GOULDS PUMPS, INC.
VERTICAL PUMP DIVISION

E11-51-C-001A-SG-002

E11-51-C-001B-SG-002
E11-51-C-001C-SG-002
E11-51-C-001D-SG-002

INSTRUCTION MANUAL

RESIDUAL HEAT REMOVAL SERVICE WATER PUMPS

ENRICO FERMI ATOMIC POWER PLANT - UNIT #2

THE DETROIT EDISON COMPANY

P. O.: IE 92034

EQUIPMENT NUMBERS:

E1151-C001A

E1151-C001B

E1151-C001C

E1151-C001D

MANUFACTURED BY:

GOULDS PUMPS, INC.
Vertical Pump Division
P. O. Box 1254
City of Industry, California 91749

REF. SHOP ORDER:
N301213

GOULDS PUMPS, INC.
VERTICAL PUMP DIVISION

INSTRUCTION MANUAL: N301213

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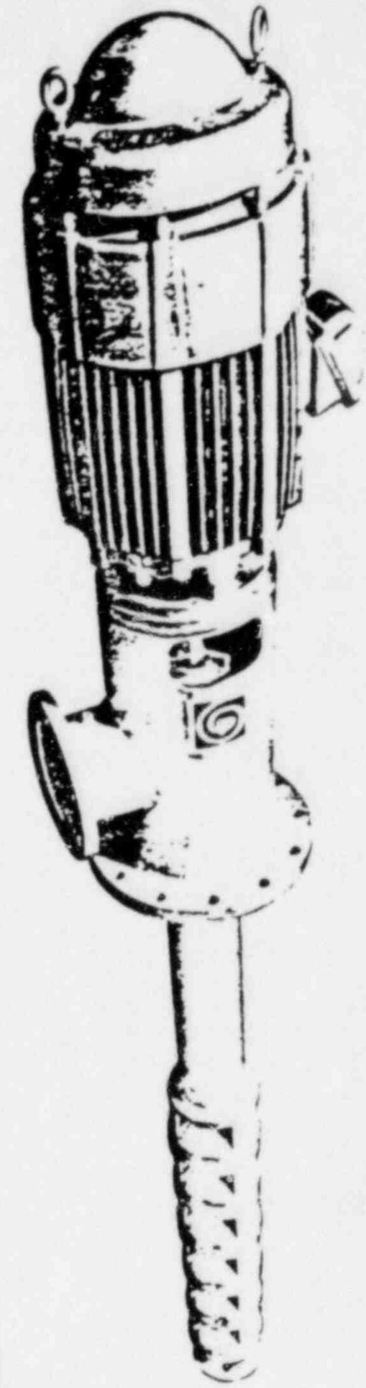
INSTALLATION AND OPERATION INSTRUCTIONS



GOULDS MODEL

VIT

VERTICAL INDUSTRIAL TURBINE PUMP

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GOULDS PUMPS
VERTICAL PUMP DIVISION
City of Industry, California 91747

SECTION I INSTALLATION

I-A Receiving

The unit should be carefully supported and unloaded. Under no circumstances should it be dropped or receive rough handling. Exercise the same care with the pump as with other pieces of engineering equipment.

I-AI Checking Shipment

All parts should be inspected upon receipt for damaged or missing components, checking each item with the shipping manifest furnished. Any deficiency should be immediately reported to the local transportation office of the carrier responsible. This will prevent any controversy when claim is made and facilitate prompt and satisfactory adjustment.

I-B Storage

If the equipment must be stored for any length of time, adequate precautions must be taken against deterioration or damage. If storage is extensive, periodic inspection should be performed and prior to installation the pump should be flushed with clean water and cleaned thoroughly. Storage should be in a dry area where a reasonably constant temperature can be maintained. Mechanical seal, if provided, should [illegible] be installed before the pump is [illegible] place.

I-C Location of Unit

The pump should be arranged so as to allow periodic inspection. Discharge piping should be independently supported near the pump and properly aligned so that no strain is transmitted to the pump when the flange bolts are tightened. Any misalignment in a column assembly can cause vibration in the unit and reduce the life of the bearings.

I-CI Foundations

The foundation should consist of material that will afford a permanent, rigid support for the baseplate. Concrete foundations should be level and built on solid ground. Foundation bolts of the proper size should be embedded in the concrete, located by a drawing or template. A pipe sleeve about two and one-half diameters larger than the bolt should be used to allow movement for the final positioning of the bolts.

When mounted directly on structural steel framework, the pump should be located directly over or as near as possible to the main building members, beams or walls. Baseplate should be bolted to the supports to avoid distortion, prevent vibration and retain proper alignment.

I-D Installation

If the unit is 20' or less, it is usually shipped completely assembled with exception of drivers, vent piping, mechanical seals or packing and in some cases, upper headshafts if a VHS driver is supplied. All bolts and nuts should be checked to insure that they are securely tightened. Care must be exercised in the handling of all parts, particularly the shaft, as it is machined to close tolerances for accurate alignment.

