 90° from the cover split. Secure with fasteners.



CAUTION: *Make certain lube plugs are installed before operating.*

ANNUAL MAINTENANCE

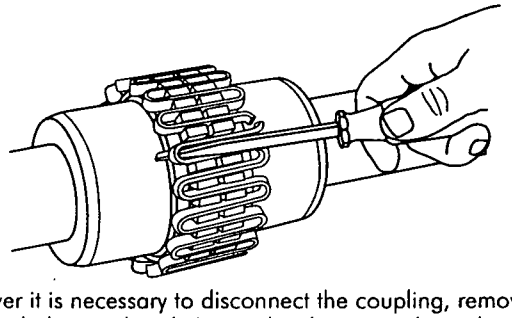
For extreme or unusual operating conditions, check coupling more frequently.

1. Check alignment per steps on Page 3. If the maximum operating misalignment limits are exceeded, realign the coupling to the recommended installation limits. See Table 2 for installation and operating alignment limits.
2. Check tightening torques of all fasteners.
3. Inspect seal ring and gasket to determine if replacement is required. If leaking grease, replace.
4. When connected equipment is serviced, disassemble the coupling and inspect for wear. Replace worn parts. Clean grease from coupling and repack with new grease. Install coupling using new gasket as instructed in this manual.

Periodic Lubrication

The required frequency of lubrication is directly related to the type of lubricant chosen, and the operating conditions. Steelflex couplings lubricated with common industrial lubricants, such as those shown in Table 1, should be relubed annually. The use of Falk Long Term Grease (LTG) will allow relube intervals to be extended to beyond five years. When relubing, remove both lube plugs and insert lube fitting. Fill with recommended lubricant until an excess appears at the opposite hole. ***CAUTION:*** *Make certain all plugs have been inserted after lubricating.*

Coupling Disassembly And Grid Removal



Whenever it is necessary to disconnect the coupling, remove the cover halves and grid. A round rod or screwdriver that will conveniently fit into the open loop ends of the grid is required. Begin at the open end of the grid section and insert the rod or screwdriver into the loop ends. Use the teeth adjacent to each loop as a fulcrum and pry the grid out radially in even, gradual stages, proceeding alternately from side to side.

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TYPE T COUPLING INSTALLATION & ALIGNMENT DATA

Maximum life and minimum maintenance for the coupling and connected machinery will result if couplings are accurately aligned. Coupling life expectancy between initial alignment and maximum operating limits is a function of load, speed and lubrication.

Values may be combined for an installation or operating condition.

Example: 1180T max. operating misalignment is .030" parallel plus .089" angular.

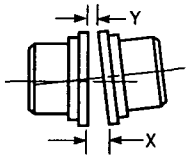
NOTE: For applications requiring greater misalignment, refer application details to the Factory.

Angular misalignment is dimension X minus Y as illustrated below.

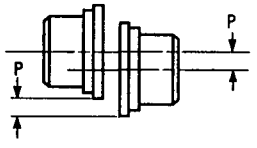
Parallel misalignment is distance P between the hub center lines as illustrated below.

End float (with zero angular and parallel misalignment) is the axial movement of the hubs(s) within the cover(s) measured from "O" gap.

ANGULAR MISALIGNMENT



PARALLEL OFFSET MISALIGNMENT



END FLOAT

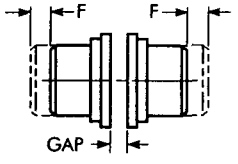


TABLE 2 — Misalignment And End Float

CPLG SIZE	Installation Limits						Operating Limits						Cover Fastener Tightening Torque Values		Allow Speed (rpm)	Lube Wt	
	Parallel Offset-P		Angular (x-y)		Normal Gap ± 10%		Parallel Offset-P		Angular (x-y)		End Float Physical Limit (Min) 2 x F						
	Max In.	Max mm	Max In.	Max mm	In.	mm	Max In.	Max mm	Max In.	Max mm	In.	mm	lb-in	Nm		lb	kg
1150T	.012	.305	.016	.406	.250	6	.024	.610	.062	1.57	.620	15.7	650	73.4	1500	4.3	1.95
1160T	.012	.305	.018	.457	.250	6	.024	.610	.070	1.79	.640	16.3	650	73.4	1350	6.2	2.81
1170T	.012	.305	.020	.508	.250	6	.024	.610	.079	2.01	.617	15.7	1300	146.9	1225	7.7	3.49
1180T	.015	.381	.022	.559	.250	6	.030	.762	.089	2.26	.717	18.2	1300	146.9	1100	8.3	3.76
1190T	.015	.381	.024	.610	.250	6	.030	.762	.097	2.46	.620	15.7	1300	146.9	1050	9.7	4.40
1200T	.015	.381	.027	.686	.250	6	.030	.762	.107	2.72	.620	15.7	2300	259.9	900	12.4	5.62
1210T	.018	.457	.029	.737	.500	13	.036	.914	.118	3.00	1.02	25.9	2300	259.9	820	23.2	10.5
1220T	.018	.457	.032	.813	.500	13	.036	.914	.129	3.28	1.15	29.2	3580	404.5	730	35.4	16.1
1230T	.019	.483	.035	.889	.500	13	.038	.965	.142	3.61	1.12	28.4	3580	404.5	680	53.0	24.0
1240T	.019	.483	.038	.965	.500	13	.038	.965	.154	3.91	1.12	28.4	5350	604.5	630	74.5	33.8
1250T	.020	.508	.042	1.07	.500	13	.040	1.02	.169	4.29	1.12	28.4	5350	604.5	580	110.5	50.1
1260T	.020	.508	.046	1.17	.500	13	.040	1.02	.183	4.64	1.01	25.7	5350	604.5	540	148.1	67.2

PARTS IDENTIFICATION

All coupling parts have identifying part numbers as shown below. Parts 3 and 4 (Hubs and Grids), are the same for both Type T10 and T20 couplings. All other coupling parts are unique to Type T10. When ordering parts, always SPECIFY SIZE and TYPE shown on the COVER.

PARTS INTERCHANGEABILITY

Parts are interchangeable between Sizes 20T and 1020T, 30T and 1030T, etc. except as noted.

GRIDS — Size 1150T thru 1260T Steelflex couplings use blue grids. Older models, 150T thru.260T, use orange grids.

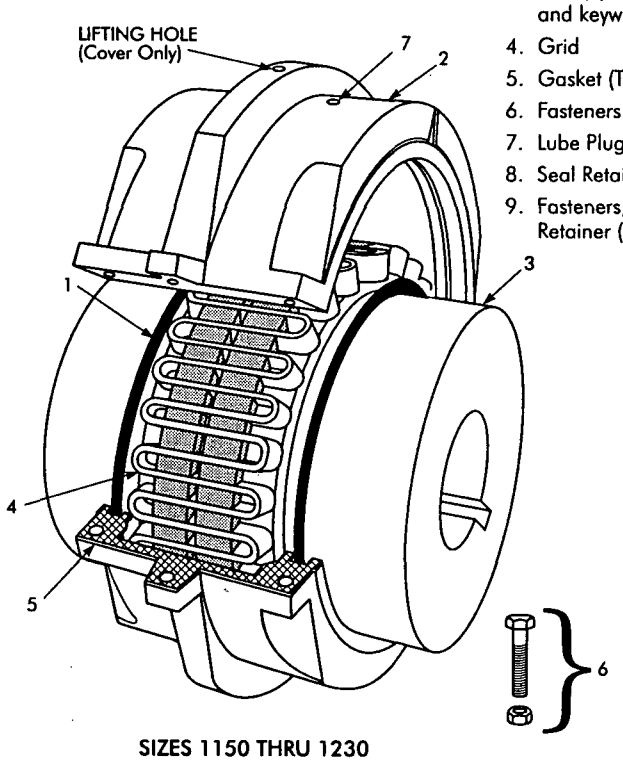
CAUTION: *Blue grids may be used in all applications, but DO NOT substitute orange grids for blue.*

CAUTION: *DO NOT mix cover halves of different designs.*

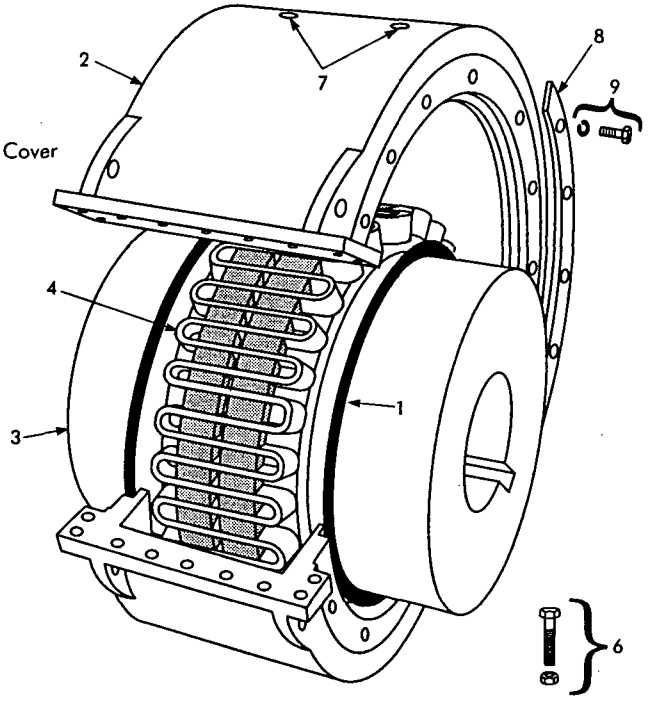
WARNING: *Mixing grid coupling components from different manufacturers may cause premature failure and personal or property damage from flying debris.*

PART NUMBERS

1. Seal (T10)
2. Cover (T10)
3. Hub (Specify bore and keyway)
4. Grid
5. Gasket (T10)
6. Fasteners (T10) — Cover
7. Lube Plug
8. Seal Retainer
9. Fasteners, Seal Retainer (T10)



SIZES 1150 THRU 1230



SIZES 1240 THRU 1260

ORDER INFORMATION

1. Identify part(s) required by name above.
2. Furnish the following information.

   EXAMPLE:

   Coupling Size: 1150
   Coupling Type: T10
   Bore: 7.500
   Keyway: 1.75 x .75
   Bore: 8.000
   Keyway: 2.00 x .75
3. Contact your Falk Distributor or Falk for price and availability.

The Falk Corporation, P.O. Box 492, Zip 53201-0492
3001 W. Canal St., Zip 53208-4200, Milwaukee, WI USA Telephone: 414-342-3131
Fax: 414-937-4359 e-mail: falkinfo@falkcorp.com web: www.falkcorp.com

Section 6 – Motor and Brake

DIETZ
ELECTRIC CO., INC.

Installation - Operation – Maintenance

Instructions

Induction Motors

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These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to Dietz Electric Co., Inc.

The contents of this instruction manual shall not become part of or modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of Dietz Electric Co., Inc. The warranty contained in the contract between the parties is the sole warranty of Dietz Electric Co., Inc. Any statements contained herein do not create new warranties or modify the existing warranty.

DIETZ

INTRODUCTION

THIS EQUIPMENT CONTAINS HAZARDOUS VOLTAGES, ROTATING PARTS AND HOT SURFACES. SEVERE PERSONAL INJURY OR PROPERTY DAMAGE CAN RESULT IF SAFETY INSTRUCTIONS ARE NOT FOLLOWED. ONLY QUALIFIED PERSONNEL SHOULD WORK ON OR AROUND THIS EQUIPMENT AFTER BECOMING THOROUGHLY FAMILIAR WITH ALL WARNINGS, SAFETY NOTICES, AND MAINTENANCE PROCEDURES CONTAINED HEREIN. THE SUCCESSFUL AND SAFE OPERATION OF THIS EQUIPMENT IS DEPENDENT UPON PROPER HANDLING, INSTALLATION, OPERATION AND MAINTENANCE.

QUALIFIED PERSON

For the purpose of this manual and product labels, qualified person is one who is familiar with the installation, construction and operation of the equipment, an the hazards involved. In addition, he has the following qualifications:

a) Is trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.

b) Is trained in the proper care and a use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.

c) Is trained in rendering first aid.

For the purpose of this manual and product labels, **DANGER**  indicates death, severe personal injury or substantial property damage will result if proper precautions are not taken.

For the purpose of this manual and product labels, **WARNING**  indicates death, severe personal injury or substantial property damage can result if proper precautions are not taken.

For the purpose of this manual and product labels, **CAUTION**  indicates minor personal injury or property damage can result if proper precautions are not taken.

INSPECTION

Care is taken at the factory to assure that the motor arrives at its destination in first class condition.If there is evidence of rough handling or damage in shipping, file a claim at once with the carrier and notify Dietz Electric Co., Inc.

Examine the outside of the motor carefully for damage, with particular attention to conduit box, fans, and covers. Inspect and tighten all hardware and accessories which may have become loosened during shipping and handling. Turn the shaft by hand to be sure that it rotates freely. If the motor has been mishandled sufficiently to break external parts, the end shield should also be removed to check for internal damage unless the motor is explosion proof. See warning below on explosion proof motors.

WARNING 

Explosion-proof motors-these motors are constructed to comply with the U.L. Label Service Procedure Manual. When repairing and reassembling a motor that has an underwriter's label, it is imperative that the unit be reinspected and:

1. All original fits and tolerance be maintained.
2. All plugs and hardware be securely fastened.
3. Any parts replacements, including hardware, be accurate duplicates of the originals.

Repair work on explosion-proof motors can only be done by the original manufacturing or U.L. certified shops. Violations of any of the above items will invalidate the significance of the U.L. Label.

STORAGE

Motors must be stored in a clean, dry, well ventilated location free from vibration and rapid or wide temperature variations. If the unit is to be stored longer than three months, consult factory. Ball bearing motors are shipped from the factory properly lubricated and ready to operate. When in storage, the motor shaft must be turned several rotations every month and the bearing relubricated every year. On non-explosion proof TEFC motors, a removable plug in the bottom of the frame or housing permits removal of accumulated moisture. Drain regularly if storage atmosphere results in formation of condensation.

INSTALLATION

Installation must be handled by qualified service or maintenance personnel. The motor foundation must rigidly support all four feet in the same plane. Place shims under the motor feet, as required, so they will not be pulled out of plane when mounting bolts are tightened. All wiring to the motor and control must be in accordance with the National Electrical Code and all local regulations. Before drive is connected, momentarily energize motor to check that direction of rotation is proper. For direct drive, accurate alignment is 0.004 inch/ft. (radius to dial indicator = one foot.)

Any change in shims requires rechecking alignment. When alignment is within limits, dowel two feet of each unit. When installing flat belt pulley, V-belt sheave, spur or helical pinion or chain drives, be certain that they are within NEMA limitations. Refer to NEMA motor and general standards, MG-1 14.07 and 14.42.

OPERATION

Repeated trial starts can overheat the motor and may result in motor burnout (particularly for across the line starting). If repeated trial starts are made, allow sufficient time between trials to permit heat to dissipate from windings and rotor to prevent overheating. Starting currents are several times running currents, and heating varies as the square of the current.

After installation is completed, but before motor is put in regular service, make an initial start as follows:

1. Check motor starting and control device connections against wiring diagrams.

2. Check voltage, phase, and frequency of line circuit (power supply) against motor nameplate.

3. If possible, remove external load (disconnect drive) and turn shaft by hand to ensure free rotation. This may have been done during installation procedure; if so, and conditions have not changed since, this check may not be necessary.

   a. If drive is disconnected, run motor at no load long enough to be certain that no unusual conditions develop. Listen and feel for excessive noise, vibration, clicking, or pounding. If present, stop motor immediately. Investigate the cause and correct before putting motor in service.

   b. If drive is not disconnected, interrupt the starting cycle after motor has accelerated to low speed. Carefully observe for unusual conditions as motor coasts to a stop.

4. When checks are satisfactory, operate at minimum load and look for unusual condition. Increase load slowly to maximum. Check unit for satisfactory operation.

CAUTION 

Guard against overloading. Overloading causes overheating and overheating means shortened insulation life. A motor subjected to a 100C temperature rise above the maximum limit for the insulation may cause the insulation life to be reduced by 50% To avoid overloading, be sure motor current does not exceed nameplate current when nameplate voltage is applied.

Electric motors operating under normal conditions become quite warm. Although some places may feel hot to the touch, the unit may be operational within limits. Use a thermocouple to measure winding temperature when there is any concern.

The total temperature, not the temperature rise, is the measure of safe operation. Investigate the operating conditions if the total temperature measured by a thermocouple placed on the winding exceeds:

230F (110C) for class "B" insulation
275F (135C) for class "F" insulation
302F (150C) for class "H" insulation

VOLTAGE REGULATION

Motors will operate successfully under the following conditions of voltage and frequency variation, but not necessarily in accordance with the standards established for operation under rated conditions:

a. When the variation in voltage does not exceed 10% above or below normal, with all phases balanced.

b. When the variation in frequency does not exceed 5% above or below normal.

c. When the sum of the voltage and frequency does not exceed 10% above or below normal (provided the frequency variation does not exceed 5%).

MAINTENANCE

Failure to properly maintain the equipment can result in severe personal injury and product failure. The instructions contained herein should be carefully reviewed, understood and followed. The following maintenance procedures should be performed regularly:

1. Bearing lubrication

2. Insulation resistance check

3. Cleaning

This checklist does not represent an exhaustive survey of maintenance steps necessary to ensure safe operation of the equipment. Particular applications may require further procedures. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to Dietz Electric Co., Inc.

Dangerous voltages are present in the equipment which can cause severe personal injury and product failure. Always de-energize and ground the equipment before maintenance. Maintenance should be performed only by qualified personnel.

The use of unauthorized parts in the repair of the equipment, tampering by unqualified personnel, or removal or alteration of guards or conduit covers will result in dangerous conditions which can cause severe personal injury or equipment damage. Follow all safety instructions contained herein.

BEARING LUBRICATION

CAUTION 

Do not lubricate motor while in operation, since excess grease will be forced through the bearings and into the motor before it will force its way out of the drain plug. Excess grease accumulation on windings reduces insulation life.

Bearing life is assured by maintaining proper alignment, proper belt or chain tension, and good lubrication at all times.

Prior to shipment, motor bearings are lubricated with the proper amount and grade to provide six months of satisfactory service under normal operation and conditions.

For best results, grease should be compounded from a polyurea base and a good grade of petroleum oil. It should be of No. 2 consistency and stabilized against oxidation. Operating temperature range should be from -150F to + 250F for class B insulation, and to +300F for class F and H. Most leading oil companies have special bearing greases that are satisfactory.

Relubricate bearings every six months (Or see chart below), as follows:

1. Stop the motor. Lock out the switch.

2. Thoroughly clean off pipe plugs and remove from housings.

3. Remove hardened grease from drains with stiff wire or rod.

4. Add grease to inlet with hand gun until small amount of new grease is forced out of drain.

5. Remove excess grease from ports, replace inlet plugs, and run motor 1/2hour before replacing drain plug.

6. Put motor back in operation.

Grease and Relubricating Instructions
To assist our customers in securing trouble-free service from electric motors, Siemens uses double shielded bearings on most NEMA size motors.

This type of bearing allows controlled migration of grease into the bearing, yet protects against overgreasing.

Replenishment grease for ball bearings should have a wide usable temperature range (-20F to +350F) and be made with a polyurea thickener and high quality oil with an NLGI #2 consistency. Chevron SRI #2 meets these requirements.

For roller bearing grease replenishment, use the grease recommended on the motor lubrication instruction plate.

Relubrication Frequency	Type of Service
6 Months	Normal-duty in relatively Clean & dry environments 8 hours a day operation.
3 Months	Heavy-duty in dirty dusty Locations, high ambients, Moisture laden atmosphere or Increased vibration levels Continous operation.

Normal Lubrication Sequence

1. Stop the motor. Lock out the switch.

2. Thoroughly clean off and remove the grease inlet and drain pipe plugs from bearing housing.

3. Remove hardened grease from drains with stiff wire or rod.

4. Add grease to inlet until a small amount of new grease is forced out drain.

5. Remove excess grease from ports, replace inlet plugs and run motor 1/2 hour before replacing drain plugs.

6. Put motor back in operation.

INSULATION RESISTANCE

Check insulation resistance periodically. Any approved method of measuring insulation resistance may be used, provided the voltage across the insulation is at a safe value for the type and condition of the insulation. A hand cranked megger of not over 500 volts is the most convenient and safest method. Standards of the Institute of Electrical and Electronics Engineers, Inc. (IEEE) recommend that the insulation resistance of stator windings at 750C, measured at 500 volts DC, after one minute should not be less than:

(Rated voltage of Machine + 1000)/1000 = Insulation Resistance In Megohms

This formula is satisfactory for most checks. For more information, see IEEE Standard No. 43, "Recommended Practice for Insulation Resistance Testing of AC Rotating Machinery".

CLEANING

WARNING 

Do not attempt to clean motor while it is operating. Contact with rotating parts can cause severe personal injury or property damage. Stop the motor and lock out switch before cleaning.

The motor exterior must be kept free of oil, dust, dirt, water, and chemicals. For fan cooled motors, it is particularly important to keep the air intake openings free of foreign material. Do not block air outlet or inlet.

On non-explosion-proof TEFC motors, a removable plug in the bottom center of the motor frame or housing permits removal of accumulated moisture. Drain regularly.

VERTICAL MOTOR THRUST BEARINGS

Top bearings - high external thrust from the driven unit is usually carried by the top bearing or bearings. If replacement is necessary, the new bearing must be the same size and type as the original. Duplex bearings must also be the same type and mounted in an identical manner. When angular contact type bearings are replaced, the new bearing must have the same thrust capacity.

Bottom bearings - grease lubricated lower bearings are adequately lubricated at the factory for at least three months operation. The relubrication procedure is the same as outlined above under "Bearing Lubrication". It is important to maintain the lower cavity full of grease at all times.

The correct replacement bearings are given on the nameplate by AFBMA (Anti-Friction Bearing Manufacturers Association) number.

SERVICE

For immediate action on your motor problems call your certified service center or contact Dietz Electric Co., Inc.

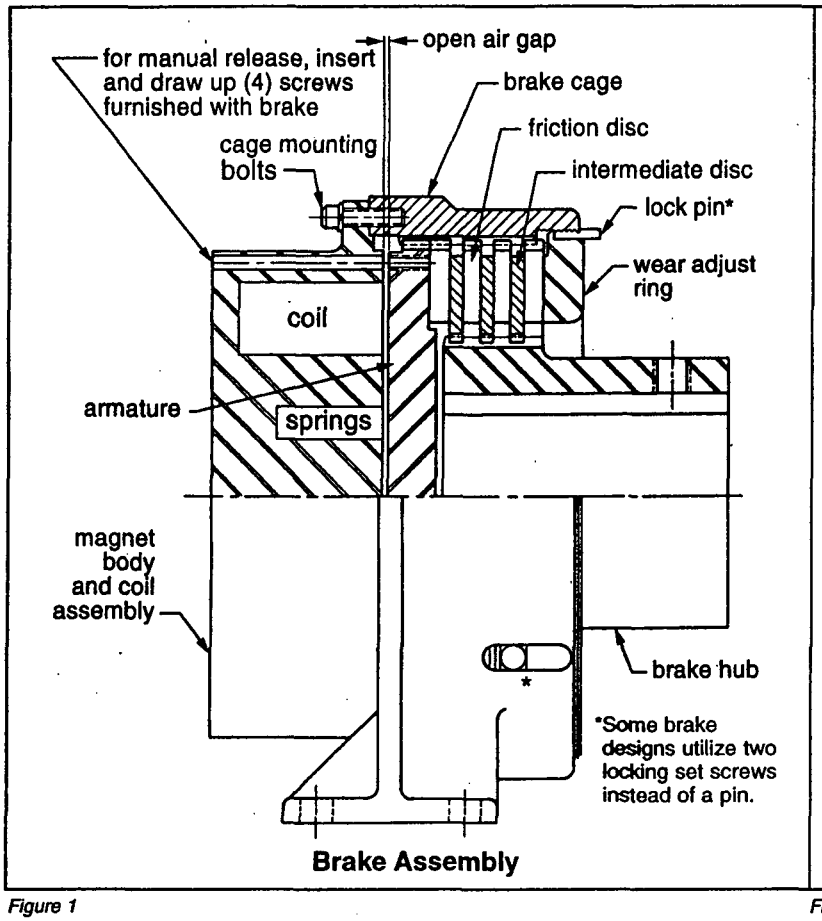
Dietz Electric Co., Inc.
4329 W Lincoln Ave
Milwaukee, WI 53219

PH: 414-645-3000
FX: 414-649-2685

P/N 8-078-881-00
effective 9/25/98

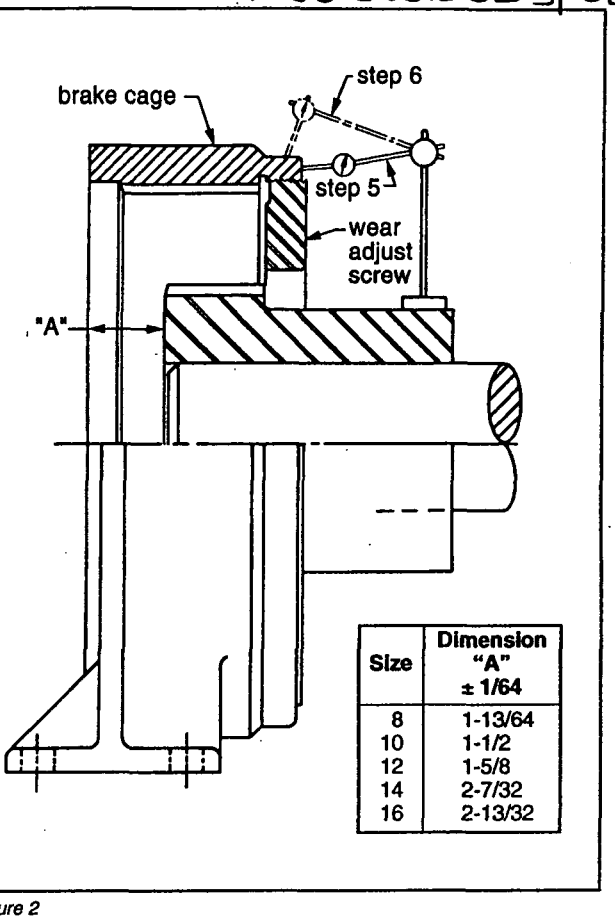
Installation and Service Instructions for Style SCEB S3 Brakes

SERIAL #
76622 D
1006 SCEB S3 SPCL



Brake Assembly

Figure 1



Size	Dimension "A" ± 1/64
8	1-13/64
10	1-1/2
12	1-5/8
14	2-7/32
16	2-13/32

Figure 2

CAUTION! Armature must be secured against magnet face *before removing cage mounting bolts.*

1. Make a temporary lead wire connection and energize unit. Insert (4) manual release bolts clamping armature to magnet body, de-energize unit and disconnect lead wires.
2. Remove cage mounting bolts, magnet body and armature assembly, friction discs and intermediate discs.
3. Assemble brake hub to shaft.
4. With shaft leveled and aligned to machine base as desired install brake cage to Dimension "A" as shown on Figure 2.
5. Mount indicator on brake hub or on shaft and indicate face of brake cage by turning shaft. Place indicator on as great a radius as possible. This operation indicates angular misalignment and must not exceed .001" T.I.R. per inch of measuring radius.

   Example: If measuring on a 6 inch radius, total indicator reading must not exceed .006".
6. Indicate machined turn on brake cage by rotating shaft. This operation indicates parallel misalignment and should not exceed .010" total indicator reading.
7. Always perform Step 5 before Step 6, since any angular misalignment which exists can introduce errors in readings for parallel misalignment. Also, after making corrective adjustments recheck both Steps 5 and 6.
8. It is recommended that the brake cage be doweled to the mounting base to prevent any shift during operation.
9. Replace friction discs and intermediate discs in order shown in Figure 1. Mount magnet body and armature to cage making certain that arrows, metal stamped on each part are in line. **(Note:** (1) hole is 1/4" offset) and tighten cage mounting screws.
10. Connect lead wires, energize unit and remove (4) manual release screws.
11. Set open air gap per *Brake Wear Adjustment.* Unit is now ready for operation.
12. The initial seating of the linings may cause some opening of the air gap. Check air gap after brake has been cycled in operation. Ordinary lining wear thereafter is very slight under normal loads. Use factory supplied feeler gauges and adjusting tool when making adjustments.

Replacement of Friction Discs

1. Energize magnet and clamp armature to magnet body with (4) manual release bolts. De-energize magnet and remove leads.
2. Remove cage mounting bolts and magnet body and armature assembly. Back off wear adjust ring slightly to allow space for new friction discs.
3. Friction discs may now be slid from hub and replaced.
4. Replace magnet body and armature assembly (arrows metal stamped on each part must be in line).
5. Reconnect lead wires, energize unit and remove (4) manual release bolts.
6. Set gap per *Brake Wear Adjustment.*

Brake Wear Adjustment

1. The operating air gap should be set to dimension shown on chart below. As lining wear continues the air gap will increase. Readjustment is recommended when the gap has increased by .015. Use factory supplied feeler gauges and adjusting tool when adjusting.
2. To adjust for wear, depress lock pin and turn wear adjust ring clockwise until lock pin snaps into next slot.

Note: Flange mounted brakes use (2) set screws in the adjusting ring instead of a locking pin. Both must be removed before adjusting.

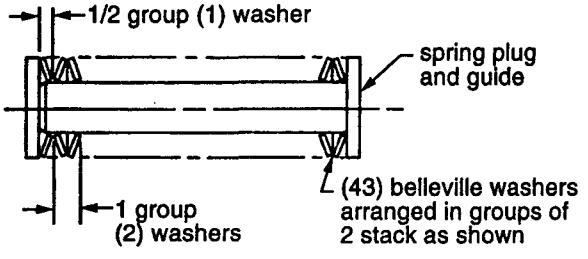
3. De-energize magnet and check open air gap.
4. If open air gap is still too large, repeat Step 2 and 3 until desired gap is obtained.

Option: Above adjustments can be completed using (4) manual release bolts through the mag body and threading into the armature.

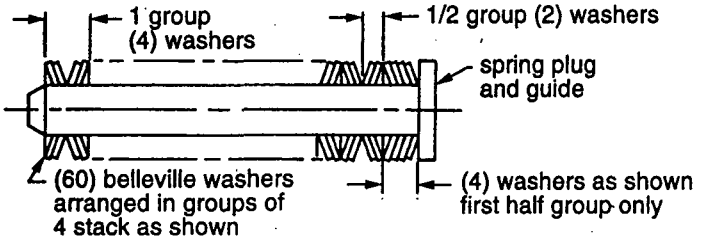
Unit Size	Operating Air Gap	Readjust When Gap Reaches
800	.040	.055
1000	.060	.075
1200	.060	.075
1400	.060	.075
1600	.060	.075

Pressure Spring Assembly

Sizes 800 and 1000 (free height of spring pack 3-7/32)



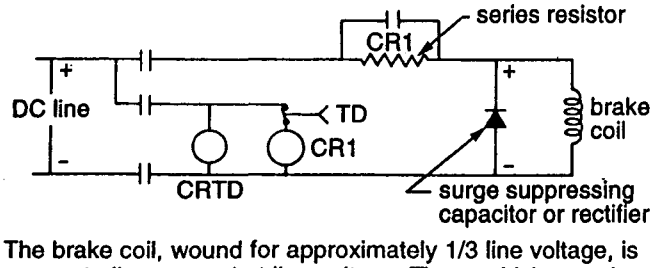
Sizes 1200, 1400 and 1600 (free height of spring pack 3-25/32)



Note: Should removal of springs become necessary, they must be reassembled as shown to insure normal operation of clutch or brake.

Typical Forcing Circuit Diagram

Note: Refer to Table for circuit values.



The brake coil, wound for approximately 1/3 line voltage, is momentarily engaged at line voltage. Timer, which must be set at approximately 5 seconds, then places the series resistor in the circuit, reducing the brake coil voltage and current to a *holding* current.

Circuit Values

Unit Size	DC Line Values				Brake Coil Holding			Suggested Resistor Rating	
	Inrush		Holding						
	Volts	Amps	Volts	Amps	Volts	Amps	Ohms	Ohms	Watts
800	115	3.54	115	1.12	36.6	1.12	32.5	70	125
800	230	1.77	230	.567	74	.567	130	275	125
800	240	1.85	240	.592	77	.592	130	275	125
800	250	1.92	250	.617	80	.617	130	275	125
1000	230	2.94	230	.98	76.3	.98	78	160	250
1000	240	3.07	240	1.02	80	1.02	78	160	250
1000	250	3.19	250	1.06	83.3	1.06	78	160	250
1200	220	3.90	220	1.06	68.2	1.21	56.4	125	250
1200	230	4.08	230	1.27	71.4	1.27	56.4	125	250
1200	250	4.43	250	1.38	77.8	1.38	56.4	125	250
1200	440	1.95	440	.605	136.5	.605	225.6	500	250
1200	115	8.22	115	2.61	35.6	2.61	14.0	30	250
1400	230	3.68	230	1.16	73	1.16	62.5	135	250
1400	250	4.0	250	1.26	79	1.26	62.5	135	250
1400	220	3.52	220	1.11	69.6	1.11	62.5	135	250
1600	230	3.7	230	1.13	71	1.13	62.2	140	250
1600	250	4.02	250	1.27	79	1.27	62.2	140	250

Note: Refer to clutch nameplate for unit size and voltage.

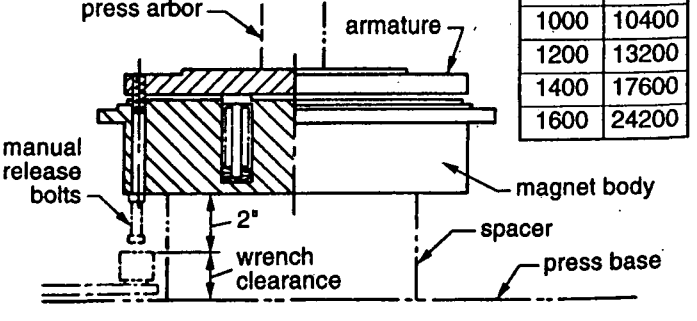
Assembly of Magnet Body and Armature - Using Press

1. Place magnet body, with manual release bolts in holes provided in magnet body, flange side of magnet body up, on press base, with spacer as shown below.
2. Insert pressure spring assemblies, set armature in place, aligning arrows on armature and magnet body. Insert temporary pins into release bolt holes for aligning.
3. Press armature against magnet body (see Table for pressure required) remove (4) temporary pins and install (4) manual release bolts and tighten to hold armature against magnet body.

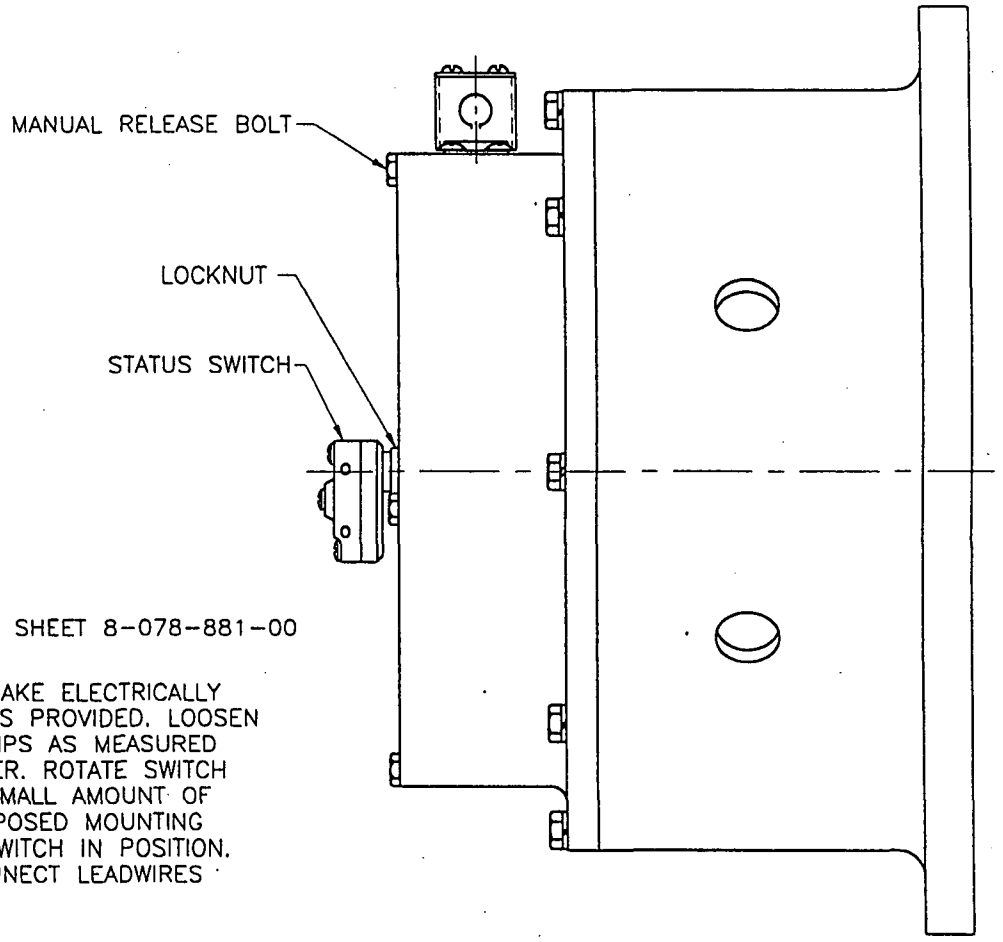
Disassembly Procedure

1. Place assembly on press with spacer.
2. Press armature against magnet body (see Table for pressure required) and remove manual release bolts from armature.
3. Slowly release pressure from press until spring pressure is relieved and remove armature. Pressure spring assemblies may now be removed.

Size	Press Force (lbs)
800	6500
1000	10400
1200	13200
1400	17600
1600	24200



Rexnord Corporation, Stearns Division, 120 North Broadway, Milwaukee, Wisconsin 53202, (414) 272-1100 Fax: (414) 277-4364



NOTES:

1. SWITCH ADJUSTMENT: USE WITH BRAKE INSTALLATION SHEET 8-078-881-00 AND OUTLINE DRAWING 2-41-3103-19-001.
2. REMOVE WIRES CONNECTED TO SWITCH. RELEASE BRAKE ELECTRICALLY OR MANUALLY FOLLOWING INSTALLATION INSTRUCTIONS PROVIDED. LOOSEN SWITCH LOCKNUT. ROTATE SWITCH UNTIL IT JUST TRIPS AS MEASURED BY AN AUDIBLE CLICK OR AS MEASURED BY A METER. ROTATE SWITCH AN ADDITIONAL 1/8TH TURN CLOCKWISE. APPLY A SMALL AMOUNT OF LOCTITE 242 OR EQUIVALENT THREADLOCKER TO EXPOSED MOUNTING THREADS OF SWITCH. TIGHTEN LOCKNUT TO HOLD SWITCH IN POSITION. REMOVE MANUAL RELEASE BOLTS, IF USED. RE-CONNECT LEADWIRES TO SWITCH.

76622D S/NUMBER

F			
E			
D			
C			
B			
A	C5896	04/09/02	MO
REVISIONS		DATE	BY

DRAWING NUMBER SB-762

REXNORD CORPORATION
STEARNS DIVISION
CUDAHY WI 53110

PLOT SCALE:	2:1
DRAWN	DATE
M.OLSON	04/09/02
APPROVED	DATE
CHECKED	DATE

DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED
DECIMAL TOLERANCES ARE:
.X= ±.03
.XX= ±.01
.XXX= ±.005
ANGLES ±0,5°
Ø SIGNIFIES CONTROLLED DIMENSION
TAPPED HOLE: SEE SA-981
BREAK ALL EDGES (.01-.03)
MACHINED SURFACES: 125
CHAMFER THREADED HOLES TO MAJOR THREAD DIA.

TITLE: STATUS SWITCH INSTALLATION

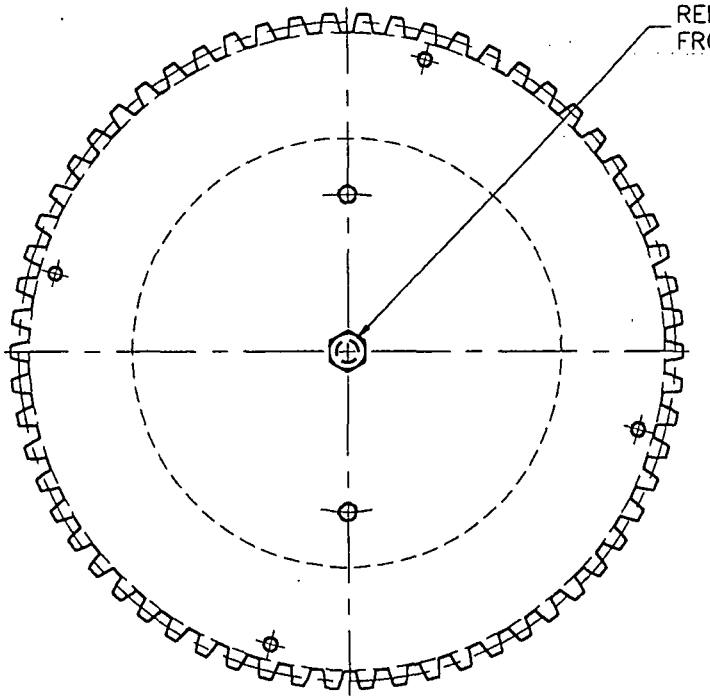
PRODUCT: 1006 SCEB-S3

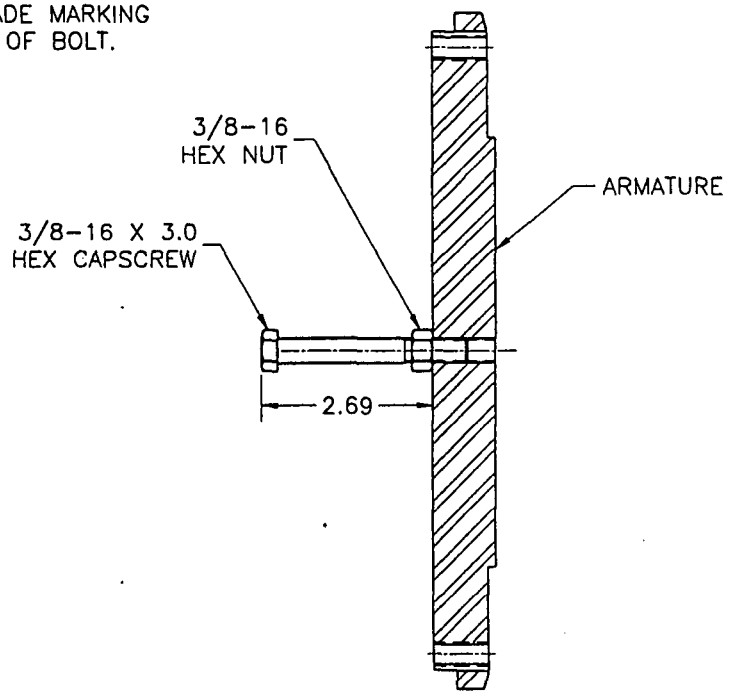
SUPERSEDES DRAWING NO.

DWG. SIZE: B

SB-762

REV. A





F			
E			
D			
C			
B			
A	C5896	04/01/02	MO
	REVISIONS	DATE	BY

DRAWING NUMBER B5-47-1020-00

REV A

REXNORD CORPORATION
STEARNS DIVISION
CUDAHY WI 53110

PLOT SCALE:	1:1
DRAWN	M.OLSON
DATE	04/01/02
APPROVED	
DATE	
CHECKED	
DATE	

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED
DECIMAL TOLERANCES ARE:
.X= ±.03
.XX= ±.01
.XXX= ±.005
ANGLES ±0.5°
Ø SIGNIFIES CONTROLLED DIMENSION
TAPPED HOLE: SEE SA-981
BREAK ALL EDGES (.01-.03)
MACHINED SURFACES: 125/
CHAMFER THREADED HOLES TO MAJOR THREAD DIA.

TITLE
ARMATURE & BOLT ASSEMBLY

PRODUCT
1006 SCEB-S3

SUPERSEDES DRAWING NO.

DWG. SIZE B

5-47-1020-00

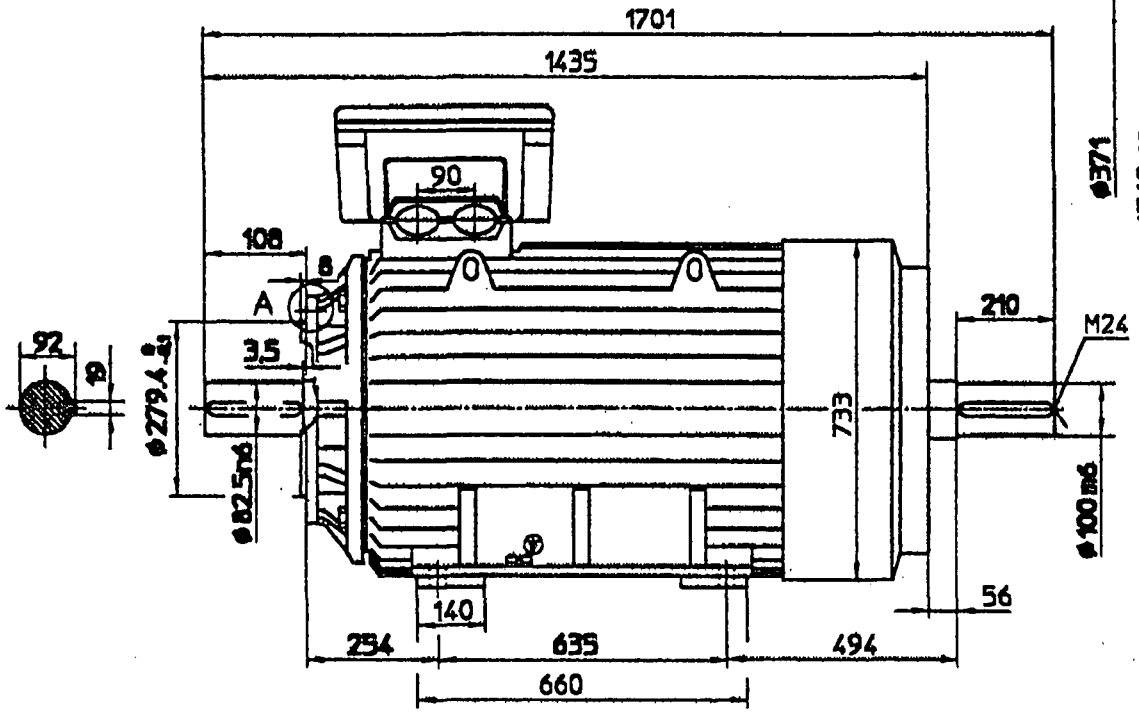
REV. A

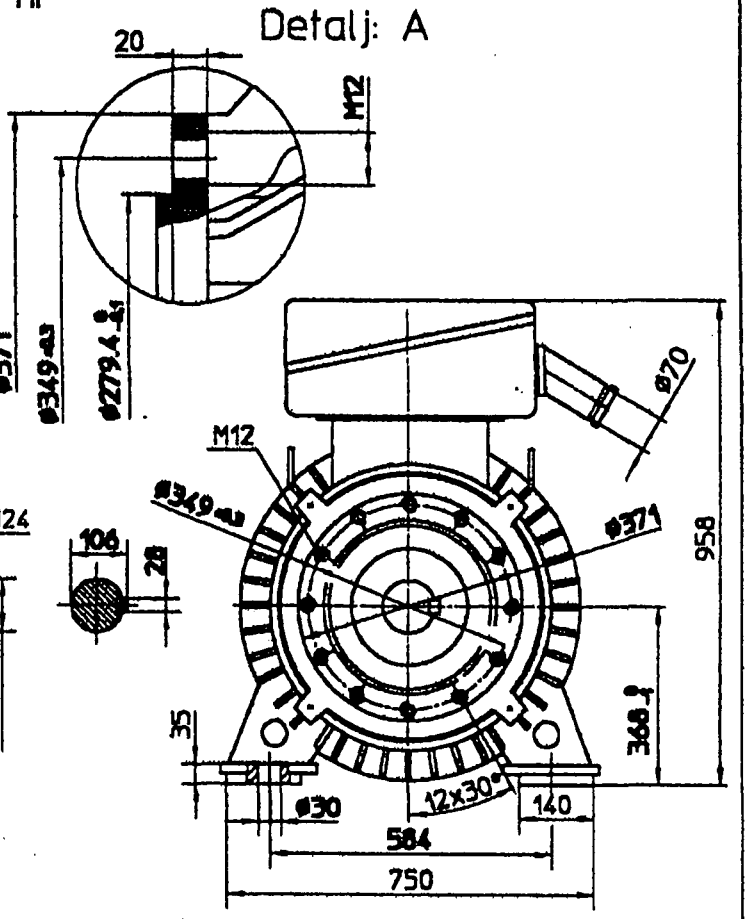
SEVER
ELEKTRIČNE MAŠINE A.D., FVEM
SUBOTICA-YUGOSLAVIA

TYP: 1.ZKIT 355 M-12/6, E-4073, 150/300 HP

Subotica, 10.01.2002.