I-E Assembly

1. Open Lineshaft (Pump element not assembled to column & head) (Refer to Fig. 1)

A. After thoroughly checking the parts and inspecting the flanges, position a suitable lifting device over foundation opening.

B. Lower pumping unit (7) to a point where shaft can be readily coupled to pump shaft and then lower column section (5) with line shaft, aligning the bolt holes on the flanges. NOTE: Do not use pipe thread sealing compound on shaft or shaft coupling.

C. Make certain air relief hole in shaft coupling centers at the shaft ends.

D. Screw lineshaft into pumpshaft. Do not apply wrenches at the point where it may come in contact with bearings.

E. Place bearing spider (6) in recess of column flange.

F. Lower next section of column assembly making sure spider ring enters recess in bottom flange of section.

G. Extreme care should be taken in tightening flange bolts. Do not attempt to pull flanges together. When joint is assembled properly and bolts tight, there should be about 1/2" gap between flanges. Repeat the above procedure for all sections if pump length necessitates their use.

H. Screw lower headshaft in place. Remove packing box assembly (3) from discharge head (2) so as not to incur damage to the shaft.

I. Lower head carefully over headshaft, having first placed spider in recess of top column flange. Bolt column to head, then mount head to foundation.

J. Replace stuffing box assembly taking caution to insure that Flexitallic gasket is in its proper position. (Refer to Fig. V(a))

2. Assembly Enclosed Lineshaft (Fig. II)

A. After the parts have been checked for damage, and flanges have been inspected, slide shaft and tube into column pipe, taking care to protect threads. A clean rag wound around the end is ample protection against dirt and damage. Let the tube extend about 6" below the column pipe and the shaft about 6" below the tube.

B. Lower column assembly (1) to a point where the shaft is slightly above pump shaft coupling. Clean end of shaft and threads. Put a few drops of oil on the threads — DO NOT USE THREAD DOPE, then lower until shaft enters coupling and thread together.

C. Check the tube threads and end to be sure they are clean, then oil and lower until tube rests on bearing at top of bowl assembly (2) and couple together.

D. After tube (3) is in place, check flanges and coat face with thin coat of thread dope or white lead and oil.

E. Lower column (1) in place and bolt flanges together.

F. Remove bronze bearing (8) from tube and pour a few ounces of light turbine oil over shaft. DO NOT FILL THE TUBE. Dope threaded O.D. of bearing and replace in tube and thread coupling on shaft.

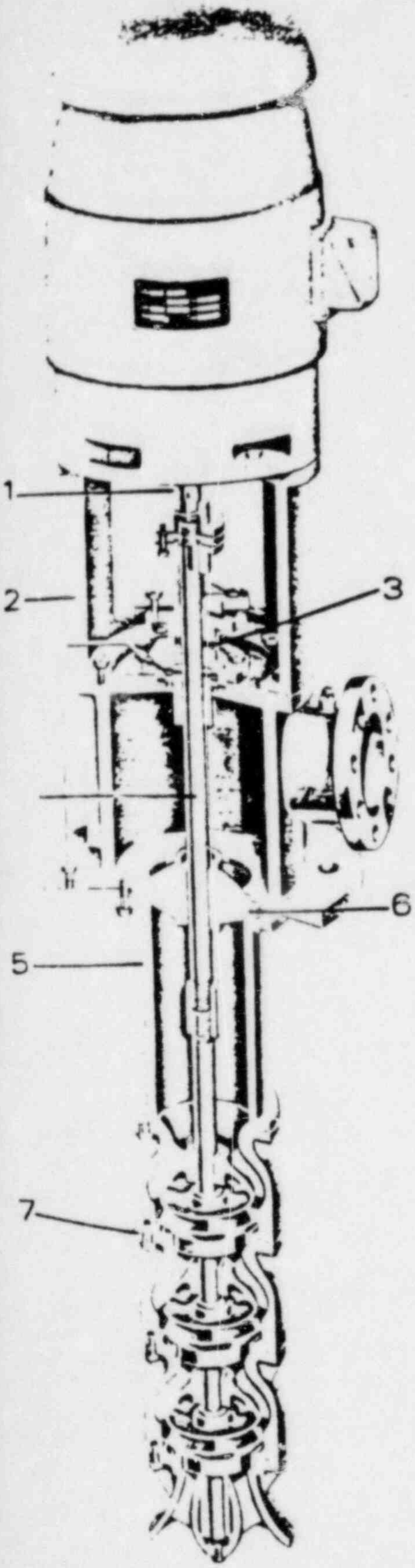


FIGURE I
Open Lineshaft

G. A steel spider is used to center the tube in the column pipe. These are placed in recess of column flange.

Repeat above operations until all column is installed.

H. Check position of shaft coupling. If coupling is in tube, the head shaft (9) is screwed into the coupling, then the tube is screwed onto the bearing. If the coupling is above the tube, screw the tube onto the bearing.

I. Place the head on the top column flange, bolt together then raise the head and lower it into the foundation. Bolt the head in place.

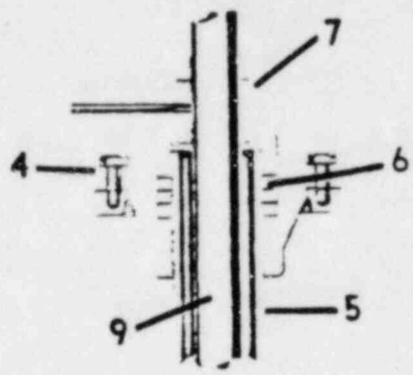
J. Dope the tube threads and the flange of the tension plate (4). Screw the plate onto the tube fairly tight so as to put considerable tension on the tube. Align the holes, insert capscrews and tighten.

K. The top of the tube nipple (5) should now be about even with the top of the tension plate; check to be sure that the tube nipple does not extend too far above the tension plate and that it will not butt on the shoulder of the tension nut. Install the tension plate packing (6) and thread the tension nut (7) down tight.

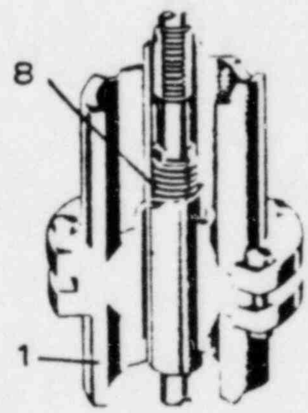
L. Refer to section II for driver mounting.

M. Connect the oil lines. Fill the automatic oiler, if electric pump drive is furnished, or oil cup for gear, with Gargoyle D.T.E. Light oil or equal. Do NOT use heavy oil, over SAE 10, in the bearings or line shafting. The leads of the automatic oiler are connected to any two leads of the motor.

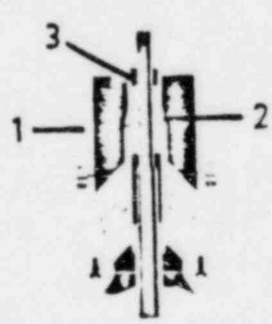
N. Check the lubricator feed and see that the oiler is flowing freely. Prior to setting proper drops per minute on the regulator, allow a generous amount of oil to flow freely down oil tube. Subsequently, the regulator can be set and, of course, this setting is dependent on the pump setting and size of shaft. The following table shows recommended regulator setting:



Stuffing Box



Enclosed Lineshaft—Water Flush



Discharge Bowl

FIGURE II
Enclosed Lineshaft

Drops per Minute	Shaft Range
8	3/4" to 1"
16	1 - 3/16" to 1 - 15/16"
20	2 - 3/16" and larger

3. Assembly Water Flush and Rifle Drilled Construction (Fig. II-A)

A. Assemble flush lines (10) to suction bowl as shown. Follow instructions in 2, A through J except F.

B. Place bushing retainer (11) into tension plate.

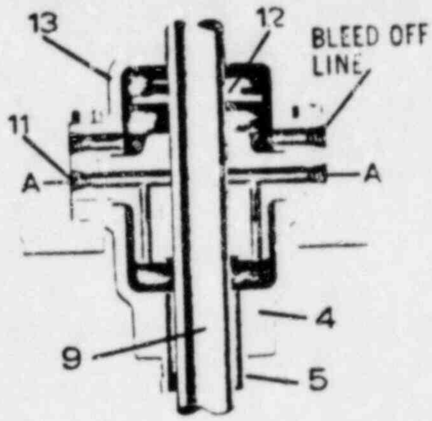
C. Secure flinger (12) onto shaft close to the top of the retainer.

D. Place bonnet (13) on top of retainer and bolt in place.

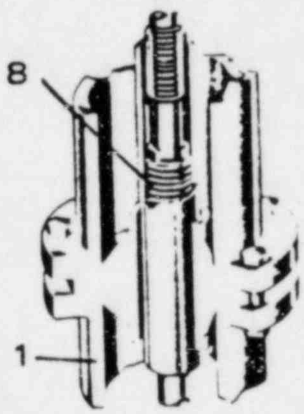
E. Refer to section II for driver mounting.

F. Connect flush lines to stuffing box at both connections at A and to the flush line to the suction bowl bearing. Connect bleedoff lines from the bonnet to the return lines in the baseplate of the discharge head.

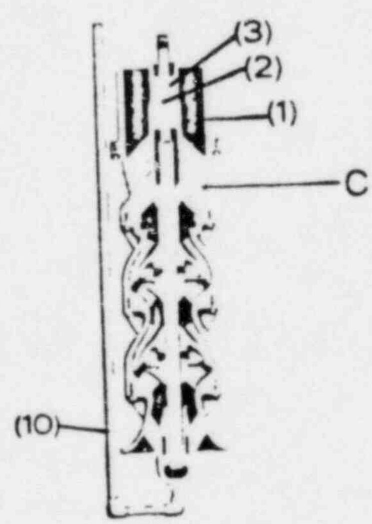
G. Turn on supply water to assure adequate flow to bearings. Flush water should be 20 psi above maximum pump discharge pressure.