JAN 10th 2002





Overio: Šef konstrukcije n.n. el.motora

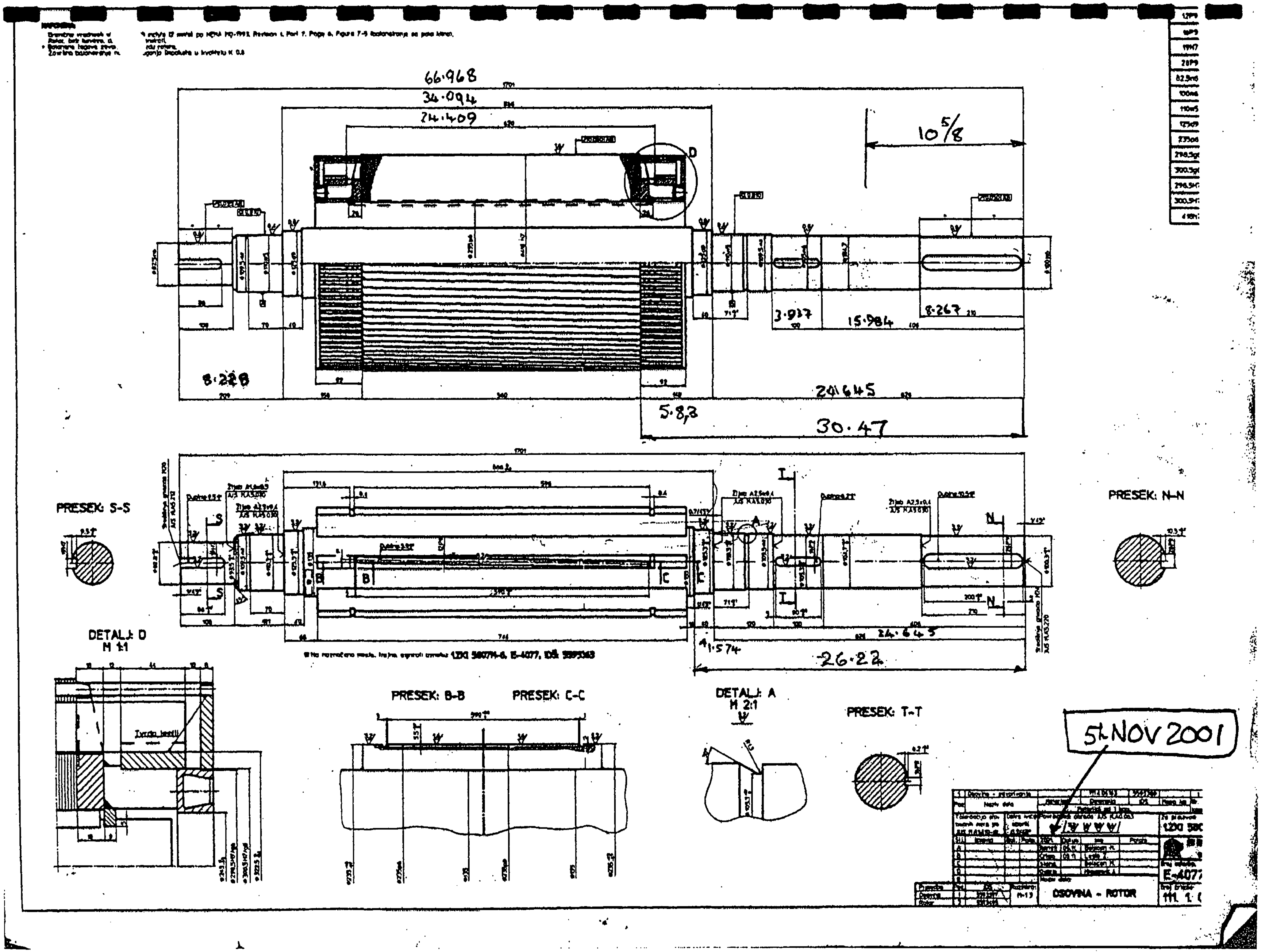
Milovanović J., ing.

Sastavio:

Belecan M.

BROJ CRTEŽA:

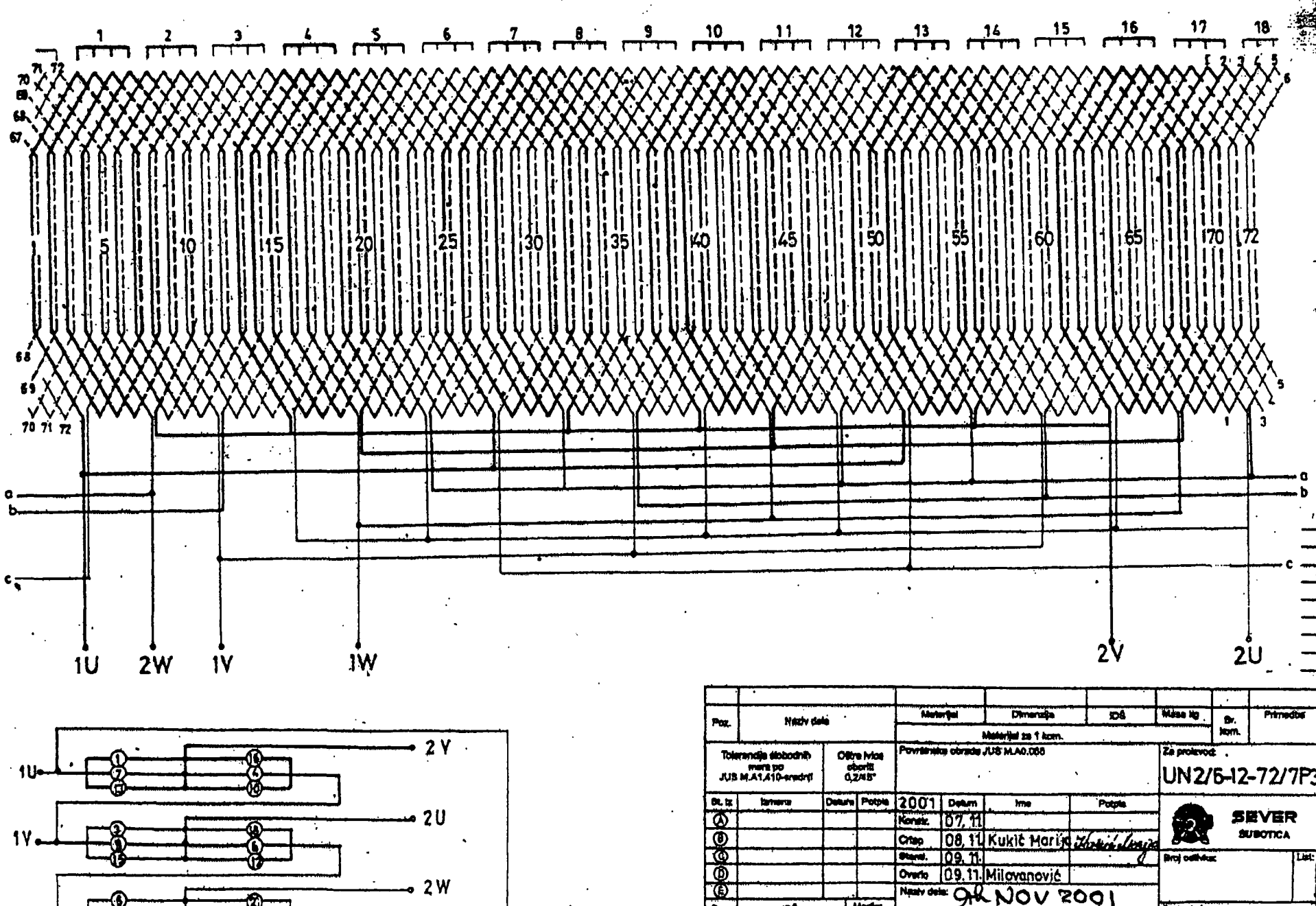
10012002/MB



66.968
34.094
24.409
10 5/8
8.228
3.937
15.984
8.267
24.645
5.8,3
30.47
PRESEK: S-S
PRESEK: N-N
DETALJ: D
M 1:1
PRESEK: B-B
PRESEK: C-C
DETALJ: A
M 2:1
PRESEK: T-T
4.574
24.645
26.22
5th NOV 2001
OSOVINA - ROTOR

[redacted] VO[redacted]UNI [redacted]LAČNI NAMOTAJ [redacted] DANLANDEROV[redacted]SPOJ [redacted]

2p=12/6 sprega: Δ Y utora: 72 korak: 1 - 7



Poz.	Naziv dela	Materijal	Dimenzija	ISO	Masa kg	Br. kom.	Primedba
		Materijal za 1 kom.					

Tolerancija slobodnih mera po JUS M.A1.410-srednji | Oštre ivice oboriti 0,2/45° | Površinska obrada JUS M.A0.056 | Za proizvod: UN2/6-12-72/7P3

Br. iz	Izmena	Datum	Potpis
A			
B			
C			
D			
E			

	Datum	Ime	Potpis
2001			
Konstr.	07.11.		
Crtao	08.11.	Kukić Marija	
Kontrol.	09.11.		
Overio	09.11.	Milovanović	

Naziv dela: 9. NOV 2001
ŠEMA NAMOTAVANJA

SEVER SUBOTICA

Broj odlivka: List:

Broj crteža: 116.3.01700

Poz.	ISO	Marka:
1		
2		

SEVER
SUBOTICA

LIST NAMOTAVANJA

07112001/ZP

7 NOV 2001

Tip: **2.ZKI 355M-6/12**	Vrsta mašine: as.motor	
Snaga: **300(Hp)/150(Hp)**	Kl. izolacije: F	Kl. rot.
Napon: **460** [V]	Učestanost: 60 [Hz]	
Vrsta veze: YY/D	Vrsta pogona: S1, ED100%	

PODACI	STATORA		ROTORA	
Br.crteža dinamo lima	112.3.08530		112.3.08530	
Spoljni prečnik	600		418	
Unutrašnji prečnik	420		235	
Dužina lim paketa	560		560	
Broj utora	72		84	
Dimenzija utora	9,5/13,1x52,5		Ø8,7/3,5/4,5/6x31	
Presek utora [mm^2]	568,4			
Vazdušni kanal				
Min. debljina zuba	9,3		6,5	
Širina jarma	36,5		43,8	
Br. navoja u utoru	14(P3)		1/1	
Dimenzija žice	9x1,6Ø		Ms Ø8 / Cu 30x3	
Masa žice (kg)	145			
Šema namotavanja	UN 2/6-12-72/7(P3)		⟹116.3.01700	
Šema priključivanja				
	Dimenzija	Br.kom.	Dimenzija	Br.kom.
Izolacija utora				
Izolacija ms. utora				
Izolacija dna utora				
Izolacija izv. namotaja				
Izolacija isp. ut. letvice				
Utorna letvica				
Izolacija glave sekcije				
Izolacija kraja sekcije				
Izolacija kabl. stopice				
Izolacija spojeva				
Izvodni kabel Radox				
Bandažna traka				
Dimenz. glave namot.				

Primedba:

-Namotaj statora vezati u 3 (tri) paralelne grana.

KARAKTERISTIKE MAŠINE

OZNAKA	RAČUNATO	MEREN
Napon [V]	460	
Io [A]	80,6/200	
Po [W]	5043/5636	
Erot [V]		
Irot [A]		
In [A]	345/293	
Pn [kW]	300(Hp)/150(Hp)	
cos φ	0,86/0,52	
η [%]	94,5/92	
Ik [A]	1384/812	
Pk [kW]	322/210	
Mk/Mn	1,19/1,6	
Mmin/Mn	0,93/1,1	
Mmax/Mn	1,63/1,8	
n_n [min^{-1}]	1186/592	

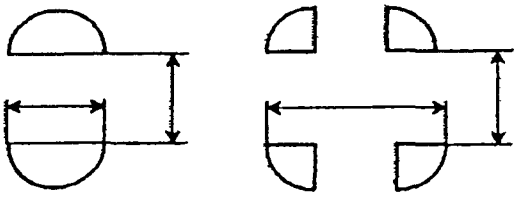
Broj faza: 3

Termička zaštita:

Klizni prstenovi:

Četkice:

Držač četkica:



A 11.04.

Namotaj:

α_{ST}= 44,57 % α_{ROT}=

Rf na 20 °C [Ω]	
Računato	Mereno

Proračunao: Milovanović Jovan el.ing.

Sastavio:

Pregledao:

C:\WINDOWS\TEMP\V2_5MS_12.x
ls\Jet1

Section 7 – Electrical Control

NOVA
SYSTEMS INC.
Systems Integration Solution Provider

Motion Control

Machine Vision

PLC/PC Programming

Control System Repair

Panel Construction

Bio-Mixer Operation

NOVA Job #0110223

Rollback:

- The Bio-Mixer must be in a rolled back position before normal operation. The rollback sequence must be performed after every power up or emergency stop.
- The Rollback sequence is initiated by pressing and holding both the ROLL BACK and the SLOW pushbuttons until the alarm stops. The mechanical brake is released and the electronic brake is energized until the Bio-Mixer comes to rest at a neutral position. The mechanical brake is then reapplied. Successful completion of the rollback sequence is indicated by the illuminated ROLL BACK COMPLETE pilot light.

Operation:

- The Bio-Mixer can be started by pushing and holding either SLOW or FAST until the warning alarm stops, at which time the start sequence will initiate. If the pushbutton is released before the alarm stops, the start sequence will be aborted.
- The start sequence consists of closing the appropriate speed contactors, releasing the mechanical brake and activating the electronic soft starter. When the Bio-Mixer is up to speed, a bypass contactor closes.
- While running, the Bio-Mixer can be switched from FAST to SLOW or SLOW to FAST by pressing the appropriate button.
- The STOP pushbutton will shut off the motor and automatically initiate a rollback sequence.

Emergency Stop:

- The Bio-Mixer can be stopped immediately by pressing any of the EMERGENCY STOP mushroom head pushbuttons. The emergency stop will cause all equipment to be turned off. This will stop the motor and set the mechanical brake.
- A power failure or power fluctuation will cause an emergency stop.
- Upon initial power up or after an emergency stop, if conditions are safe, use the RESET button to enable the control system. Pressing the RESET button will not cause any motion to occur.
- A rollback must be performed after a power up or an emergency stop.

11629 West Dearbourn Avenue • Milwaukee, Wisconsin 53226-3971 USA
Phone: 414.771.4800 • FAX: 414.771.4847 • Web Site: www.novasystemsinc.com

Bill of Materials			Date: 10.04.02	Page: 1
Project Name: BIO-MIXER		NOVA SYSTEMS INC.		
Description: Sumter Solid Waste		11629 West Dearbourn Ave.		
Drawing No.: 0110223		Milwaukee, WI 53226-3971		
Job Number: BMO1-3123		Web: www.novasystemsinc.com		

Item	Dev.Id	Part No.	Description	Manufacturer
1	A1212110	A-1212CHNFSS	STAINLESS ENCLOSURE	HOFFMAN
2	A1212110	A-1212CHNFSS	STAINLESS ENCLOSURE	HOFFMAN
3	A7260201	A726020ULP	ENCLOSURE	HOFFMAN
4	A7260201	01/109/120	DSFU HANDLE	MTE
5	A7260201	01/1100/80	FUSED DISCONNECT	MTE
6	ABC103	ABC550-P	ELECTRONIC BRAKE	MOTORTRONI
7	AH278	4A967	HORN	GRAINGER
8	AH278	4A969	WEATHERPROOF BOX	GRAINGER
9	BRDG_REC	M2550TB1200	BRIDGE RECTIFIER	GALCO
10	CR248	CA4-9-10-120	3 POLE CONTACTOR	SPRECHER +
11	CR248	CS4-P20	AUX CONTACT	SPRECHER +
12	CR262	760022	DIN MT RELAY 24VDC	LUTZE

13	CR265	760022	DIN MT RELAY 24VDC		LUTZE
14	CR268	760022	DIN MT RELAY 24VDC		LUTZE
15	CR914	760022	DIN MT RELAY 24VDC		LUTZE
16	CR917	760022	DIN MT RELAY 24VDC		LUTZE
17	CR929	760801	JUMPER BAR		LUTZE
18	CR929	760022	DIN MT RELAY 24VDC		LUTZE
19	CR964	760022	DIN MT RELAY 24VDC		LUTZE
20	DASDC335	UF5408	DIODE		GALCO
21	DS104	01/109/120	DSFU HANDLE		MTE
22	DS104	01/1100/80	FUSED DISCONNECT		MTE
23	FU203	FRN-R-2	FUSE 2A	TIME-DELAY	BUSSMANN
24	FU208	FRN-R-10	FUSE 10A	TIME-DELAY	BUSSMANN

continued on page 2

Project Name: BIO-MIXER	NOVA SYSTEMS INC.
Install. Name: Sumter Solid Waste	11629 West Dearbourn Ave.
Drawing No.: 0110223	Milwaukee, WI 53226-3971
Job Number: BMO1-3123	Web: www.novasystemsinc.com

Item	Dev.Id	Part No.	Description	Manufacturer
25	FU301	KLDR-3.5	FUSE 3.5 AMP FUSE	BUSSMANN
26	FU303	KLDR-3.5	FUSE 3.5 AMP FUSE	BUSSMANN
27	FU313	FRN-R-2	FUSE 2A TIME-DELAY	BUSSMANN
28	FU313.1	FRN-R-10	FUSE 10A TIME-DELAY	BUSSMANN
29	FU327	ABC10	FUSE	BUSSMANN
30	FU327.1	ABC10	FUSE	BUSSMANN
31	IDECPS22	PS5R-D24	POWER SUPPLY	IDEC
32	K1	CA4-9-10-24D	3 POLE CONTACTOR	SPRECHER +
33	K2	CA4-9-10-24D	3 POLE CONTACTOR	SPRECHER +
34	K3	CA4-9-10-24D	3 POLE CONTACTOR	SPRECHER +
35	K3	CS4-P20	AUX CONTACT	SPRECHER +
36	LT213	800T-QBH24G	GREEN ILLUM PB	ALLEN BRAD
37	LT218	800T-QBH24G	GREEN ILLUM PB	ALLEN BRAD
38	LT223	800T-QBH24G	GREEN ILLUM PB	ALLEN BRAD
39	LT932	800T-QBH24G	GREEN ILLUM PB	ALLEN BRAD
40	LT935	800T-QBH24G	GREEN ILLUM PB	ALLEN BRAD

41	LT938	800T-QBH24G	GREEN ILLUM PB	ALLEN BRAD
42	LT946	800T-QBH24G	GREEN ILLUM PB	ALLEN BRAD
43	LT949	800T-QBH24G	GREEN ILLUM PB	ALLEN BRAD
44	LT952	800T-QH24A	24 V AMBER PILOT LI	ALLEN BRAD
45	LT955	800T-QH24A	24 V AMBER PILOT LI	ALLEN BRAD
46	LT958	800T-QH24A	24 V AMBER PILOT LI	ALLEN BRAD
47	LT961	800T-QH24A	24 V AMBER PILOT LI	ALLEN BRAD
48	M262	01/51/20	AUX CONTACT	MTE

continued on page 3

Parts List	Project: BIO-MIXER	Date: 10.04.02	Page: 3

Project Name: BIO-MIXER	NOVA SYSTEMS INC.
Install. Name: Sumter Solid Waste	11629 West Dearbourn Ave.
Drawing No.: 0110223	Milwaukee, WI 53226-3971
Job Number: BMO1-3123	Web: www.novasystemsinc.com

Item	Dev.Id	Part No.	Description	Manufacturer
49	M262	01/51/20	AUX CONTACT	MTE
50	M262	01/37060/120	CONTACTOR	MTE
51	M266	01/51/20	AUX CONTACT	MTE

52	M266	01/51/20	AUX CONTACT	MTE
53	M266	01/38060/120	CONTACTOR	MTE
54	M270	01/51/20	AUX CONTACT	MTE
55	M270	01/51/20	AUX CONTACT	MTE
56	M270	01/38060/120	CONTACTOR	MTE
57	M274	01/51/20	AUX CONTACT	MTE
58	M274	01/51/20	AUX CONTACT	MTE
59	M274	01/38060/120	CONTACTOR	MTE
60	MOV325	Z250EH5	METAL OXIDE VARISTO	GALCO
61	MT304	1GPOG10WGAOT-1	TRANSFORMER	BADGER TRA
62	PB244	800T-FX6D1	E STOP PB	ALLEN BRAD
63	PB244.1	800T-FX6D1	E STOP PB	ALLEN BRAD
64	PB244.2	800T-FX6D1	E STOP PB	ALLEN BRAD
65	PB706	800T-A2D1	PUSHBUTTON	1-NO, BLACK, ALLEN-BRAD
66	PB709	800T-A2D1	PUSHBUTTON	1-NO, BLACK, ALLEN-BRAD
67	PB712	800T-A2D1	PUSHBUTTON	1-NO, BLACK, ALLEN-BRAD
68	PB715	800T-A2D1	PUSHBUTTON	1-NO, BLACK, ALLEN-BRAD

69	PB756	800T-B6D1	PUSHBUTTON	1-NO, RED	ALLEN-BRAD
70	PB759	800T-B6D1	PUSHBUTTON	1-NO, RED	ALLEN-BRAD
71	PB762	800T-B6D1	PUSHBUTTON	1-NO, RED	ALLEN-BRAD
72	PLC419	O7CR41	8 IN 6 OUT CENTRAL		ABB

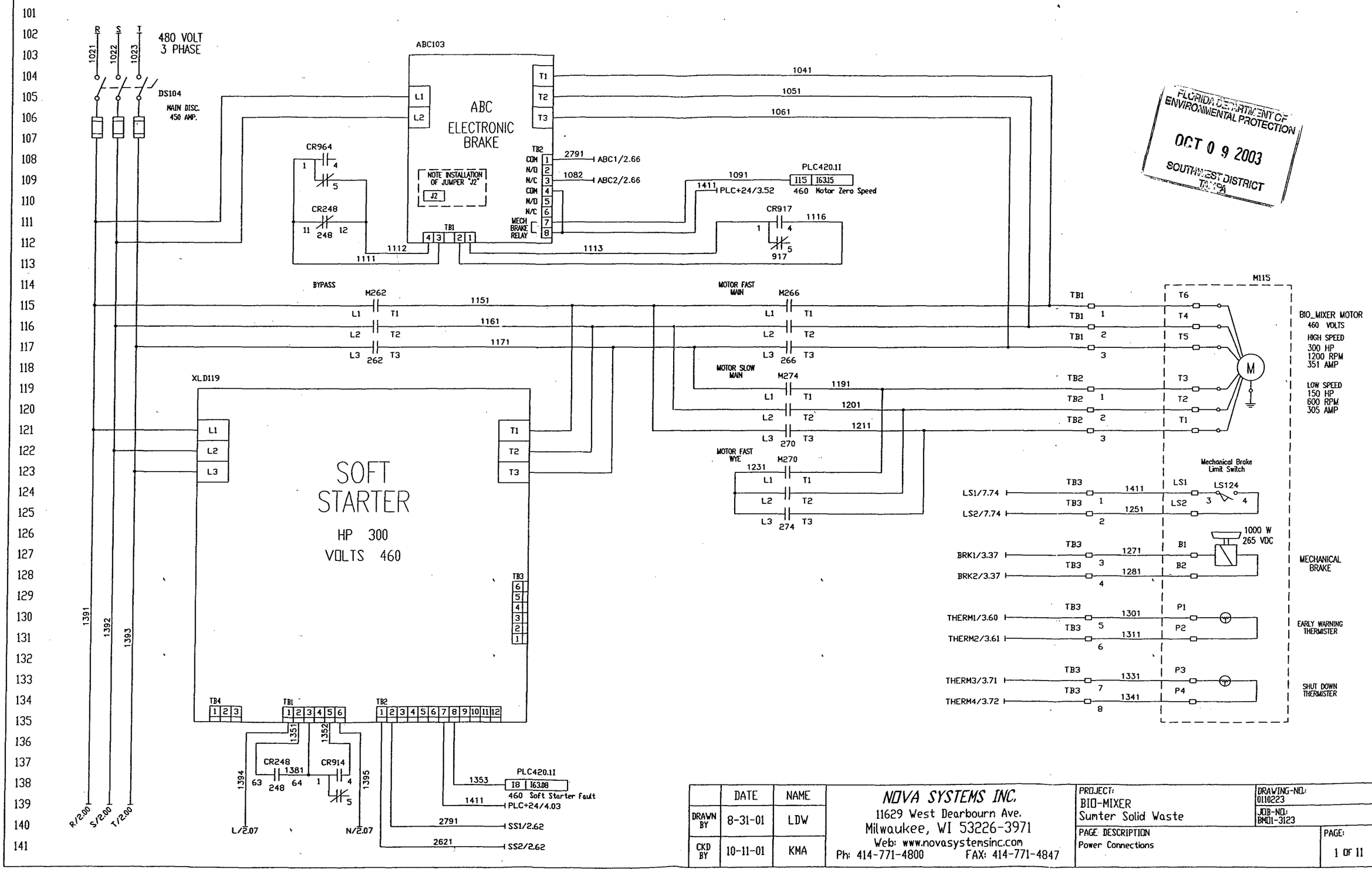
continued on page 4

Parts List Project: BIO-MIXER Date: 10.04.02 Page: 4

Project Name: BIO-MIXER	NOVA SYSTEMS INC.
Install. Name: Sumter Solid Waste	11629 West Dearbourn Ave.
Drawing No.: 0110223	Milwaukee, WI 53226-3971
Job Number: BMO1-3123	Web: www.novasystemsinc.com

Item	Dev.Id	Part No.	Description	Manufacturer
73	PLC420.1	XI16E1	16 INPUT EXTENTION	ABB
74	PLC420.2	XI16E1	16 INPUT EXTENTION	ABB
75	PLC420.3	XO08R1	8 RELAY OUTPUT EXT	ABB
76	PLC420.4	XO08R1	8 RELAY OUTPUT EXT	ABB
77	T206	E1100	TRANSFORMER	HEVI DUTY
78	TRC356	TRC-1	THERMISTER CONTROL	DIETZ
79	TRC367	TRC-1	THERMISTER CONTROL	DIETZ

80	XLD119	XLD-414PX	DIGITAL SOFT STARTE	MOTORTRONI



	DATE	NAME
DRAWN BY	8-31-01	LDW
CKD BY	10-11-01	KMA

NOVA SYSTEMS INC.
11629 West Dearbourn Ave.
Milwaukee, WI 53226-3971
Web: www.novasystemsinc.com
Ph: 414-771-4800 FAX: 414-771-4847

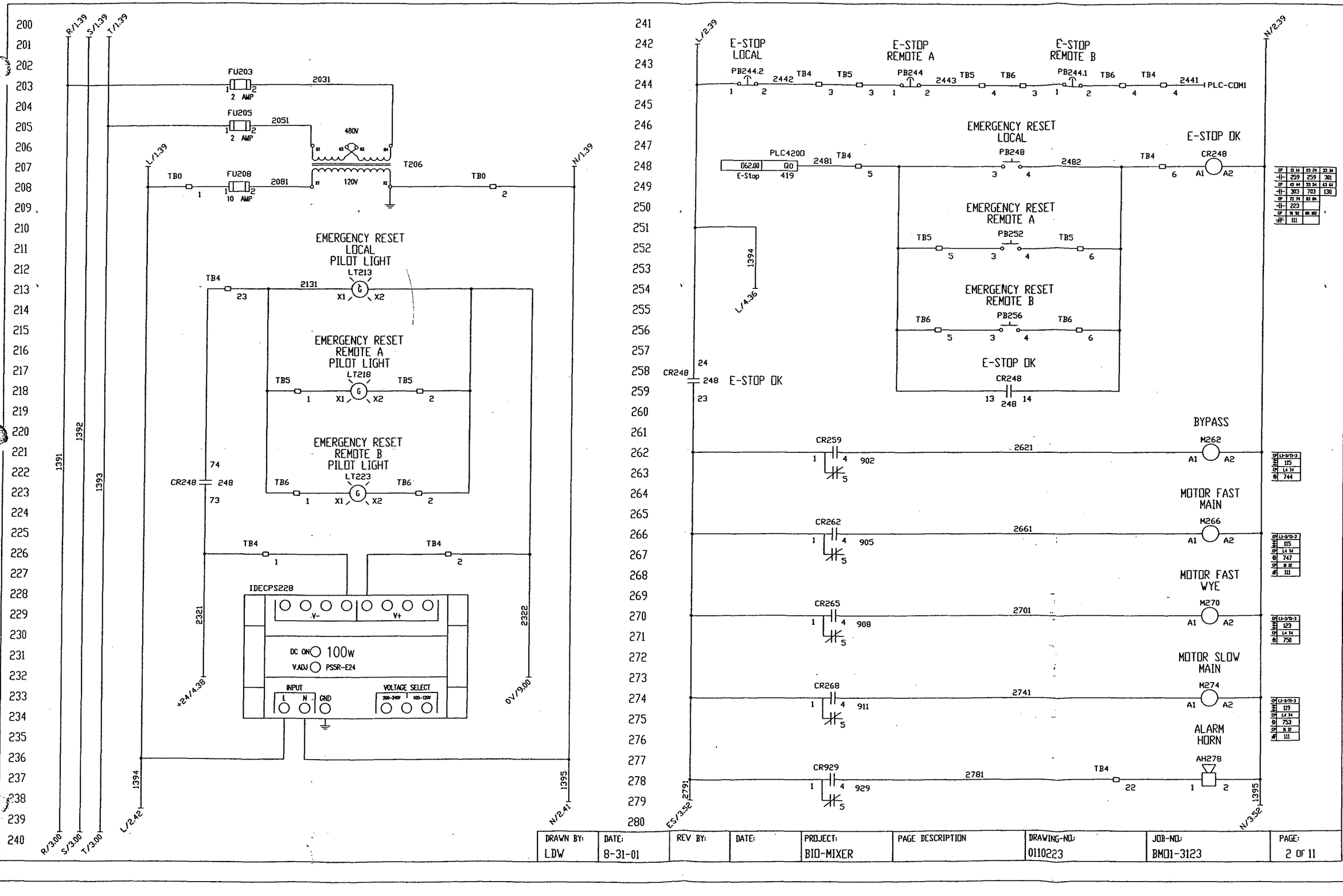
PROJECT:
BIO-MIXER
Sumter Solid Waste

DRAWING-NO.:
0110223

JOB-NO.:
BM01-3123

PAGE DESCRIPTION
Power Connections

PAGE:
1 OF 11



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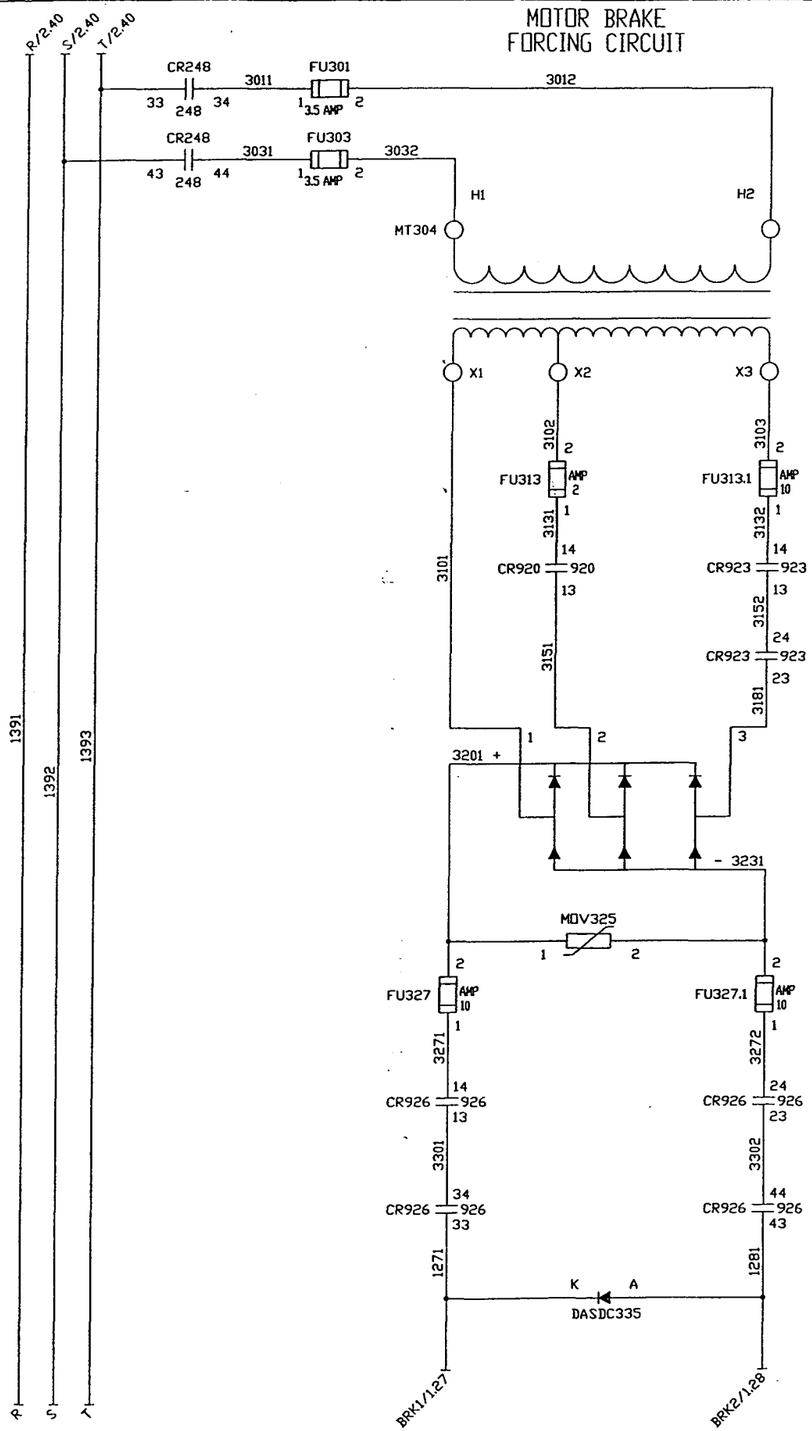
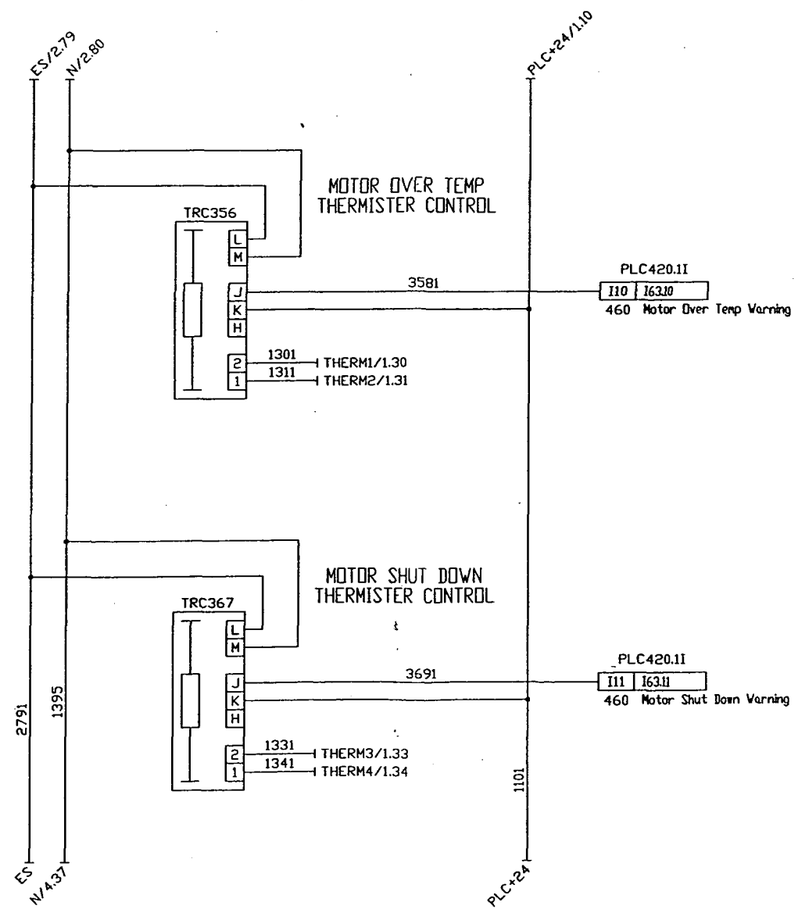
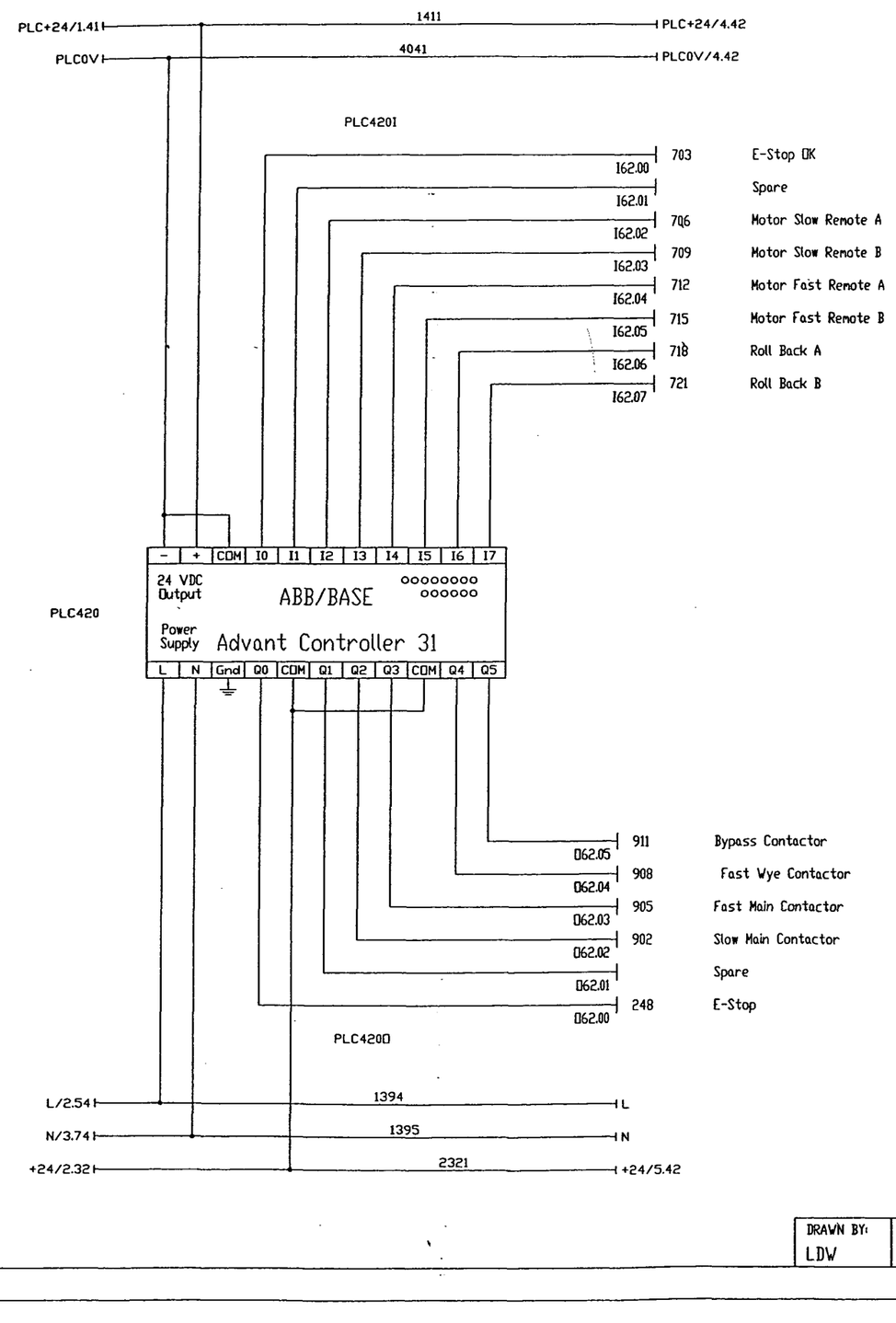
LDW	8-31-01			BIO-MIXER		0110223	BM01-3123	2 OF 11

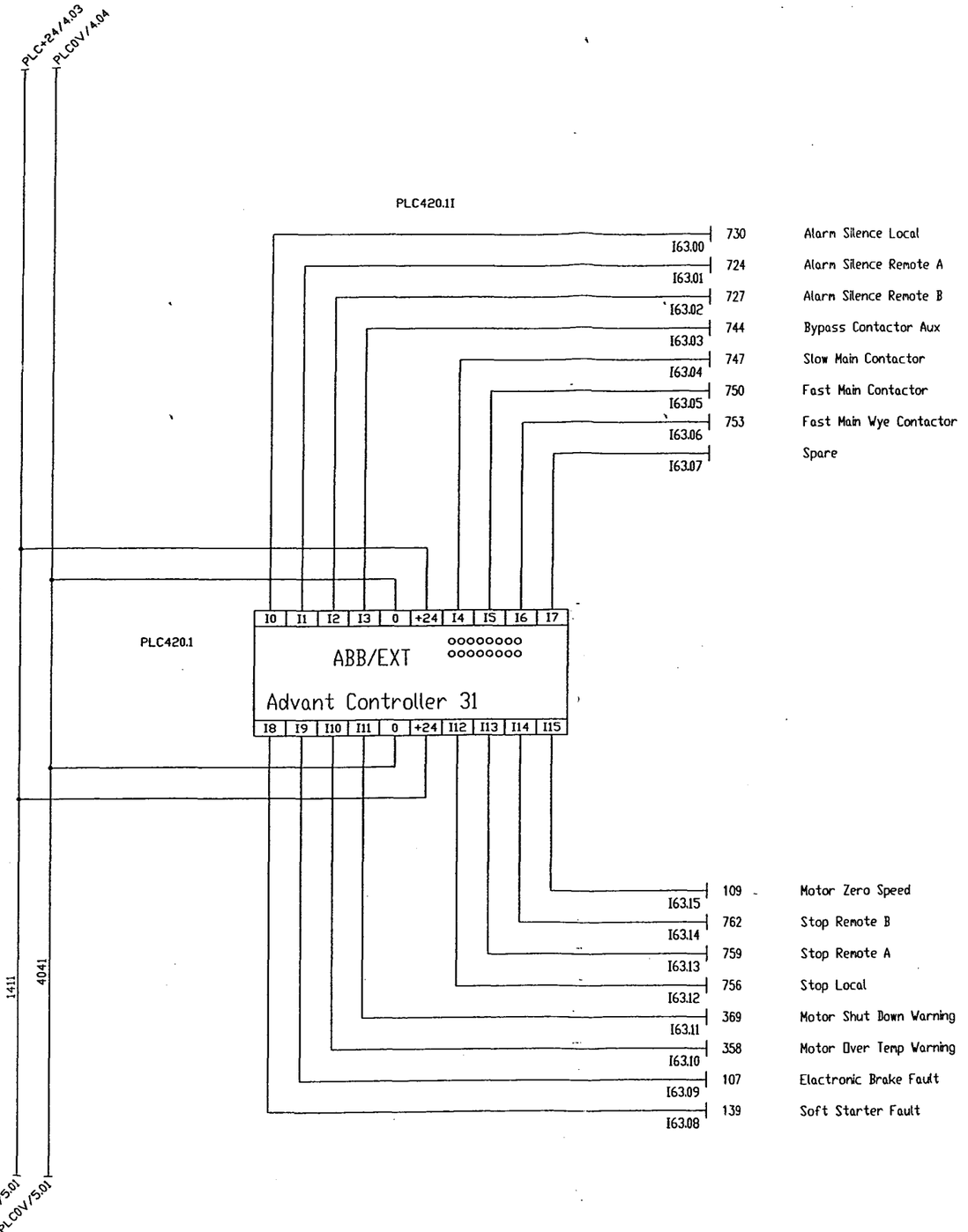
MOTOR BRAKE FORCING CIRCUIT



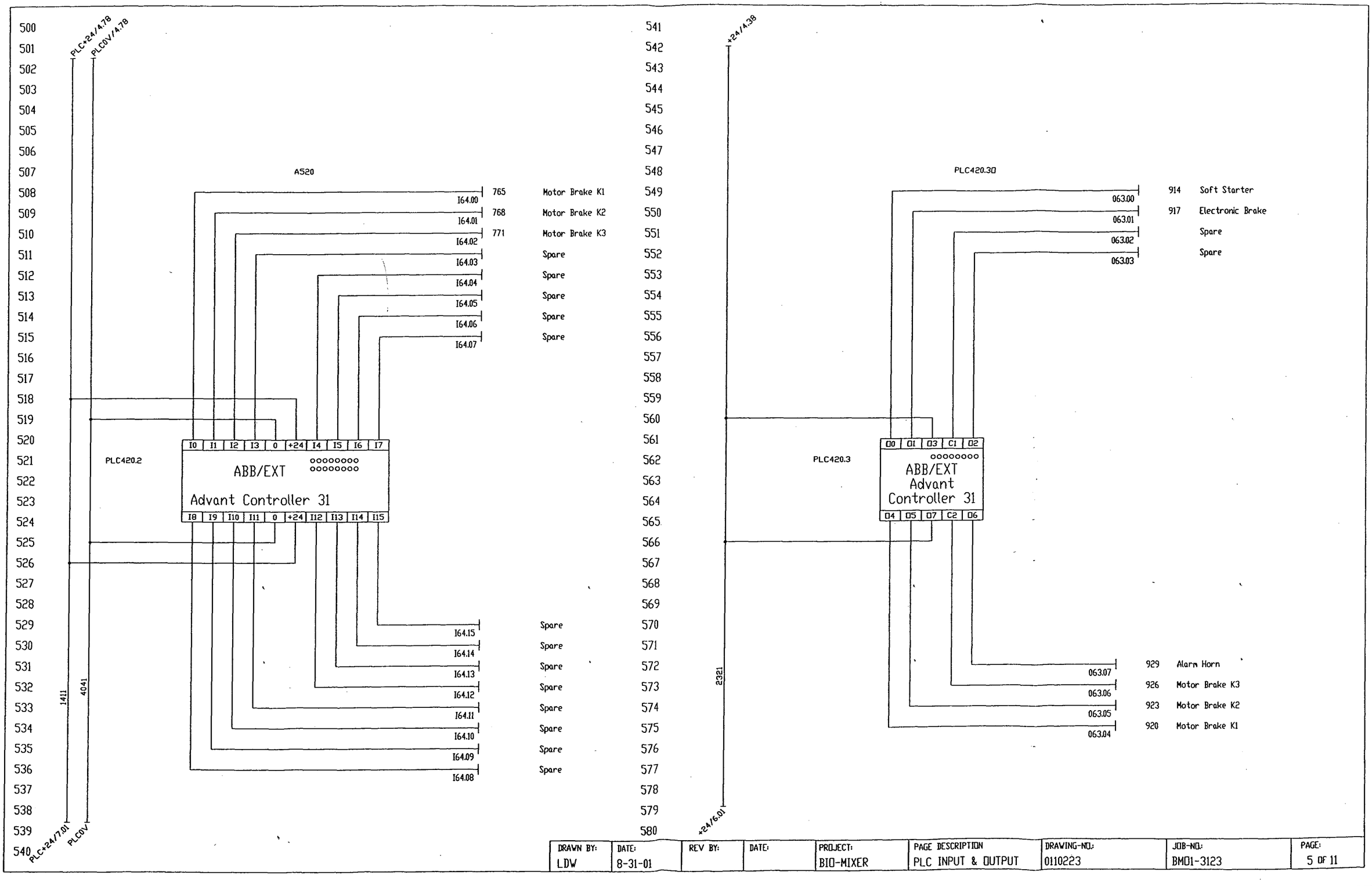


DRAWN BY:	DATE:	REV BY:	DATE:	PROJECT:	PAGE DESCRIPTION	DRAWING-NO:	JOB-NO:	PAGE:
LDW	8-31-01			BIO-MIXER		0110223	BM01-3123	3 OF 11