Packless Stuffing Box



Enclosed Lineshaft - Water Flush



Bowl Assembly

FIGURE II-A

SECTION II DRIVER MOUNTING

II-A Vertical Hollow Shaft — Motor or Gear

A. Remove the drive coupling from the motor or gear drive and insert a cloth in the openings to prevent any foreign materials from falling into the driver.

B. Position the driver on the discharge head and bolt down, making sure the pump is vertically aligned.

C. Carefully lower the drive shaft through the hollow shaft on the driver.

D. Couple the shaft with the threaded coupling provided taking care to center the coupling between the two shafts. (See Fig. III if flanged coupling is furnished.) Drive shaft must be centered in driver bore. If shaft is not centered, check misalignment between driver and head, or check for bent head shaft. Correct misalignment.

E. For electric motor units, make electrical connections according to tagged leads or diagram attached to the motor. Check motor rotation. Be sure this is done before installing the drive coupling. CAUTION: DO NOT RUN IN REVERSE DIRECTION AS SHAFTING MAY UNTHREAD AND CAUSE SERIOUS DAMAGE TO THE DRIVE AND/OR PUMP. The motor must rotate counter-clockwise when looking down from above. See arrow on pump nameplate. If motor does not rotate counter-clockwise, change motor rotation by interchanging any two leads.

F. Slip on the drive coupling and install the gib head key. This key should be a slide fit, permitting adjustment of the pump headshaft by means of the adjusting nut. Secure the coupling, making certain coupling is properly seated.

G. Use the adjusting nut to adjust the impellers. (See instructions for impeller adjustment II-C).

H. Lock adjusting nut with capscrew provided.

II-A1 Flanged Coupling (Fig. III-3)

A. Refer to A, B, & C above.

Disassemble the coupling and slide the upper half of the coupling onto the drive shaft with key in place and position split anular ring into anular groove. Slide the coupling half over the split rings in order to hold them in place.

C. Assemble lower coupling half on head shaft and raise over split rings as in B.

D. Bolt flange halves and proceed per E, F, G, H above.

II-B Gear Drive Units

A. Make cooling connections as required. Use tubing of flexible hose at the gear drive. The amount of water required may best be determined by regulating to the temperature on the discharge of the cooler.

B. Fill gear drive to proper level with oil recommended by the gear manufacturer.

C. The flexible shaft flanges should push fit on the gear drive and engine without the use of excess force. Hammering on the shafts will damage the bearings and destroy the adjustment of the gears in the gear drive. The shafts to be connected need not line up axially, but should be within two degrees parallel. Keep the lugs of the flange yokes in the same position as shipped from the factory. If slip joint is moved, be sure lugs are re-aligned. Use only a pure mineral oil of 140 S.A.E. grade when lubricating the universal joints.

D. Check the rotation of the power unit and pump in relation to that of the drive, as shown by arrows on the case. Rotate the drive by hand before applying power as a precaution against a bound or locked installation. The pump always rotates counterclockwise as viewed from the top of the drive shaft. CAUTION: DO NOT RUN IN REVERSE DIRECTION AS SHAFTING MAY UNTHREAD AND CAUSE DAMAGE TO THE GEAR DRIVE AND/OR PUMP.

C Impeller Clearance for Open or Enclosed Impellers

Refer to figure IV.

II-C1 Vertical Hollowshaft Driver

Adjust impeller with the adjusting nut at top of driver —
Note: Thread is left hand.

A. With impellers touching bowl faces, turn adjusting nut C.C.W. until bottom face of nut makes contact with motor coupling.

B. Find hole "A" in adjusting nut which is closest to hole "C" in motor coupling and line them up.

C. Put capscrew in hole "B". Turn adjusting nut C.C.W. until "B" and "D" line up. This gives minimum adjustment 1/20 of one turn or .004" vertical movement.