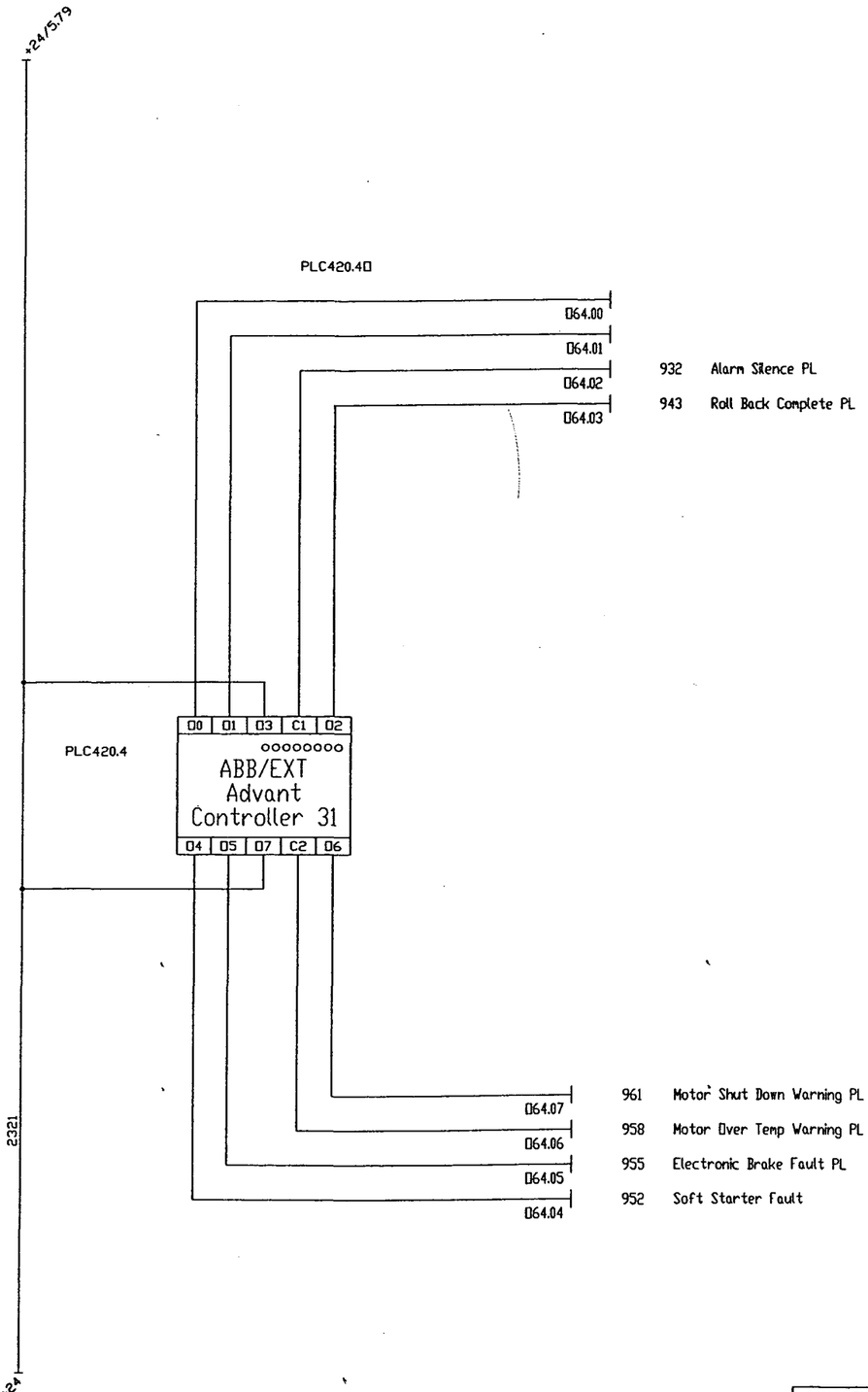




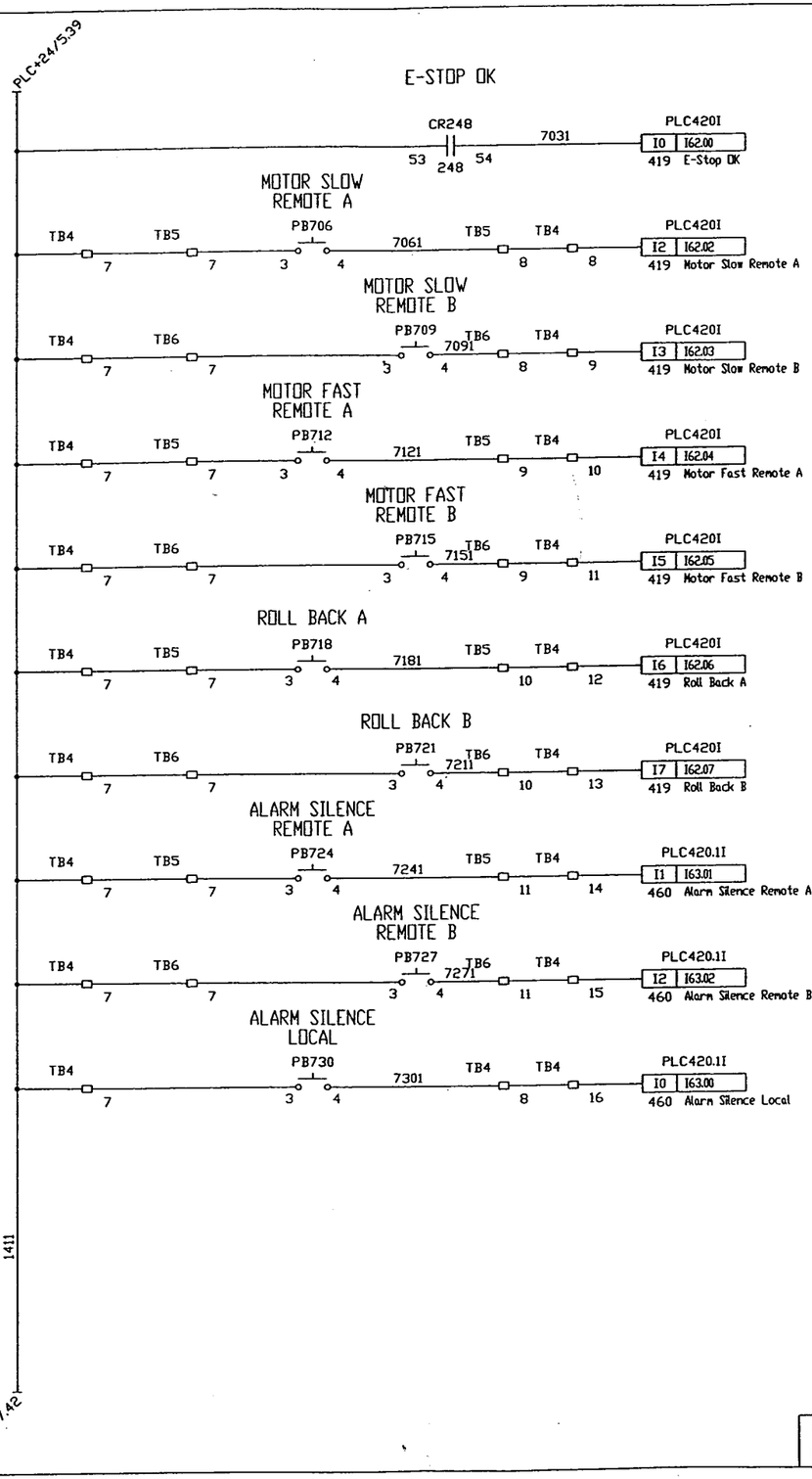
DRAWN BY:	DATE:	REV BY:	DATE:	PROJECT:	PAGE DESCRIPTION	DRAWING-NO.:	JOB-NO.:	PAGE:
LDW	8-31-01			BIO-MIXER	PLC BASE & INPUT	0110223	BM01-3123	4 OF 11

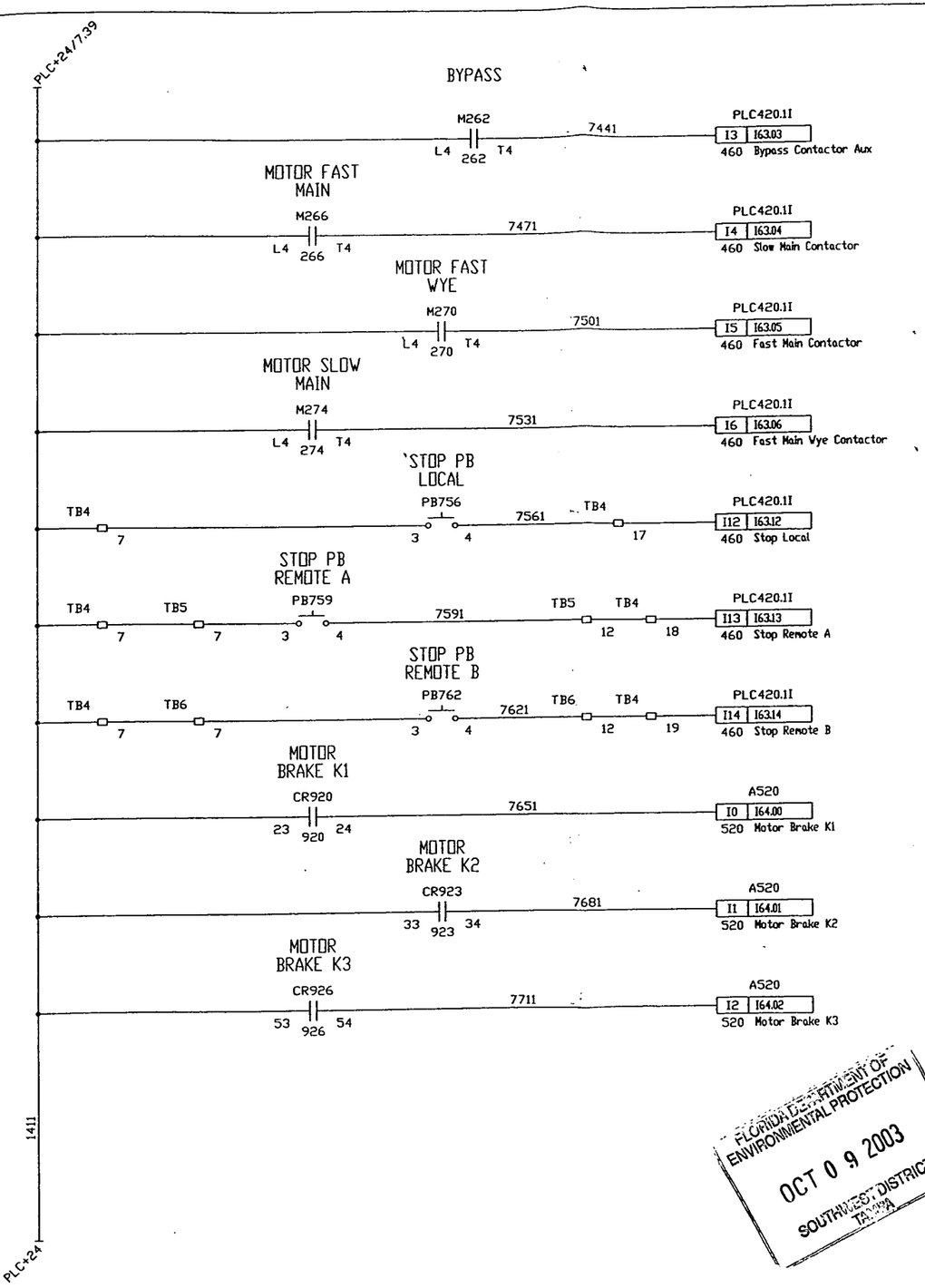


DRAWN BY:	DATE:	REV BY:	DATE:	PROJECT:	PAGE DESCRIPTION	DRAWING-NO:	JOB-NO:	PAGE:
LDW	8-31-01			BIO-MIXER	PLC INPUT & OUTPUT	0110223	BM01-3123	5 OF 11



DRAWN BY:	DATE:	REV BY:	DATE:	PROJECT:	PAGE DESCRIPTION	DRAWING-NO.:	JOB-NO.:	PAGE:
LDW	8-31-01			BIO-MIXER	PLC OUTPUT	0110223	BM01-3123	6 OF 11





DRAWN BY:	DATE:	REV BY:	DATE:	PROJECT:	PAGE DESCRIPTION	DRAWING-NO.:	JOB-NO.:	PAGE:
LDW	8-31-01			BIO-MIXER	INPUTS	0110223	BM01-3123	7 OF 11

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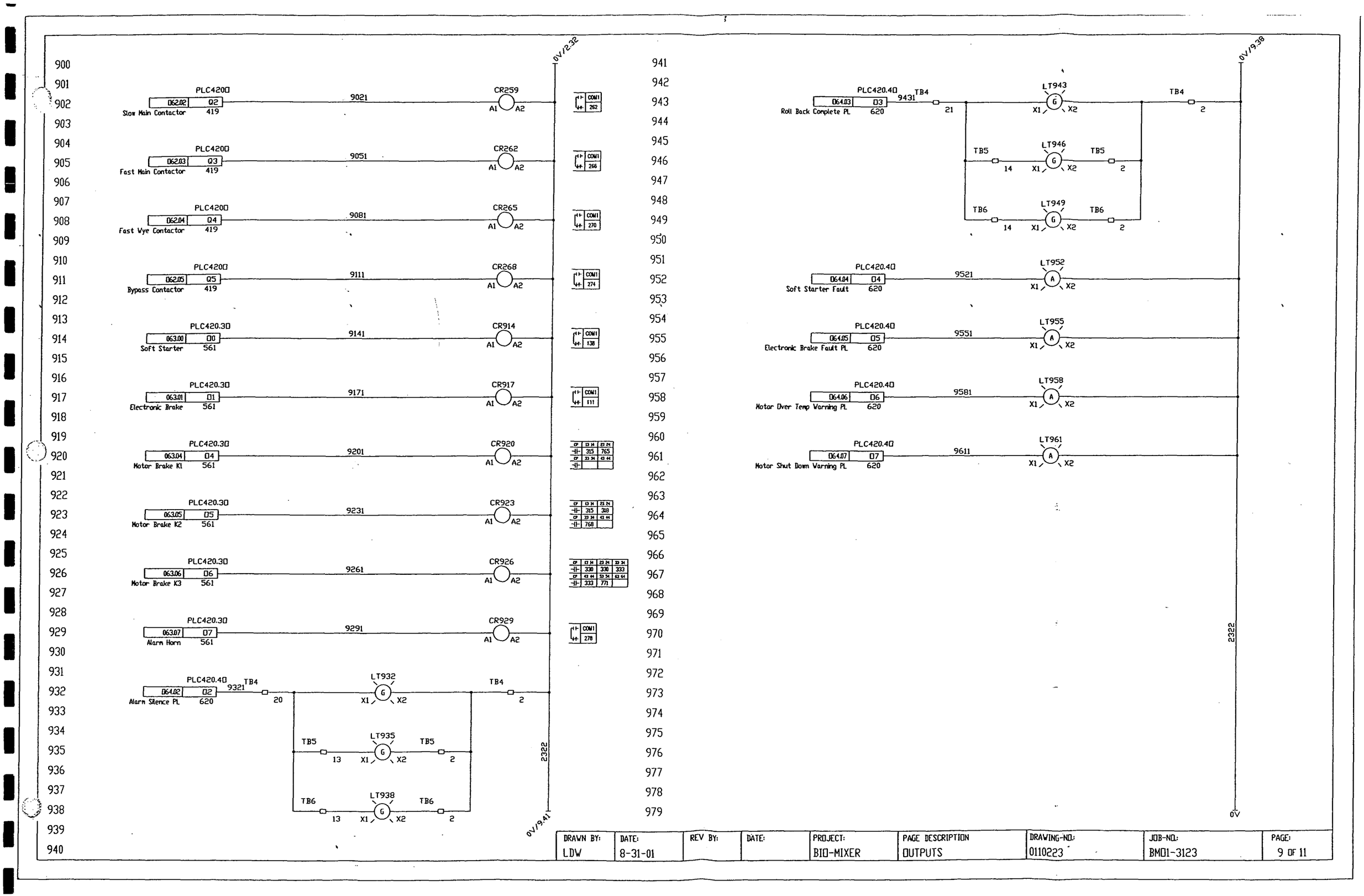
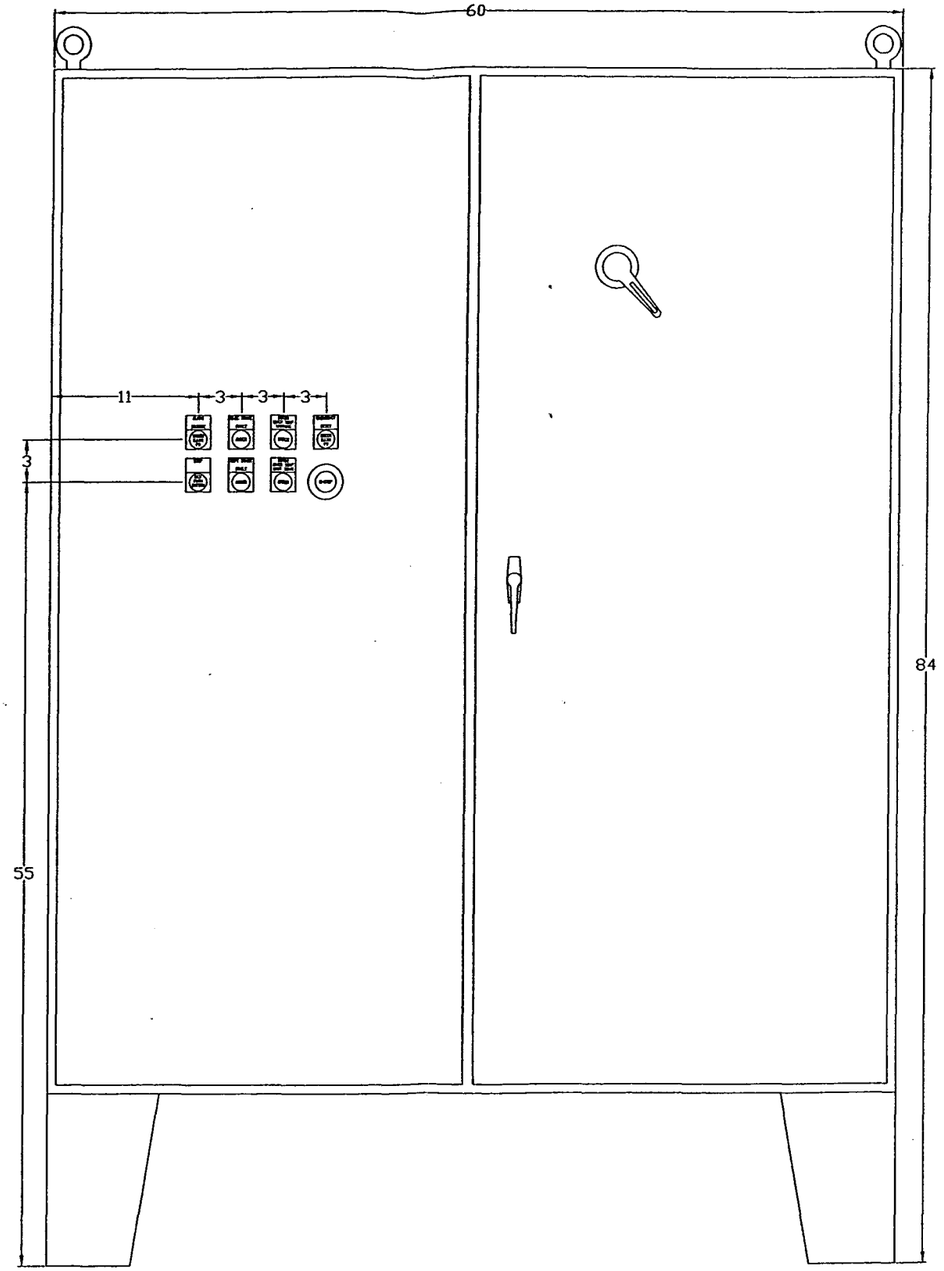
DRAWN BY:	DATE:	REV BY:	DATE:	PROJECT:	PAGE DESCRIPTION	DRAWING-NO.:	JOB-NO.:	PAGE:
LDW	8-31-01			BIO-MIXER		0110223	BM01-3123	8 OF 11



DRAWN BY:	DATE:	REV BY:	DATE:	PROJECT:	PAGE DESCRIPTION	DRAWING-NO:	JOB-NO:	PAGE:
LDW	8-31-01			BIO-MIXER	OUTPUTS	0110223	BM01-3123	9 OF 11



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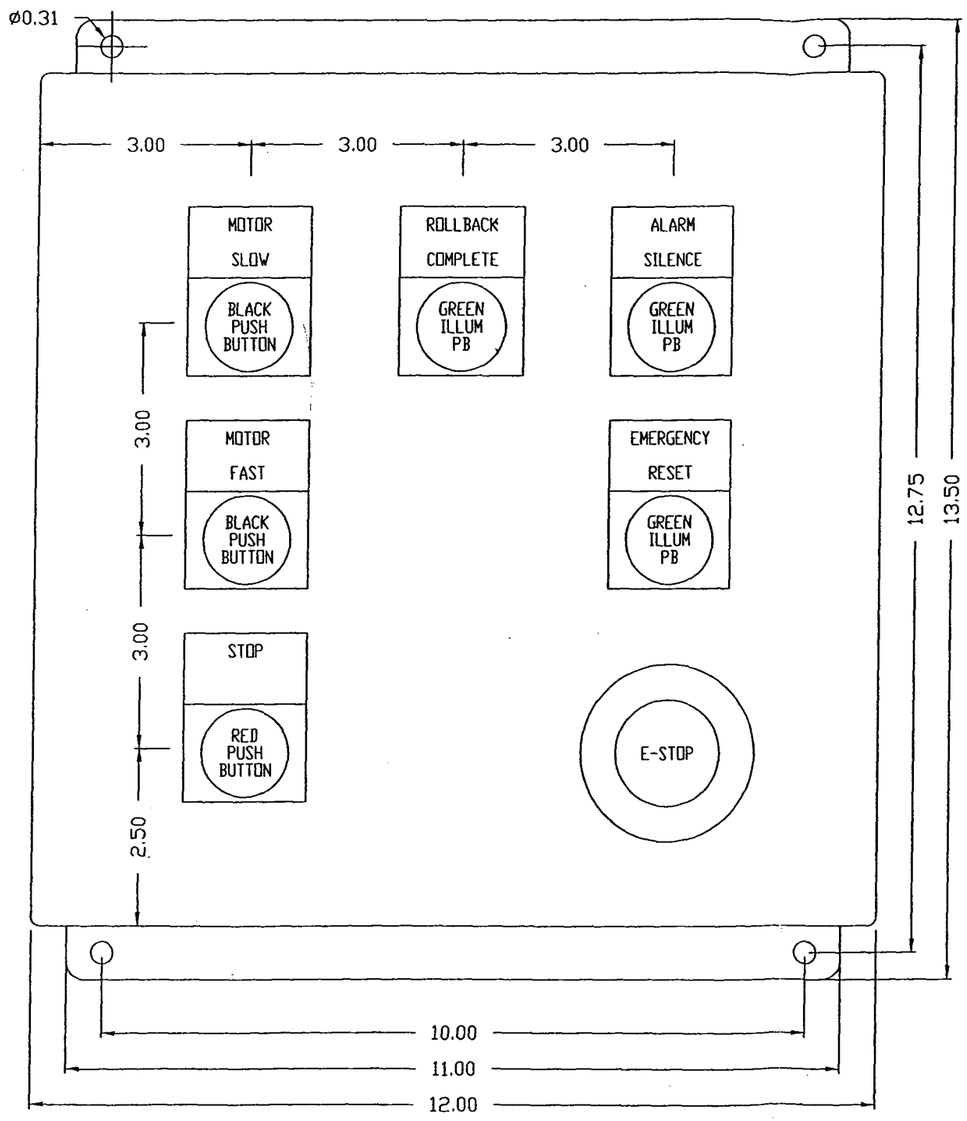
LYLE	10-3-01			BIO-MIXER	ENCLOSURE	0110223	BM01-3123	10 OF 11



Enclosure To Be:
NEMA 4X Stainless Steel

DRAWN BY:	DATE:	REV BY:	DATE:	PROJECT:	PAGE DESCRIPTION	DRAWING-NO.:	JOB-NO.:	PAGE:
LYLE	10-4-01			BIO-MIXER	REMOTE CONTROLS	0110223	BM01-3123	11 OF 11

Section 8 – Discharge Doors and Air Piping

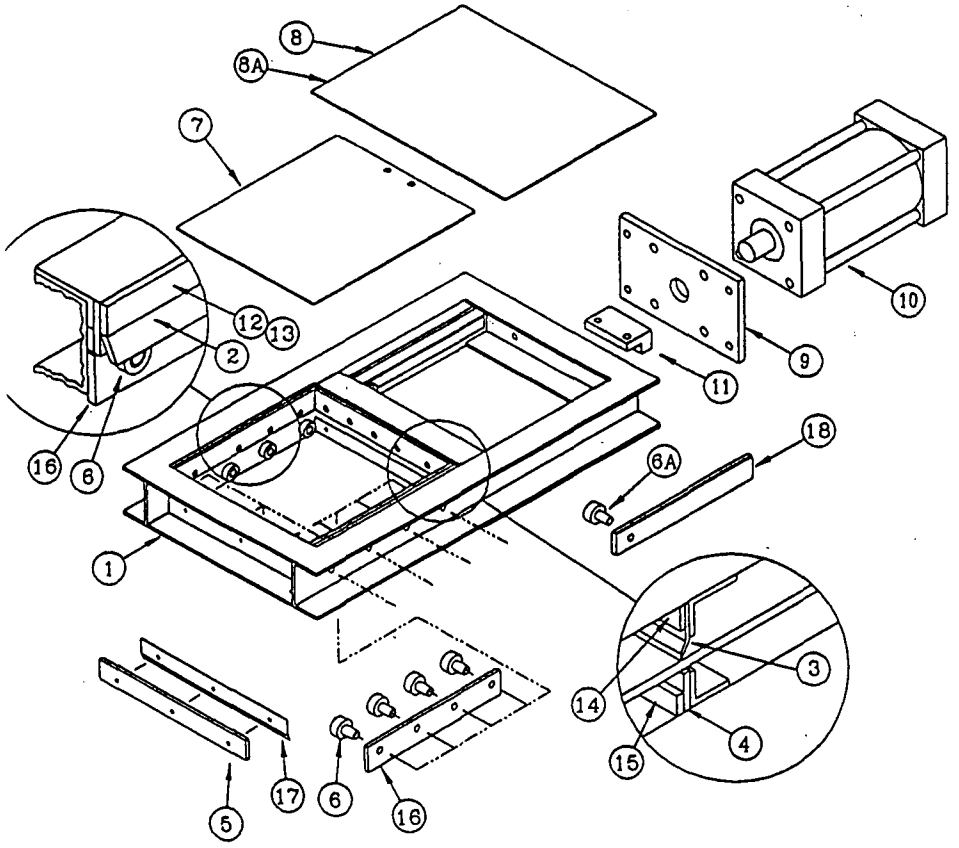
SALINA VORTEX® CORP.
3024 ARNOLD AVENUE / SALINA, KANSAS 67401
TELEPHONE (913) 825-7177

AGGREGATE GATE VALVE MAINTENANCE-REPAIR

MODEL: A(SIZE) AGGREGATE VALVE, AIR CYLINDER ACTUATOR

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
00	A AGGREGATE VALVE	09	CYLINDER MOUNT
01	FRAME ASSEMBLY	** 10	AIR CYLINDER
02	SIDE SEAL	11	CLEVIS
03	** UPPER BONNET SEAL	12	SIDE SEAL RETAINER-LH
04	** LOWER BONNET SEAL	13	SIDE SEAL RETAINER-RH
05	** END SEAL	14	UPPER SEAL RETAINER
06	** SLIDE ROLLER	15	LOWER SEAL RETAINER
06A	** BONNET ROLLER	16	ROLLER SPACER
07	SLIDE BLADE	17	END SEAL RETAINER
08	UPPER COVER PLATE	18	BLADE GUIDES
08A	LOWER COVER PLATE		

** INDICATES PARTS THAT REQUIRE REPLACEMENT DUE TO WEAR OR INADVERTENT DAMAGE.



SALINA VORTEX® CORP.
3024 ARNOLD AVENUE / SALINA, KANSAS 67401
TELEPHONE (913) 825-7177

GENERAL MAINTENANCE INFORMATION
Field Installation
SW9701

BEFORE SERVICING EQUIPMENT:
De-Energize and Lockout all Electrical connections.
Lockout all pneumatic and or hydraulic power from the valve assembly.
Follow all other applicable lockout/tagout procedures.

DIS-ASSEMBLY FOR BLADE REPLACEMENT

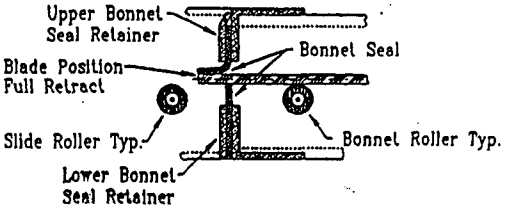
01. Retract the Slide Blade (07) to a mid-position.
02. Remove the (2) Cover Plates (08 & 08A) from the Aggregate Gate.
03. Remove the Clevis (11) from the Slide Blade (07).
04. Remove the Bonnet Slide Rollers (06a) to allow for removal of the Slide Blade.
05. With the Air Cylinder Shaft (10) in the fully RETRACTED position, pull the Slide Blade up and towards the Air Cylinder end. Remove the Slide Blade from the assembly.
06. Remove all of the Seal Retainers (12, 13, 14, 15, & 17) and the Seals (02, 03, 04, & 05)

RE-ASSEMBLY

07. Replace the Slide Blade.
08. Replace and or install the Slide Rollers and Bonnet Rollers. Tighten into position.
09. Place the (2) Side Seals (02), End Seal (05), and the Bonnet Seals (03 & 04) into position. Minute adjustment may have to be made on the length/width of the Seal Assembly. The joints should be "snug" where the Side Seal and Upper Seal join.
10. Replace the Seal Retainers. Bonnet Seal Retainers (14 & 15) first, then Side Seal Retainers (12 &13) and End Seal Retainer (17).
12. Replace the Clevis onto the Blade. In the FULL OPEN position, Slide Blade Retracted, the leading edge of the Slide Blade should be flush with the Upper Bonnet Seal (03). MAXIMUM distance allowed past the Upper Bonnet Seal is 1/8". If there is more than 1/8" protrusion, the Slide Blade will receive excessive wear.
13. Replace the (2) Cover Plates.

Hardened Steel Rollers

14. With the Roller Gate in the closed position, remove the silicon plug from the interior portion of the Slide Roller.
15. Insert a suitable tool and drive the steel plug out of the Slide Roller.
16. Hold the Slide Roller in place with a 1/4" allen wrench and remove the retaining nut.
17. Install the new Slide Roller and use the allen wrench the secure the bearing.
18. Make sure the new Slide Roller is fully greased. Insert the steel plug and tap it until the pin is flush with the bearing face.
19. Put a small amount of silicon in the inner portion of the bearing, this will will prevent dirt from degrading the seals on the Slide Roller.



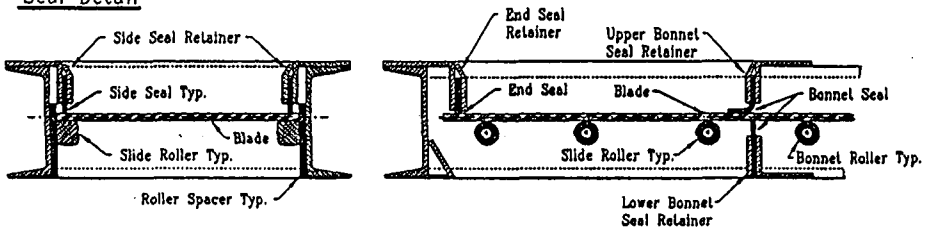
SALINA VORTEX® CORP.
3024 ARNOLD AVENUE / SALINA, KANSAS 67401
TELEPHONE (913) 825-7177

GENERAL MAINTENANCE INFORMATION
Field Installation
SW9701

FIELD INSTRUCTIONS FOR SEAL REPLACEMENT

01. Extend the Slide Blade (07) to the FULL EXTEND Position.
02. Remove all Seal Retainers (12, 13, 14, 15, & 17) from the Gate Valve.
03. Remove all Seals (02, 03, 04, & 05) from the Gate Valve.
04. Place the (2) Side Seals (02), End Seal (05), and the Bonnet Seals (03 & 04) into position. Minute adjustment may have to be made on the length/width of the Seal Assembly. The joints should be "snug" where the Side Seal and Upper Seal join.
05. Replace the Seal Retainers. Bonnet Seal Retainers (14 & 15) first, then Side Seal Retainers (12 &13) and End Seal Retainer (17).

Seal Detail

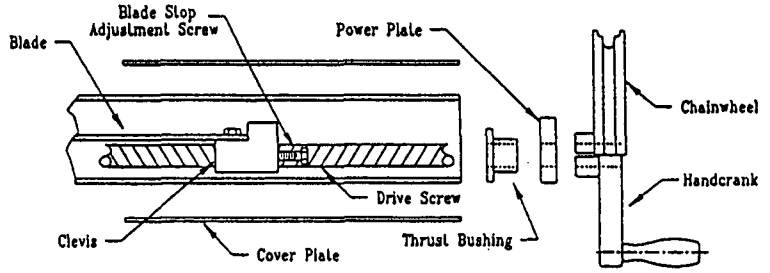


GENERAL MAINTENANCE INFORMATION
Field Installation - Drive Screw - Thrust Bushing - Clevis

MODEL: A (size) Salina Aggregate Gates:: Chainwheel - Handcrank (Manual Actuator)

01. Remove the (2) Power Covers (08 & 08A) from the bonnet area of the Aggregate Gate.
02. Open the Aggregate Gate to the 1/2 Open position. This allows access to the bolts securing the Clevis (16) to the Slide Blade (07).
03. Unbolt and remove the Clevis from the Slide Blade. This has to be removed to allow the manual positioner to be removed.
04. To remove the Drive Screw, remove the bolts securing the Power Plate (21) to the Gate Frame (01). With these bolts removed, the Drive Screw and Thrust Bushing (18) may now be unscrewed from the Drive Screw/Clevis Assembly.
05. With the Clevis off of the Drive Screw, The Drive Screw may now be removed from the Gate by pulling it through the bonnet area of the Gate.
06. Insert the new Power Screw through the bonnet area of the Gate. Screw on the Clevis and bolt the Clevis to the Gate Blade.
07. Replace the Thrust Bushing onto the Drive Screw and screw the assembly in until the Flange Bearing is snug against the Power Plate of the Gate. Bolt the Power Plate into place.
08. Replace the Manual Actuator (20) and tighten the pinch bolt securely to the Drive Screw.
09. To adjust the stroke of the Aggregate Gate: Open Position: There are (2) bolts extending from the rear of the Clevis assembly. These bolts HAVE to be adjusted to stop the Gate Blade from being out of the Bonnet Seals (03 & 06) in the Open position. TO ADJUST: Open the Gate until The Blade is in the Open position, flush with the Upper Bonnet Seal. Adjust the (2) bolts so they will butt against the end frame of the gate, and stop the Blade Travel.
10. Replace the (2) Cover Plates.

Handcrank / Chainwheel Assembly



SALINA VORTEX® CORPORATION
3024 Arnold Avenue Salina, Kansas 67401-8105
Telephone (785) 825-7177 FAX (785) 825-7194
Home Page: www.svortex.com / e-mail: vortex@svortex.com

ASSEMBLY: L48Y
JR9804

L48YCOMPOST.DWG

DIMENSIONAL INFORMATION
BASIC ASSEMBLY UNIT: AGGREGATE GATE VALVE, AIR CYLINDER ACTUATOR
MODEL: A48-X

MOUNTING:
THE GATE IS TO BE MOUNTED IN THE HORIZONTAL POSITION WITH THE "INLET" UP.

ACTUATION:
8" BORE DOUBLE ACTING MAGNETIC AIR CYLINDER. THE AIR CYLINDER REQUIRES A MINIMUM OF 80 PSIG, FILTERED, COMPRESSED AIR FOR THE MOST RELIABLE SERVICE. LUBRICATION OF THE AIR CYLINDER IS NOT REQUIRED BUT IS RECOMMENDED FOR EXTENDED WEAR LIFE OF THE CYLINDER.

AIR USAGE:
8.87 SCF FOR (1) OPEN OR (1) CLOSE STROKE OF THE AIR CYLINDER.

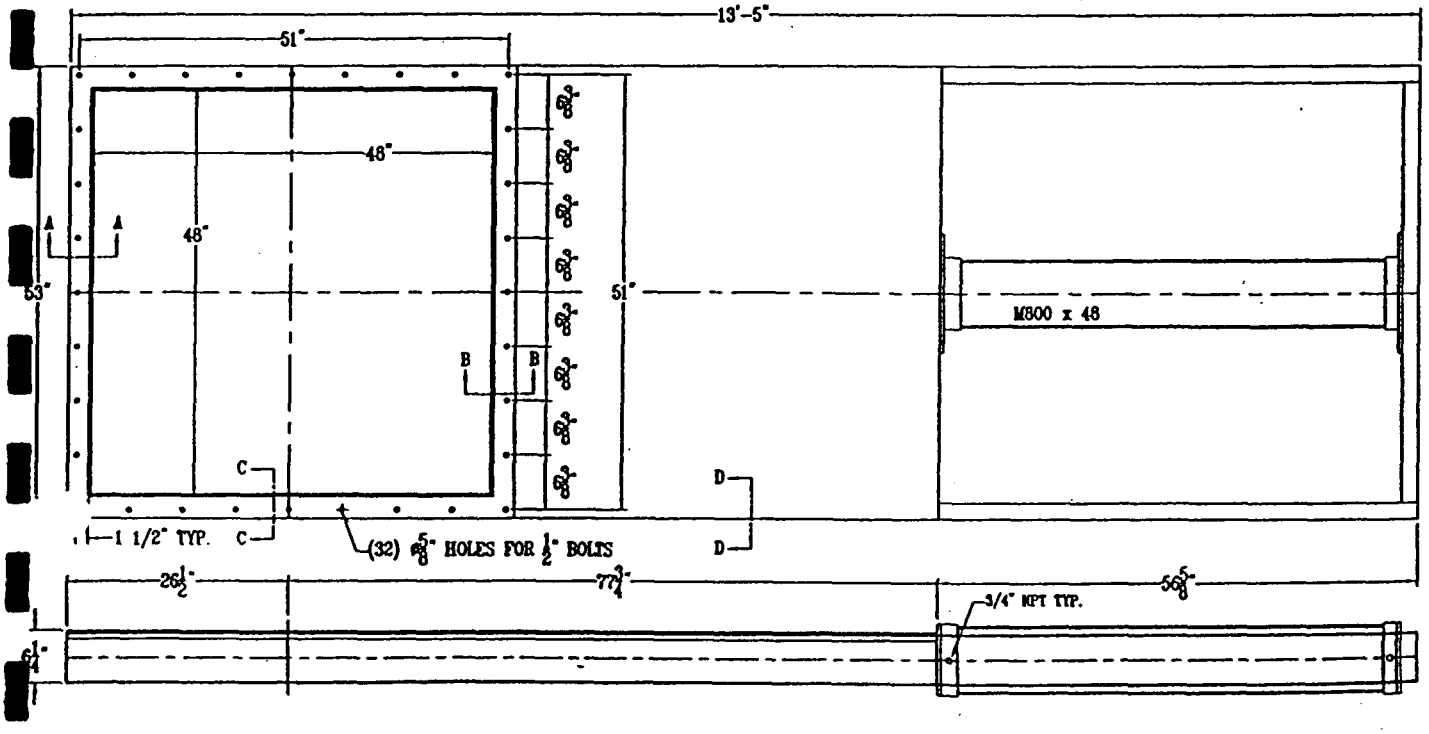
AIR CONTROL:
A 2 POSITION, 4 WAY LEVER OR SOLENOID OPERATED COMPRESSED AIR CONTROL REQUIRES A MINIMUM FLOW OF 5.0 Cv TO OPERATE THE ACTUATING AIR CYLINDER.

HOLES FOR FLANGE ATTACHMENT:
(32) 9/16" DIA. HOLES FOR 1/2 BOLTS. (PER FLANGE)

TEMPERATURE:
180°F MAXIMUM CONTINUOUS SERVICE.

APPROX GATE VALVE WEIGHT:
1100 LBS. WITH AIR CYLINDER ACTUATOR.

CONSTRUCTION:
CARBON STEEL CHANNEL FRAME, MULTI-PLY RUBBER SEALS.
BLADE: 5/8" AR PLATE.
DESIGNED FOR DRY MATERIAL IN GRAVITY FLOW APPLICATIONS.



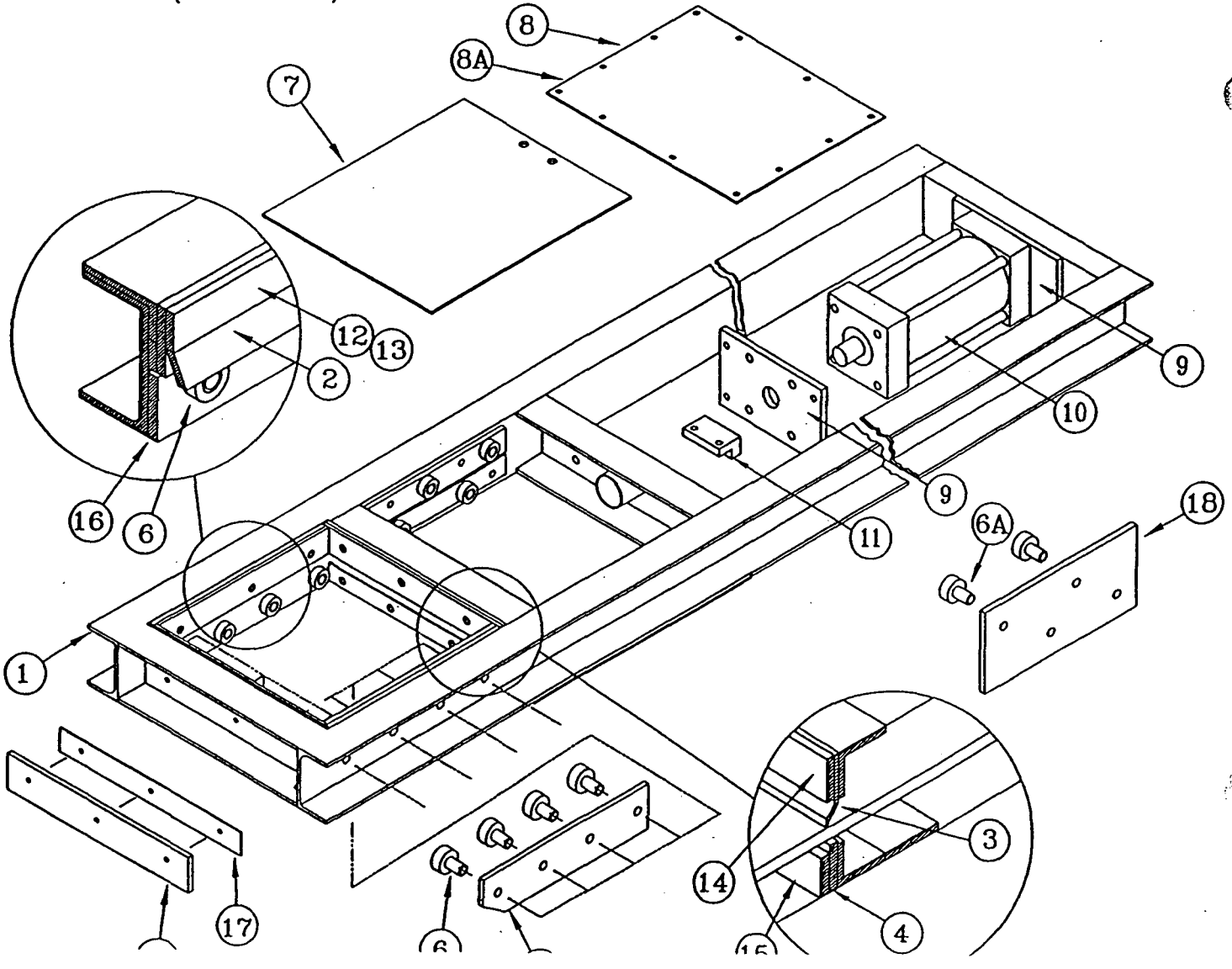
ASSEMBLY: L48Y
PARTS LIST

BASIC ASSEMBLY UNIT: AGGREGATE GATE VALVE, AIR CYLINDER ACTUATOR
MODEL: A48-X

ITEM NO.	DESCRIPTION	QTY. EA.
00	A48 AGGREGATE VALVE	1 EA
01	FRAME ASSEMBLY	1 EA
02	** SIDE SEAL	2 EA
03	** UPPER BONNET SEAL	1 EA
04	** LOWER BONNET SEAL	1 EA
05	** END SEAL	1 EA
06	** SLIDE ROLLER ø1 1/4"	20 EA
06A	** BONNET ROLLER ø1 1/4"	30 EA
07	SLIDE BLADE *5/8 AR PLATE*	1 EA
08	UPPER COVER PLATE (CARBON STEEL)	1 EA
08A	LOWER COVER PLATE (EXPANDED METAL)	1 EA

ITEM NO.	DESCRIPTION	QTY. EA.
09	CYLINDER MOUNT	2 EA
** 10	AIR CYLINDER 800 x 48	1 EA
11	CLEVIS	1 EA
12	SIDE SEAL RETAINER-LH	1 EA
13	SIDE SEAL RETAINER-RH	1 EA
14	UPPER SEAL RETAINER	1 EA
15	LOWER SEAL RETAINER	1 EA
16	ROLLER SPACER	2 EA
17	END SEAL RETAINER	1 EA
18	BLADE GUIDES	2 EA

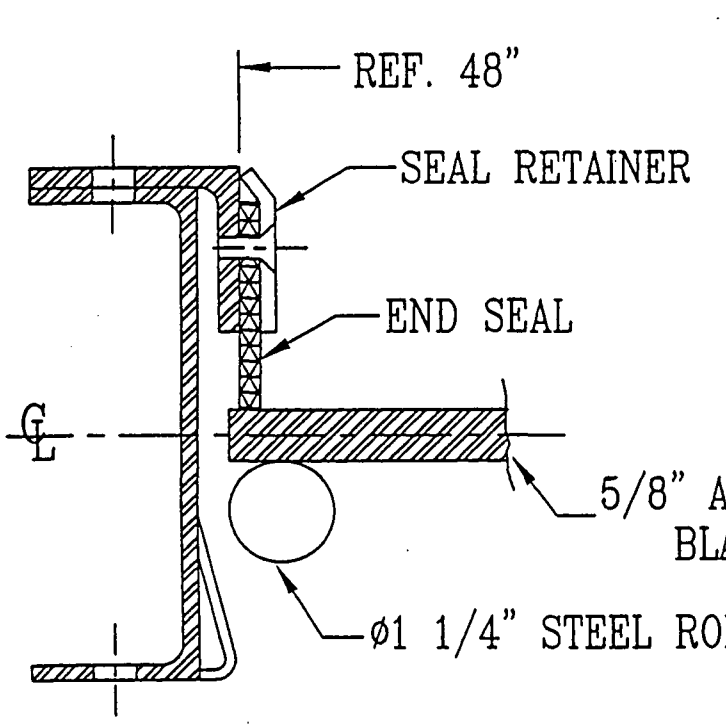
** INDICATES PARTS THAT REQUIRE REPLACEMENT DUE TO WEAR OR INADVERTENT DAMAGE.