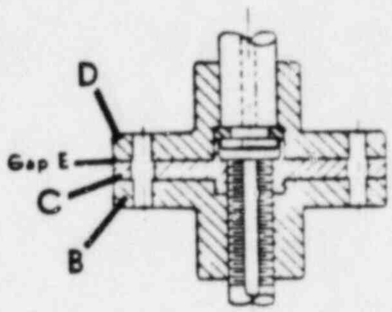


FIGURE III — 1

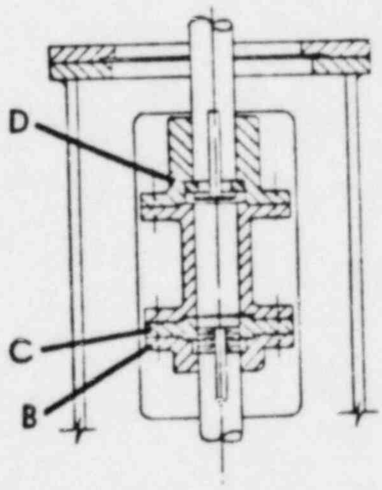


FIGURE III — 2

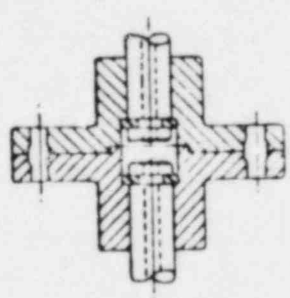


FIGURE III — 3

D. By turning adjusting nut still more and lining up holes "E" and "G" impellers are raised 2/20 turn or .008". Where holes "F" and "H" line up adjustment is 3/20 turn or .012" and so on.

E. Turn adjusting nut for impeller clearance of 0.015" for pumps with up to 10 feet of column, add 0.020" for each additional 10 feet of column. If pump performance is not satisfactory with specified clearance, lower impellers as required, but be sure not to allow impellers to drag. For enclosed impellers use 3/16" clearance.

II-C2 Vertical Solid Shaft — Motor or Gear (Fig. III-1-2)

A. Disassemble the coupling. Slide the upper half of the coupling (D) onto the driver shaft with key in place. Fit the split thrust rings into the shaft and slide the coupling down over the rings. If the coupling is the spacer type, assemble the spacer to the upper half with the studs provided.

B. Slide the bottom half coupling (B) and key onto the head shaft. Screw the adjusting nut (C) as far as possible on the head shaft.

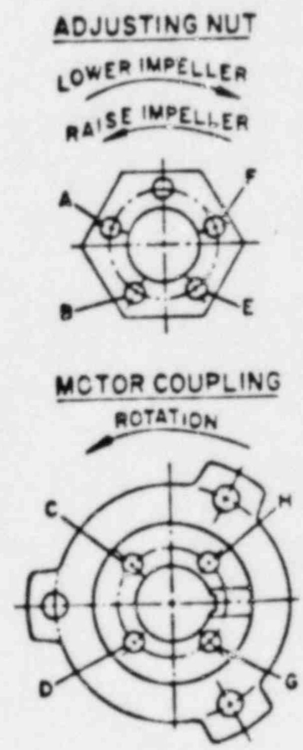


FIGURE IV
Impeller Adjustment VHS Driver

C. Hoist driver and set in place on pump head. Bolt down securely.

D. Rotate drive by hand before applying power as a precaution against a bound installation. Pump always rotates counter-clockwise as viewed from top of drive shaft.

CAUTION: DO NOT RUN IN REVERSE DIRECTION AS SHAFTING MAY UNTHREAD AND CAUSE SERIOUS DAMAGE.

E. For Electric Driver — Make electrical connections according to tagged leads or diagram attached to the motor. Do not connect drive coupling until motor rotation is checked. Motor must rotate counter-clockwise when looking down from above. See arrow on pump nameplate. If motor does not rotate counter-clockwise change motor rotation by interchanging and two leads. CAUTION: DO NOT RUN IN REVERSE DIRECTION AS SHAFTING MAY UNTHREAD AND CAUSE SERIOUS DAMAGE.

F. For gear drive units, see section II-B.

G. For steam turbine drivers — In connecting steam piping to turbine, be sure that adequate expansion joints are used, otherwise temperature changes may cause misalignment.

II-D Impeller Clearance for Open or Enclosed Impellers

II-DI Vertical Solid Shaft Driver

A. Refer to figure III-1 and 2. With pump installed and the impellers on the bottom turn the adjusting plate (C) on the thread to obtain .015" clearance between the flanges (gap-E) for pumps with up to 10' of column. Add an additional .020" for every additional 10' of column. If pump performance is not satisfactory with specified clearance, lower impellers as required, but be sure not to allow impellers to drag. For closed impellers use 3/16" gap.

B. Insert coupling bolts and pull coupling flanges together snugly. This raises the impellers the amount of the clearance between the flanges.

C. IF A MECHANICAL SEAL IS SUPPLIED, DO NOT SECURE SAME UNTIL AFTER THE IMPELLER ADJUSTMENT IS COMPLETE.

SECTION III PUMP START UP

III-A Priming

The first stage impeller must always be fully submerged.

If the pump is run dry, the rotating parts within the pump may gall and seize to the stationary parts as they depend on the liquid being pumped for lubrication.

III-B Check for Free Turning

Before the pump is started, turn pump over by hand to be sure it is free, and does not rub or bind.

SECTION IV OPERATION

IV-A Prior to Starting

1. Before the pump is started initially, make the following inspection:

A. Check alignment between pump and motor.

B. Assure that bearings are properly lubricated.

C. Check all connections to motor and starting device with wiring diagram.

Check voltage, phase, and frequency on motor nameplate with line circuit.