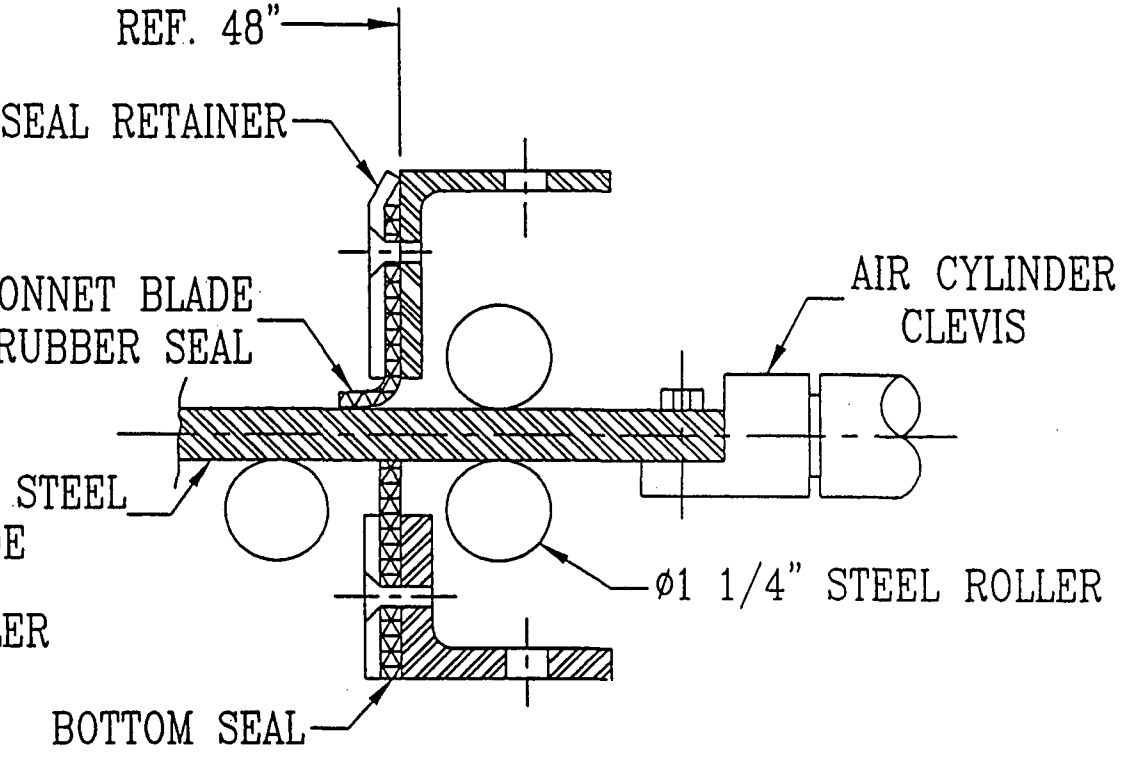
CUST ER: _____ VON: _____

TITLE:	SALINA VORTEX CORP.®	QUAN: _____ FAB BY: _____ TO SHIP: _____ COMPLETE: _____	MFG #: DATE: 9804 DRAWN BY: JLR DWG. NAME: A48 FAB
AGG 48 x 48 SECTION VIEWS			

ITEM:	QUAN:	MATERIAL DESCRIPTION
1	1	CHANNEL, HR CARBON STEEL, C6 x 8.2



SECTION A-A

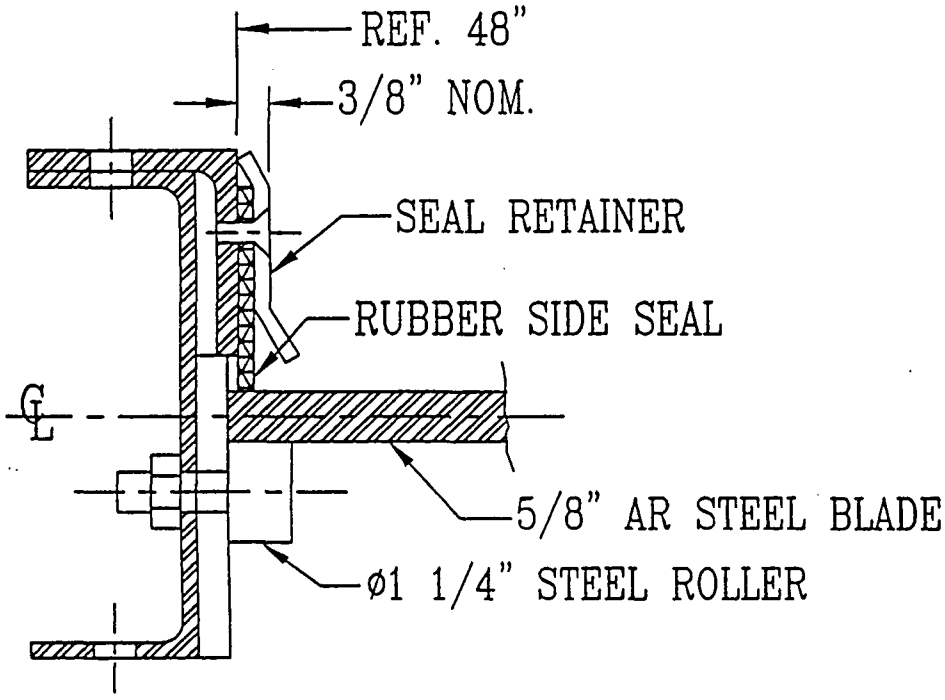


SECTION B-B

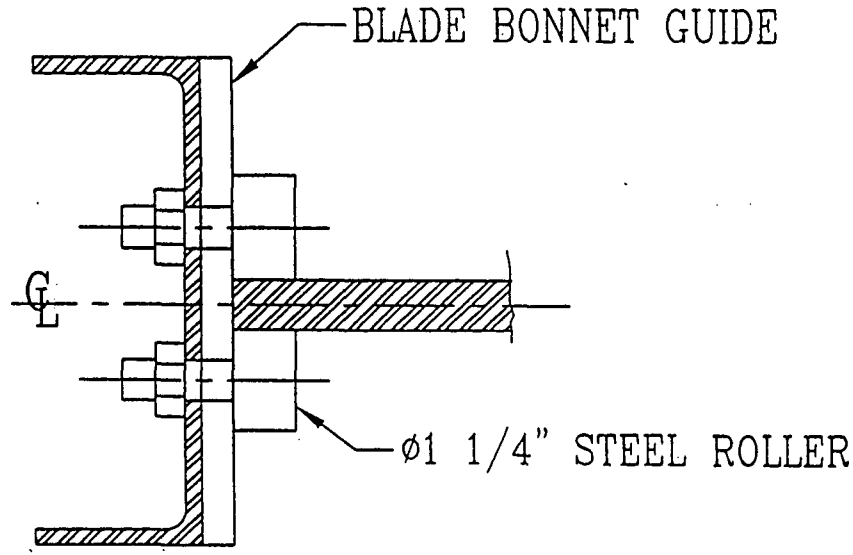
CUST[illegible]ER: _____ VON: _____

TITLE:	SALINA VORTEX CORP.®	QUAN: _____ FAB BY: _____ TO SHIP: _____ COMPLETE: _____	MFG #: DATE: 9804 DRAWN BY: JLR DWG. NAME: A48 FAB
AGG 48 x 48 SECTION VIEWS			

ITEM:	QUAN:	MATERIAL DESCRIPTION
1	1	CHANNEL, HR CARBON STEEL, C6 x 8.2



SECTION C–C

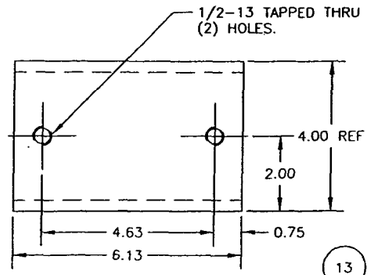


SECTION D–D

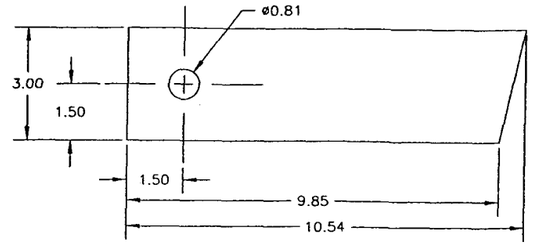
ITEM	QTY	DESCRIPTION	MAT'L SIZE	MAT'L	PART NO./NOTES
1	50 ft	SUPPLY LINE	1-1/8"O.D. x .050" WALL	COPPER	1" NOMINAL, TYPE L
2	35 ft	SUPPLY LINE - VALVE TO CYLINDER	7/8"O.D. x .045" WALL	COPPER	3/4" NOMINAL, TYPE L
3	4	4-WAY AIR CONTROL VALVE	3/4" NPT		NOPAK P/N H4A-6-SRN
4	4	MALE BRANCH TEE	1-1/8"O.D. TUBE x 3/4" NPT		COMPRESSION FITTING
5	8	MALE 90° ELBOW	7/8"O.D. TUBE x 3/4" NPT		COMPRESSION FITTING
6	2	MALE UNION	1-1/8"O.D. TUBE x 1" NPT		COMPRESSION FITTING
7	8	MALE UNION	7/8"O.D. TUBE x 3/4" NPT		COMPRESSION FITTING
8	8	SUPPORT LEG	1/2" x 3.0" x 10.54"LG	A36	4.3 LBS
9	8	HEX BOLT	3/4"-10 x 2.0"LG	GRADE 5	
10	8	HEX NUT	3/4"-10	GRADE 5	
11	16	FLAT WASHER	3/4"		
12	4	EXHAUST MUFFLER/FILTER	3/4" NPT		
13	4	BASE	C4x7.25 x 6.13" LG	A-36	
14	8	HEX BOLT	1/2-13 x 1.25" LG	GRADE 5	
15		TUBING SUPPORT	2.7" H x 2.8" W x 1.2" DP	SEED PLATE POLYPROPYLENE	QUANTITY AS NEEDED
16		TUBING SUPPORT	1.8" H x 2" W x 1.2" DP	SEED PLATE POLYPROPYLENE	QUANTITY AS NEEDED

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE FOR QUOTE PURPOSES ONLY	10/2/2001	SMK

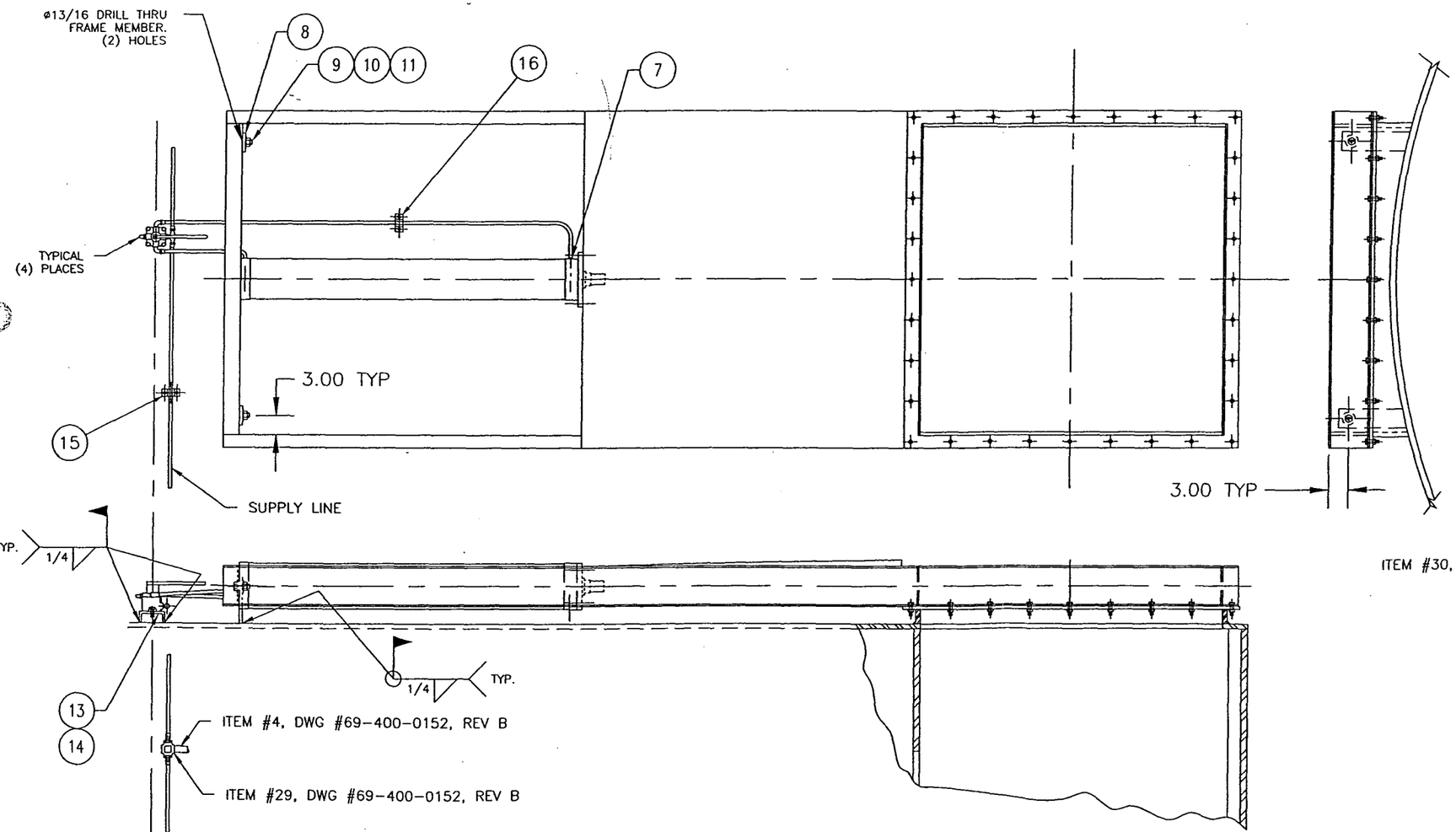
#	DESCRIPTION	DATE	APPROVED
A	RELEASED FOR MANUFACTURING	10/02/2001	smk1
B	ADDED ITEMS #15 & 16	11/27/2001	SMK1



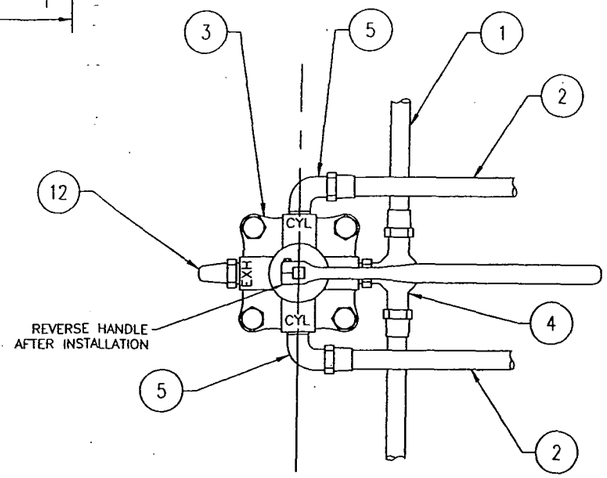
13 BASE
QTY REQ'D :4
MATR'L : A36
STOCK : C4x7.25 x 6.13" LG
SCALE : 5x
WEIGHT : 3.7 LBS

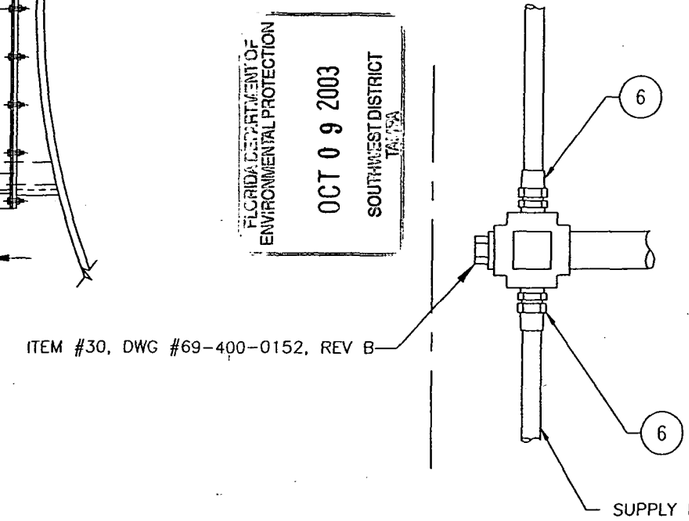


8 SUPPORT LEG
QTY REQ'D :8
MATR'L : A36
STOCK : 1/2" x 3.0" x 10.54"LG
SCALE : 5x
WEIGHT : 4.3 LBS



DETAIL AIR CONNECTIONS FOR
HYDRAULIC CYLINDERS
SEE DWG#69-400-0152





ITEM #30, DWG #69-400-0152, REV B

REMOVE ALL BURRS, SHARP EDGES, ETC

JOB NAME: SUMTER COUNTY SOLID WASTE

CONFIDENTIAL - PROPERTY OF: a-c equipment services, MILWAUKEE, WISCONSIN U.S.A.

NAME: CYLINDER AIR SUPPLY DISCHARGE DOOR

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982.
LIMITS UNLESS OTHERWISE NOTED
LINEAR: ANGLES: ±.50°
.X ±.06
.XX ±.03
.XXX ±.01
125 MACHINED SURFACE TEXTURE

MAT'L: SEE PARTS LIST

AUTOCAD FILE: 69-4157

DR. smk1 10/02/2001
CH.
AP.

JOB NO. BM01-3123
SCALE 1:10
SHEET 1 OF1
THIRD ANGLE PROJECTION
REFERENCE DWG:
SIZE D
PART NO. 69-400-0157
REVISION B

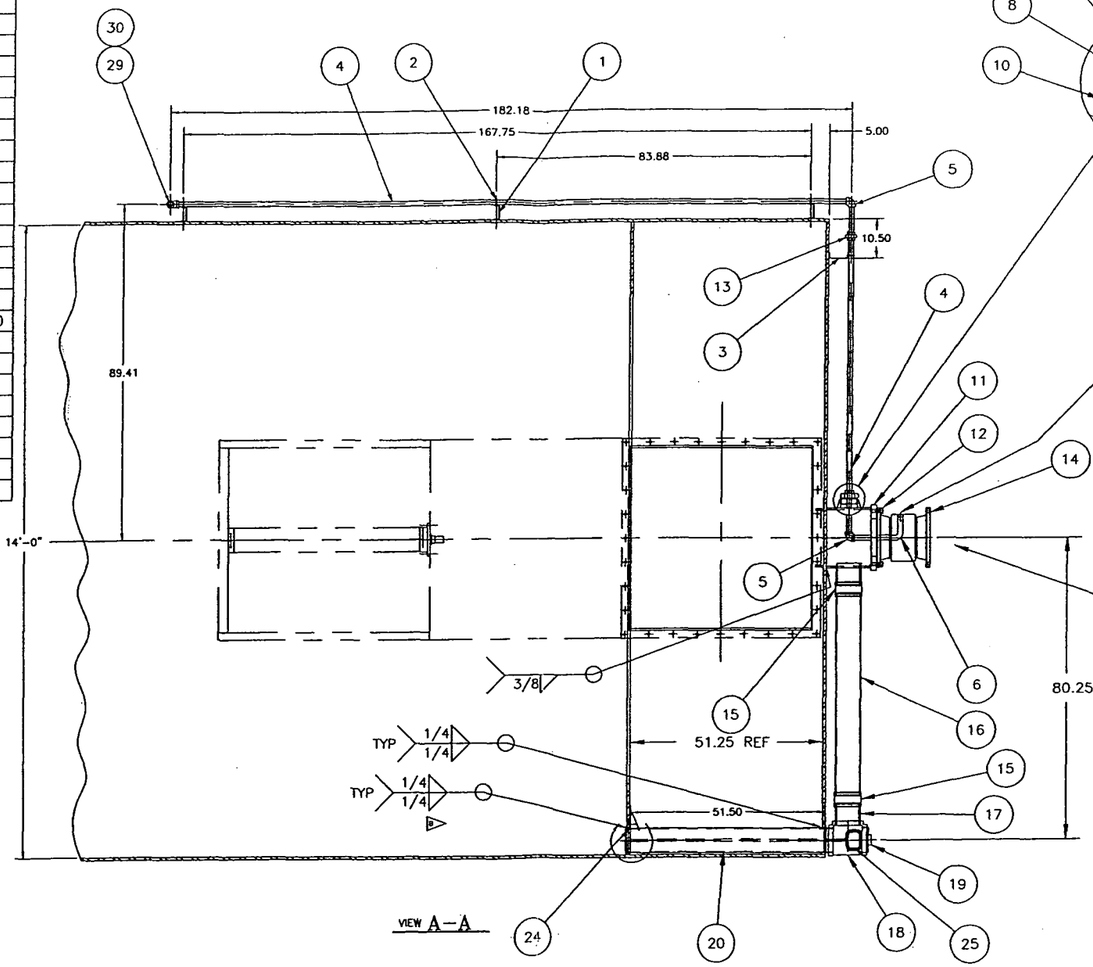
Nov 27, 2001 - 13:28

F:\Engineer\ACD\WGS\BioMixers\SumterCo\BM01-3123\69-4157.dwg, 11/29/2001 08:28:20 AM, SMK1, 11x17, 1:19.9842

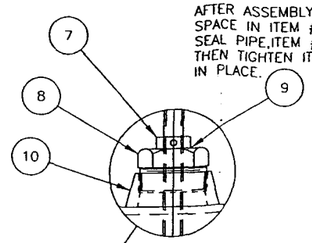
ITEM	QTY	DESCRIPTION	MAT'L SIZE	MAT'L	PART NO./NOTES
1	3	SUPPORT BRACKET	C4x5.4 CHANNEL x 2.25" LG	ASTM A-36	MANUFACTURED
2	4	U-BOLT	1" IPS, 3/8-16 THD		
3	1	SUPPORT BRACKET	3/16" x 2-1/2" x 7.85" LG		MANUFACTURED
4	24 FT	PIPE	1" Sch 40		THREADED BOTH ENDS
5	2	ELBOW - 90°	1" NPT		SUPPLIED WITH COUPLING
6	1	PIPE	1" Sch 40		SUPPLIED WITH COUPLING
7	1	SHAFT COLLAR	1 3/8" I.D.		MODIFIED
8	1	PIPE PLUG	4" NPT		MANUFACTURED
9	1	BLUE RTV SEALANT			
10	1	THREADED ANVILET	4" NPT		
11	1	MANIFOLD	ø16" x 12" LG		MANUFACTURED
12	12	HEX BOLT	7/8-9 x 2 1/2" LG	GR2	
13	1	UNION	1" NPT	A105	
14	1	SWIVEL JOINT w/O-RING FLANGE SEALS	10"		ROTARY SYSTEMS
15	4	FLEXIBLE PIPE COUPLING	6" IPS		
16	2	TUBE	6 5/8" OD x 12Ga x 54" LG		
17	2	NIPPLE	6" Sch 40 x 6" LG		
18	2	STRAIGHT TEE	6" NPT		
19	2	PIPE PLUG	6" NPT	CAST IRON	
20	2	PIPE	6" Sch 40 x 55" LG		
21	1	PIPE	16" Sch 40 x 12" LG		83 LBS, FOR MANIFOLD
22	2	PIPE	6" Sch 40 x 6.0" LG		9.5 LBS, FOR MANIFOLD
23	1	FLANGE PLATE	1-3/4" x ø17.50" OD		80 LBS, FOR MANIFOLD
24	2	SCREEN STOP	1/2" x ø6.00 OD x ø5.00 ID	ASTM A-36	1.2 LBS
25	2	DEBRIS SCREEN/CLEANER		ASTM A-36	9 LBS
26	2	SCREEN	1/2" x ø5.82" OD	ASTM A-36	1.5 LBS
27	2	POSITIONER	1/2" x ø5.82" OPD	ASTM A-36	1 LB
28	2	HANDLE	ø5/8" ROD x 72.91" LG	ASTM A-36	6.4 LBS
29	1	TEE	1" NPT	A105	
30	1	PIPE PLUG	1" NPT	A105	

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	9/26/2001	SMK
	FOR QUOTE PURPOSES ONLY		

#	DESCRIPTION	DATE	APPROVED
A	RELEASED FOR MANUFACTURING	09/27/2001	smk1
	ADDED ITEMS #24-#30		
B	ADJUSTED BULKHEAD & RINGDAM PLATE TO 3/4" THICK	10/10/2001	smk1
	CHANGED WELD SYMBOL TO FILLET WELDS		



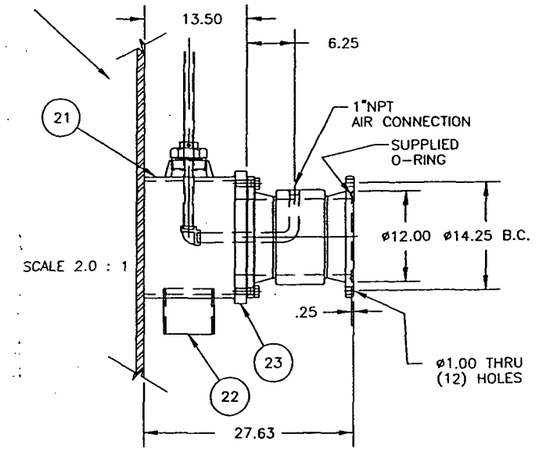
AFTER ASSEMBLY, FILL SPACE IN ITEM #8 TO SEAL PIPE, ITEM #4 THEN TIGHTEN ITEM #7 IN PLACE.



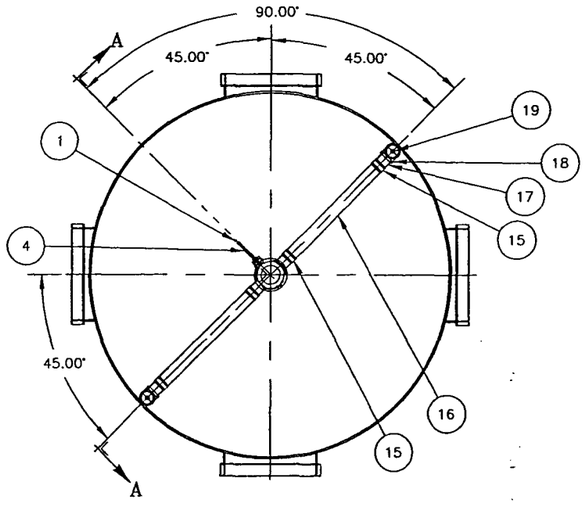
SCALE 4.0 : 1

1" AIR IN THREADED CONNECTION ON SWIVEL

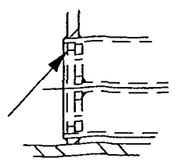
10" AIR IN FLANGED CONNECTION



SCALE 2.0 : 1



SCALE 1.0 : 2



DETAIL A
SCALE 1:5

REMOVE ALL BURRS, SHARP EDGES, ETC

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL.

CONFIDENTIAL - PROPERTY OF: a-c equipment services, MILWAUKEE, WISCONSIN U.S.A.

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED
LINEAR: ANGLES: ±.50'
.X ±.05
.XX ±.03
.XXX ±.01

125 MACHINED SURFACE TEXTURE

NAME: AIR INJECTION SYSTEM & ACTUATING AIR SUPPLY

MAT'L: SEE PARTS LIST

AUTOCAD FILE: 69-4152A

R WT F

DR. smk 10/25/2001
CH. ——— ———
AP. ——— ———

JOB NO. BM01-3123

THIRD ANGLE PROJECTION

REFERENCE DWG:

SIZE D

SCALE 1:20

SHEET 1 OF 3

PART NO. 69-400-0152

REVISION B

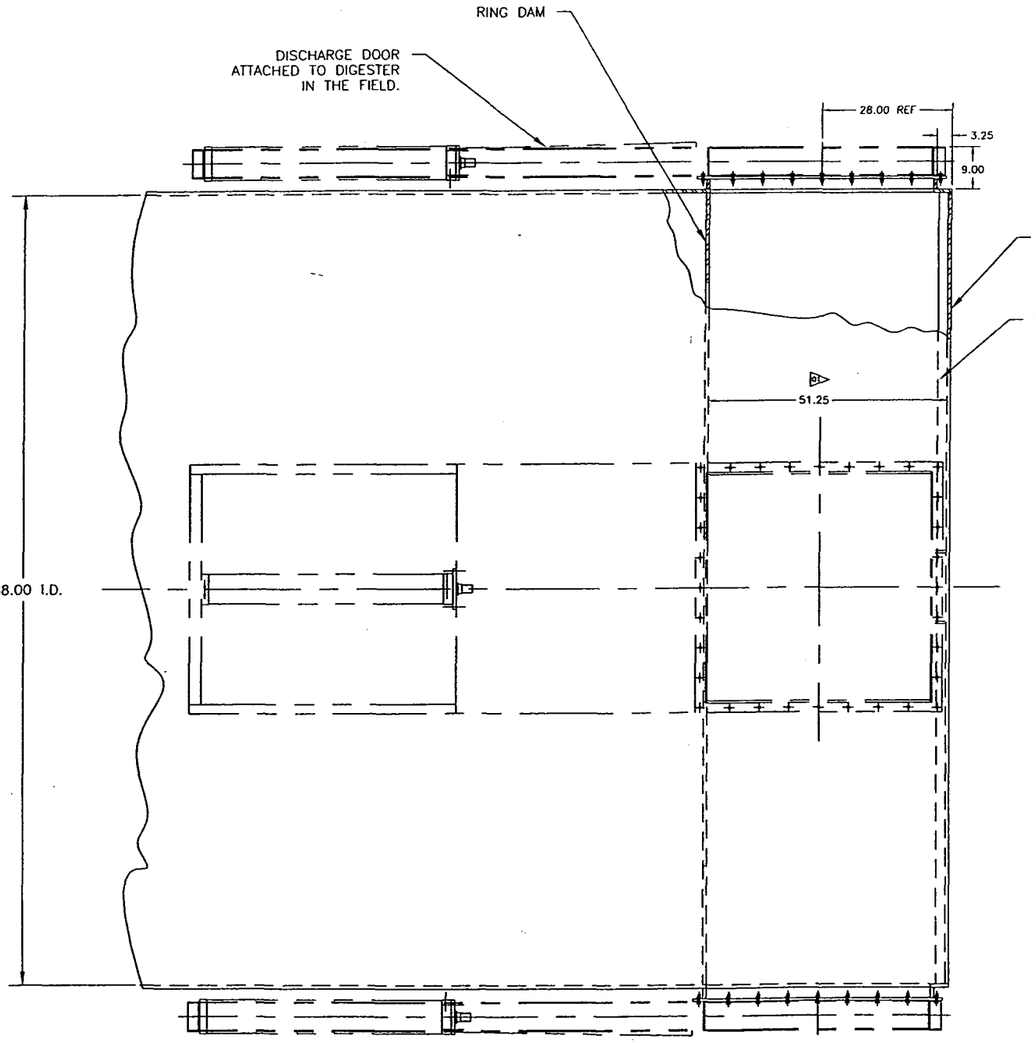
Oct 10, 2001 - 09:53

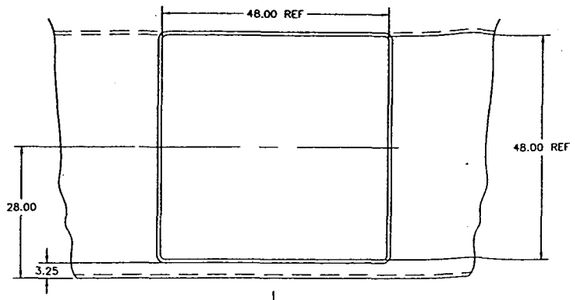
F:\Engineer\ACD\WGS\BioMixers\SumterCo\BM01-3123\69-4152A.dwg, 11/14/2001 10:22:47 AM, SMK1, 11x17, 1:39.968

ITEM	QTY	DESCRIPTION	MAT'L SIZE	MAT'L	PART NO./NOTES
1	6	DISCHARGE DOOR MOUNTING ASSEMBLY			
2	128	HEX BOLT	1/2-13 x 1.75" LG	GRADE 5	
3	128	SECURITY LOCK NUT	1/2-13	GRADE 5	

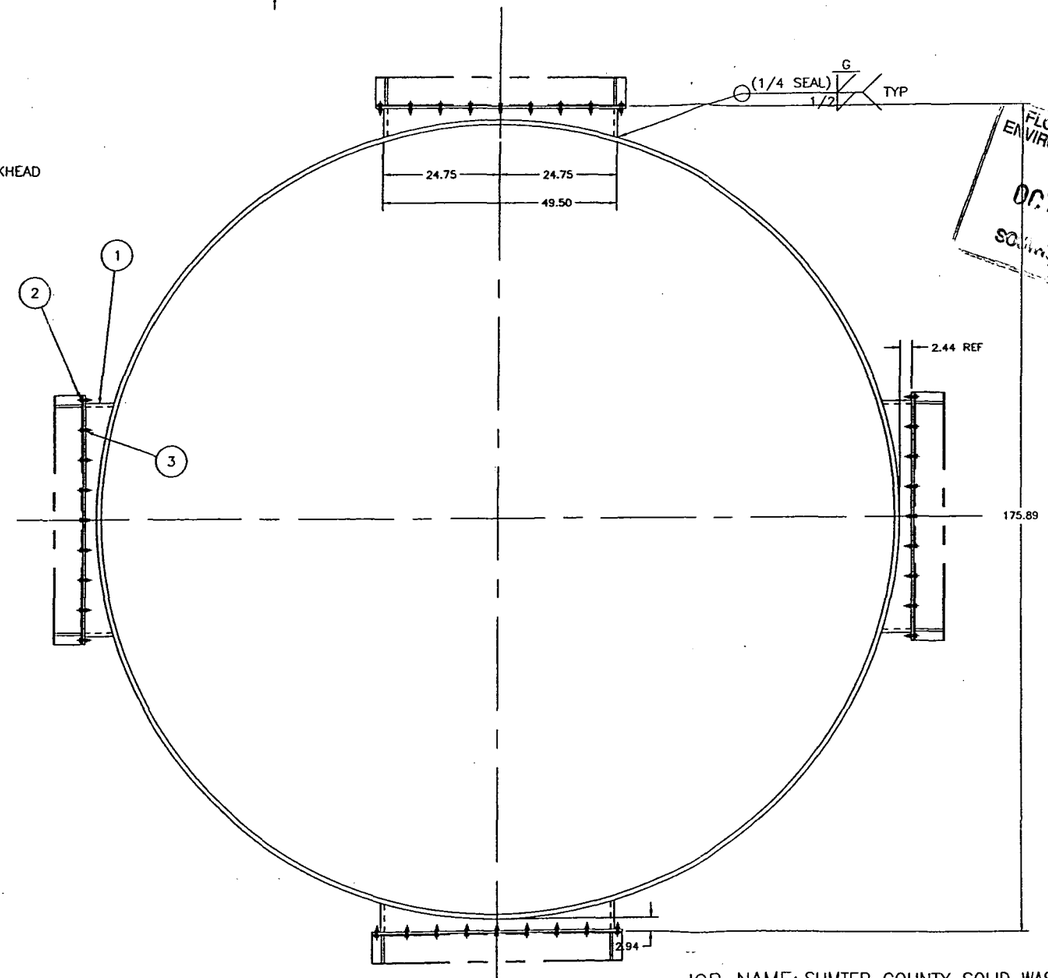
#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE FOR QUOTE PURPOSES ONLY	SMK	9/14/2001

#	DESCRIPTION	DATE	APPROVED
01	51.25" WAS 51.00"	09/19/2001	smk1
A	RELEASED FOR MANUFACTURING	09/28/2001	smk1





NOTE:
LOCATE ITEM 1, DISCHARGE DOOR MOUNTING ASSEMBLY, AND TACK WELD IN PLACE. USE INSIDE OF HOUSING, 48" x 48", AS A TEMPLATE TO BURN OUT OPENING IN SHELL.



JOB NAME: SUMTER COUNTY SOLID WASTE – BUSHNELL, FL.

CONFIDENTIAL – PROPERTY OF: a-c equipment services, MILWAUKEE, WISCONSIN U.S.A.

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED
LINEAR: .x ±.06, .xx ±.03, .xxx ±.01
ANGLES: ±.50"
125 MACHINED SURFACE TEXTURE

DR. smk1 09/14/2001
CH. ——
AP. ——

JOB NO. BM01-3123
SCALE 3/4"=1'0"
SHEET 1 OF1

NAME: DISCHARGE DOOR – 48" x 48" MOUNTING BRACKET INSTALLATION
MAT'L: SEE PARTS LIST
AUTOCAD FILE: 69-4148
WT R F
THIRD ANGLE PROJECTION
REFERENCE DWG:
SIZE D
PART NO. 69-400-0148
REVISION A

REMOVE ALL BURRS, SHARP EDGES, ETC

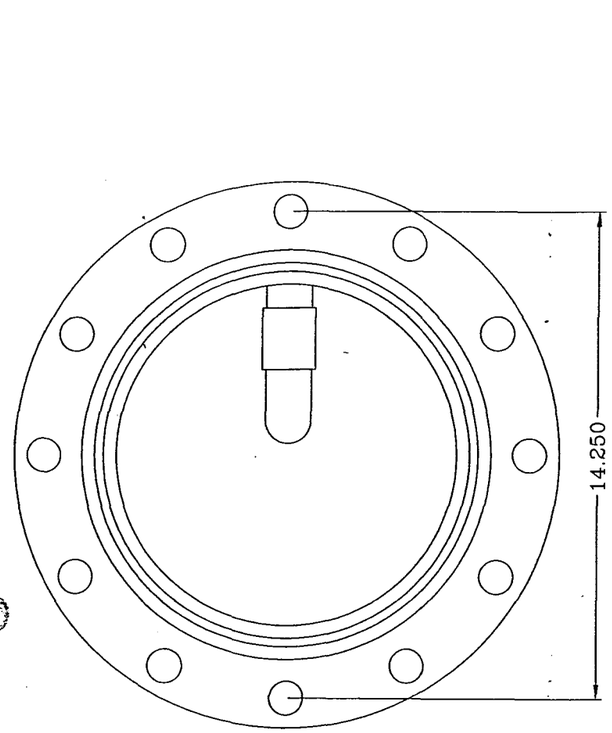
Oct 02, 2001 – 14:41

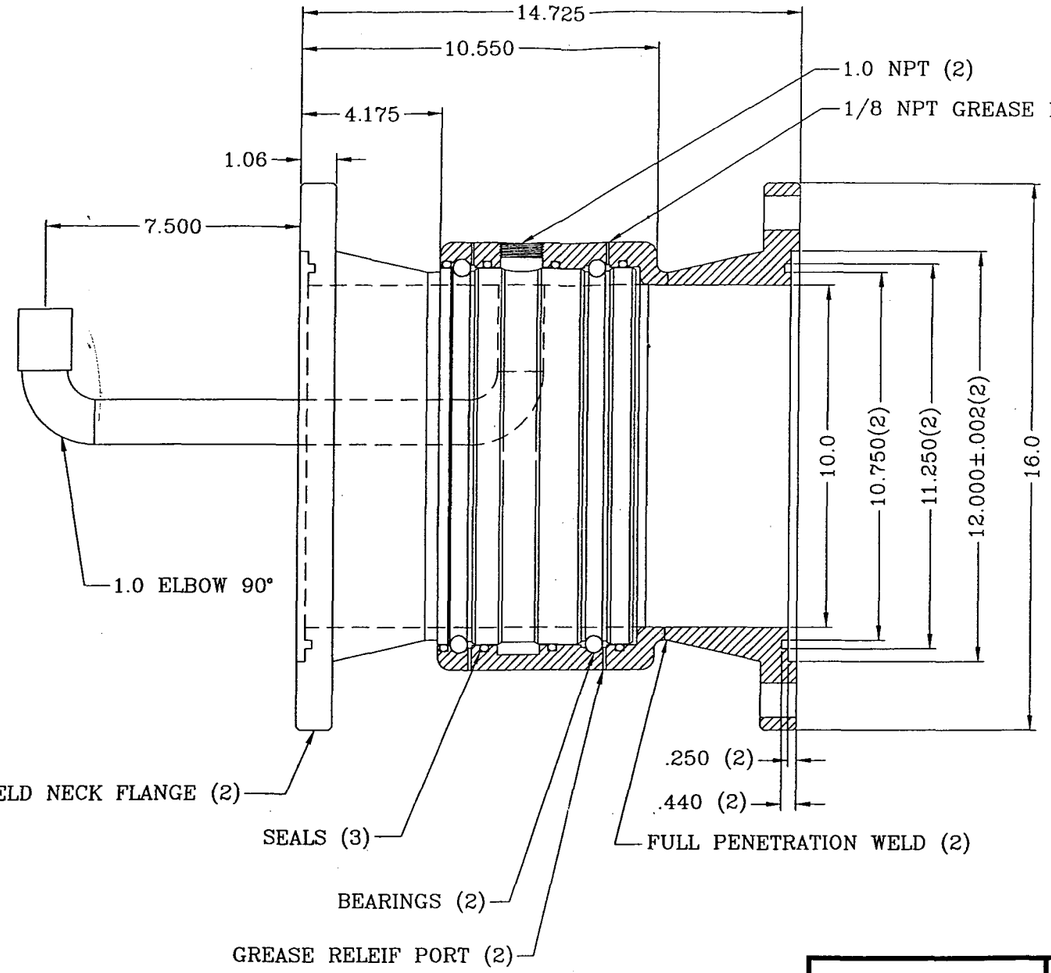
F:\Engineer\ACD\WGS\BioMixers\SumterCo\BM01-3123\69-4148.dwg, 11/14/2001 10:21:17 AM, SMK1, 11x17, 1:31.9547

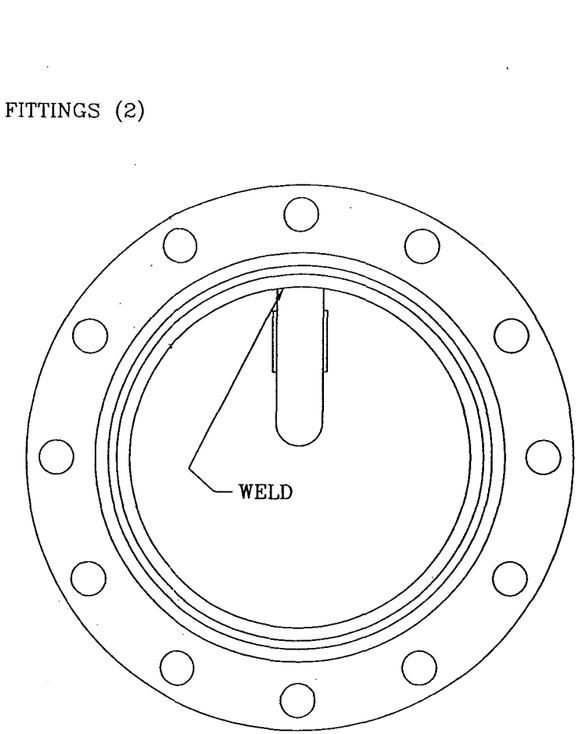
Section 9 – Rotary Coupling

Maintenance Recommendations for A-C Rotary Union

Rotary union should be visually inspected weekly for smooth and leak free operation. If any rough movement or leakage appears, unit should be removed from service and returned to Rotary Systems immediately for repairs. Any disassembly of the rotary union can damage inner components and may lead to costly repairs. Grease zerks should receive 5-10 pumps of grease every 1-2 months. Grease should be inserted during 1 full revolution of the rotary union if possible. Please feel free to contact Rotary Systems about any questions at 1-800-959-0146.







CUSTOMER APPROVAL BY / DATE	

THIS DRAWING IS THE PROPERTY OF ROTARY SYSTEMS INC. AND IS FURNISHED SUBJECT TO RETURN ON DEMAND. ALL OR PART OF THIS DOCUMENT CONTAINS INFORMATION PROPRIETARY TO ROTARY SYSTEMS. RECIPIENT AGREES NOT TO DISCLOSE OR REPRODUCE ALL OR PART OF THIS DRAWING OR USE ITS CONTENTS IN ANY WAY DETRIMENTAL TO OWNERS INTEREST.

UNLESS OTHERWISE SPECIFIED
XXX + – .010
XX + – .025
X + – .050
FRA. + – 1/32
ANG. + – 1 DG.
REMOVE ALL BURRS AND SHARP EDGES

FUNCTION	DATE
DRAWN	3/99
CHECK	3/99
REV B	4/99

MATERIAL

CARBON STEEL

ROTARY SYSTEMS

1036 McKINLEY STREET
ANOKA, MINNESOTA 55303
800–959–0146

NAME

A–C EQUIPMENT

SIZE	P/N
B	D0309

Section 10 – Corrosion Protection System

CORROSION PROTECTION

"A cathodic protection system using sacrificial anodes has been installed in the digester to mitigate corrosion due to the compost environment and the carbon steel of the digester. These anodes are manufactured from an aluminum-zinc alloy (Galvalum) and are directly welded to the interior of the digester. There are a total of some 210 anodes installed throughout the digester.

In addition, a permanent reference electrode has been installed in each compartment to enable the potentials of the digester steel to be measured without physically entering the digester. These reference electrodes, CuCuSO4, protrude into the interior from the outside of the digester and the lead wires are routed back to a terminal box adjacent the riding rings of the digester. A potential measurement is taken at these terminal boxes using a digital voltmeter.

Readings of the reference electrode should be taken on a monthly basis for the first year and quarterly thereafter and appropriate records of the values kept on a form. These reading will enable the evaluation of the levels of cathodic protection within the digester and aid in the scheduling of anode replacement."

Respectfully

CORRPRO CANADA, INC.

G.G. Firth, P.Eng.

Permacell® 801TH and 803TH

Permanent Reference Cells

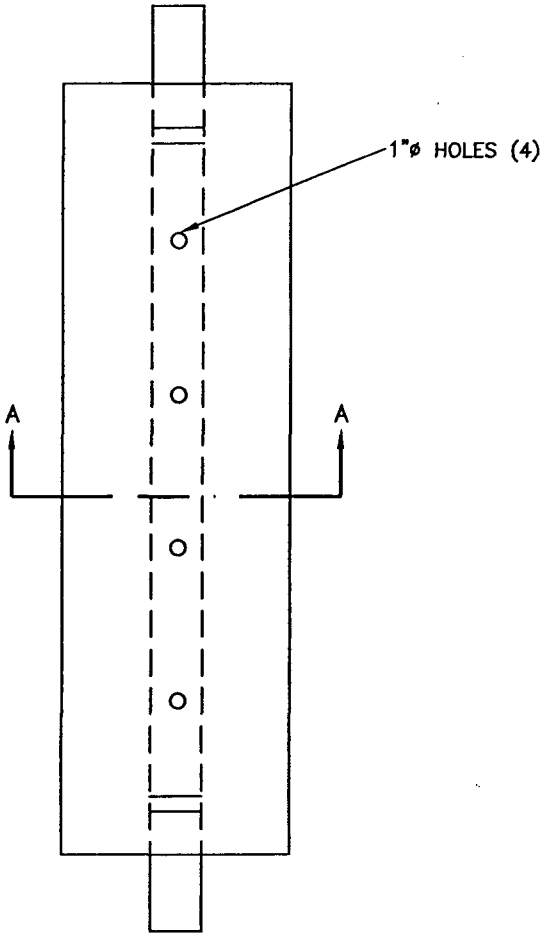
For Thru-Hull Mounting

Obtaining potential values on structures such as condenser water boxes, heater treaters, and pressure vessels where human access is difficult and space is limited, requires the use of uniquely designed reference electrodes. For these special applications Harco offers the 801TH and 803TH permanent reference cells. The 801TH is a copper/copper sulfate reference cell intended for use in environments with low chloride ion concentrations. It is composed of a 99.99% pure copper element, which is surrounded by a super saturated mixture of copper sulfate and housed in G-10 fiberglass. The 803TH reference cell is made with a pure silver element which remains electrically stable in environments such as brackish and salt waters. Like the 801, the element for the 803 cell is housed in G -10 fiberglass and surrounded by a super saturated mixture of silver chloride ions to minimize cell contamination. Both cells are designed for thru-hull mounting and are provided with cast metal junction boxes.

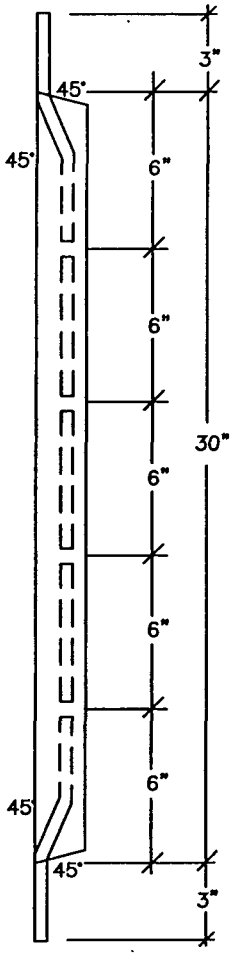
Installation of Harco's 801TH and 803TH reference cells is fast and easy. The cells are constructed with stainless steel nipples which are threaded for mounting to the protected structure. To prevent leaks, these nipples are filled with Harco's SPL™ sealant, and prior to shipping, each cell is pressure tested to 350 psi. The cells can also be provided with special connections for hot tap mounting.

Typical Applications

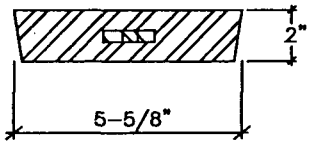
Harco's 801TH and 803TH permanent reference cells are designed for use in heater treaters, pressure vessels, condenser water boxes and other aqueous processing tanks. The 801TH cell is specifically designed for areas with low chloride ion concentrations, while the 803TH is developed for installation in environments such as brackish and salt waters which contain higher chloride levels. Both cells will remain accurate to within five millivolts for a minimum of five years. They can operate in temperatures up to 140°F and should be protected against freezing.



TOP



SIDE



SECTION A-A

TOTAL WEIGHT = 35 lbs.
MOUNTING BAR = 2"x3/16" FLAT BAR

NOTES:
-FLAT BAR TO BE SAND/GRIT BLASTED
-ANODE MOUNTING BAR TO BE ON WIDE SIDE OF TAPER

REF.	REVISION	DATE	BY
1	MULTIPLE UPDATES	99 01 18	DGP

Corrpro Canada, Inc.

·Edmonton · Calgary ·
·Estevan · Ft.St.John ·
· Lloydminster ·

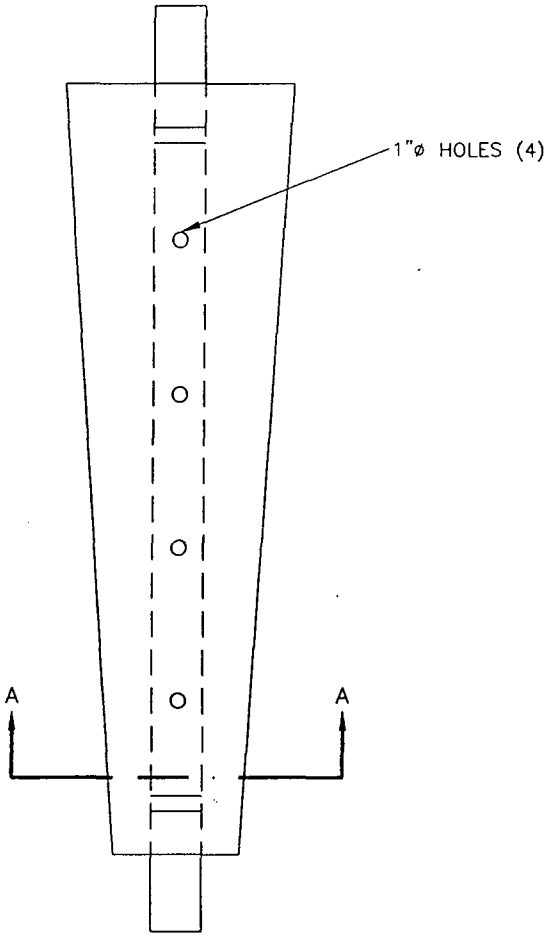
CUSTOMER: A-C EQUIPMENT SERVICES

LOCATION

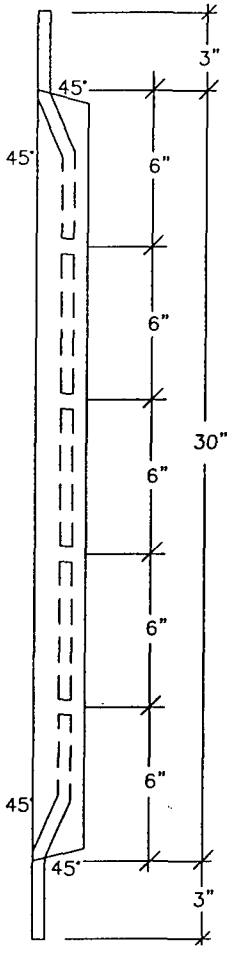
TYPICAL GALVANUM (ALUMINUM) ANODE c/w FLAT BAR MOUNTING

DWG.BY: D.G.P.
DSGN.BY:
CHK.BY:

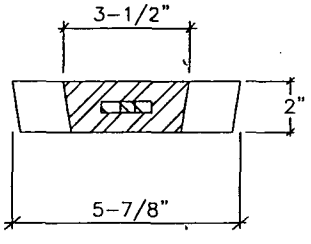
SCALE: 1/8"=1" | DATE: 98 04 27 | DWG.NO.: A-15267 A



TOP



SIDE



SECTION A-A
nts

TOTAL WEIGHT = 25 lbs.
MOUNTING BAR = 2"x3/16" FLAT BAR

NO.	REVISION	DATE	BY

Corrpro Canada, Inc.

• Edmonton • Calgary •
• Estevan • Ft.St.John •
• Lloydminster •

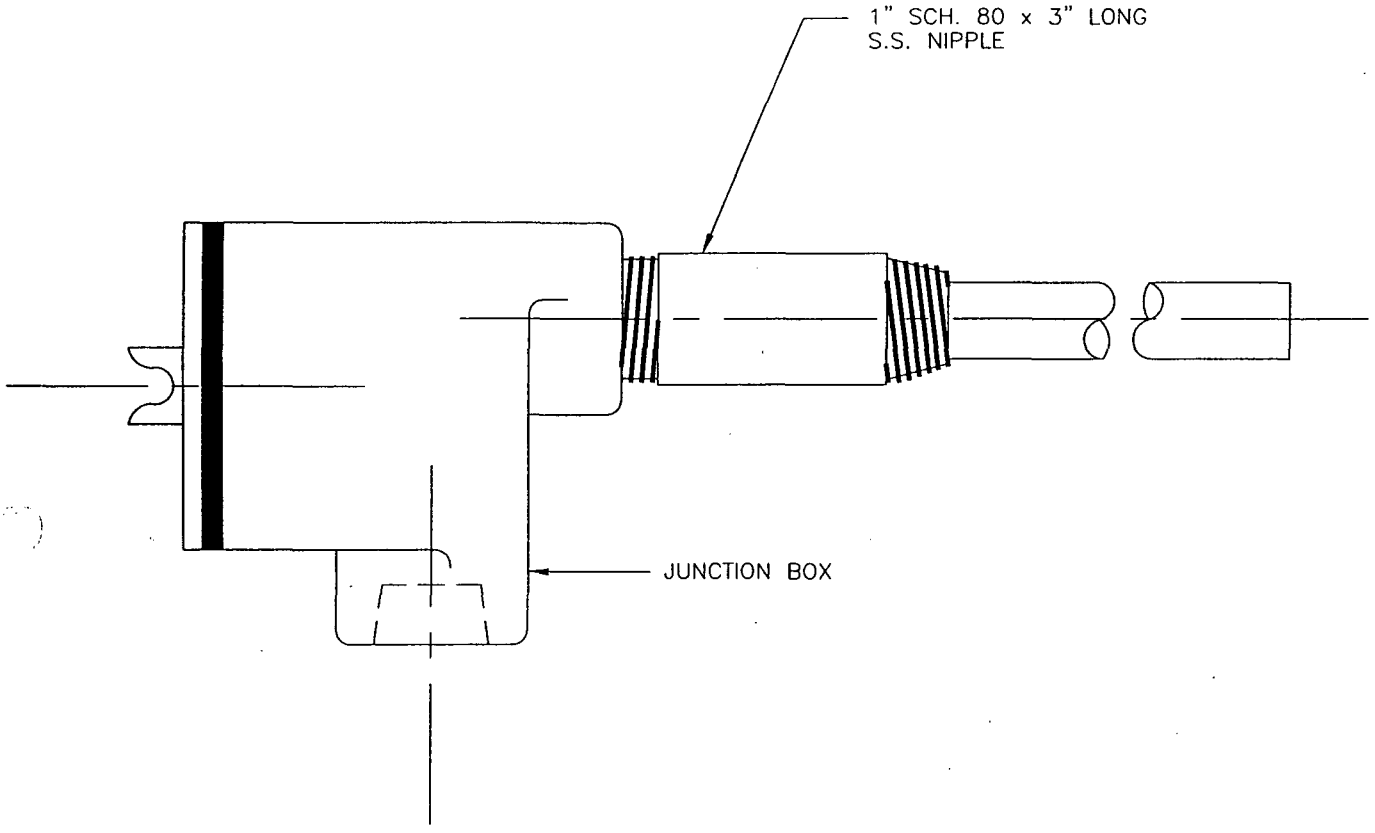
CUSTOMER: A-C EQUIPMENT SERVICES

LOCATION

TYPICAL GALVANUM (ALUMINUM) ANODE c/w FLAT BAR MOUNTING TAPERED 30" ANODE

DWG.BY	DSGN.BY	CHK.BY
D.G.P.		

SCALE	DATE	DWG.NO.
1/8"=1"	2001 11 12	A-15267C



REF.	REVISION	DATE	BY

Corrpro Canada, Inc.

• Edmonton • Calgary •
• Estevan • Ft.St.John •
• Lloydminster •

CUSTOMER

A-C EQUIPMENT SERVICES

DWG.BY D.G.P.

DSGN.BY

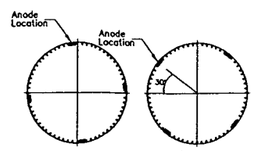
CHK.BY

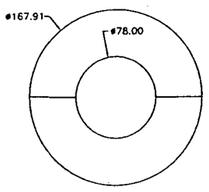
ITEM

ROTARY DIGESTER
REFERENCE ELECTRODE
PERMACELL® 801TH
Permanent Reference Cells

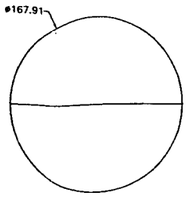
SCALE	DATE	DWG.NO.
NTS	99 05 11	A-15888

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	12/10/2001	SMK
	FOR QUOTE PURPOSES ONLY		





FEED END BULK HEAD
ø167.91"OD X ø78.00"ID X 3/4" PLATE
SCALE 1/4" = 1'



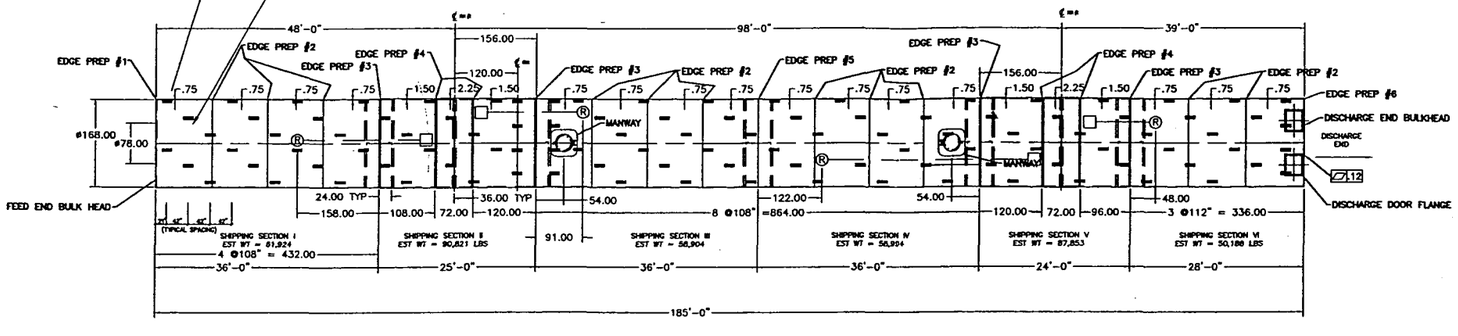
DISCHARGE END BULK HEAD
ø167.91"OD X 3/4" PLATE
SCALE 1/4" = 1'

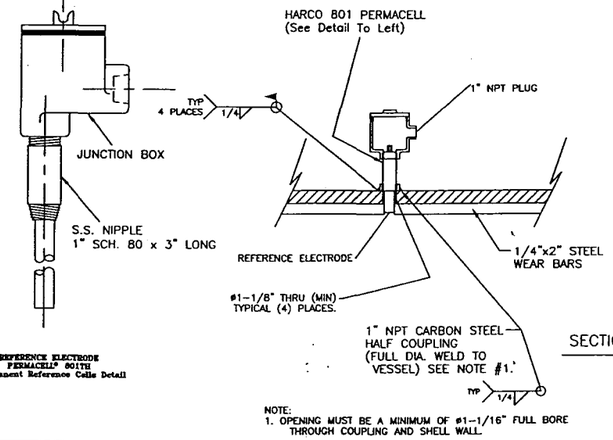
LEGEND

- GALVALUM ANODE – (5 5/8"x30")
- Ⓡ CuCuSO4 REFERENCE ELECTRODE (See Detail Drawing Number A-15888)
- □ TERMINAL BOX

CATHODIC PROTECTION NOTES:

1.) GALVALUM ANODES TO BE ARCWELDED ONTO INTERIOR OF DIGESTER.
2.) ANODES TO BE POSITIONED EVERY 90° AROUND CIRCUMFERENCE OF DIGESTER.
3.) ANODE GROUPS TO BE STAGGERED EVERY 30° FROM EACH OTHER EVERY 42 INCHES.(±6 INCHES)
4.) ADDITIONAL ANODES INSTALLED IN VICINITY OF RIDING RING WELDS.
5.) TOTAL ANODES – APPROX. 210
6.) COPPER-COPPER SULPHATE REFERENCE ELECTRODES (4) TO BE INSTALLED FROM EXTERIOR OF DIGESTER IN 1" NPT ACCESS PORTS.

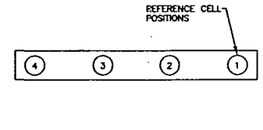




REFERENCE ELECTRODE
PERMACELL® 801TH
Permanent Reference Cells Detail

SECTION "A-A"

NOTE:
1. OPENING MUST BE A MINIMUM OF ø1-1/16" FULL BORE THROUGH COUPLING AND SHELL WALL.



DESCRIPTION	A-C EQUIPMENT SERVICES		Dwn. by D.G.P.
LOCATION	SUMTER COUNTY SOLID WASTE BUSHNELL, FL.		Chk. by G.F.
	ROTARY DIGESTER-SHELL GENERAL 14' ø I.D. x 185' LG		Appd. by
	AS PROPOSED CATHODIC PROTECTION SYSTEM		Mach. by G.F.
SCALE 1/8"=1'0"	DATE 2001 11 12	DWG. NO. D-17680	

JOB NAME: SUMTER COUNTY SOLID WASTE – BUSHNELL, FL.

CONFIDENTIAL – PROPERTY OF: A-C equipment services, MILWAUKEE, WISCONSIN U.S.A.

NAME: CORROSION PROTECTION SYSTEM CORRPRO DRAWING #D-17680

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982.
LIMITS UNLESS OTHERWISE NOTED
LINEAR: .X ±.06, .XX ±.03, .XXX ±.01
ANGLES: ±.50°
125 MACHINED SURFACE TEXTURE

MATL

AUTOCAD FILE: 69-4165A
WT R F

DR. SMK 12/11/2001
CH. ____ ____
AP. ____ ____

JOB NO. BM01-3123
SCALE 3/32"=1'0"
SHEET 1 OF 3

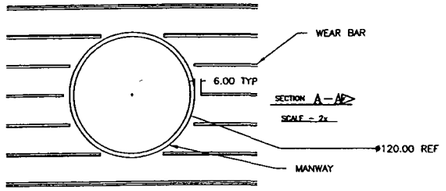
THIRD ANGLE PROJECTION
REFERENCE DWG:
SIZE D

PART NO. 69-400-0165
REVISION 00

REMOVE ALL BURRS, SHARP EDGES, ETC

PLOT CONTROL DATE: Dec 11, 2001 – 11:31

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	12/10/2001	SMK
	FOR QUOTE PURPOSES ONLY		



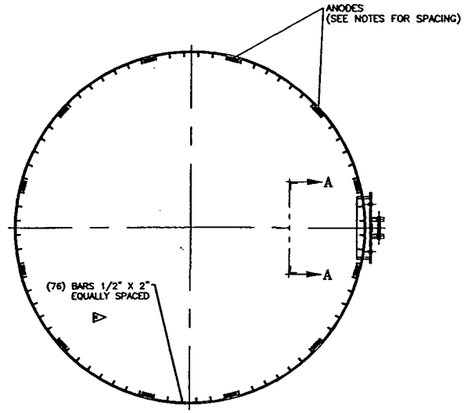
LEGEND

GALVALUM ANODE - (5 5/8"x30")

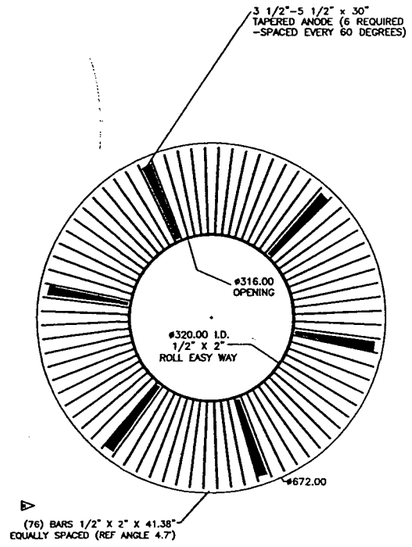
Ⓡ CuCuSO4 REFERENCE ELECTRODE (See Detail Drawing Number A-15888)

CATHODIC PROTECTION NOTES:

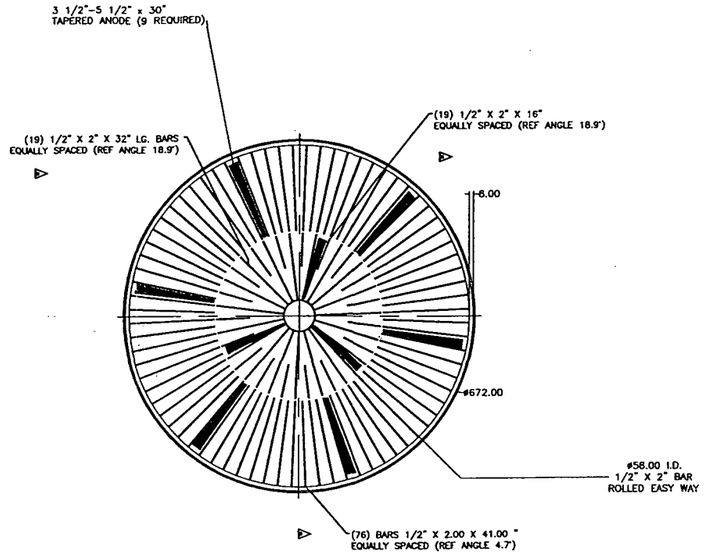
1.) GALVALUM ANODES TO BE ARCWELDED ONTO INTERIOR OF DIGESTER.
2.) ANODES TO BE POSITIONED EVERY 90° AROUND CIRCUMFERENCE OF DIGESTER.
3.) ANODE GROUPS TO BE STAGGERED EVERY 30° FROM EACH OTHER EVERY 42 INCHES.(±6 INCHES)
4.) ADDITIONAL ANODES INSTALLED IN VICINITY OF RIDING RING WELDS.
5.) TOTAL ANODES - APPROX. 210
6.) COPPER-COPPER SULPHATE REFERENCE ELECTRODES (4) TO BE INSTALLED FROM EXTERIOR OF DIGESTER IN 1" NPT ACCESS PORTS.



CIRCUMFERENTIAL WEAR BAR LAYOUT
WEIGHT OF WEAR BARS VARIES WITH LENGTH OF SHIPPING SECTION.



FEED END WEAR BAR LAYOUT
ESTIMATED WEIGHT OF WEAR BARS: 1213 LBS.



DISCHARGE END WEAR BAR LAYOUT
ESTIMATED WEIGHT OF WEAR BARS: 1465 LBS.

INFORMATION TAKEN FROM "A-C EQUIPMENT SERVICES" DRAWING NUMBER "BM-400-0148 B"

COMPANY	A-C EQUIPMENT SERVICES		DWG. BY: D.G.P.
LOCATION	SUMTER COUNTY SOLID WASTE BUSHNELL, FL.		DES. BY: G.F.
	ROTARY DIGESTER-SHELL GENERAL 14' ø I.D. x 185' LG		APPR. BY:
	AS PROPOSED CATHODIC PROTECTION SYSTEM		ENGR. BY: G.F.
SIZE	NTS	DATE: 2001 11 12	DWG. NO: D-17681

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL.

CONFIDENTIAL - PROPERTY OF: a-c equipment services, MILWAUKEE, WISCONSIN U.S.A.

NAME: CORROSION PROTECTION SYSTEM CORRPRO DRAWING #D-17681

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED
LINEAR: .X ±.06, .XX ±.03, .XXX ±.01 ANGLES: ±.50°

125 MACHINED SURFACE TEXTURE

MATL

AUTOCAD FILE: 69-4165B

WT R F

REMOVE ALL BURRS, SHARP EDGES, ETC

PLOT CONTROL DATE: Dec 11, 2001 - 11:32

DR. SMK 12/11/2001
CH. ____ ____
AP. ____ ____

JOB NO. BM01-3123

SCALE 3/32"=1'0"

SHEET 2 OF 3

THIRD ANGLE PROJECTION

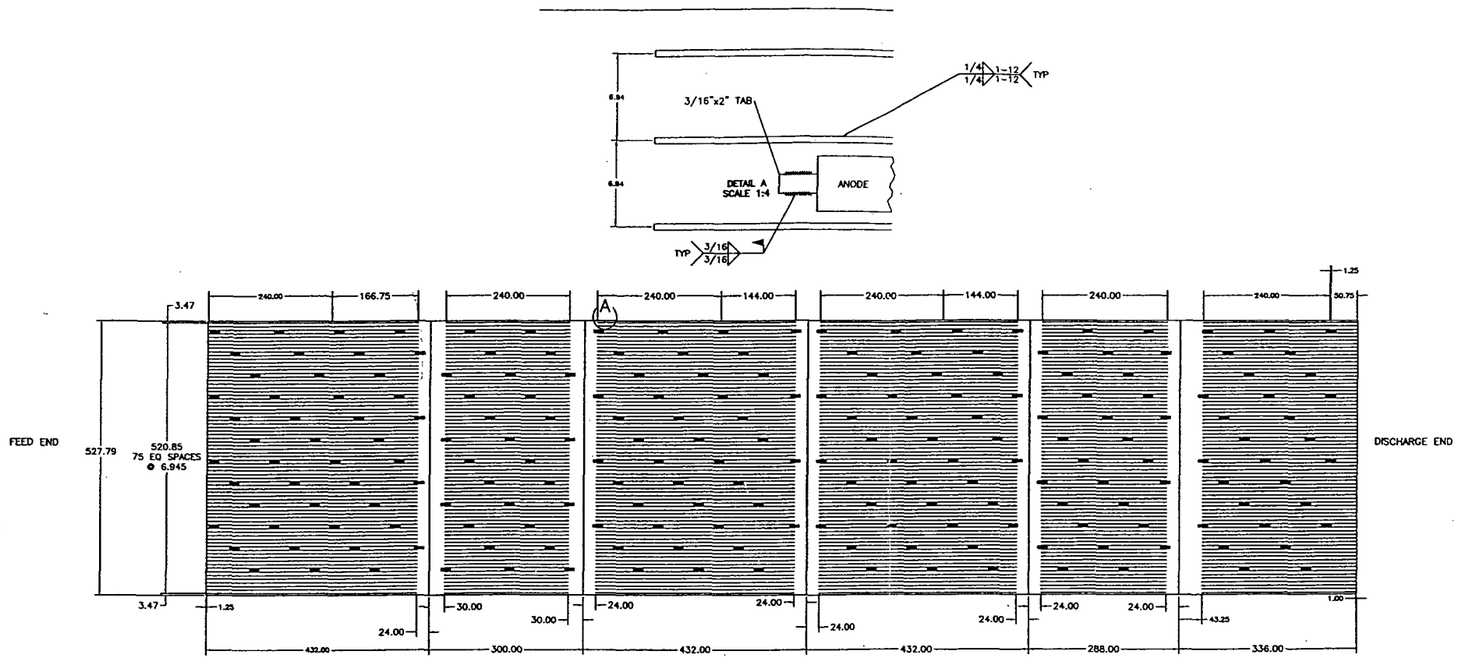
REFERENCE DWG:

SIZE D

PART NO. 69-400-0165

REVISION 00

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	12/10/2001	SMK
	FOR QUOTE PURPOSES ONLY		



LEGEND

▬ GALVALUM ANODE – (5 5/8"x30")

Ⓡ CuCuSO4 REFERENCE ELECTRODE
(See Detail Drawing Number A-15888)

CATHODIC PROTECTION NOTES:

1.) GALVALUM ANODES TO BE ARCWELDED ONTO INTERIOR OF DIGESTER.
2.) ANODES TO BE POSITIONED EVERY 90° AROUND CIRCUMFERENCE OF DIGESTER.
3.) ANODE GROUPS TO BE STAGGERED EVERY 30" FROM EACH OTHER EVERY 1050mm. (±150mm)
4.) ADDITIONAL ANODES INSTALLED IN VICINITY OF RIDING RING WELDS.
5.) TOTAL ANODES – APPROX. 300
6.) COPPER-COPPER SULPHATE REFERENCE ELECTRODES (4) TO BE INSTALLED FROM EXTERIOR OF DIGESTER IN 1" NPT ACCESS PORTS.

MFG	REMARKS	DATE	BY

Corrpro Companies, Inc. – Corrosion Control Engineers – Consultants – Contractors

CONTRACTOR: A-C EQUIPMENT SERVICES — DRN. BY: D.G.P.
LOCATION: SUMTER COUNTY SOLID WASTE BUSHNELL, FL. — CHK. BY: C.F.
ROTARY DIGESTER-SHELL GENERAL 14' ø I.D. x 160' LG — APVD. BY:
AS PROPOSED CATHODIC PROTECTION SYSTEM — MGR. APP.: C.F.
SCALE: 1/8"=1'0" | DATE: 2001 11 12 | DRG. NO.: D-17679

JOB NAME: SUMTER COUNTY SOLID WASTE – BUSHNELL, FL.

CONFIDENTIAL – PROPERTY OF: a-c equipment services, MILWAUKEE, WISCONSIN U.S.A.

NAME: CORROSION PROTECTION SYSTEM CORRPRO DRAWING #D-17679

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED
LINEAR: X ±.06, .XX ±.03, .XXX ±.01 — ANGLES: ±.50°
125 MACHINED SURFACE TEXTURE

MAT'L

AUTOCAD FILE: 69-4165C — WT R F

REMOVE ALL BURRS, SHARP EDGES, ETC

PLOT CONTROL DATE: Dec 11, 2001 – 11:33

DR. SMK 12/11/2001 — JOB NO. BM01-3123 — SCALE 3/32"=1'0" — SHEET 3 OF 3

THIRD ANGLE PROJECTION — REFERENCE DWG: — SIZE D

CH. —— —— — PART NO. 69-400-0165 — REVISION 00

AP. —— ——

Section 11 – Installation Outline and Shell Fabrication Drawings

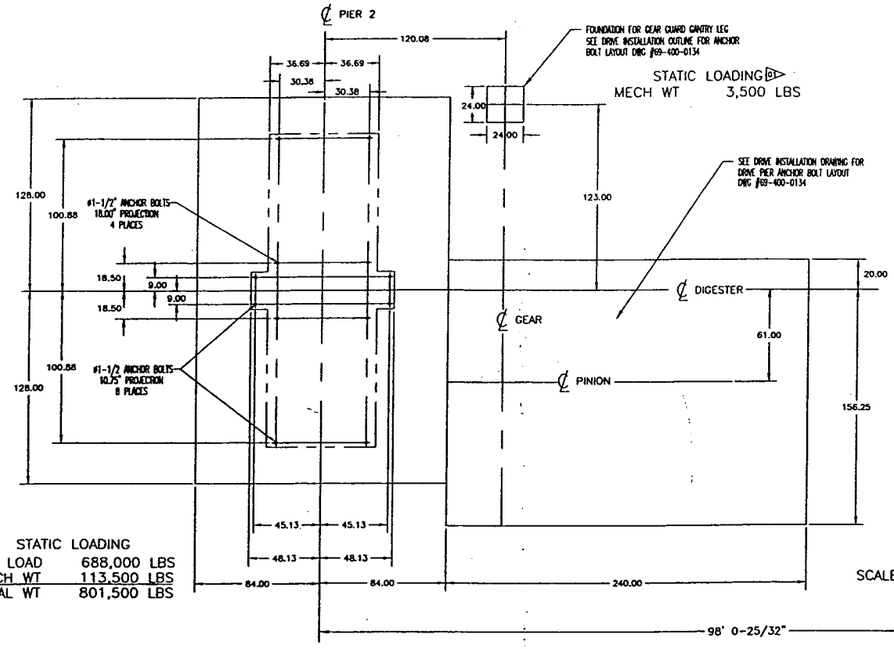
INSTALLATION & ASSEMBLY DRAWINGS
for
14'-0" I.D. x 185'-0" LG
ROTARY BIOMIXER

LOCATED AT:
SUMTER COUNTY SOLID WASTE
835 CR 529
LAKE PANASOFFKEE, FLORIDA 33538

a-c equipment services
MILWAUKEE, WISC.

PIER #	RIDING RING SIZE	CARRYING ROLLER DIAMETER	CARRYING BEARING SIZE	THRUST ROLLER SIZE	THRUST ROLLER BEARING SIZE
1	196.0" OD. 22" FACE	54" OD. x 24" FACE	18" x 22"		
2	196.0" OD. 22" FACE	54" OD. x 24" FACE	18" x 22"	36" x 4"	12" x 15"

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	8/13/2001	SMK
	FOR QUOTE PURPOSES ONLY		
#	DESCRIPTION	DATE	APPROVED
01	ADDED LOADING FOR GEAR GUARD	09/12/2001	smk1
	GANTRY PIER		
A	RELEASED FOR CONSTRUCTION	09/28/2001	smk1



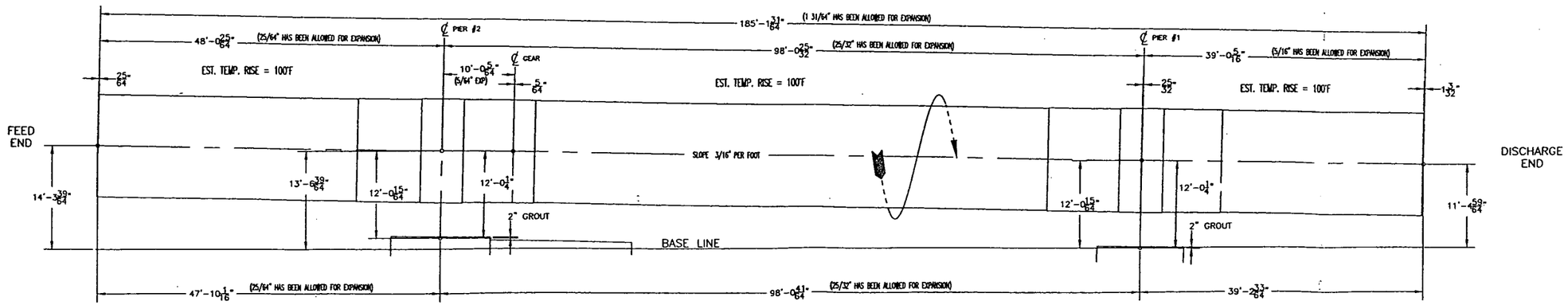
NOTES:

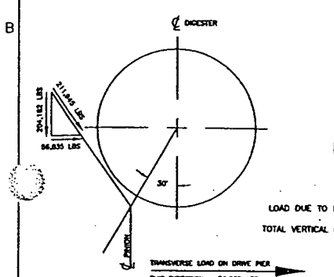
1. THE AXIAL THRUST LOAD OF BIOMIXER IS 41,700 LBS. THIS LOAD IS TO BE APPLIED TO EACH PIER IN BOTH UPHILL AND DOWNHILL DIRECTIONS.
2. WHEN ALIGNING PINION TO MAIN GEAR, THRUST RIDING RING MUST BE TIGHT AGAINST DOWNHILL THRUST ROLLER.
3. DESIGN FOR ALL PIERS SHOULD PROVIDE 36" OF CLEARANCE ON UPHILL SIDE OF ROLLER FRAME TO ALLOW JACKS TO BE PLACED FOR SUPPORTING DRUM WHEN IT IS NECESSARY TO MAKE A CHANGE IN THE CARRYING MECHANISM.
4. ALL EXPANSIONS ARE BASED ON ASSUMED TEMPERATURE RISES.
5. PLACE CENTERLINE OF CARRYING MECHANISM FRAMES ON RIDING RING CENTERLINES IN THE OPERATING CONDITION.
6. BIOMIXER COLD SETTING SHOULD BE TAKEN WHEN THRUST RIDING RING IS AGAINST DOWNHILL THRUST ROLLER AND CARRYING ROLLER SHAFT IS AGAINST END THRUST WEARING PLATE OF DOWNHILL CARRYING ROLLER
7. FOUNDATION BOLTS, NUTS, AND WASHERS ARE TO BE SUPPLIED AS PART OF THE FOUNDATION. FOUNDATION BOLT DIAMETERS WILL BE SPECIFIED BY A-C EQUIPMENT SERVICES.
8. CARRYING MECHANISM FRAMES ARE TO BE SET ON SLOPE AND LEVEL WITHIN .002"/FT. BEFORE GROUTING.
9. AFTER GROUTING UNDER FRAMES, A CONCRETE PIER CAP SHOULD BE POURED AS SHOWN. IT IS RECOMMENDED THE CONCRETE PIER CAP BE DOWELED TO THE TOP OF THE ROUGH PIER AND REINFORCED WITH REBAR AND OPTIONALLY WITH WIRE MESH.
10. THOROUGHLY CLEAN, DEBUR, AND COAT THE BORE OF THE RIDING RINGS AND TIRE PADS UNDER RIDING RINGS WITH A THICK PASTE OF GRAPHITE AND OIL OR EQUIVALENT BEFORE MOUNTING TIRES.
11. THE ROTATION OF THE BIOMIXER IS CLOCKWISE WHEN VIEWED FROM THE DISCHARGE END.
12. TRANSVERSE LOADS FOR A STRAIGHT, WELL ALIGNED ROTARY BIOMIXER ARE NORMALLY NEGLIGIBLE, BUT IT IS SUGGESTED THAT A TRANSVERSE FORCE EQUAL TO 50% OF THE TOTAL VERTICAL STATIC LOAD, AS SHOWN, BE ASSUMED IN BOTH DIRECTIONS AT EACH PIER.
13. EXCEPT FOR TRANSVERSE LOADS, IT IS SUGGESTED THAT THE SHOWN LOADS BE INCREASED 100% FOR DESIGN OF FOUNDATIONS.
14. EQUIPMENT IS TO BE ALIGNED AND LEVELED IN THE FIELD AS NECESSARY TO MAINTAIN INSTALLATION DIMENSIONS BEFORE AND AFTER FIELD JOINTS ARE WELDED. FIELD JOINTS ARE TO BE FITTED IF NECESSARY.
15. CARRYING MECHANISM FRAMES MUST BE SET AT THE ELEVATION AND LOCATION SHOWN. DEVIATION FROM SPECIFIED ELEVATION AND AXIAL SPACING MUST NOT EXCEED 0.06 INCHES.
16. ROTARY BIOMIXER REFERENCE DRAWINGS.

INSTALLATION OUTLINE DRAWING.	69-400-0133
DRIVE INSTALLATION OUTLINE DRAWING.	69-400-0134
CARRYING MECHANISM GENERAL ASSEMBLY.	69-400-0135
THRUST MECHANISM GENERAL ASSEMBLY.	69-400-0136

17. CARRYING ROLLER FRAMES ARE TO BE SET ON SLOPE OF BIOMIXER. THE ANCHOR BOLTS MUST BE SET ON SLOPE SO THAT THEY ARE PERPENDICULAR TO THE CARRYING ROLLER FRAMES.
18. PIER OUTLINE DIMENSIONS SHOWN ARE MINIMUM REQUIRED.
19. SLEEVES ARE TO BE USED WITH ALL ANCHOR BOLTS TO ALLOW FOR FIELD ADJUSTMENTS.

IMPORTANT: SEE NOTES #17 & #19 BEFORE SETTING ANCHOR BOLTS

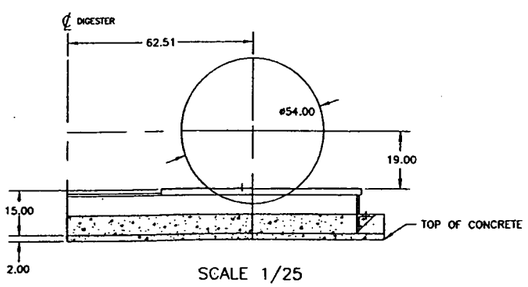




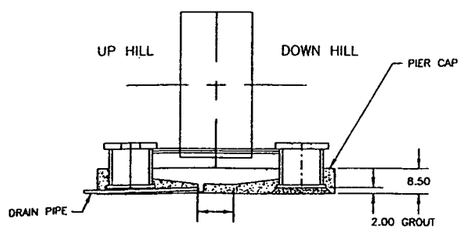
SECTION A-A

DRIVE PIER LOADING

LOAD DUE TO PINION REACTION 136,760 LBS
STATIC LOAD 67,422 LBS
TOTAL VERTICAL LOAD ON DRIVE PIER 204,182 LBS



SCALE 1/25



REMOVE ALL BURRS, SHARP EDGES, ETC

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL.

CONFIDENTIAL - PROPERTY OF: a-c equipment services MILWAUKEE, WISCONSIN U.S.A.

NAME: INSTALLATION OUTLINE ROTARY BIOMIXER ø14' I.D. x 185' LG

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES. INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED LINEAR: .X ±.06, .XX ±.03, .XXX ±.01 ANGLES: ±.50°. 125 MACHINED SURFACE TEXTURE.

MAT'L

AUTOCAD FILE: 69-4133

WT R F

DR. smk1 08/13/2001

CH. ——

AP. ——

JOB NO. BM01-3123

SCALE 1:100

SHEET 1 OF1

THIRD ANGLE PROJECTION

REFERENCE DWG:

SIZE D

PART NO. 69-400-0133

REVISION A

Oct 02, 2001 - 14:33

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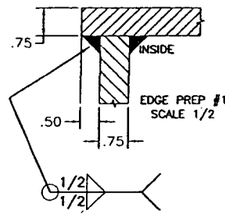
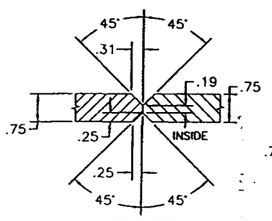
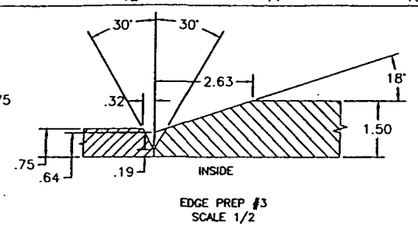


EDGE PREP #1
SCALE 1/2



EDGE PREP #2
SCALE 1/2



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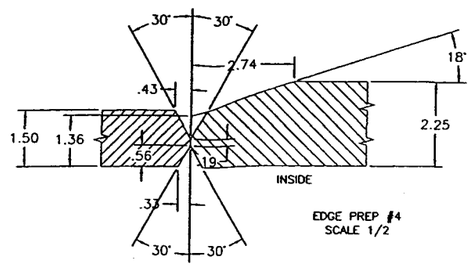

EDGE PREP #4
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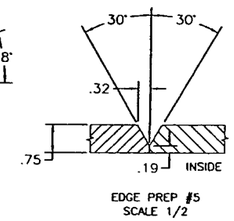
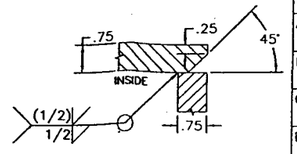
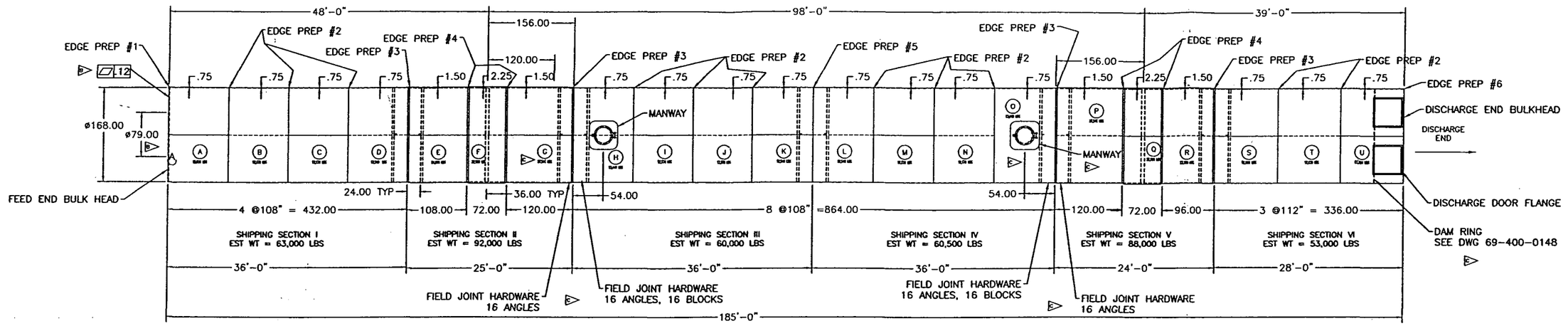


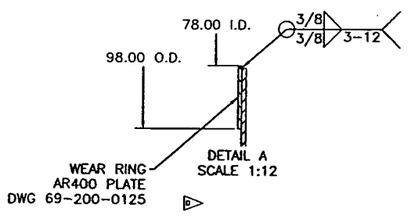
EDGE PREP #5
SCALE 1/2



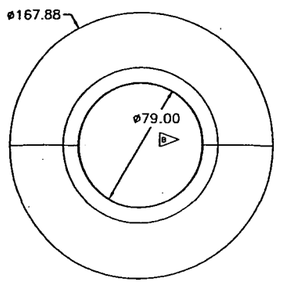
EDGE PREP #6
SCALE 1/2

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	8/17/01	
	FOR QUOTE PURPOSES ONLY		
#	DESCRIPTION	DATE	APPROVED
A	RELEASE FOR MANUFACTURING	09/06/01	mbs
		69-400-0137	
B	F.E. OPENING WAS 78.00, ADD NOTE #8	09/14/01	mbs
	ROTATE CAN "0" BY 45°, DE FLATNES	69-100-0137	
C	MANWAY POSITON ROTATED 180°	09/14/01	mbs
	ADD RING DAM, OMIT SPIDERS	69-100-0137	
D	ADD WEAR RING	10/2/01	mbs
		69-100-0137	

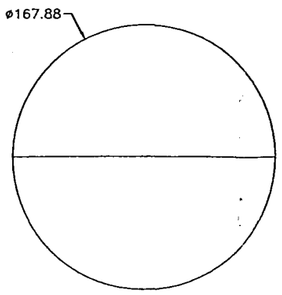




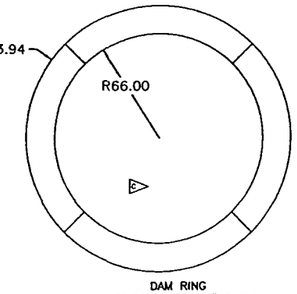
NOTES:
1. FABRICATION TOLERANCES SHALL CONFORM TO THE FOLLOWING SPECIFICATIONS: 96-100-0424, 0425, 0426, & 0427.
2. GRIND LONGITUDINAL WELD ID & OD, RIDING RING SHELLS ONLY.
3. INSTALL FILLER BARS PER DWG 69-200-0120 & 69-200-0121. PRIOR TO MACHINING FILLER BARS.
4. MACHINE OD OF FILLER BARS PER DWG 69-200-0122.
5. INSTALL FEED END AND DISCHARGE END BULKHEAD AS SHOWN.
6. INSTALL WEAR BARS PER DWG #69-400-0146.
7. INSTALL DISCHARGE DOOR FLANGES PER DWG #69-400-0147.
8. ROTATE WELD SEAM ON CAN "0" BY 90° TO KEEP WELD SEAM AWAY FROM MANWAY.



FEED END BULK HEAD
ø167.91"OD X ø78.00"ID X 3/4" PLATE
SCALE 1/4" = 1'



DISCHARGE END BULK HEAD
ø167.88"OD X 3/4" PLATE
SCALE 1/4" = 1'



DAM RING
ø167.88"OD X 3/4" PLATE
SCALE 1/4" = 1'

REMOVE ALL BURRS, SHARP EDGES, ETC

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL

CONFIDENTIAL - PROPERTY OF:
A-C equipment services
MILWAUKEE, WISCONSIN U.S.A.

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED
LINEAR: ANGLES: ±.50°
.X ±.06
.XX ±.03
.XXX ±.01
125 MACHINED SURFACE TEXTURE

NAME: BIOMIXER SHELL FABRICATION DRAWING 14'ID X 185' LG

MAT'L: ASTM A-36 / ASTM A-36

AUTOCAD FILE: 69-4137

WT R F

DR. mbs 08/09/01
CH. ——
AP. ——

JOB NO. BM01-3123

SCALE 1/8"=1'0" SHEET 1 OF1

THIRD ANGLE PROJECTION

REFERENCE DWG:

SIZE D

PART NO. 69-400-0137

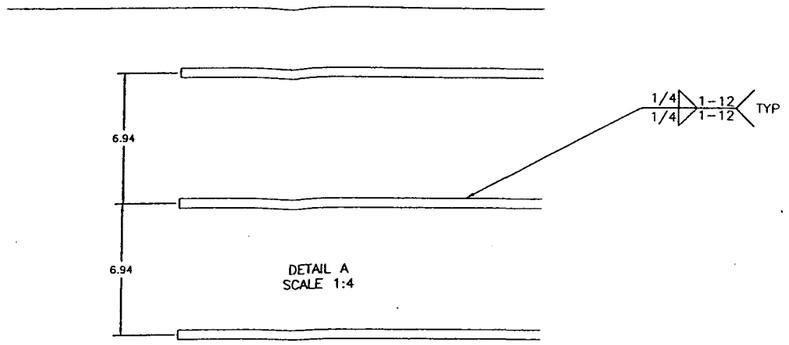
REVISION D

F:\Engineer\ACDWGS\BioMixers\SumterCo\BM01-3123\69-4137.dwg, 11/14/2001 10:12:58 AM, SMK1, 11x17, 1:191.744

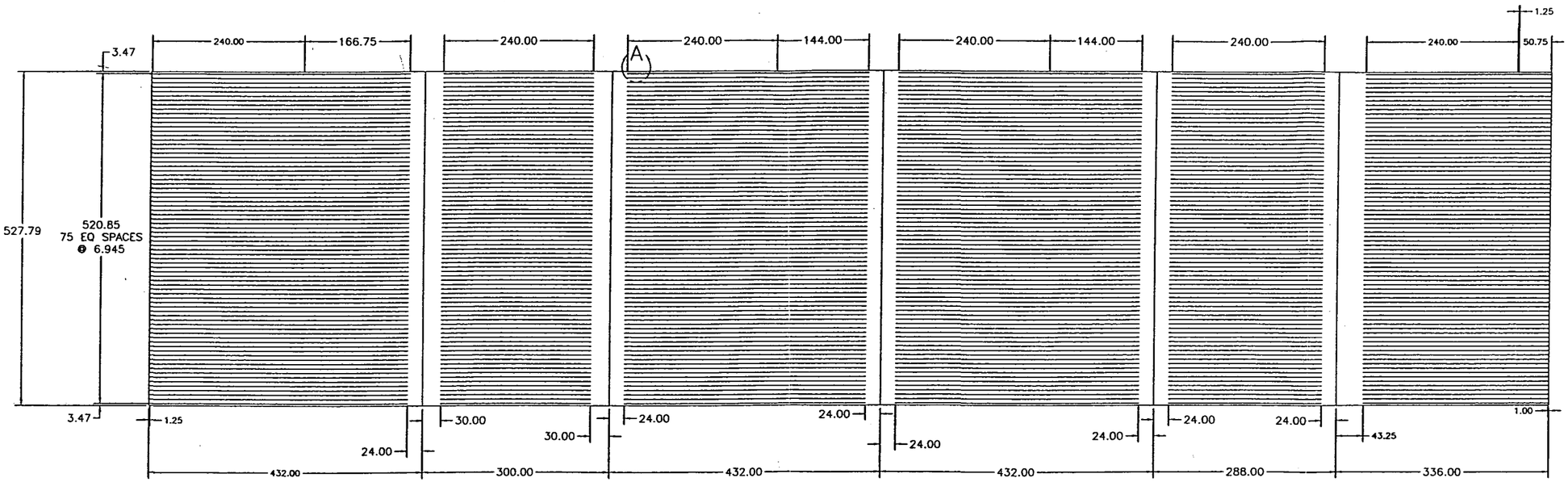
ITEM	QTY	NAME	Parts List DESCRIPTION	MATERIAL	NOTE
1	460	H.R.BAR	1/2" X 2" X 240"	ASTM A-36	68 LBS EA
2	76	H.R. BAR	1/2" X 2" X 166.75		
3	152	H.R. BAR	1/2" X 2" X 144.00"	ASTM A-36	41 LBS EA
4	76	H.R. BAR	1/2" X 2" X 50.75"	ASTM A-36	14 LBS EA
5	84	H.R. BAR	1/2" X 2" X 41.00"	ASTM A-36	12 LBS EA
7	14	H.R. BAR	1/2" X 2" X 32"	ASTM A-36	1 LB EA
8	84	H.R. BAR	1/2" X 2" X 16"	ASTM A-36	4.5 LB EA
9	1	H.R. BAR	1/2" X 2" X 42.25"	ASTM A-36	12 LBS EA
10	1	BAR ROLLED EASY WAY	1/2" X 2" X 14.50" I.D.	ASTM A-36	13 LB
	1	BAR ROLLED EASY WAY	1/2" X 2" X 80" I.D.	ASTM A-36	71 LBS EA

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	9/12/01	
	FOR QUOTE PURPOSES ONLY		

#	DESCRIPTION	DATE	APPROVED
A	REALEASE FOR FABRICATION	09/12/01	mbs
		69-400-0146	



DETAIL A
SCALE 1:4



NOTES:

1.) CAUTION! LOCATE WEAR BAR WELDS TO AVOID WELDING ON SHELL WELDS.

2.) OMIT 50.75" BARS AS REQUIRED TO ALLOW FOR DISCHARGE DOORS.

3.) TRIM WEAR BARS PER SECTION A-A (SHEET #2) TO ALLOW FOR MANWAYS.

4.) TRIM WEAR BARS AS REQUIRED FOR TEMPERATURE PROBE ETC.
THE SENSORS ARE TO BE LOCATED 180° FROM MANWAYS.

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL

CONFIDENTIAL - PROPERTY OF:
B-C equipment services
MILWAUKEE, WISCONSIN U.S.A.