D. Check rotation — be sure that the pump operates in the direction indicated by the arrow on the pump head, as serious damage can result if the pump is operated with incorrect rotation.

E. Check impeller adjustment.

F. Turn rotating element by hand to assure that it rotat... ' ..'.

G. Check discharge piping and pressure gauges for proper operation.

H. If pump bearings are lubricated by water flush, allow water to lubricate bearings for two or three minutes before starting pump.

IV-B Starting

1. Follow the steps below in the order indicated to start pump:

A. Close valve in discharge line.

B. Turn on power to pump driver.

C. When pump is operating at full speed, open discharge valve slowly.

IV-C Stopping Pump

When stopping the pump, close the discharge valve first. The pump, however, should never run for any length of time with discharge valve closed due to danger of increased temperatures.

SECTION V DISASSEMBLY & ASSEMBLY

V-A1 Product Lube

A. To disassemble the pump, remove canopy on motor to allow access to the drive coupling.

B. Remove the lockscrew from adjusting nut to allow removal of adjusting nut.

C. Remove adjusting nut.

D. The gib head key should then be removed and the upper headshaft can be uncoupled from the coupling located in discharge head, and removed by pulling up through driver.

E. Remove the driver and set aside for later inspection.

For solid shaft drivers remove coupling bolts and remove driver.

F. To remove the packing box, slide the packing gland (1) off the shaft and remove the packing (2) and lantern ring (5). Disconnect any bleed lines and remove the capscrews holding the assembly in the discharge head. Remove the stuffing box (3), taking caution not to damage the flexitallic gasket (6). Removal of the stuffing box bushing (7) can now be accomplished and inspection can be performed.

G. Raise discharge head to allow access to the flange and disassemble the flange bolts. Secure column so it won't drop. Remove discharge head and bearing retainer. Care should be taken not to damage the shaft during this procedure.

H. The shaft coupling should now be exposed and strap wrenches can be used to disassemble the head shaft (NOTE: THREADS ARE LEFT HAND).

I. Continue the above procedure, one column section at a time, until removal of the entire bowl assembly can be accomplished.

V-A2 Oil Lube

A. Follow A, B, C, D and E above then disconnect oil line from tube tension nut (7) (Fig. V(b)).

B. Remove tube tension nut in order to accomplish removal of the packing.

C. Remove bolts holding tube tension plate (4) and unscrew tube tension plate from tube tension nipple (5).

D. Remove head mounting bolts and raise head in order to disconnect flange bolts, taking caution to adequately brace the pump.

E. Remove tube tension nipple (5) and lower headshaft.

F. Continue to remove enclosing tube column and lineshaft in sequence, until removal of the entire bowl assembly can be accomplished.

V-A3 Water Flush Arrangement (Figure V(c)).

A. Follow V-A1, A through E.

B. Disconnect flush lines and bleed off lines from bonnet.

C. Remove Bonnet (13)

D. Remove flinger (12)

E. Remove bushing retainer (11)

F. Remove tension plate (4) by unthreading from tube tension nipple (5). Follow V-A2, Items D, E and F.

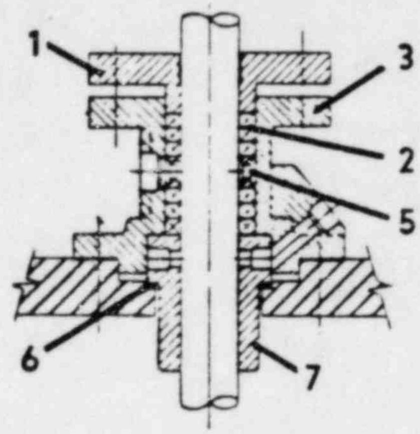


FIGURE V(a)
Product Lubricated
Stuffing Box.

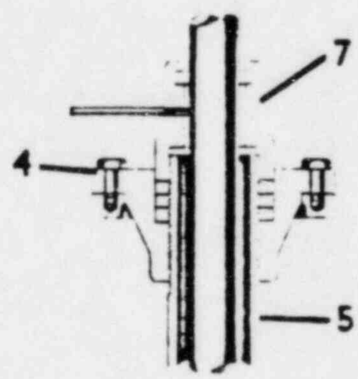


FIGURE V(b)
Oil Lubricated
Stuffing Box

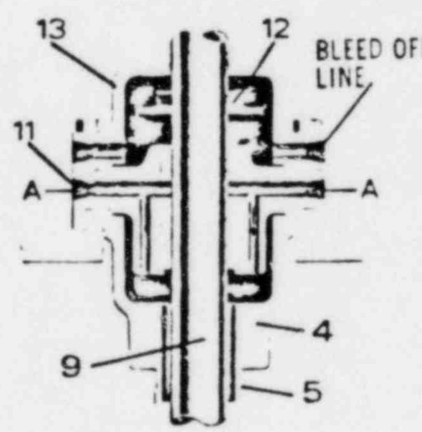


FIGURE V(c)
Water Flush
Arrangement

V-B Disassembly Pump Bowls

V-B1 Product Lubrication (Figures VI(a) and (c))

A. Unscrew pump shaft coupling (3) and remove capscrews from top bowl.

B. Slide the discharge bowl (1) off the pump shaft (2) so impeller (4) is exposed. NOTE: To insure proper reassembly, flanges should be marked in sequence of disassembly.