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED
LINEAR: .X ±.06, .XX ±.03, .XXX ±.01
ANGLES: ±.50°
125 MACHINED SURFACE TEXTURE

NAME: BIOMIXER SHELL WEAR BR LAYOUT 14'ID X 185' LG
MAT'L: ASTM A-36 / ASTM A-36
AUTOCAD FILE: 69-4146A
WT R F

DR. mbs 9/12/01
CH. ——
AP. ——
JOB NO. BM01-3123
SCALE 1/8"=1'0"
SHEET 1 OF1
THIRD ANGLE PROJECTION
REFERENCE DWG:
SIZE D
PART NO. 69-400-0146
REVISION A

REMOVE ALL BURRS, SHARP EDGES, ETC

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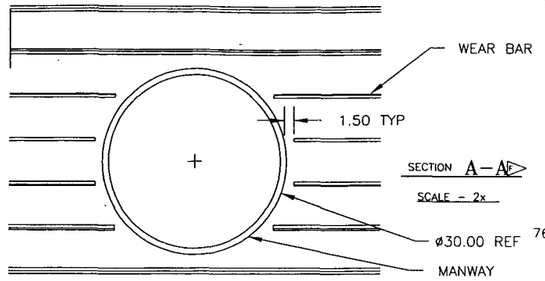
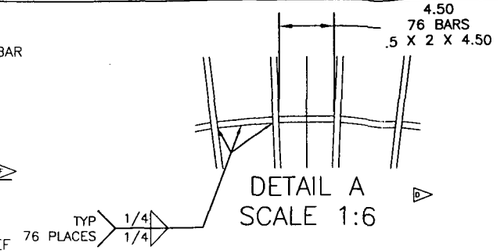
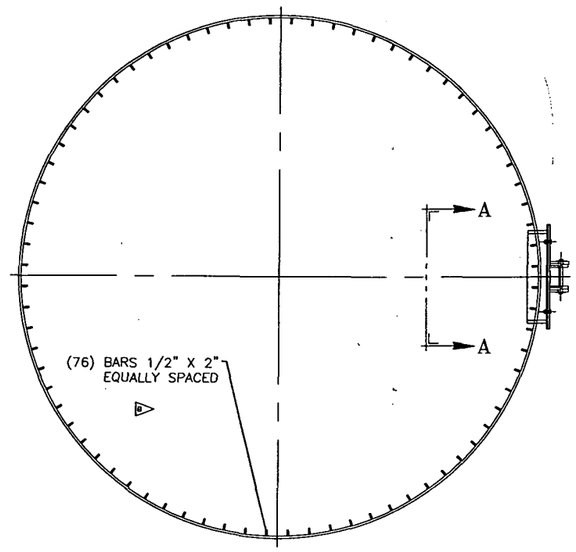
#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	MBS	
	FOR QUOTE PURPOSES ONLY		
#	DESCRIPTION	DATE	APPROVED
A	RELEASE FOR MANUFACTURING	09/13/01	mbs
		69-400-0146	
B	QTY OF WEAR BARS WAS 84	09/19/01	mbs
		69-400-0146	
C	ADD ø6.88 HOLES	10/10/01	mbs
	ADD WEAR BARS TO DAM	69-400-0146	
D	ADD 1" X 2" RING	7/3/02	mbs
	ADD .50 X 2.00 BARS	69-400-0146	

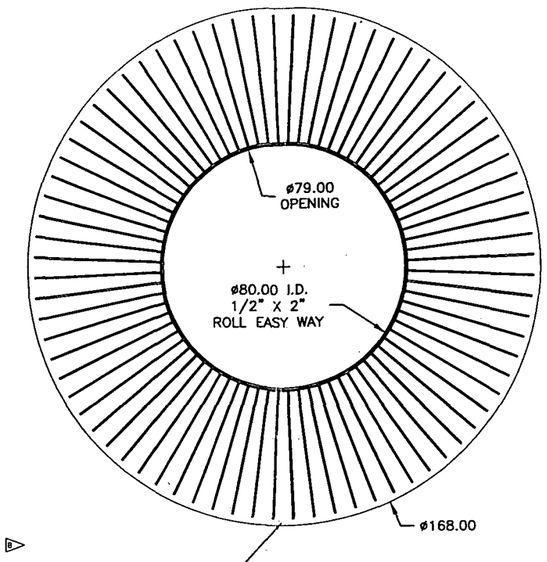




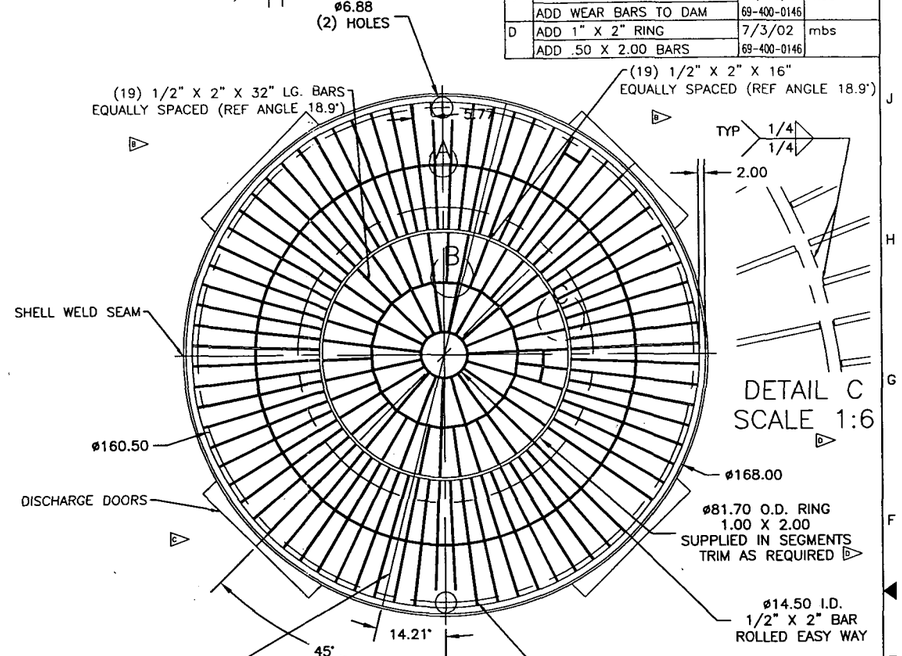
DETAIL A
SCALE 1:6



CIRCUMFERENTIAL WEAR BAR LAYOUT
WEIGHT OF WEAR BARS VARIES WITH LENGTH OF SHIPPING SECTION.

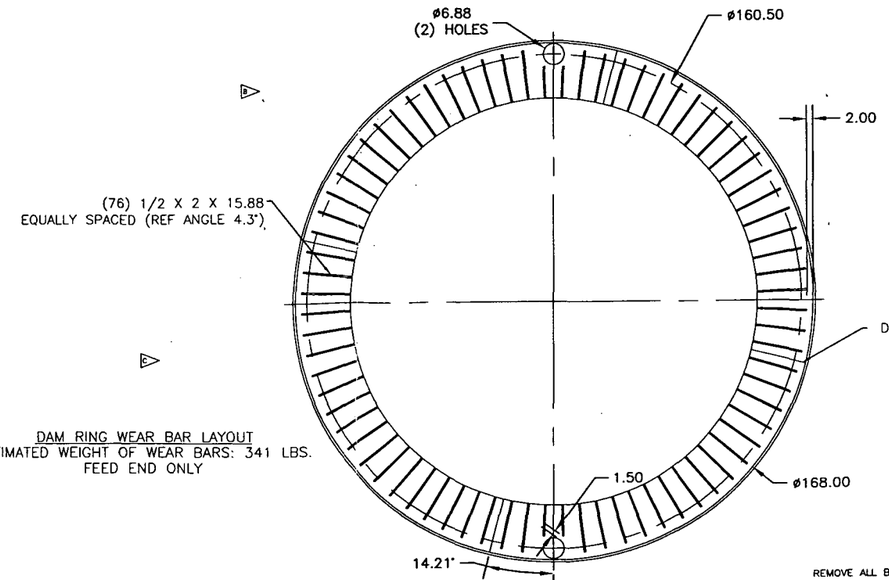


FEED END WEAR BAR LAYOUT
ESTIMATED WEIGHT OF WEAR BARS: 1213 LBS.

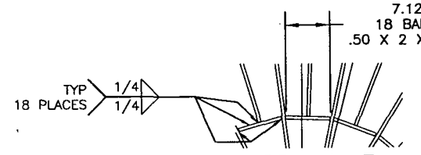


DETAIL C
SCALE 1:6

DISCHARGE END WEAR BAR LAYOUT
ESTIMATED WEIGHT OF WEAR BARS: 1465 LBS.



DAM RING WEAR BAR LAYOUT
ESTIMATED WEIGHT OF WEAR BARS: 341 LBS.
FEED END ONLY



DETAIL B
SCALE 1:12

REMOVE ALL BURRS, SHARP EDGES, ETC

JOB NAME: SUMTER COUNTY SOLID WASTE – BUSHNELL, FL

CONFIDENTIAL – PROPERTY OF: a-c equipment services, MILWAUKEE, WISCONSIN U.S.A.

NAME: WEAR BAR LAYOUT DETAILS

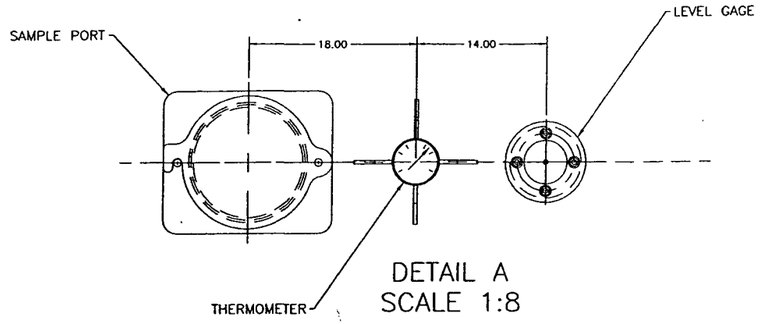
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M–1982.
LIMITS UNLESS OTHERWISE NOTED
LINEAR: ANGLES: ±.50°
.X ±.06
.XX ±.03
.XXX ±.01
125 MACHINED SURFACE TEXTURE

MATL: ASTM A–36
ASTM A–36

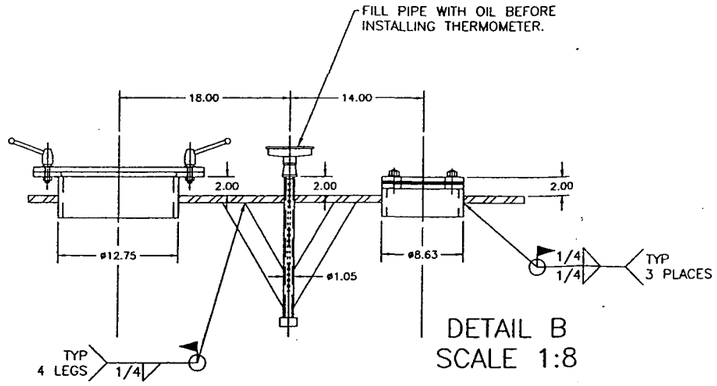
AUTOCAD FILE: 69–4146B
WT R F

DR. mbs (9/11/01)
CH. ——
AP. ——
JOB NO. BM01–3123
SCALE 1/2"=1'0"
SHEET 2 OF2
THIRD ANGLE PROJECTION
REFERENCE DWG:
SIZE D
PART NO. 69–400–0146
REVISION D

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	10/1/2001	SMK
	FOR QUOTE PURPOSES ONLY		
#	DESCRIPTION	DATE	APPROVED
A	RELEASED FOR CONSTRUCTION	10/02/2001	smk1



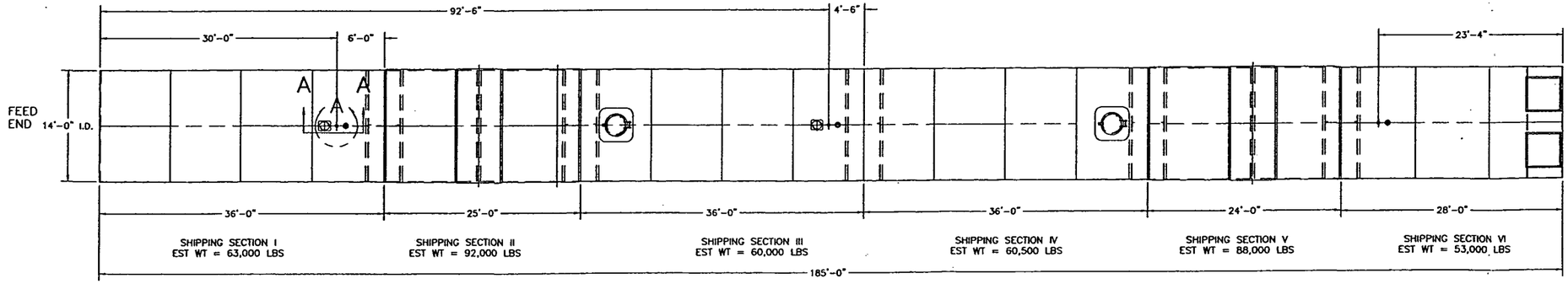
DETAIL A
SCALE 1:8

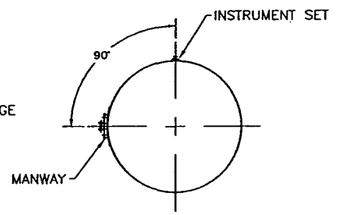


DETAIL B
SCALE 1:8

(B)

SECTION A–A





NOTE:
INSTRUMENT SET ROTATED 90° CLOCKWISE FROM MANWAYS.

JOB NAME: SUMTER COUNTY SOLID WASTE – BUSHNELL, FL.

CONFIDENTIAL – PROPERTY OF:
a-c equipment services
MILWAUKEE, WISCONSIN U.S.A.

NAME: INSTRUMENT SET LOCATION & FIELD INSTALLATION

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M–1982. LIMITS UNLESS OTHERWISE NOTED
LINEAR: .X ±.06, .XX ±.03, .XXX ±.01
ANGLES: ±.50°
125 MACHINED SURFACE TEXTURE

MAT'L

AUTOCAD FILE: 69–4155

WT R F

DR. smk1 10/01/2001
CH. ——— ———
AP. ——— ———

JOB NO. BM01–3123

THIRD ANGLE PROJECTION

REFERENCE DWG:

SIZE D

SCALE 1/8"=1'0"

SHEET 1 OF 1

PART NO. 69–400–0155

REVISION A

REMOVE ALL BURRS, SHARP EDGES, ETC

Oct 02, 2001 – 14:52

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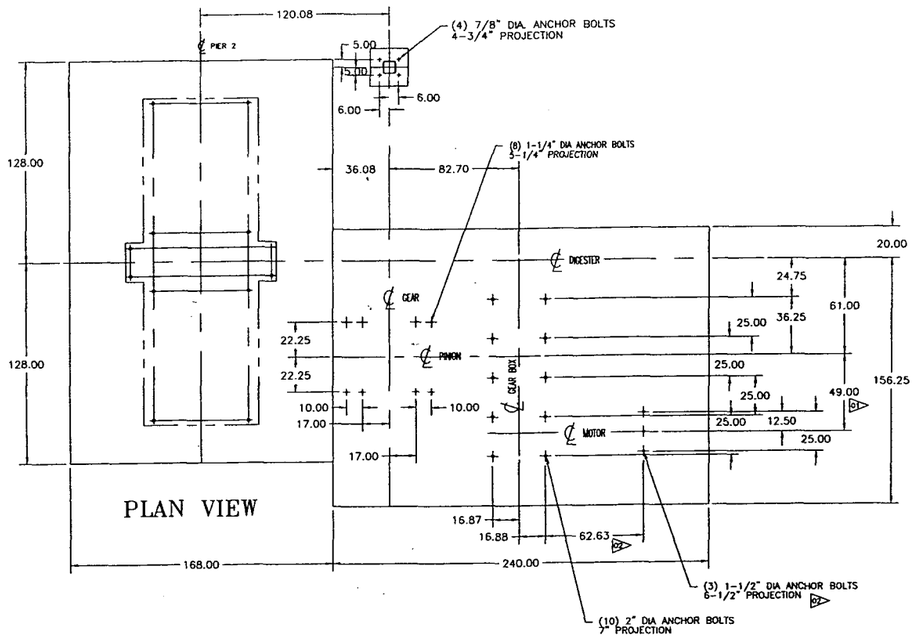
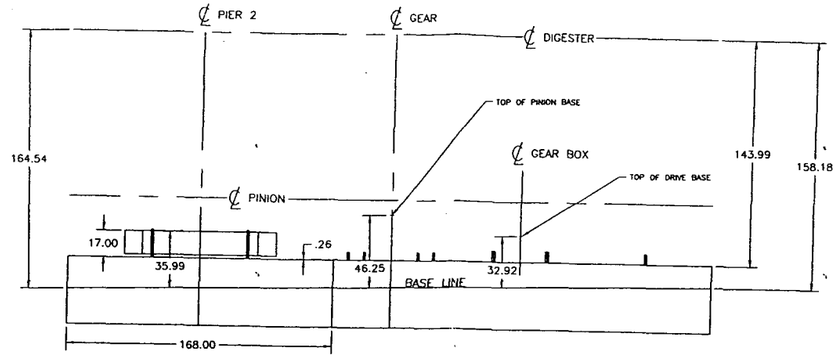
Section 12 – Drive Installation, Guard and Equipment Arranagements

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	8/14/2001	smk
	FOR QUOTE PURPOSES ONLY		
#	DESCRIPTION	DATE	APPROVED
01	49.00" was 44.00"	09/12/2001	smk1
02	ANCHOR BOLT LOCATION CHANGED PER REDUCER BASE CERTIFIED PRINT 62.63" WAS 57.88"	09/25/2001	smk1
A	RELEASED FOR CONSTRUCTION	09/28/2001	smk1
B	UPDATED H.S. COUPLING DATA	05/15/2002	SMK1



PLAN VIEW

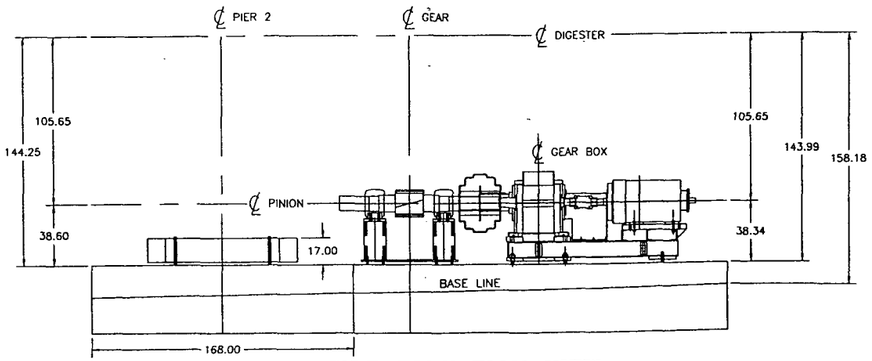


SIDE ELEVATION VIEW SHOWN AT EXACT SLOPE

NOTES:

1. FOR INSTRUCTIONS IN SETTING DRIVE GEAR AND PINION SEE DWG #69-400-0110
2. FOUNDATION OUTLINE DIMENSIONS SHOWN ARE RECOMMENDED BY A-C EQUIPMENT SERVICES, HOWEVER THESE DIMENSIONS MAY BE VARIED TO ACCOMMODATE FOUNDATION DESIGNER'S REQUIREMENTS.
3. A-C EQUIPMENT SERVICES SUGGESTS THAT THE LOADS ON THE DRIVE PIER BE INCREASED BY 100% WHEN DESIGNING FOUNDATION.
4. DRIVE EQUIPMENT IS TO BE INSTALLED ON SLOPE (3/16 PER FOOT) WITH BIOMIXER. ANCHOR BOLTS MUST BE INSTALLED PERPENDICULAR TO SLOPE OF BIOMIXER (3/16 PER FOOT GRADE).
5. SLEEVES ARE TO BE USED WITH ALL ANCHOR BOLTS FOR FIELD ADJUSTMENTS.
6. REFERENCE INSTALLATION OUTLINE DWG #69-400-0133.
7. BASE LINE SHOWN IS THE ELEVATION OF CENTER OF PIER #1 AT TOP OF THE ROUGH CONCRETE.

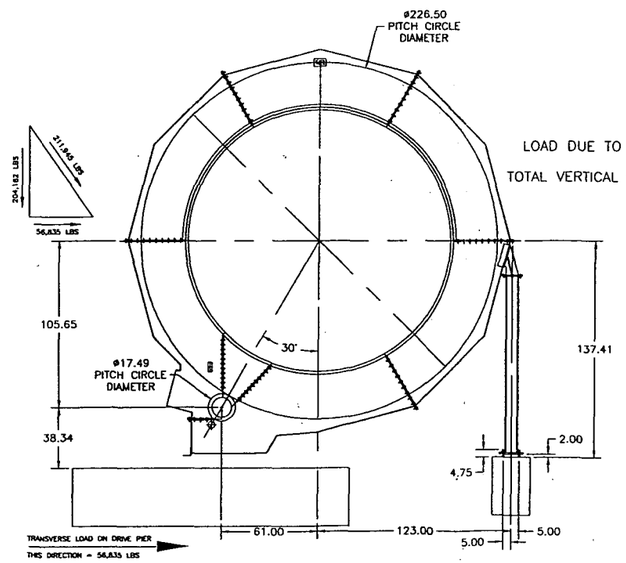
IMPORTANT: SEE NOTE #4 BEFORE SETTING ANCHOR BOLTS



SIDE ELEVATION VIEW

DRIVE EQUIPMENT

MOTOR - SEVER 300 HP./1200 RPM
GEAR - 226 TEETH/1DP./ 18" FACE (HELICAL)
PINION - 17 TEETH/1DP./18" FACE (HELICAL)
REDUCER - FALK TYPE 525A-3 RATIO 85.94:1
▷ HS. COUPLING - FALK FULL SPACER/SIZE 1090T31
LS. COUPLING - FALK STEELFLEX/SIZE 1220T10
LS. COUPLING GUARD
HS. COUPLING GUARD



SECTION A-A

DRIVE PIER LOADING

LOAD DUE TO PINION REACTION 136,760 LBS
STATIC LOAD 67,422 LBS
TOTAL VERTICAL LOAD ON DRIVE PIER 204,182 LBS

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL.

CONFIDENTIAL - PROPERTY OF: a-c equipment services, MILWAUKEE, WISCONSIN U.S.A.

NAME: DRIVE INSTALLATION OUTLINE ROTARY BIOMIXER ø14' I.D. x 185' LG

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES. INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED LINEAR: ANGLES: ±.50' .X ±.06 .XX ±.03 .XXX ±.01

125 MACHINED SURFACE TEXTURE

MATL

AUTOCAD FILE: 69-4134

WT R F

DR. smk 08/14/2001

CH. ____ ____

AP. ____ ____

JOB NO. BM01-3123

THIRD ANGLE PROJECTION

REFERENCE DWG:

SIZE D

SCALE 1/4"=1'0"

SHEET 1 OF 1

PART NO. 69-400-0134

REVISION B

REMOVE ALL BURRS, SHARP EDGES, ETC

May 15, 2002 - 11:14

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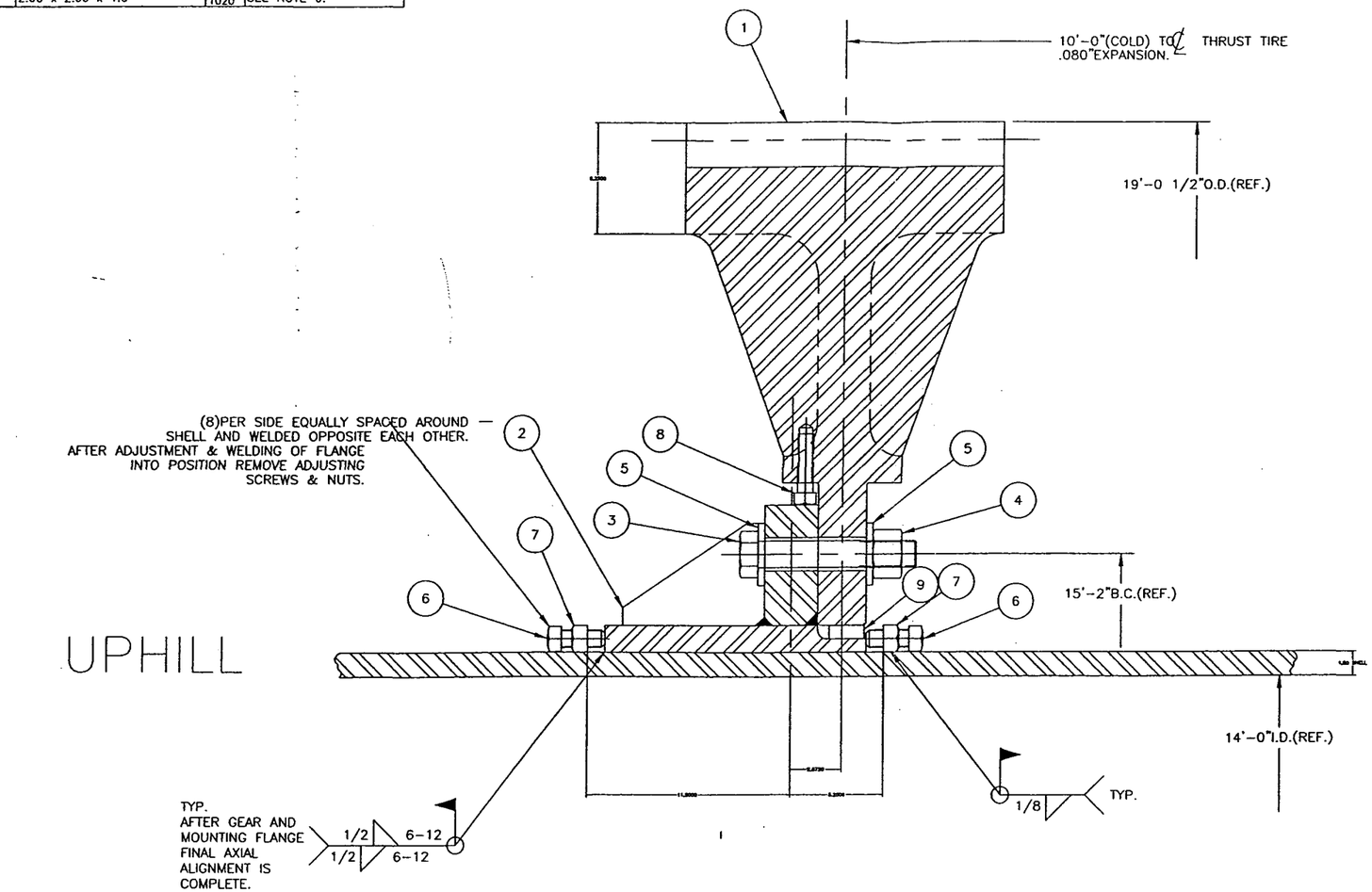
ITEM	QTY	DESCRIPTION	MAT'L SIZE	MAT'L	PART NO./NOTES
1	1	GEAR	228.5"O.D.,18.0"FACE,226 TEETH		FALK M.O.#95-076250-G
2	1	GEAR FLANGE	187.5"O.D.,14.75"WIDE		DWG #69-400-0109
3	48	HEX BOLT	1.5"-6 x 9.0"LG	GRADE 5	
4	48	SECURITY LOCKNUT	1.5"-6		P/N SH533
5	96	FLAT WASHER - HARDENED	1.62"I.D. x 3.5"O.D. x .38"THK	STEEL 1045	DWG #96-100-0006
6	16	SET SCREW - SQ. HD., CUP PT.	1"-8 x 2.5"LG		
7	16	SQUARE NUT	1"-8		
8	18	SET SCREW - SQ. HD., CUP PT.	7/8"-9 x 2.5"LG		
9	12	CENTERING BLOCK	2.00 x 2.00 x 1.0"	STEEL 1020	SEE NOTE 6.

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	11/6/2001	
	FOR QUOTE PURPOSES ONLY		
#	DESCRIPTION	DATE	APPROVED
A	RELEASED FOR MANUFACTURE	7/28/96	SMK
	FOR SEVIERVILLE D-4 PROJECT	69-400 0110	
B	ADDED ITEMS 8 & 9, AND NOTE 6	11/06/01	dwb
	BOLT TORQUE WAS 880 FT. LBS.		



NOTES:
1. FOR RING GEAR ASSEMBLY REFER TO THE FALK CORPORATION, BULLETIN 638-110, INSTALLATION MANUAL.
2. USE THE (2)TWO INDICATOR METHOD FOR CHECKING RIM FACE RUNOUT.
3. ALLOWABLE RIM FACE RUNOUT: .029"
4. RECOMMENDED BACKLASH: .140"- .150"
5. TORQUE ITEMS #3,4&5 TO 1,300 FT. LBS. (LUBRICATED)
6. 12 CENTERING BLOCKS (IT. 9) TO BE FIELD INSTALLED IN BETWEEN THE GEAR AND FLANGE UPON COMPETION OF GEAR ALIGNMENT. THE BLOCK THICKNESS TO BE MACHINED TO .010" LESS THAN THE MEASURED GAP BETWEEN THE GEAR BORE AND THE FLANGE TURN AT 12 LOCATIONS EQUALLY SPACED AROUND THE GEAR. THE MACHINED BLOCKS ARE INSERTED AT THEIR PROPER LOCATION AND WELDED TO THE FLANGE.

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL

CONFIDENTIAL - PROPERTY OF: a-c equipment services, MILWAUKEE, WISCONSIN U.S.A.

NAME: GEAR INSTALLATION INSTRUCTIONS ø14'-0" x 185'-0" LG. BIO-MIXER

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED LINEAR: X ±.06, .XX ±.03, .XXX ±.01 ANGLES: ±.50°

125 MACHINED SURFACE TEXTURE

MATL

AUTOCAD FILE: 69-4110B

WT R F

DR. SMK 2/28/96

CH. ____ ____

AP. ____ ____

JOB NO. BM01-3123

SCALE 3"=1'0" SHEET 1 OF1

THIRD ANGLE PROJECTION

REFERENCE DWG:

SIZE D

PART NO. 69-400-0110

REVISION B

REMOVE ALL BURRS, SHARP EDGES, ETC

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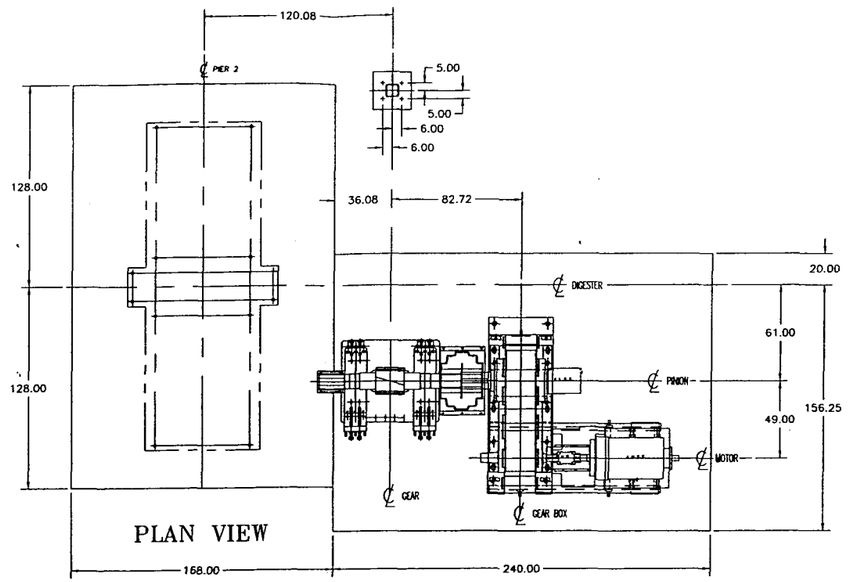
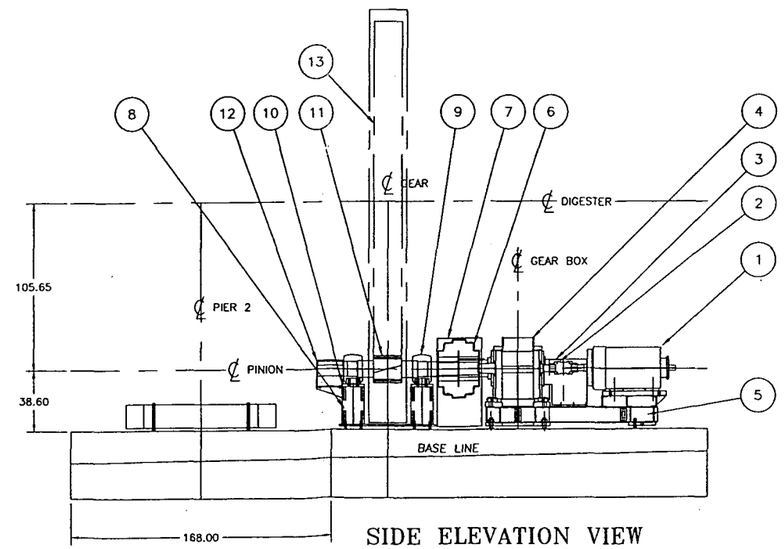
Parts List

ITEM	QTY	DESCRIPTION	DESCRIPTION 2	NOTE
1	1	MOTOR	2400 LBS	SEVER 300/150 HP 1200/600 RPM
2	1	HIGH SPEED COUPLING	56 LBS	FALK 1090T31 w/9.75" SPACER
3	1	HIGH SPEED COUPLING GUARD		
4	1	REDUCER	10,250 LBS	FALK 525A-3 @ 85.94:1
5	1	REDUCER/MOTOR BASE	2,329 LBS	FALK
6	1	LOW SPEED COUPLING	3935 LBS	FALK 1220T10
7	1	LOW SPEED COUPLING GUARD	400 LBS	DWG 96-400-0131
8	1	PINION BASE	1,900 LBS	DWG 69-400-0141
9	2	PILLOW BLOCK BEARINGS	625 LBS EA.	SAF 23148
10	1	PILLOW BLOCK SHIMS		DWG 69-200-0020
11	1	PINION GEAR & SHAFT	2,450 LBS	FALK - 17 TEETH
12	1	PINION SHAFT EXTENSION COVER	75 LBS	DWG 69-400-0130
13	1	GIRTH GEAR	32,550 LBS	FALK - 226 TEETH

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	SMK	8/15/2001
	FOR QUOTE PURPOSES ONLY		
#	DESCRIPTION	DATE	APPROVED
01	CHANGED TO SEVER MOTOR	09/12/2001	smk1
	@300 HP/ 1200 RPM		
A	RELEASED FOR CONSTRUCTION	09/28/2001	smk1
B	UPDATED H.S. COUPLING DATA	05/15/2002	SMK1



PLAN VIEW



SIDE ELEVATION VIEW

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL.

CONFIDENTIAL ~ PROPERTY OF: S-C equipment services, MILWAUKEE, WISCONSIN U.S.A.

NAME: BIOMIXER DRIVE GENERAL ARRANGEMENT

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED LINEAR: .X ±.06, .XX ±.03, .XXX ±.01 ANGLES: ±.50'

125 MACHINED SURFACE TEXTURE

MAT'L

AUTOCAD FILE: 69-4138

WT R F

DR. smk1 08/15/2001

CH. ----- -----

AP. ----- -----

JOB NO. BM01-3123

THIRD ANGLE PROJECTION

REFERENCE DWG:

SIZE D

SCALE 1/4"=1'0" SHEET 1 OF1

PART NO. 69-400-0138

REVISION B

REMOVE ALL BURRS, SHARP EDGES, ETC

May 15, 2002 - 11:24

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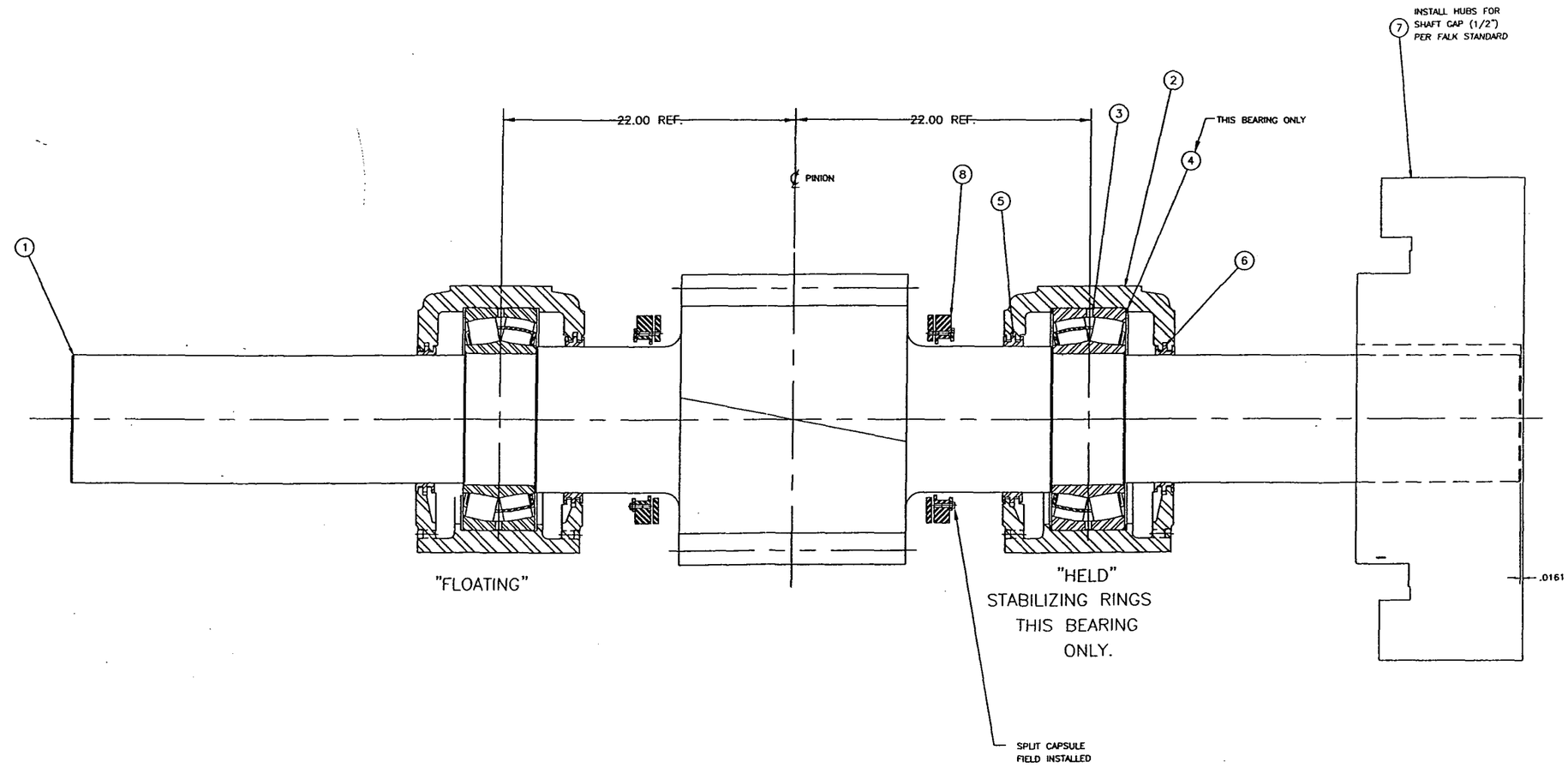
Parts List

ITEM	QTY	DESCRIPTION	MATERIAL SIZE	MATERIAL	NOTE
1	1	PINION SOS	17T., 1.0 NDP, 18" FACE 90° OA	365 -415 BHN	MO 01-076215-P
2	2	PILLOW BLOCK HOUSING	SAF 3148		
3	2	SPHERICAL ROLLER BEARING	23148/W33		
4	2	STABILIZING RING	SR-44-38-1		HELD BEARING ONLY
5	2	TRIPLE SEAL RING	LER 16659		INBOARD
6	2	TRIPLE SEAL RING	LER 16660		OUTBOARD
7	1	LOW SPEED COUPLING HUB	1220T10		DRIVEN
8	2	SEAL RETAINER CAPSULE	69-200-0127	SEAL R1050-13848	INSTALL IN FIELD

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	11/7/2001	
	FOR QUOTE PURPOSES ONLY		



DRAWING NOT TO SCALE

REMOVE ALL BURRS, SHARP EDGES, ETC

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL

CONFIDENTIAL - PROPERTY OF: a-c equipment services, MILWAUKEE, WISCONSIN U.S.A.

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED
LINEAR: X ±.06, .XX ±.03, .XXX ±.01
ANGLES: ±.50°

125 MACHINED SURFACE TEXTURE

NAME: PINION ASSEMBLY 17 T., 1.0 NDP, 18" FACE FOR ø14'-0" x 185'-0" BIO-MIXER

MAT'L

AUTOCAD FILE: 69-4163

WT R F

DR. dwb 11/07/01

CH.

AP.

JOB NO. BM03123

SCALE 1:6

SHEET 1 OF1

THIRD ANGLE PROJECTION

REFERENCE DWG:

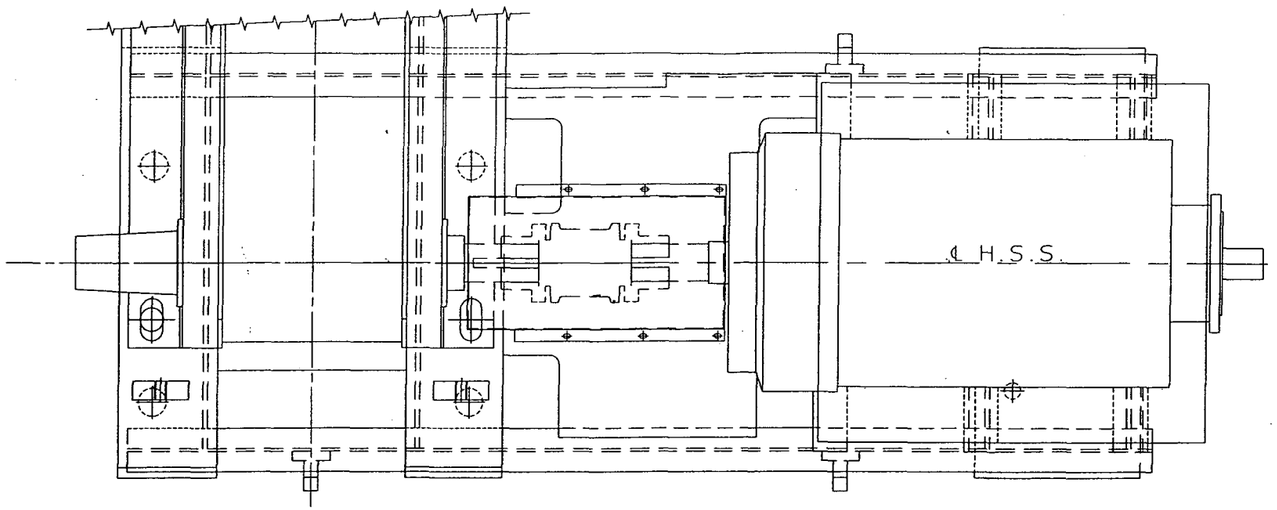
SIZE D

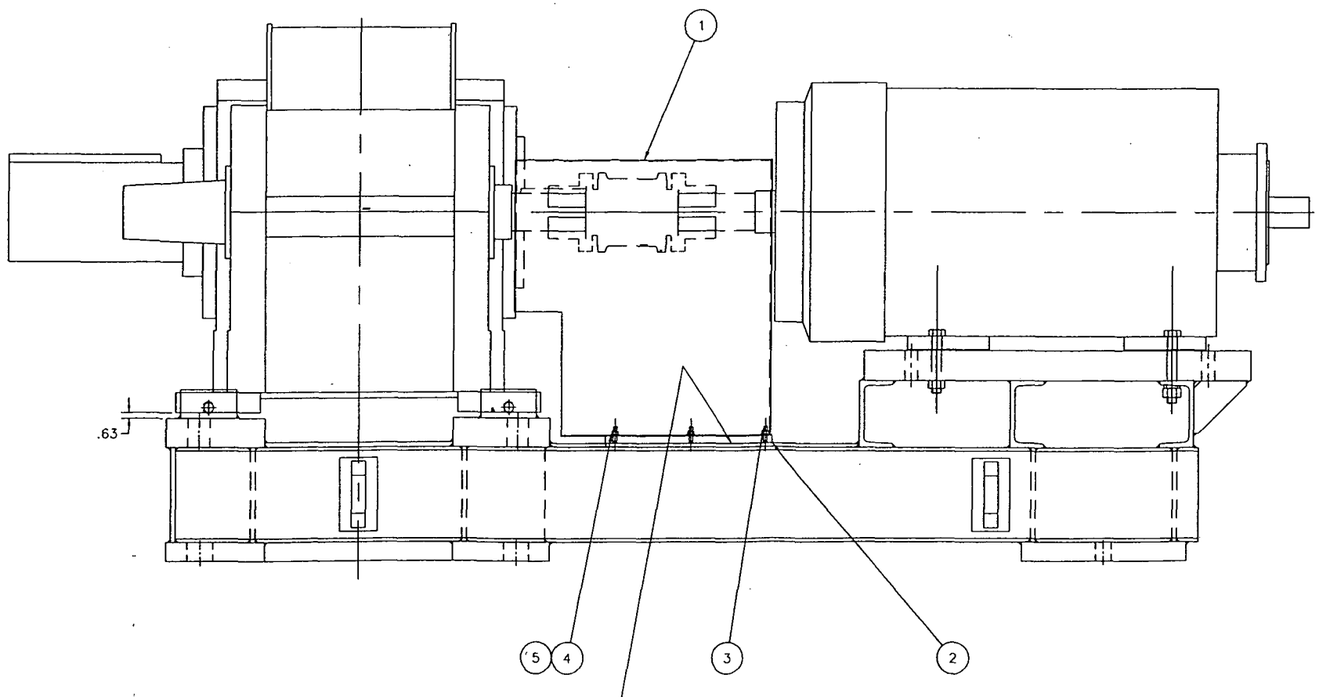
PART NO. 69-400-0163

REVISION A

Ports List				
ITEM	QTY	DESCRIPTION	MATERIAL SIZE	MATERIAL	NOTE
1	1	HIGH SPEED COUPLING GUARD		ASMT A-36	83 LBS
2	2	MOUNTING BAR	3/4" x 1.25" 17.75" LG	ASMT A-36	4.7 LBS EA.
3	6	STUD	3/8-16 x 1.5" LG	GRADE 2	
4	6	HEX NUT	3/8-16		
5	6	FLAT WASHER	3/8"		

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE FOR QUOTE PURPOSES ONLY	10/23/2001	SMK
#	DESCRIPTION	DATE	APPROVED
A	RELEASED FOR MANUFACTURING	10/29/2001	smk1
B	INCREASED SHAFT COVERAGE AREA	11/28/2001	SMK1
C	CHANGED COUPLING SIZE AND MOTOR CONFIGURATION	01/10/2002	SMK1
D	ADJUSTED GUARD TO FINAL MOTOR DIMENSIONS	01/14/2002	SMK1





REMOVE ALL BURRS, SHARP EDGES, ETC

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL.

CONFIDENTIAL - PROPERTY OF:
a-c equipment services
MILWAUKEE, WISCONSIN U.S.A.

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED
LINEAR: .X ±.06, .XX ±.03, .XXX ±.01
ANGLES: ±.50°
125 MACHINED SURFACE TEXTURE

NAME: HIGH SPEED COUPLING GUARD
MAT'L: SEE PARTS LIST
AUTOCAD FILE: 69-4162A
WT R F

DR. smk1 10/23/2001
CH. ---- ----
AP. ---- ----
JOB NO. BM01-3123
SCALE 1:8
SHEET 1 OF2
THIRD ANGLE PROJECTION
REFERENCE DWG:
SIZE D
PART NO. 69-400-0162
REVISION D

Jan 14, 2002 - 13:54

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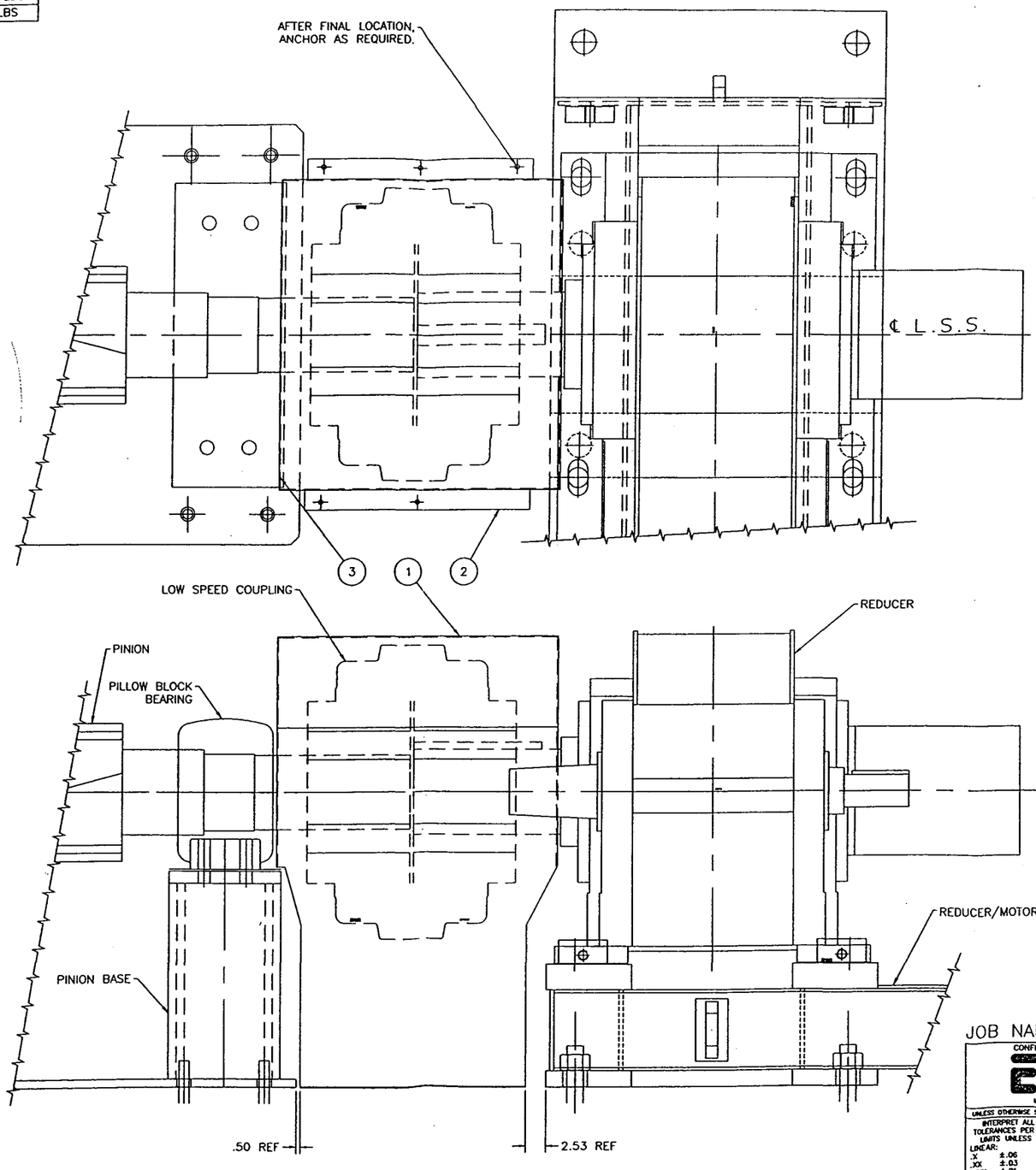
Parts List					
ITEM	QTY	DESCRIPTION	MATERIAL SIZE	MATERIAL	NOTE
1	1	LOW SPEED COUPLING GUARD		ASTM A-36	220 LBS
2	1	COVER PLATE	1/8" x 35.08" x 141.22" LG	ASTM A-36	162.5 LBS
3	2	END PLATE	1/8" x 28.34" X 38.25" LG	ASTM A-36	28.7 LBS

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE FOR QUOTE PURPOSES ONLY	10/23/2001	smk
#	DESCRIPTION	DATE	APPROVED
A	RELEASED FOR MANUFACTURING	10/29/2001	smk1
B	INCREASED COVERAGE AREA OF SHAFT	11/28/2001	SMK1



REMOVE ALL BURRS, SHARP EDGES, ETC

JOB NAME: SUMTER COUNTY SOLID WASTE- BUSHNELL, FL.

CONFIDENTIAL - PROPERTY OF: B-C equipment services, MILWAUKEE, WISCONSIN U.S.A.

NAME: LOW SPEED COUPLING GUARD

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES. INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED. LINEAR: .X ±.06, .XX ±.03, .XXX ±.01. ANGLES: ±.50°. 125 MACHINED SURFACE TEXTURE.

MAT'L: SEE PARTS LIST

AUTOCAD FILE: 69-4161A. WT R F

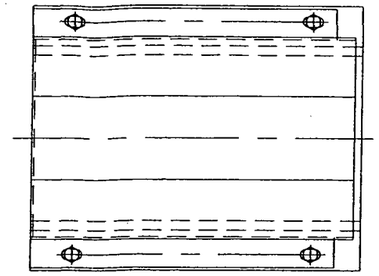
DR. smk 1 10/23/2001 | CH. | AP. | JOB NO. BM01-3123 | SCALE 1:8 | SHEET 1 OF2 | THIRD ANGLE PROJECTION | REFERENCE DWG: | SIZE D | PART NO. 69-400-0161 | REVISION B

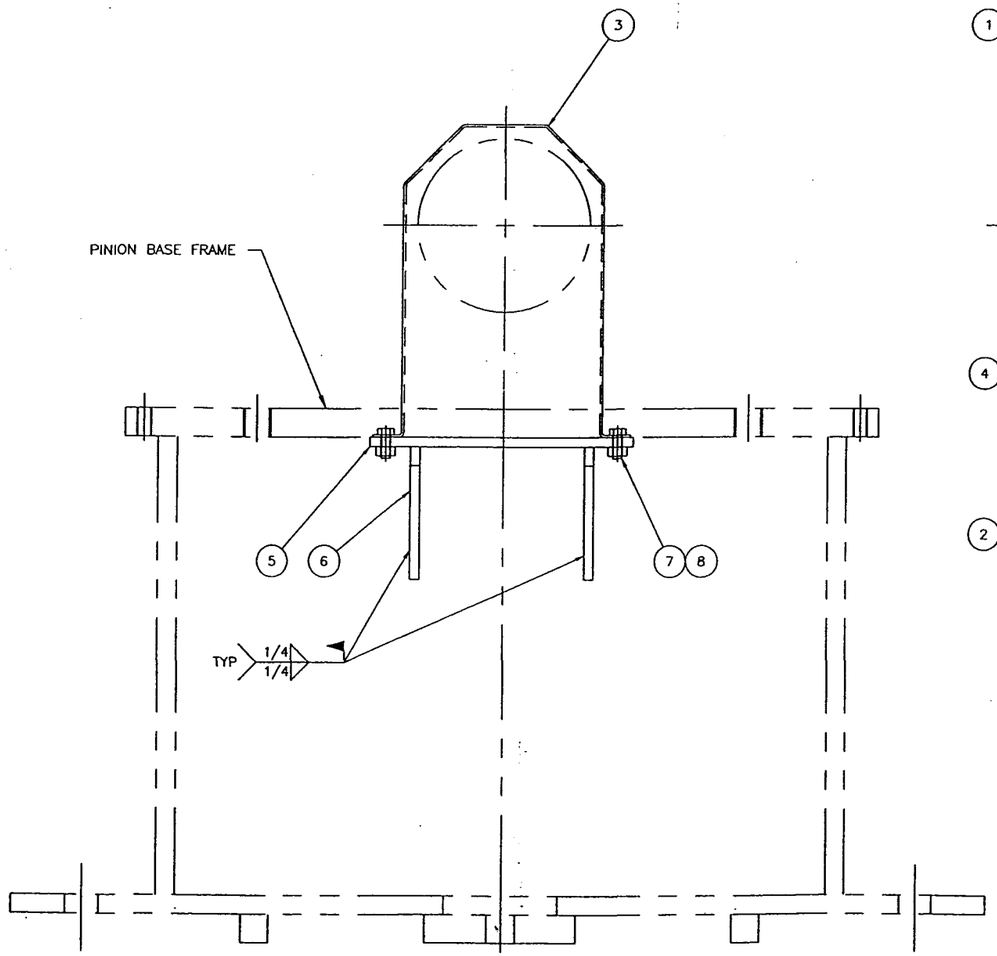
Nov 28, 2001 - 14:42

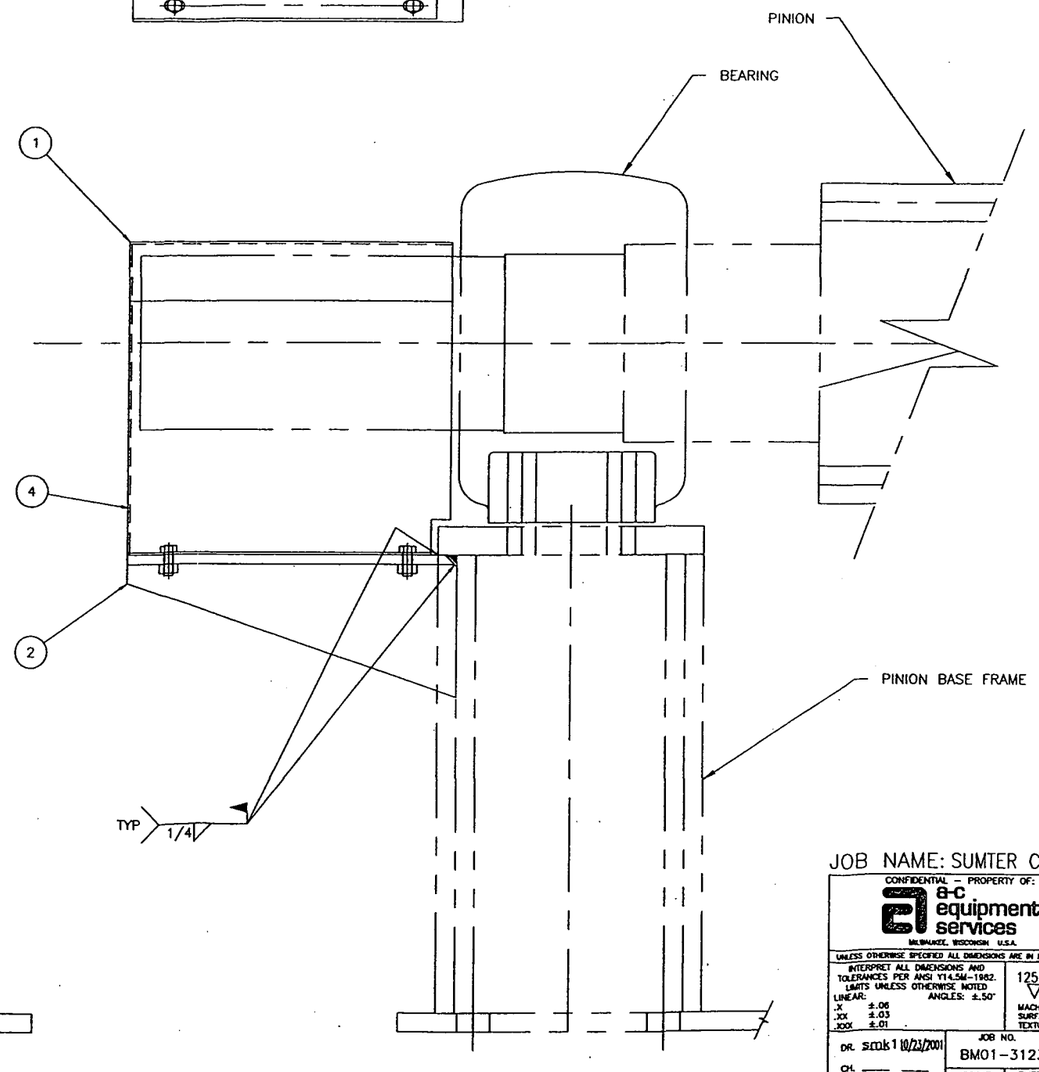
F:\Engineer\ACDWGS\BioMixers\SumterCo\BM01-3123\69-4161A.dwg, 11/29/2001 08:28:51 AM, SMK1, 11x17, 1:15.9773

Parts List					
ITEM	QTY	DESCRIPTION	MATERIAL SIZE	MATERIAL	NOTE
1	1	SHAFT EXTENSION COVER		ASTM A-36	33 LBS
2	1	MOUNTING BRACKET		ASTM A-36	57 LBS
3	1	COVER PLATE	1/8" x 17.25" x 42.75" LG	ASTM A-36	26 LBS
4	1	END PLATE	1/8" x 10.44" x 16.43" LG	ASTM A-36	5.8 LBS
5	1	MOUNTING PLATE	1/2" x 14.00" x 17.63" LG	ASTM A-36	35 LBS
6	2	GUSSET	1/2" x 7.00" x 17.63" LG	ASTM A-36	10 LBS EA.
7	4	HEX BOLT	1/2-13 x 1-1/4" LG	GR 2	
8	4	HEX NUT	1/2-13	GR 2	

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	10/23/2001	SMK
	FOR QUOTE PURPOSES ONLY		
#	DESCRIPTION	DATE	APPROVED
A	RELEASED FOR MANUFACTURING	10/29/2001	smk1
B	MADE WELDS FIELD WELDS	11/26/2001	SMK1







REMOVE ALL BURRS, SHARP EDGES, ETC

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL.

CONFIDENTIAL - PROPERTY OF: a-c equipment services, MILWAUKEE, WISCONSIN U.S.A.

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED
LINEAR: ANGLES: ±.50°
.X ±.06
.XX ±.03
.XXX ±.01

125 MACHINED SURFACE TEXTURE

DR. smk1 10/23/2001
CH. ——
AP. ——

JOB NO. BM01-3123
SCALE 3"=1'0"
SHEET 1 OF2

NAME: SHAFT EXTENSION COVER
MAT'L: SEE PARTS LIST
AUTOCAD FILE: 69-4160A
WT R F
THIRD ANGLE PROJECTION
REFERENCE DWG:
SIZE D
PART NO. 69-400-0160
REVISION B

Nov 26, 2001 - 13:36

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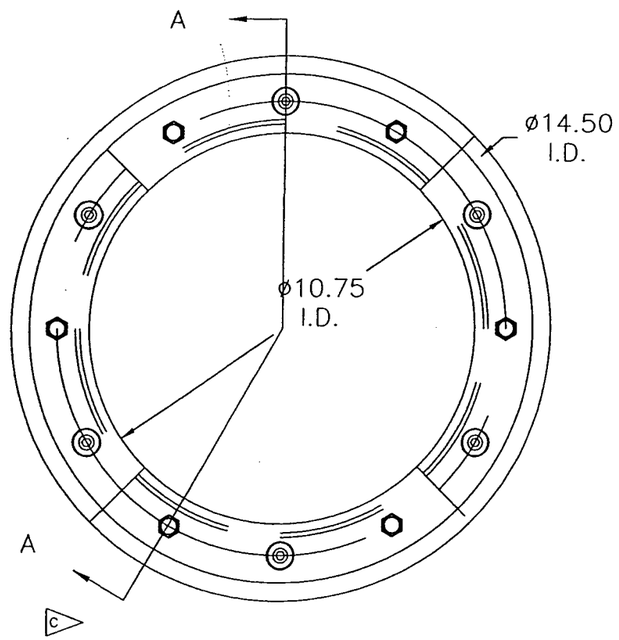
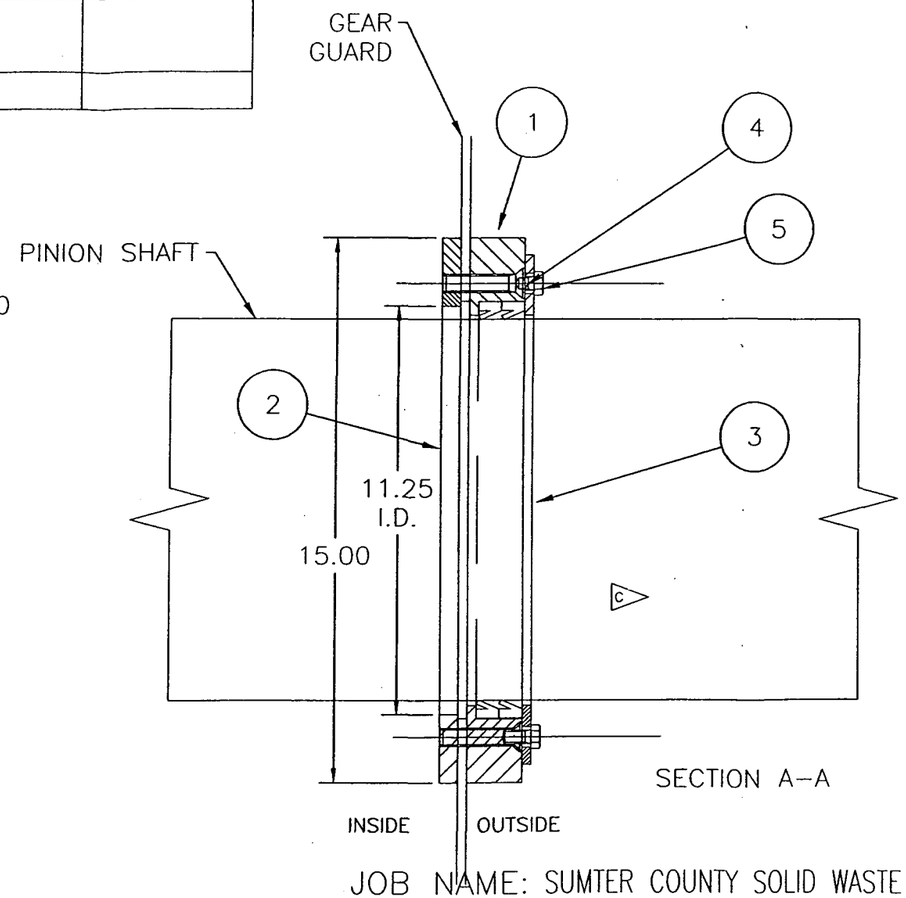
Parts List

ITEM	QTY	NAME	DESCRIPTION	MATERIAL	NOTE
1	1	SEAL RING	15.00 O.D. X 10.75 I.D. X 1.50	ASTM A-36	27 LBS
2	1	INNER RETAINING RING	15.00 O.D. X 11.25 I.D. X .50	ASTM A-36	13 LBS
3	1	OUTER RETAINING RING	14.00 O.D. X 10.75 I.D. X .25	ASTM A-36	5.2 LBS
4	6	HEX SOCKET C'SINK FLAT HEAD CAP SCREW	3/8-16UNC X 2.25" LG	GRADE 2	
5	6	HEX BOLT	3/8-16 UNC X 3/4" LG	GRADE 2	

#	DESCRIPTION	DATE	APPROVED
A	ORIGINAL RELEASE	10/02/01	mbs
B	ADD INSTALATION INSTRUCTIONS	11/21/01	mbs
C	SECTION LINE A-A, SHOW PINION SHAFT SHOW PINION SHAFT & SEAL	11/21/01	mbs





INSTALLATION INSTRUCTIONS

B

1.) ASSEMBLE ITEM # 1 TO ITEM #2 ONE HALF AT A TIME ALTERNATING SPLIT BY 90°.
2.) INSTALL SEALS POINTING THE LIP TOWARDS THE PINION ONE AT A TIME THEN PUSH INTO RETAINING RING
3.) INSTALL ITEM #3 ONE HALF @ A TIME AGAIN ROTATE THE SPLIT BY 90°.
4.) REPEAT STEPS #1 through #3 ON THE OPPOSITE SIDE.

REMOVE ALL BURRS, SHARP EDGES, ETC.

CAD PLOT DATE / TIME
Oct 02, 2001 - 13:52

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL

CONFIDENTIAL - PROPERTY OF:
a-c equipment services
MILWAUKEE, WISCONSIN U.S.A.

NAME: OILING PINION OIL SEAL ASSEMBLY DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982.
LIMITS UNLESS OTHERWISE NOTED
LINEAR: ANGLES: ±.50°
.X ±.06
.XX ±.03
.XXX ±.01
125 MACHINED SURFACE TEXTURE

MAT'L: ASTM A-36
ASTM A-36

AUTOCAD FILE: 69-2127A
R 47
WT F LBS EA

DR. 10/01/01 mbs
CH. ____ ____
AP. ____ ____

JOB NUMBER: BM01-3123
SCALE: 3"=1'0"
SHEET: 2 OF2

THIRD ANGLE PROJECTION
REFERENCE DRAWING:
SIZE: B

PART NO.: 69-200-0127
REVISION: C

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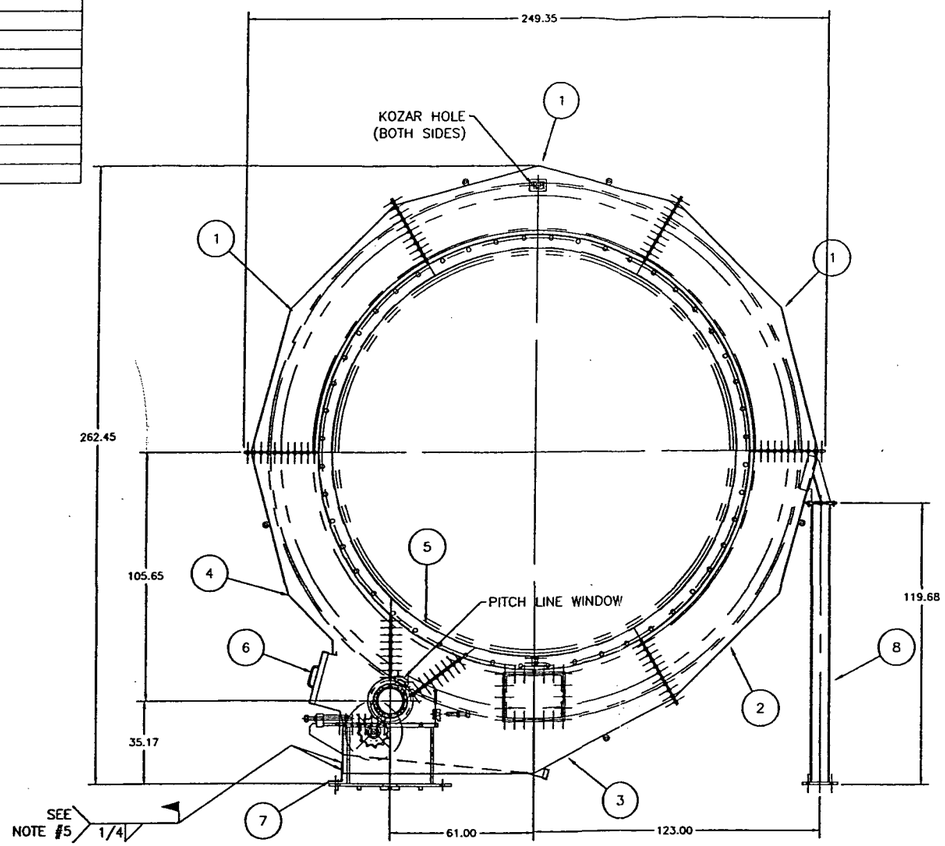
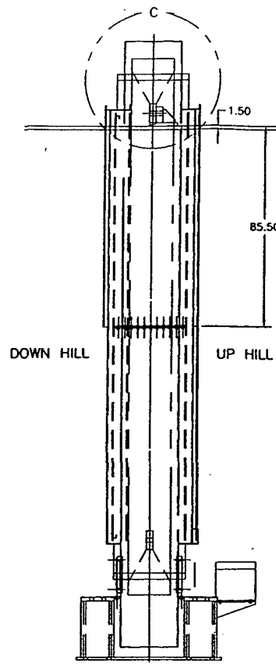
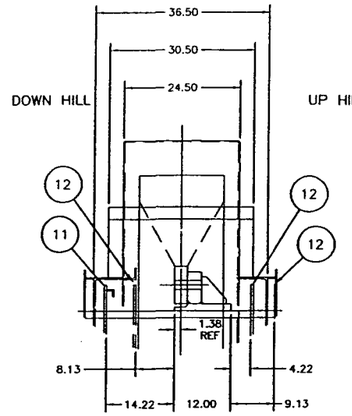
Parts List					
ITEM	QTY	NAME	DESCRIPTION	MATERIAL	NOTE
1	3	TOP SEGMENT	124.56 X 46.61 X 40.37		
2	1	SIDE SEGMENT	124.56 X 46.61 X 38.50		
3	1	BOTTOM SEGMENT	39.5 X 64.14 X 146.53		
4	1	DRIVE SIDE SEGMENT	38.50 X 63.56 X 115.40		
5	1	DRIVE SEGMENT			
6	1	COVER	22.75 X 24.75 X 2.5		
7	1	SUPPORT ANGLE	L8 X 6 X 1/2 X 24		
8	1	GANTRY LEG			
9	218	HEX NUT	1/2-13 UNC		
10	218	HEX BOLT	1/2-13UNC X 1.75" LG		
11	1	DOWN HILL DRIP RING	171" ID X 1.5"		
12	3	DRIP RING - PLAIN	171" ID X .50"		
13	2	PITCH LINE WINDOW	.25" X 3.25 X 6.00		
14	1	WIPER	.50" X 3.00" X 4.50"		

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	8/16/01	
	FOR QUOTE PURPOSES ONLY		
#	DESCRIPTION	DATE	APPROVED
A	ORIGINAL RELEASE	11/21/01	mbs

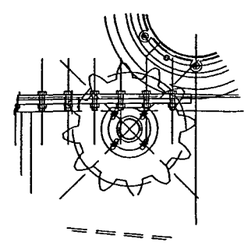




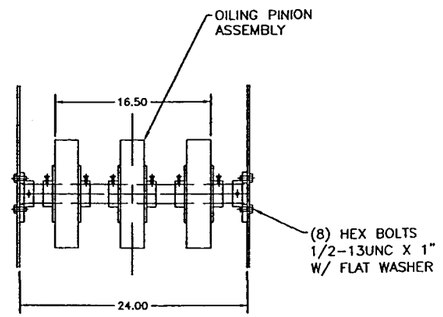


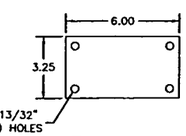
DETAIL C
SCALE 1:16

NOTE:
1.) INSTALL DRIP RINGS AS SHOWN AFTER GEAR AND PINION HAVE BEEN INSTALLED. WELD AS SHOWN.
2.) INSTALL BOTTOM SEGMENT. NOTE THAT ITEM #7 SHIPPED LOOSE TO PROVIDE SPACE TO SLIDE GEAR GUARD BENEATH BIOMIXER. TACK WELD ONLY ADJUSTMENT MAY BE REQUIRED LATER.
3.) ASSEMBLE THE REMAINING SEGMENTS FROM THE BOTTOM UPWARD SEAL EACH JOINT WITH BLUE RTV OR EQUIVALENT. NOTE THAT EACH SEGMENT IS MATCH MARKED ON THE OUTSIDE EDGE OF THE JOINT BAR.
4.) ALIGN WITH DRIP RINGS. OPEN "KOZAR" HOLES TO MEASURE AIGNMENT @ THE TOP.
5.) ONCE THE GUARD IS IN IT'S FINAL LOCATION WELD ITEM #7 TO THE GUARD.
6.) INSTALL PINION OIL SEALS WITH THE LIP FACING THE PINION. SEE DETAIL C.
7.) INSTALL OILING PINIONS
8.) INSTALL PITCH LINE WINDOW BOTH SIDES.
9.) INSTALL WIPER DOWN HILL SIDE ONLY.



DETAIL A
SCALE 1:8





13 PITCH LINE WINDOW
QTY REQ'D :1
MATR'L : APET PLASTIC
STOCK : .25 X 3.25 X 6.00
SCALE :
WEIGHT :

REMOVE ALL BURRS, SHARP EDGES, ETC

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL

CONFIDENTIAL - PROPERTY OF:
S-C equipment services
MILWAUKEE, WISCONSIN U.S.A.

NAME: GEAR GUARD GENERAL ASSEMBLY

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982.
LIMITS UNLESS OTHERWISE NOTED
LINEAR: ANGLES: ±.50°
.X ±.06
.XX ±.03
.XXX ±.01
125 MACHINED SURFACE TEXTURE

MAT'L: ASTM A-36
ASTM A-36

AUTOCAD FILE: 69-4164
WT R F

DR. mbs 11/20/01
CH. —— ——
AP. —— ——
JOB NO. BM01-3123
SCALE 3/8"=1'0"
SHEET 1 OF 1
THIRD ANGLE PROJECTION
REFERENCE DWG:
SIZE D
PART NO. 69-400-0164
REVISION A

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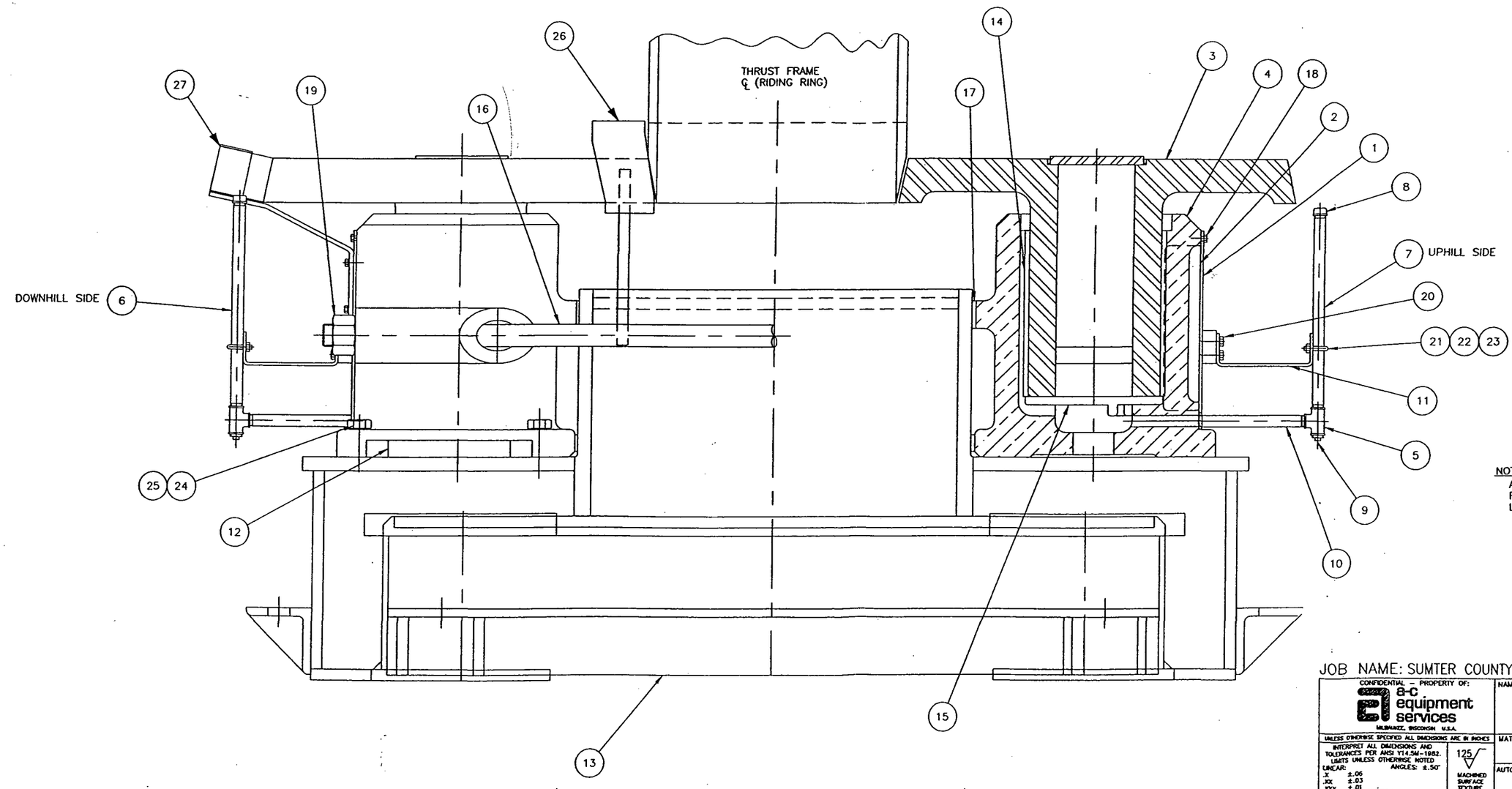
Section 13 – Thrust Mechanism

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY .RELEASE	8/15/2001	SMK
	FOR QUOTE PURPOSES ONLY		
#	DESCRIPTION	DATE	APPROVED
01	ADDED ITEMS #26 & #27	09/26/2001	smk1
A	RELEASED FOR CONSTRUCTION	09/28/2001	smk1

1) (2) WATER JACKET COVER
2) (2) WATER JACKET COVER GASKET
3) (2) THRUST ROLLER
4) (2) THRUST BEARING HOUSING
5) (2) 1" PIPE TEE
6) (1) 1" PIPE X 19" LG. (DOWNHILL SIDE)
7) (1) 1" PIPE X 18"LG. (UPHILL SIDE)
8) (2) 1" PIPE CAP
9) (2) SQ.HEAD PIPE PLUG
10) (2) 1" PIPE X 10" LG.
11) (2) OIL PIPE SUPPORT
12) (4) THRUST BEARING RETAINING BLOCK
13) (1) THRUST CARRYING ASSEMBLY FRAME
14) (2) ROLLER BEARING BUSHING
15) (2) THRUST WEAR PLATE
16) (2) THRUST TIE ROD
17) (2) MOUNTING SHIM
18) (34) HHCS (0.38-16UNC-2B X 0.75" LG.)
19) (4) TIE ROD HEX NUT
20) (4) HHCS (0.50-13UNC X 1.50"LG.)
21) (2) U-BOLT, RND END, (0.38-16UNC X 2.00 LG. X 1.50)
22) (4) 0.38 PLAIN WASHER
23) (4) 0.38-16UNC HEX NUT
24) (8) HHCS (1.25-7UNC x 4.5"LG)
25) (8) 1.25 PLAIN WASHER
26) (4) PINCH GUARD
27) (2) LUBRICATOR



NOTE:
APPROX. AMOUNT OF OIL REQ'D TO FILL BEARING TO THE OPERATING OIL LEVEL IS 3.3 GAL.(12.5 LTRS)

REMOVE ALL BURRS, SHARP EDGES, ETC

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL.

CONFIDENTIAL - PROPERTY OF: B-C equipment services, MILWAUKEE, WISCONSIN U.S.A.

NAME: THRUST MECHANISM GENERAL ASSEMBLY

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED
LINEAR: .X ±.06, .XX ±.03, .XXX ±.01
ANGLES: ±.50°
125 MACHINED SURFACE TEXTURE

MAT'L:

AUTOCAD FILE: 69-4136
WT R F

DR. smk 10/15/2001
CH.
AP.
JOB NO. BM01-3123
SCALE 1:5
SHEET 1 OF1
THIRD ANGLE PROJECTION
REFERENCE DWG:
SIZE D
PART NO. 69-400-0136
REVISION A

Oct 02, 2001 - 14:38

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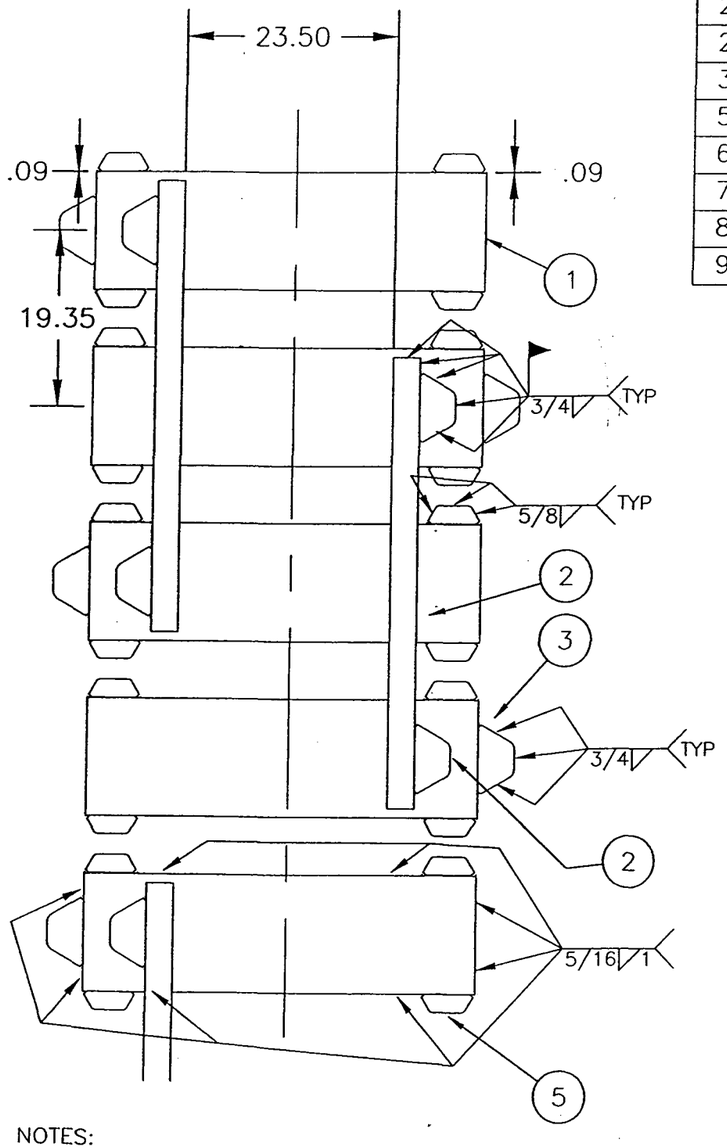
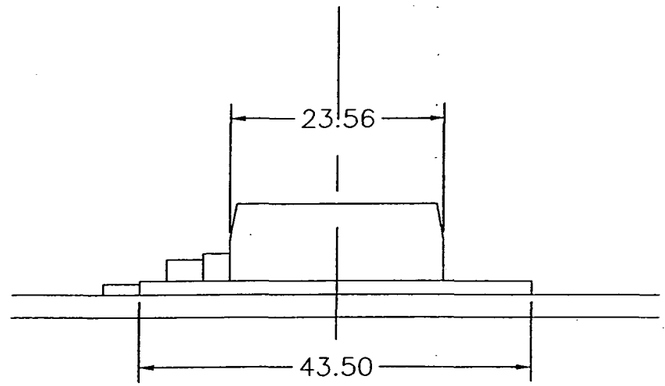
Parts List				
ITEM	QTY	DESCRIPTION	NOTE	MATERIAL
1	28	FILLER BAR	96-100-0105	A-36
2	28	END RETAINER BLOCK	96-200-0214	A-36
2	14	TIRE RETAINER SEG	96-100-0104	A-36
3	28	TIRE RETAINER BLOCK	96-200-0214	A-36
5	112	SIDE RETAINER BLOCK	96-200-0212	A-36
6	28	SHIM RETAINER	96-100-0404	A-36
7	28	SHIM 11 GA		STEEL
8	28	SHIM 16 GA		
9	28	SHIM 20GA		

#	DESCRIPTION	DATE	APPROVED
00	MBS | ORIGINAL RELEASE 8/14/01 | FOR QUOTE PURPOSES ONLY		
A	RELEASE FOR MANUFACTURING	10/02/01	mbs
		96-200-0121	





SECTION A-A

SCALE - 1:1

NOTES:
1.) ALLOW FOR .090" CLEARANCE BETWEEN SIDE BLOCKS AND FILLER BARS. ONE SIDE ONLY.
2.) .060" CLEARANCE TO BE PROVIDED BETWEEN THE RIDING RING AND TIRE RETAINING SEGMENTS. ONE SIDE ONLY.
3.) REMOVE ALL WELDS BETWEEN SHELL & FILLER BARS AT FINAL ASSEMBLY.

REMOVE ALL BURRS, SHARP EDGES, ETC.

CAD PLOT DATE / TIME
Oct 03, 2001 - 12:09

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL

CONFIDENTIAL - PROPERTY OF:
a-c equipment services
MILWAUKEE, WISCONSIN U.S.A.

NAME: FILLER BAR ARRANGEMENT 14'ID X 185' THRUST

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED
LINEAR: ANGLES: ±.50°
.X ±.06
.XX ±.03
.XXX ±.01
125 MACHINED SURFACE TEXTURE

MAT'L: ASTM A-36
ASTM A-36

AUTOCAD FILE: 69-2121
WT R F

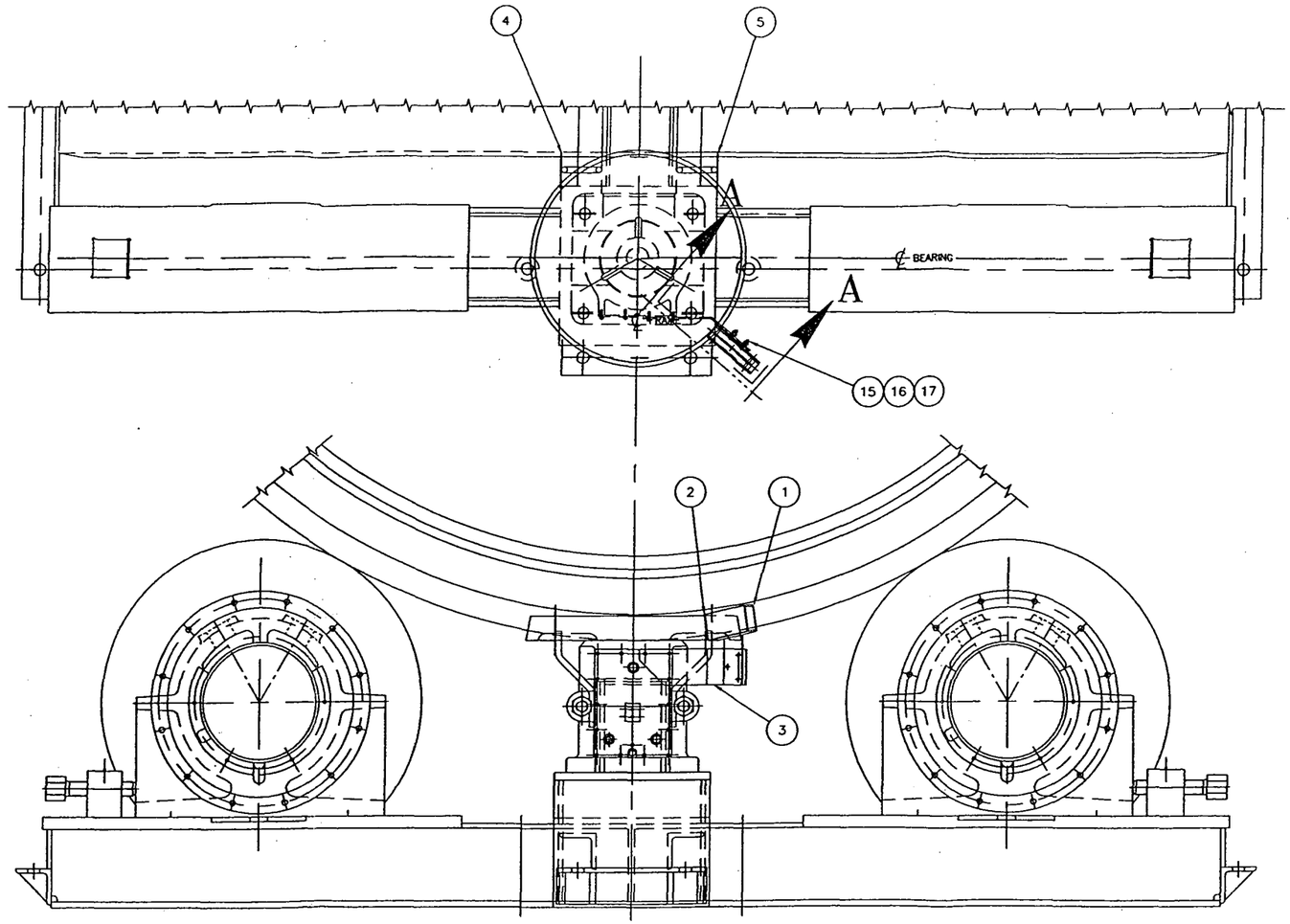
DR. 08/13/01 mbs
CH. ____ ____
AP. ____ ____

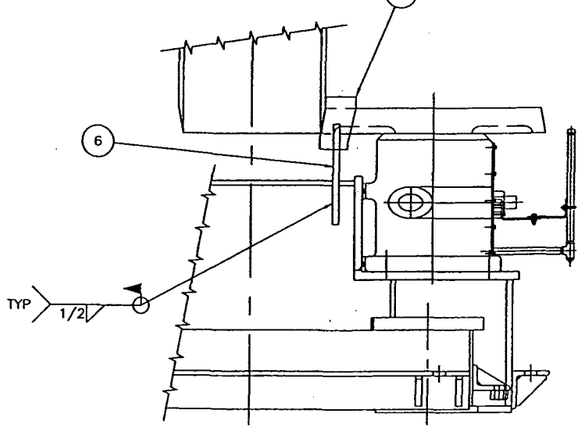
JOB NUMBER: BM01-3123
THIRD ANGLE PROJECTION
REFERENCE DRAWING:
SIZE: B
SCALE: 3/4"=1'0"
SHEET: 1 OF1
PART NO.: 69-200-0121
REVISION: A

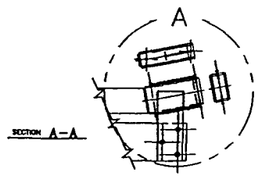
Parts List

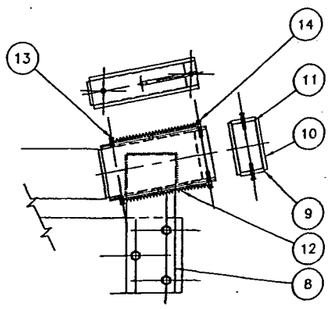
ITEM	QTY	DESCRIPTION	MATERIAL SIZE	MATERIAL	NOTE
1	2	LUBE BLOCK HOLDER WELDMENT		ASTM A-36	10 LBS
2	2	LUBE BLOCK	1.88" x 3.88" x 8.00" LG	GRAPHITE H80-D	P/N 69-100-0107
3	2	MOUNTING BRACKET	1/4" x 6.00" x 19.78" LG	ASTM A-36	7.75 LBS
4	2	PINCH GUARD -RIGHT HAND		ASTM A-36	5.5 LBS
	2	PINCH GUARD - LEFT HAND		ASTM A-36	5.5 LBS
	1	HANDLE	ø1" x 18.25" LG	ASTM A-36	4 LBS
7	4	PINCH GUARD PLATE	1/8" x 5.82" x 8.38" LG	ASTM A-36	1.4 LBS
8	2	HOLDER ARM	1/4" x 4.00" x 11.00" LG	ASTM A-36	3 LBS
9	4	SIDE PLATE	1/4"x 2.00" x 8.75" LG	ASTM A-36	1.1 LBS
10	4	END PLATE	1/4"x 4.25" x 8.75" LG	ASTM A-36	2.6 LBS
11	2	PUSH BLOCK	1.00" x 1.88" x 3.88" LG	ASTM A-36	2 LBS
12	4	EXTENSION SPRING	ø3/8 OD, WIRE ø: .041, 3-1/4" OAL	HARD DRAWN STEEL	McMASTER CARR #9654K296
13	4	BUTTON HD CAP SCREW, HEX	1/4-28 x 5/8" LG	GR 2	
14	4	BUTTON HD CAP SCREW, HEX	1/4-28 x 1-1/4" LG	GR 2	
15	6	HEX BOLT	1/2-13 x 1-1/2" LG	GR 2	
16	6	HEX NUT	1/2-13		
17	6	LOCK WASHER	1/2"		

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	10/19/2001	SMK
	FOR QUOTE PURPOSES ONLY		
#	DESCRIPTION	DATE	APPROVED
A	RELEASED FOR MANUFACTURING	10/29/2001	smk1









DETAIL A
SCALE 1:6

REMOVE ALL BURRS, SHARP EDGES, ETC

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL.

CONFIDENTIAL - PROPERTY OF: G-C equipment services, MILWAUKEE, WISCONSIN U.S.A.