C. Pull shaft out as far as possible, then strike the impeller hub using a collect hammer sliding on the shaft. This action drives the hub off the taper lock (5). Usually several blows are needed to free it.

D. When the impeller has been freed, insert a screwdriver into the slot in the taper lock to spread it. This allows removal off the shaft. The impeller can now be removed. Proceed in this manner until entire bowl unit is completely dismantled.

E. Remove pump shaft from suction bowl (9). Bronze sand collar must not be removed unless pump shaft is being replaced.

F. See section V-D and Figure IX for keyed impellers.

V-B2 Oil Lubrication Figures VI(b) and (c)

A. Unscrew pump shaft coupling (3) and remove.

B. Remove screw bearing (6) from discharge bowl (1).

C. Remove cap screws from top bowl (1) and remove top and discharge bowls from shaft (2).

D. Proceed per C, D and E above.

V-C Assembly — Figures VI, VII & VIII

A. Slide the pump shaft into bearing in suction bowl until the sand collar (8) rests on the hub of the bowl (9). (If new shaft is used contact nearest sales office for positioning sand collar.)

B. Holding the shaft in place with a washer and capscrew placed in suction bearing housing, slide the first impeller (4) over shaft until it seats on the bowl.

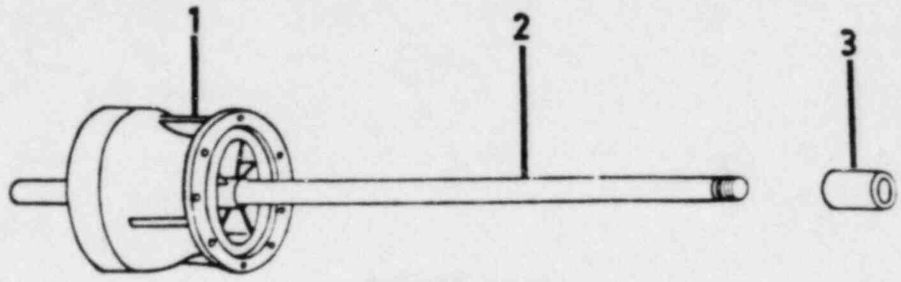


FIGURE VI(a)
Product Lubrication Bowl Assembly

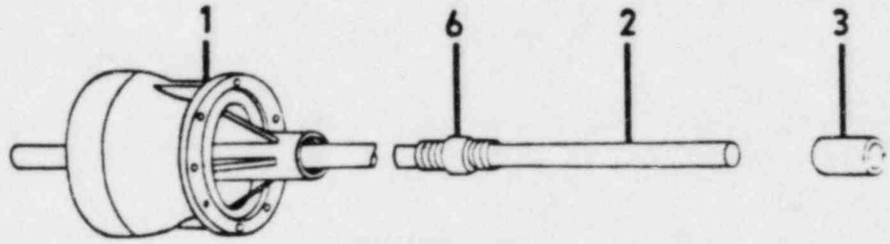


FIGURE VI(b)
Oil Lubrication Bowl Assembly

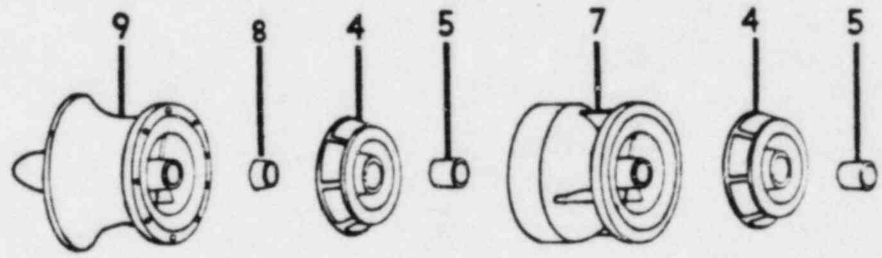


FIGURE VI(c)
Bowl Assembly

C. Drive a small wedge into slot of taper lock (5) spreading it to allow placement over the shaft. Holding the impeller against the bowl, slide taper lock into hub, removing the wedge after insertion.

D. Drive the lock in place with a collet hammer.

E. Slide first intermediate bowl (7) over impellers and bolt bowls together with capscrews.

F. Repeat the above procedure until all stages are assembled.

V-D Keyed Impellers

When furnished, the split ring collar may be of either the bolted or screwed type. (Figure IX)

Insert the lateral key into keyway on pumpshaft and slide impeller down over the key making sure the anular groove for the split radial key is exposed above the impeller hub. Insert the split anular key and position the split ring collar either with capscrews or threads, tightening same until no lateral movement of the impeller is experienced.