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED
LINEAR: X ±.06, .XX ±.03, .XXX ±.01
ANGLES: ±.50°

125 MACHINED SURFACE TEXTURE

NAME: PINCH GUARD & LUBE BLOCK HOLDER THRUST ROLLER/RIDING RING

MATL: SEE PARTS LIST

AUTOCAD FILE: 69-4159A

WT: R, F

DR. smk1 10/19/2001
CH. ——
AP. ——

JOB NO. BM01-3123

SCALE 1"=1'0" SHEET 1 OF 2

THIRD ANGLE PROJECTION

REFERENCE DWG:

SIZE D

PART NO. 69-400-0159

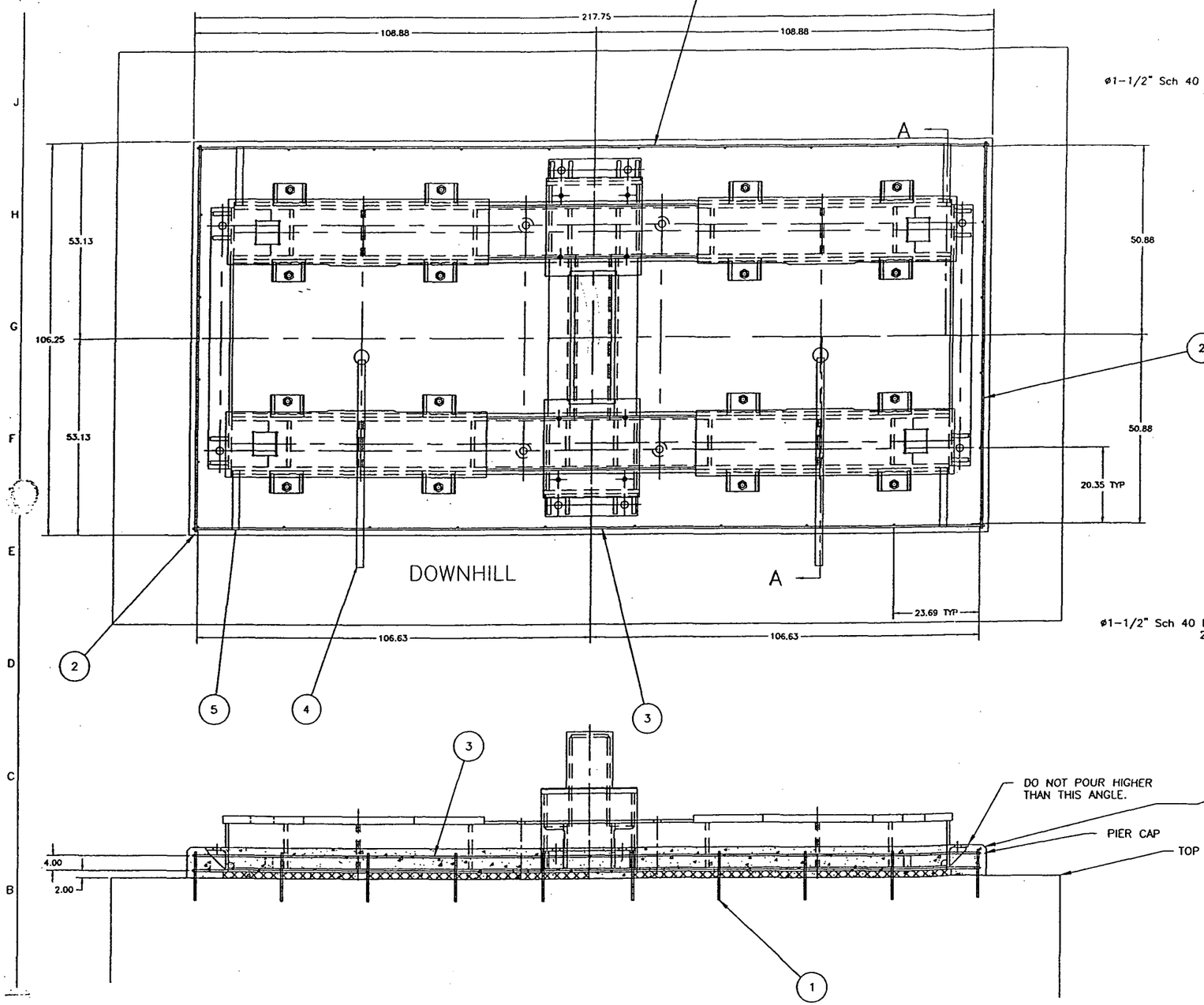
REVISION A

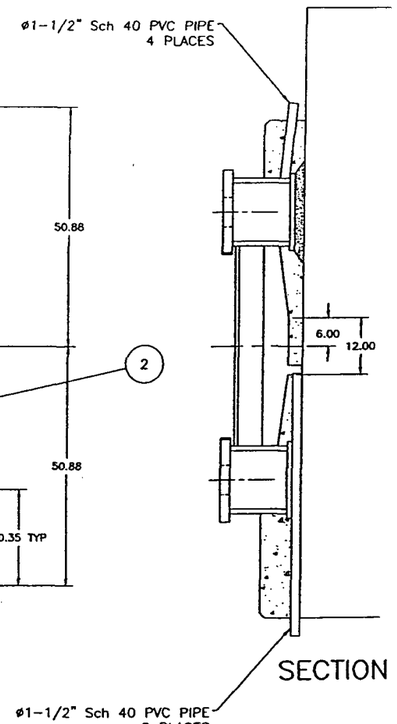
Oct 29, 2001 - 13:54

F:\Engineer\ACDWGS\BioMixers\SumterCo\BM01-3123\69-4159A.dwg, 11/14/2001 10:27:06 AM, SMKT, 11x17, 1:23.968

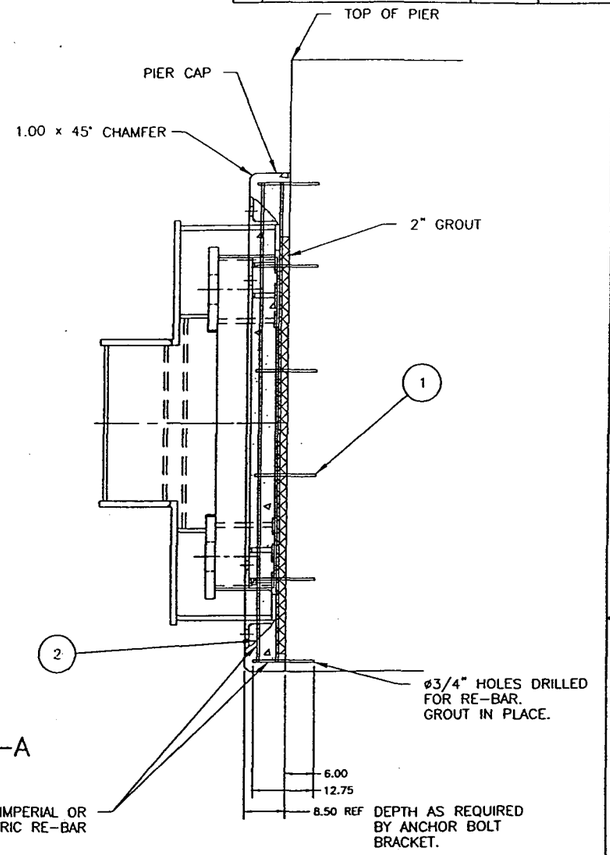
ITEM	QTY	DESCRIPTION	MAT'L SIZE	MAT'L	PART NO./NOTES
1	28	REBAR - VERTICAL	#4 IMPERIAL OR #13 "SOFT" METRIC x 12.75" LG	SEE NOTE 5	
2	4	REBAR	#4 IMPERIAL OR #13 "SOFT" METRIC x 104.25" LG	SEE NOTE 5	
3	4	REBAR	#4 IMPERIAL OR #13 "SOFT" METRIC x 215.25" LG	SEE NOTE 5	
4	2	DRAIN PIPE	1-1/2" SCH 40 PIPE x 56.00" LG	PVC	
4	4	DRAIN PIPE	1-1/2" SCH 40 PIPE x 16.00" LG	PVC	

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	9/25/2001	SMK
	FOR QUOTE PURPOSES ONLY		
#	DESCRIPTION	DATE	APPROVED
A	RELEASED FOR CONSTRUCTION	10/02/2001	smk1
B	ADDED SECTION VIEW & 1-1/2" PVC DRAIN PIPE	11/27/2001	SMK1





SECTION A-A



NOTE:
1. TIE RE-BAR AS REQUIRED TO HOLD POSITION.
2. PIER TOP TO BE BRUSHED CLEAN.
3. SURFACE OF PIER CAP TO BE BULL FLOATED AND BROOM FINISHED.
4. REINFORCING BAR MATERIAL TO BE ASTM A615 OR EQUIVALENT.
5. BONDING AGENT TO BE USED. FOLLOW MANUFACTURERS RECOMMENDATIONS FOR SURFACE PREPARATION.
6. APPLY CURING COMPOUND TO PIER CAP.
7. PIER CAP TO BE A MINIMUM OF 3,500 PSI CONCRETE OR EQUIVALENT.

JOB NAME: SUMTER COUNTY SOLID WASTE

CONFIDENTIAL - PROPERTY OF: a-c equipment services, MILWAUKEE, WISCONSIN U.S.A.

NAME: PIER CAP INSTALLATION THRUST FRAME

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED LINEAR: .X ±.05, .XX ±.03, .XXX ±.01 ANGLES: ±.50°

125 MACHINED SURFACE TEXTURE

MAT'L: SEE PARTS LIST

AUTOCAD FILE: 69-4154B

WT R F

DR. smk 10/25/2001

CH. ——— ———

AP. ——— ———

JOB NO. BM01-3123

SCALE 3/4"=1'0" SHEET 2 OF2

THIRD ANGLE PROJECTION

REFERENCE DWG:

SIZE D

PART NO. 69-400-0154

REVISION B

REMOVE ALL BURRS, SHARP EDGES, ETC

Nov 27, 2001 - 09:54

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Section 14 – Carrying Mechanism

CARRYING MECHANISM LIST OF PARTS

413-A	CARRYING ROLLER
413-B	CARRYING BEARING OIL SEAL (INNER)
413-C	CARRYING BEARING OIL SEAL (OUTER)
413-D	CARRYING BEARING RETAINING RING SEGMENT
413-E	CARRYING BEARING HOUSING
413-F	CARRYING BEARING BUSHING
413-G	CARRYING BEARING END COVER
413-H	OIL LEVEL STAND PIPE ASSEMBLY (LOW SIDE)
413-K	OIL LEVEL STAND PIPE ASSEMBLY (HIGH SIDE)
413-L	CARRYING ROLLER SHAFT
413-M	END COVER THRUST PLATE
413-N	CARRYING BEARING OIL PAN
413-P	CARRYING BEARING OIL BUCKET
413-Q	CARRYING MECHANISM FRAME
413-R	ADJUSTING LUG BLOCK
413-S	ADJUSTING SCREW
413-T	ROLLER GUARD CROSS MEMBER
413-U	ROLLER GUARD SIDE PLATE
413-V	LUBRICATING BLOCK
413-W	CARRYING BEARING WATER JACKET COVER
413-X	INSPECTION PORT COVER
413-Y	INSPECTION PORT COVER GASKET
413-Z	OIL FILL/VENT

CARRYING MECHANISM LIST OF HARDWARE

▷ 414-A	(12) OIL SEAL RETAINER BOLTS (1/2-13 UNC x 1.5" LG. GR. 2)
414-B	(4) BUSHING RETAINER BOLTS (5/8 - 11 UNC x 2.00" LG. GR. 2)
414-C	(24) END COVER BOLTS (1 - 8 UNC x 4.5" LG. GR. 5)
▷ 414-D	(56) WATER JACKET COVER BOLTS (1/2-13 UNC x 1.0" LG. GR. 2)
▷ 414-E	(24) INSPECTION COVER BOLTS (1/2-13 UNC x 1.0" LG. GR.2)
414-F	(4) OIL PAN BOLTS (1/2 - 13 UNC x 4.75" LG. GR. 2)
414-G	(4) OIL PAN LOCK WASHERS FOR 1/2" BOLT
414-H	(8) OIL BUCKET BOLTS (5/8 - 11 UNC x 1.25" LG. GR. 2)
414-J	(6) THRUST PLATE RETAINING SCREWS (5/8 - 11 UNC x 1.50" LG. (BRASS))
414-K	(4) BUSHING RETAINER BOLT WASHER (FLAT) FOR 5/8" BOLT
414-L	(24 CARTRIDGES) RTV 732 SILICON SEALANT

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	8/15/2001	SMK
	FOR QUOTE PURPOSES ONLY		
#	DESCRIPTION	DATE	APPROVED
01	CHANGED BOLT SIZES TO 1/2-13 TO	09/06/2001	smk1
	CONFORM TO BEARING HOUSING MACHINING DRAWING		
A	RELEASED FOR CONSTRUCTION	09/28/2001	smk1

NOTES:

1.) 180° BUSHING CENTERLINE MUST BE INSTALLED 30° FROM THE VERTICAL CENTERLINE AS SHOWN. NOTE THAT THE HIGH SIDE OF THE BUSHING WILL BE TOWARD THE OUTSIDE. (AWAY FROM THE CENTERLINE OF THE BIOMIXER.)

2.) DURING INITIAL INSTALLATION OF MACHINE, OR IF MACHINE IS NOT TO BE PLACED IN IMMEDIATE OPERATION, OR IF THE MACHINE IS TO BE IDLE FOR ANY APPRECIABLE PERIOD OF TIME, EACH BEARING SHOULD BE FILLED WITH ENOUGH OIL TO COMPLETELY COVER THE SHAFT.

3.) DURING INSTALLATION OF THE SPLIT OIL SEALS ON SHAFTS CHECK TO SEE THAT THE SEAL LIP IS BEING HELD IN CONTACT WITH THE SHAFT BY THE GARTER SPRING. IF INSTALLED PROPERLY THE SEAL SHOULD ROTATE FREELY ON A GREASED PORTION OF THE SHAFT WITH APPROXIMATELY 10 TO 15 LBS. OF FORCE. THE GARTER SPRING LENGTH MAY BE ADJUSTED ACCORDINGLY. IF THE SEAL IS STIFF DUE TO COLD TEMPERATURE THE FORCE IN THIS CHECK WILL BE AFFECTED; HERETO, SPRING ADJUSTMENTS MUST BE ALTERED.

4.) EXTREME CARE MUST BE TAKEN DURING THE APPLICATION OF ANY SEALANT, OR OTHER ADHESIVE MATERIAL, TO ASSURE THAT NO EXCESS MATERIAL WILL BE SQUEEZED INTO, OR OTHERWISE ENTER THE LUBRICATION CHAMBER OF THE BEARING HOUSINGS. THE RESULTING CONTAMINATION WILL IMPAIR PROPER LUBRICATION, AND COULD LEAD TO BEARING FAILURE.

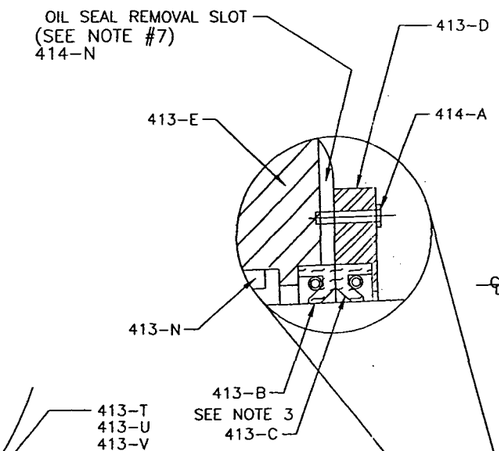
5.) SEE THE INSTALLATION OUTLINE DRAWING (69-400-0133) FOR PROPER INITIAL SETTING OF CARRYING BEARING HOUSINGS ON CARRYING MECHANISM FRAME.

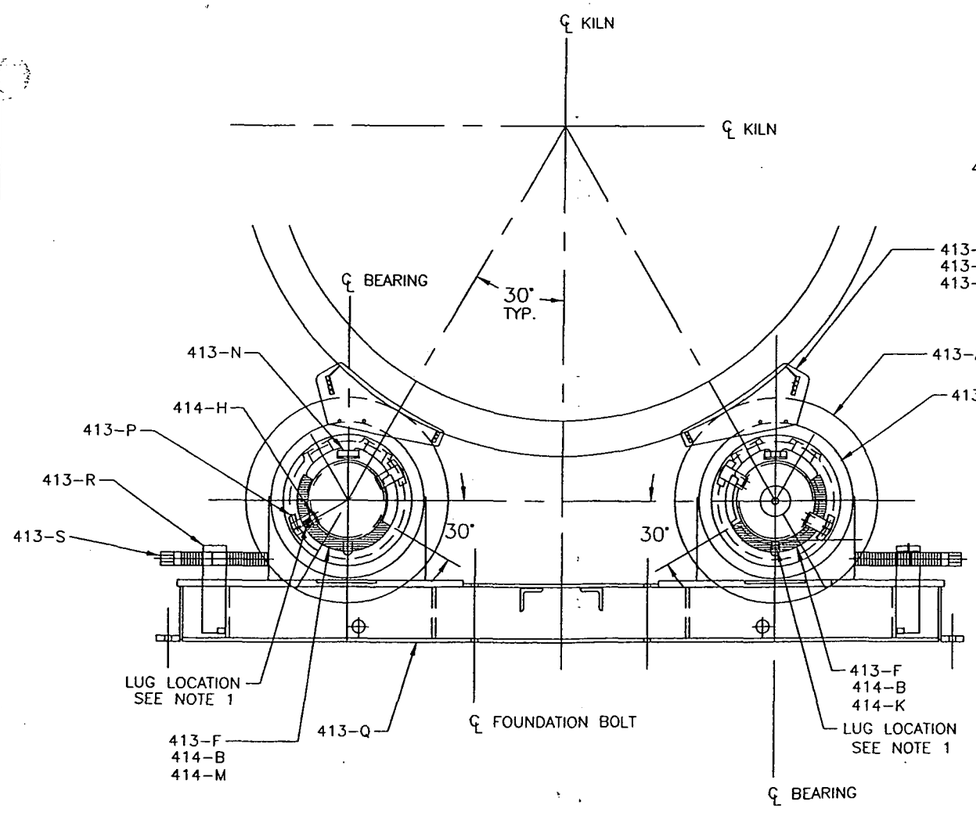
6.) APPROX. AMOUNT OF OIL REQ'D TO FILL BEARING TO THE OPERATING OIL LEVEL IS 4.5 GAL. (17 LTRS.)

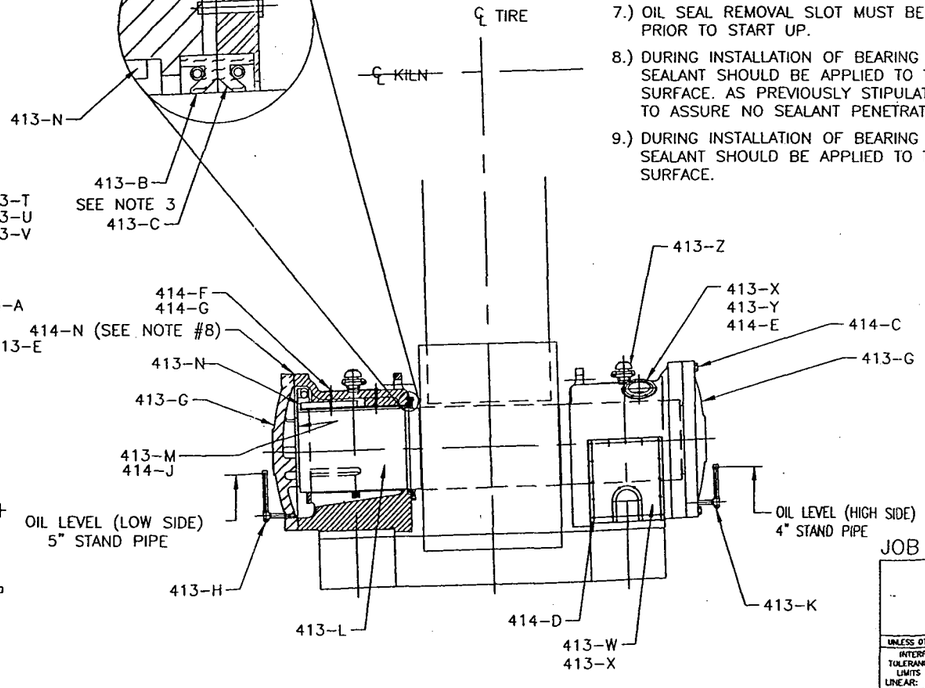
7.) OIL SEAL REMOVAL SLOT MUST BE FILLED W/RTV SILICON SEALANT PRIOR TO START UP.

8.) DURING INSTALLATION OF BEARING END COVERS, A VERY FINE BEAD OF SILICON SEALANT SHOULD BE APPLIED TO THE OUTER EDGE OF THE MATING BRG. HOUSING SURFACE. AS PREVIOUSLY STIPULATED IN NOTE #4, EXTREME CARE NEEDS TO BE TAKEN TO ASSURE NO SEALANT PENETRATES INTO THE LUBRICATION CAVITY OF THE BRG. HOUSING.

9.) DURING INSTALLATION OF BEARING WATER JACKET COVERS, A VERY FINE BEAD OF SILICON SEALANT SHOULD BE APPLIED TO THE OUTER EDGE OF THE MATING BRG. HOUSING SURFACE.







JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL.

CONFIDENTIAL - PROPERTY OF: a-c equipment services, MILWAUKEE, WISCONSIN U.S.A.

NAME: CARRYING MECHANISM GENERAL ASSEMBLY

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED LINEAR: ANGLES: ±.50' .X ±.06 .XX ±.03 .XXX ±.01

125 MACHINED SURFACE TEXTURE

MATL

AUTOCAD FILE: 69-4135

WT R F

DR. smk 10/15/2001

CH. ——

AP. ——

JOB NO. BM01-3123

THIRD ANGLE PROJECTION

REFERENCE DWG:

SIZE D

SCALE 1'0"=1'0"

SHEET 1 OF1

PART NO. 69-400-0135

REVISION A

REMOVE ALL BURRS, SHARP EDGES, ETC

Oct 02, 2001 - 14:36

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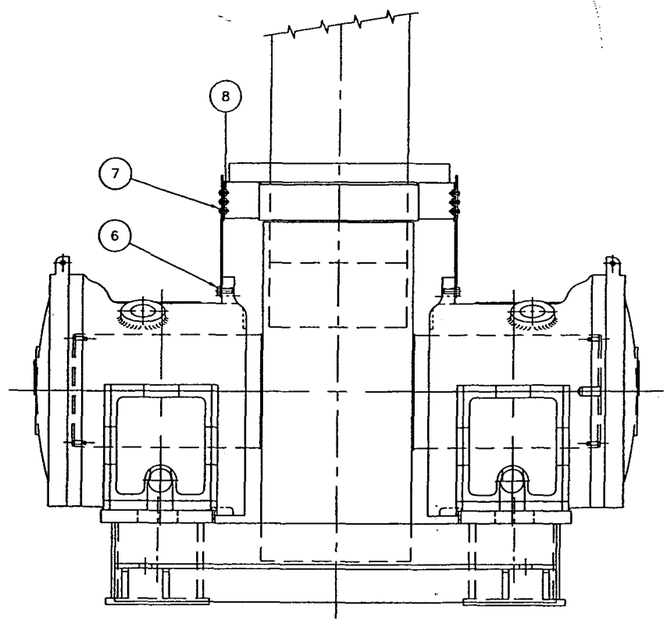
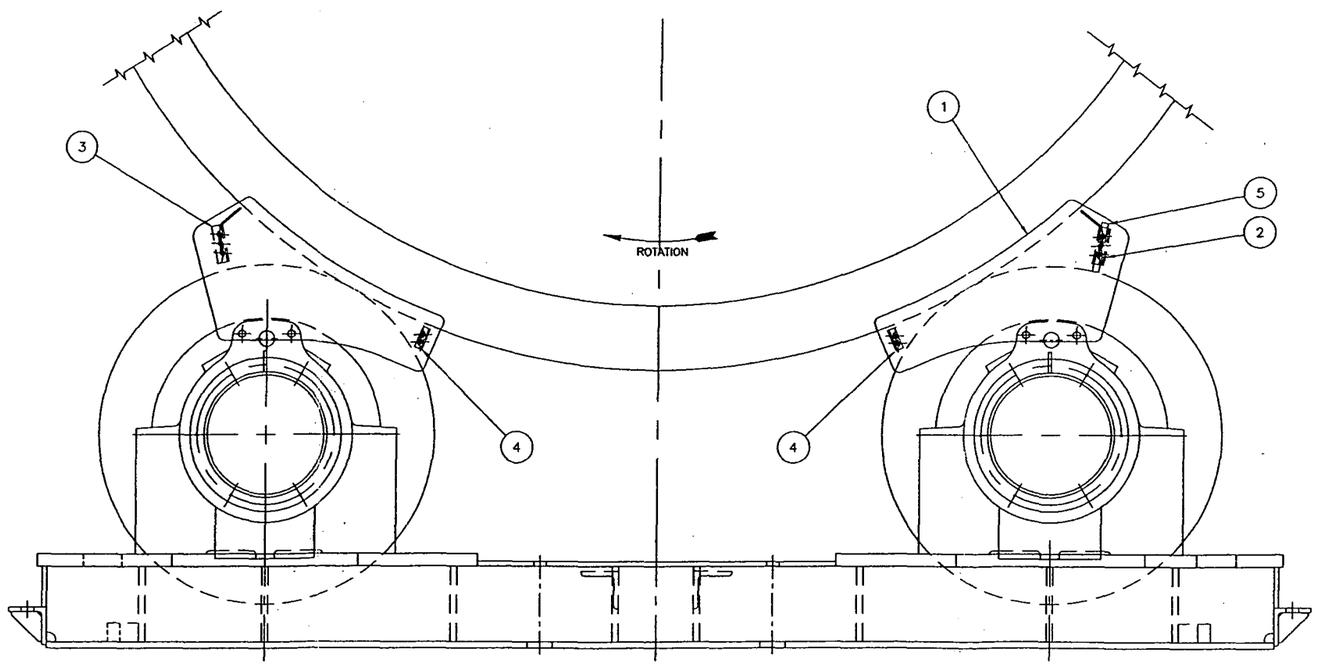
Ports List					
ITEM	QTY	DESCRIPTION	MATERIAL SIZE	MATERIAL	NOTE
1	8	SIDE PLATE	1/4" x 28.32" x 40.97" LG	ASTM A-36	40 LBS EA.
2	2	PINCH GUARD/LUBE BLOCK HOLDER	1/4" x 10.00" x 39.09" LG & 1/4" x 6.00" x 27.84" LG	ASTM A-36	39 LBS EA.
3	2	PINCH GUARD	1/4" x 10.00" x 39.09" LG	ASTM A-36	27 LBS EA.
	4	PINCH GUARD	1/4" x 3.50" x 39.09" LG	ASTM A-36	10 LBS EA.
	3	LUBE BLOCK	1.00" x 8.00" x 24.75" LG	GRAPHITE H80-D	1 SPARE
6	16	HEX BOLT	3/4-10 x 2.00" LG	GRADE 2	
7	40	HEX BOLT	7/16-14 x 1-1/8" LG	GRADE 2	
8	40	SQUARE NUT	7/16-14		

#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE	10/3/2001	SMK
	FOR QUOTE PURPOSES ONLY		
#	DESCRIPTION	DATE	APPROVED
A	RELEASED FOR MANUFACTURE	10/08/2001	smk1





SHOP NOTES:
1. BLAST AND PAINT 2 COATS WITH GREY PRIMER

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL.

CONFIDENTIAL - PROPERTY OF: B-C equipment services, MILWAUKEE, WISCONSIN U.S.A.

NAME: PINCH GUARD/LUBE BLOCK HOLDER

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982.
LIMITS UNLESS OTHERWISE NOTED
LINEAR: .X ±.06, .XX ±.03, .XXX ±.01
ANGLES: ±.50°
125 MACHINED SURFACE TEXTURE

MAT'L: SEE PARTS LIST

AUTOCAD FILE: 69-4158A
WT: R F

DR. smk1 10/03/2001
CH. ——
AP. ——

JOB NO. BM01-3123

THIRD ANGLE PROJECTION

REFERENCE DWG:

SIZE: D

SCALE: 1"=1'0" SHEET: 1 OF2

PART NO. 69-400-0158

REVISION: A

REMOVE ALL BURRS, SHARP EDGES, ETC

Oct 03, 2001 - 16:16

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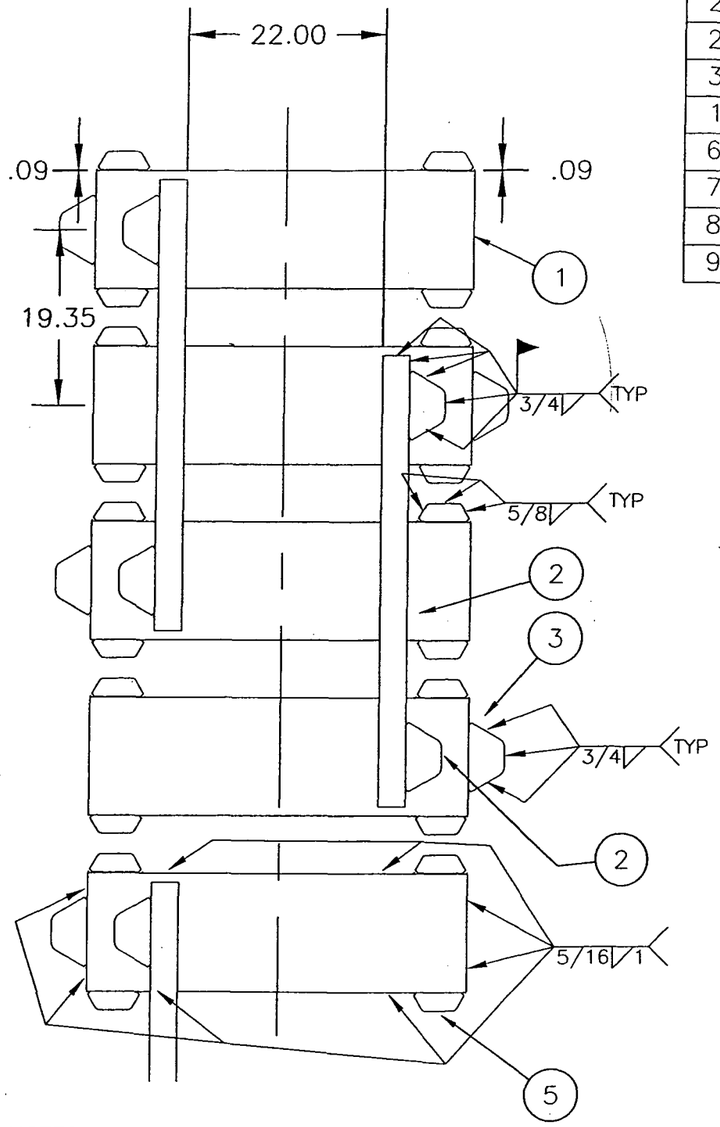
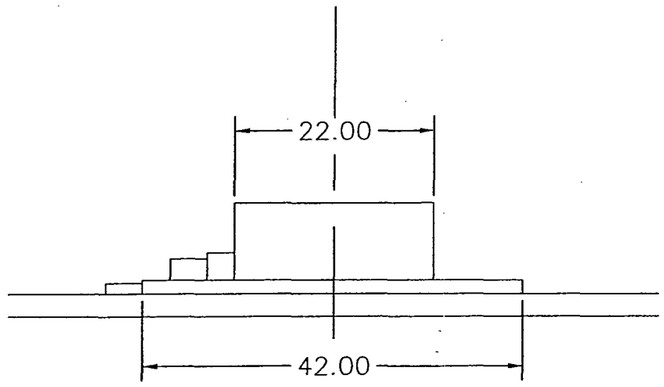
Parts List				
ITEM	QTY	DESCRIPTION	NOTE	MATERIAL
5	112	SIDE RETAINER BLOCK	96-200-0212	A-36
2	28	END RETAINER BLOCK	96-200-0214	A-36
2	14	TIRE RETAINER SEG	96-100-0104	A-36
3	28	TIRE RETAINER BLOCK	96-200-0214	A-36
1	28	FILLER BAR	96-100-0103	A-36
6	28	SHIM RETAINER	96-100-0404	A-36
7	28	SHIM 11 GA		STEEL
8	28	SHIM 16 GA		
9	28	SHIM 20GA		

00	MBS 8/14/01	ORIGINAL RELEASE FOR QUOTE PURPOSES ONLY		
#		DESCRIPTION	DATE	APPROVED
A		RELEASE FOR MANUFACTURING	10/02/01	mbs
			96-200-0120	



NOTES:
1.) ALLOW FOR .090" CLEARANCE BETWEEN SIDE BLOCKS AND FILLER BARS. ONE SIDE ONLY.
2.) .060" CLEARANCE TO BE PROVIDED BETWEEN THE RIDING RING AND TIRE RETAINING SEGMENTS. ONE SIDE ONLY.
3.) REMOVE ALL WELDS BETWEEN SHELL & FILLER BARS AT FINAL ASSEMBLY.



SECTION A-A

SCALE - 1:1

REMOVE ALL BURRS, SHARP EDGES, ETC.

CAD PLOT DATE / TIME
Oct 03, 2001 - 12:08

JOB NAME: SUMTER COUNTY SOLID WASTE - BUSHNELL, FL

CONFIDENTIAL - PROPERTY OF:
a-c equipment services
MILWAUKEE, WISCONSIN U.S.A.

NAME
FILLER BAR ARRANGEMENT
14'ID X 185'
PIER #1 (PLAIN)

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED
LINEAR: ANGLES: ±.50°
.X ±.06
.XX ±.03
.XXX ±.01

125 MACHINED SURFACE TEXTURE

MAT'L
ASTM A-36
ASTM A-36

AUTOCAD FILE: 69-2120

WT R F

DR. 08/13/01 mbs
CH. ____ ____
AP. ____ ____

JOB NUMBER BM01-3123

THIRD ANGLE PROJECTION

REFERENCE DRAWING:

SIZE B

SCALE 3/4"=1'0"

SHEET 1 OF1

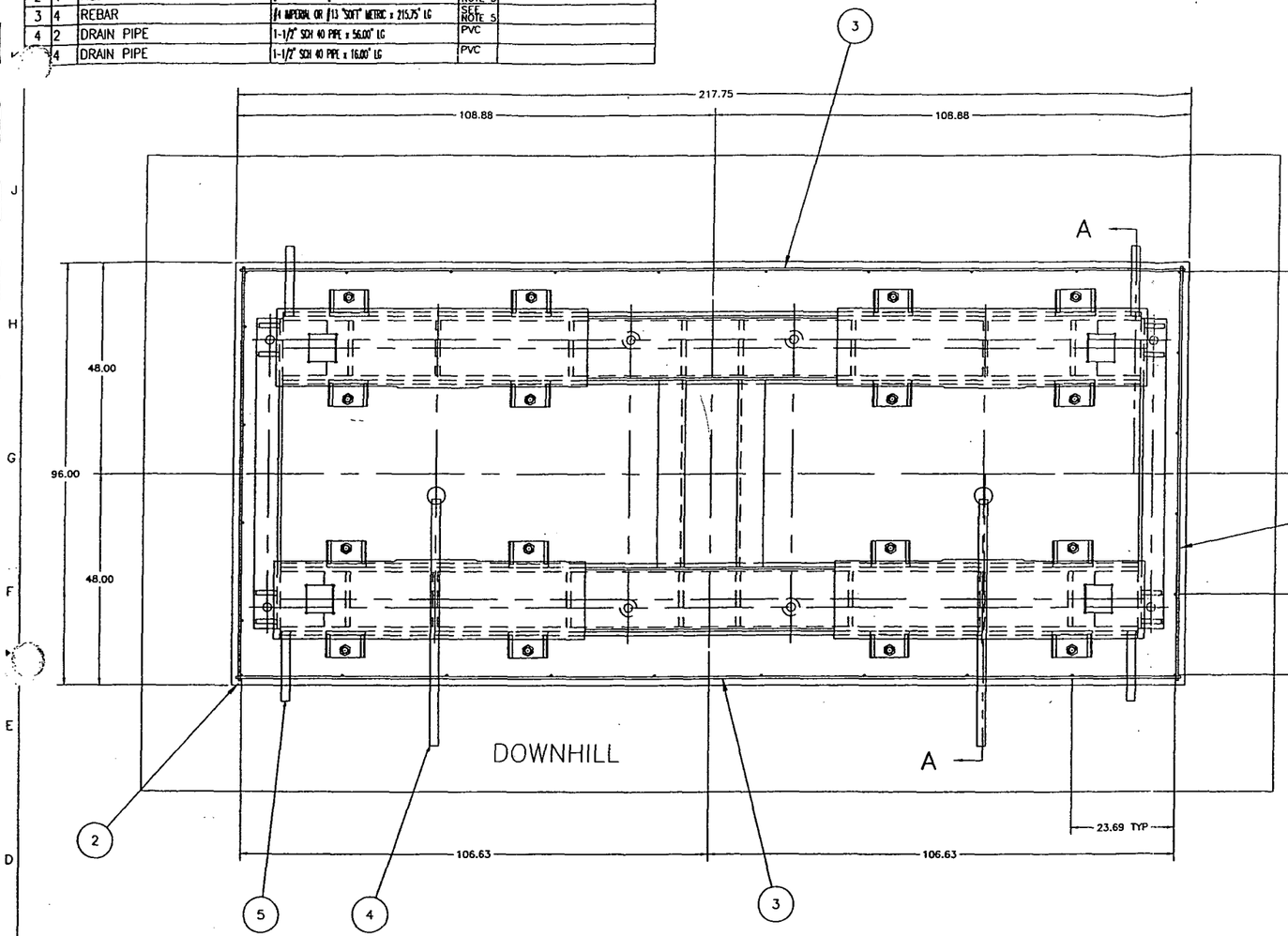
PART NO. 69-200-0120

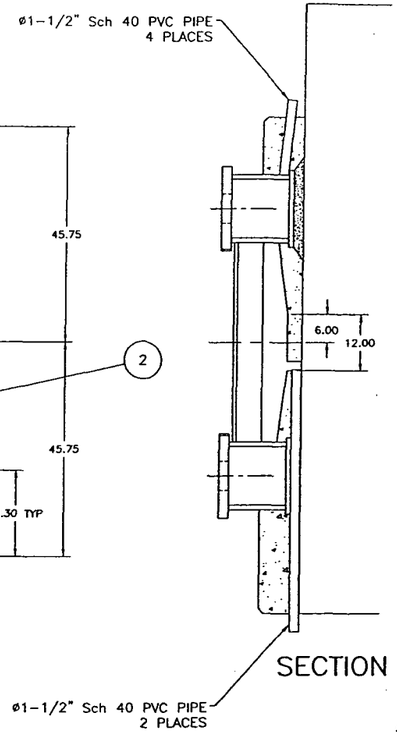
REVISION A

ITEM	QTY	DESCRIPTION	MAT'L SIZE	MAT'L	PART NO./NOTES
1	28	REBAR - VERTICAL	#4 IMPERIAL OR #13 "SOFT" METRIC x 12.75" [324] LG	SEE NOTE 5	
2	4	REBAR	#4 IMPERIAL OR #13 "SOFT" METRIC x 94.00" LG	SEE NOTE 5	
3	4	REBAR	#4 IMPERIAL OR #13 "SOFT" METRIC x 215.75" LG	SEE NOTE 5	
4	2	DRAIN PIPE	1-1/2" SCH 40 PIPE x 56.00" LG	PVC	
4	4	DRAIN PIPE	1-1/2" SCH 40 PIPE x 16.00" LG	PVC	

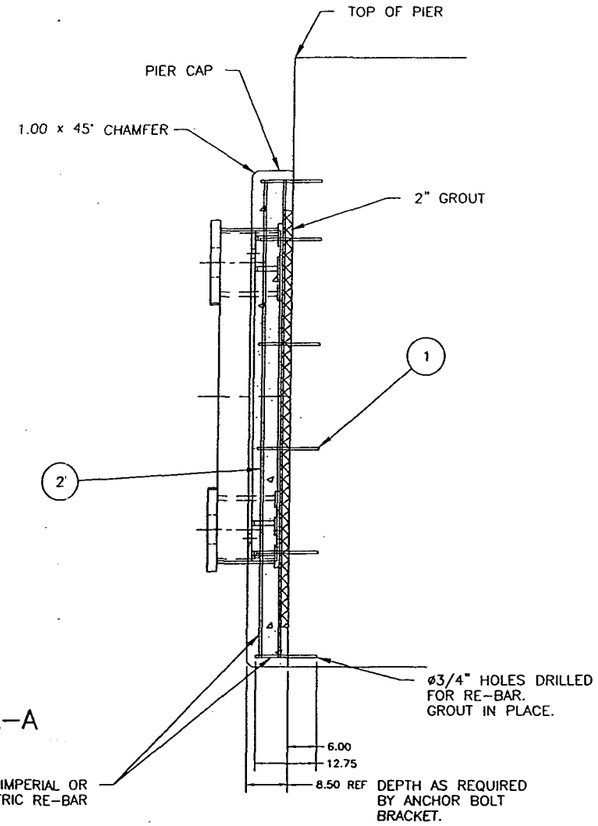
#	DESCRIPTION	DATE	APPROVED
00	PRELIMINARY RELEASE FOR QUOTE PURPOSES ONLY	9/25/2001	SMK

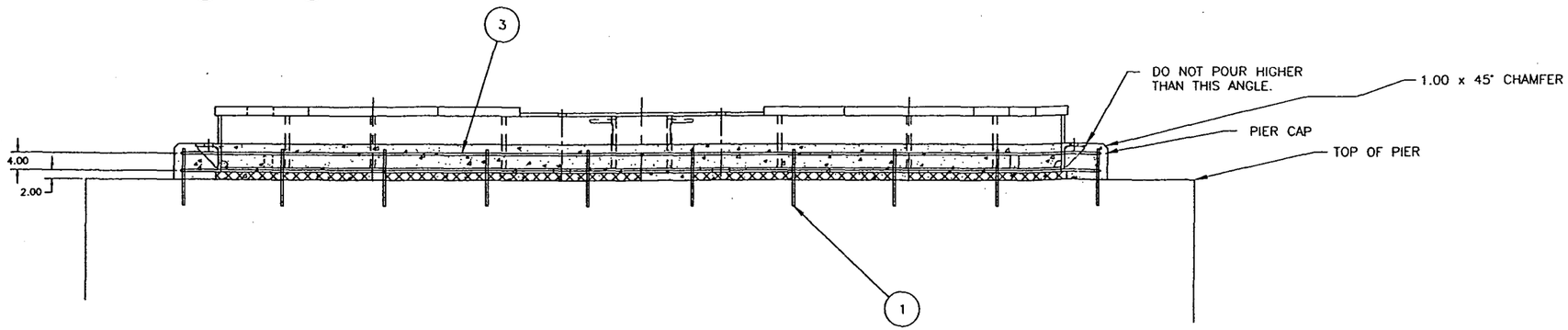
#	DESCRIPTION	DATE	APPROVED
A	RELEASED FOR CONSTRUCTION	10/02/2001	smk1
B	ADDED SECTION VIEW & 1-1/2" PVC DRAIN PIPING	11/27/2001	SMK1





SECTION A-A





NOTE:
1. TIE RE-BAR AS REQUIRED TO HOLD POSITION.
2. PIER TOP TO BE BRUSHED CLEAN.
3. SURFACE OF PIER CAP TO BE BULL FLOATED AND BROOM FINISHED.
4. REINFORCING BAR MATERIAL TO BE ASTM A615 OR EQUIVALENT.
5. BONDING AGENT TO BE USED. FOLLOW MANUFACTURERS RECOMMENDATIONS FOR SURFACE PREPARATION.
6. APPLY CURING COMPOUND TO PIER CAP.
7. PIER CAP TO BE A MINIMUM OF 3,500 PSI CONCRETE OR EQUIVALENT.

REMOVE ALL BURRS, SHARP EDGES, ETC

JOB NAME: SUMTER COUNTY SOLID WASTE

CONFIDENTIAL - PROPERTY OF: a-c equipment services, MILWAUKEE, WISCONSIN U.S.A.

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

INTERPRET ALL DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982. LIMITS UNLESS OTHERWISE NOTED. LINEAR: .X ±.06, .XX ±.03, .XXX ±.01. ANGLES: ±.50°. 125 MACHINED SURFACE TEXTURE.

NAME: PIER CAP INSTALLATION PLAIN FRAME

MATL: SEE PARTS LIST

AUTOCAD FILE: 69-4154A

WT: R F

DR. smk1 09/25/2001

CH. ——

AP. ——

JOB NO. BM01-3123

SCALE 3/4"=1'0" SHEET 1 OF2

THIRD ANGLE PROJECTION

REFERENCE DWG:

SIZE D

PART NO. 69-400-0154

REVISION B

Nov 27, 2001 - 09:49

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Section 15 – Recommended Spare Parts List and Ordering Information

A Listing of recommended spare parts has been included in this section:

To order contact:

A-C Equipment Services – Parts Department
6623 W. Washington Street
Milwaukee, WI USA 53214

Phone: (414) 475- 2554
Fax : (414) 475-3328

Email: rchristen@a-cequip.com

In the event that you need to contact the manufacturer of an outsourced item please see the following table:

COMPONENT	SUPPLIER	LOCATION	TELEPHONE	FAX
ROTARY COUPLING	Rotary Systems Inc.	Anoka, Minnesota	(800) 959-0146	(612) 323-1622
DISCHARGE DOORS	Salina Vortex	Salina, Kansas	(785) 825-7177	(785) 825-7194
PINION BEARINGS	Miether Bearings	Odessa, Texas	(800) 643-8437	(915) 363-8211
DRIVE EQUIPMENT	Falk Corporation	Milwaukee, Wisconsin	(414) 342-8513	(414) 937-9004
OIL SEALS - Carrying bearings	J M Clipper	Nacogdoches, Texas	(800) 233-3900	(409) 560-8998
LUBE BLOCKS - Carrying rollers	R.W. Elliot & Sons	Ellwood City, Pennsylvania	(412) 752-9082	(412) 752-9963
CORROSION PROTECTION	Corrpro Canada	Edmonton, Alberta	(780) 447-4565	(780) 447-3215

SUMTER COUNTY SOLID WASTE
BIO-MIXER PROJECT
RECOMMENDED SPARE PARTS

ITEM	DESCRIPTION	QTY.
Required for start-up		
THRUST ROLLER BUSHING	96-100-0035-1215	2
CARRYING BEARING PAIR (two right halves)	96-200-0034-1822	4
CARRYING ROLLER OIL SEAL	1800-19987 H1/L5 (SPLIT)	8
OILING BUCKET	96-200-0256	12
OIL PAN	96-100-0265	4
Recommended for first year of operation		
PINION SHAFT SEAL	1050-13848 H1/L5 (SPLIT)	2
CARRYING ROLLER / SHAFT ASS'Y	69-200-0118	2
BEARING HOUSING	96-400-0308	4
PHENOLIC THRUST DISK	96-100-0037-1822	8
LUBE BLOCK CR	69-400-0158 MK5	8
LUBE BLOCK TR	69-100-0107	2
PHENOLIC WEAR PAD	96-100-0036-1215	4
DISCHARGE DOOR ASSEMBLY	A48-X	2
AIR CYLINDER	800 x 48	4
SIDE SEAL	ITEM 02	8
UPPER BONNET SEAL	ITEM 03	4
LOWER BONNET SEAL	ITEM 04	4
END SEAL	ITEM 05	4
SLIDE ROLLER	ITEM 06	80
BONNET ROLLER	ITEM 06A	120
CORROSION PROTECTION SYSTEM		
SACRIFICIAL ANODE	A-15267A	180
SACRIFICIAL ANODE	A-15267C	30
REFERENCE CELL	A-15888	4
DIGITAL VOLTMETER	supplied by others	1
ROTARY COUPLING -	D 0309	1
Recommended for second year of operation		
THRUST ROLLER	69-200-0105	2
THRUST BUSHING HOUSING	96-400-0145	2
TIRE RETAINER SEGMENTS	69-100-0104	1 SET
TIRE RETAINER BLOCKS	96-200-0214	1 SET
BRAKE FRICTION DISC		4
THRU ROD	69-200-0123	2
THRU ROD WASHER	2	4
THRU ROD NUT	2 - 4.5 UNC	4
Recommended for five years of operation		
DRIVE PINION	358394	1
DRIVE REDUCER	FALK525 A3 85.94:1 RATIO	1
PILLOW BLOCK BEARING	SAF 23148	2
HOUSINGS ASSEMBLY	SAF 3148	2
SPHERICAL BEARING	23148/W 33	2
STAB. RINGS	SR-44-38-1	2
INBOARD TRIPLE SEAL RING	LER-16659	2
OUTBOARD TRIPLE SEAL RING	LER-16660	2
OILING PINION ASS'Y	69-400-0156	1
CARRYING BEARING HOUSING	96-400-0308	4
ADJUSTING BOLT	69-400-0145	4
ADJUSTING LUG BLOCK	69-400-0145	4
GEAR SPLIT HARDWARE	MO 01-076215	1 SET
LOW SPEED COUPLING	FALK 1220 T10	1
COUPLING GRID	1220T10	1 SET
GASKET	1220T10	2
SEALS	1220T10	2
Additional Recommended Spare Parts		
PLAIN TIRE	69-200-0114	1
THRUST TIRE	69-200-0115	1
DRIVE GEAR ASSEMBLY	523844	1
BEARING END COVER	96-400-0309	2
PINION SEAL RETAINER	69-200-0127	2
C.R. OIL SEAL RETAINER RING	96-300-0106	4
HARDWARE KIT		
BEARING BOLT	5/8-11 x 1.25"LG.	4
BEARING FLAT WASHER	5/8 FLAT	4
END COVER BOLT	1 -8UNC x 4.5" LG.	24
BUCKET BOLTS	1/2-13 x 1.50" LG.	24
PAN BOLTS	1/2-13 x 4.75" LG.	4
W.J. COVER BOLTS	1/2 - 13 x 1" LG.	84
SEAL RETAINER BOLTS	1/2 - 13 x .75" LG.	24