V-E Bowl Wear Rings

V-E1 Removal

Using a diamond point chisel, cut two "V" shaped grooves approximately 180° apart. Extreme care should be taken so as not to damage the wear ring seat. Using the chisel, knock the ends of one half the ring in and pry ring out.

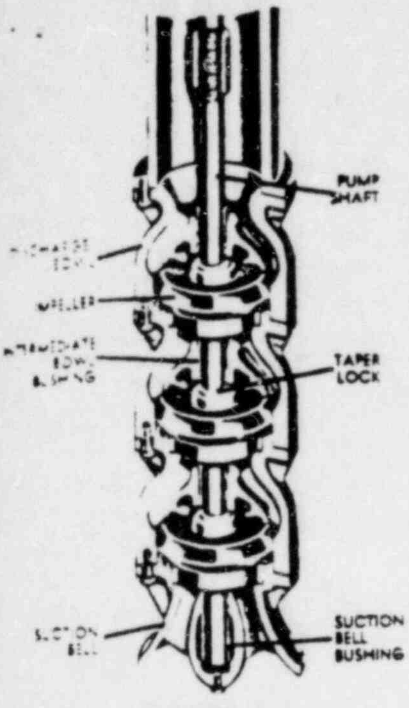


FIGURE VII
Product Lubrication

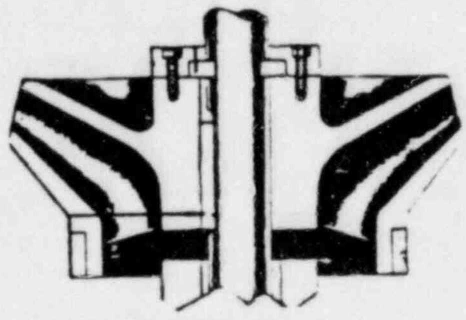


FIGURE IX(a)
Keyed Impellers
Bolted Type

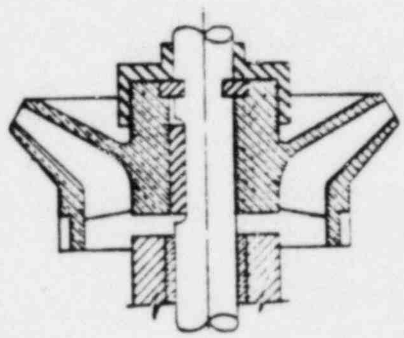


FIGURE IX(b)
Keyed Impellers
Screwed Type

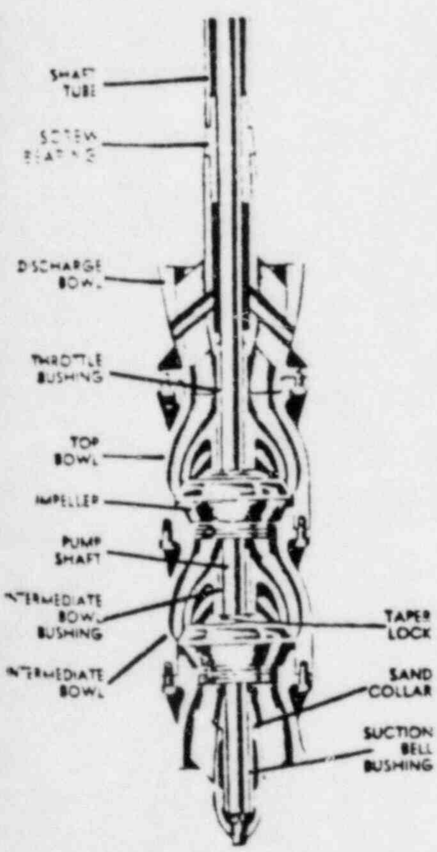


FIGURE VIII
Oil Lubrication

V-E2 Installation

Place the chamfered face of the bowl ring towards the ring seat and press into seat making sure it is flush with edge of wear ring seat.

Recommended clearance are as follows:

Model	Clearance
3 x 4 LC — 6 x 5 HC	.015
6 x 7 LC — 12 x 13 MC	.016 — .018
12 x 14 LC — 20 x 20 HC	.020 — .025

V-F Impeller Wear Rings

V-F1 Removal

The recommended method for removal of impeller rings is to set up the impeller in a lathe and machine the ring off, taking care not to machine or damage the ring seat or impeller hub.

V-F2 Installation

Follow procedure noted under bowl ring installation.

REPAIR PARTS ORDERING INFORMATION

Always give serial number of the pump as stamped on the nameplate. This is essential as similar pumps often differ according to conditions of service. Also, when ordering, give the name and number of the parts as marked on the Sectional Drawing.

It is recommended that the spare parts be purchased in order to insure against costly delays. The service in which the particular pump is used will determine the number of parts which may be required. Any further information is available upon request from your area representative or the Sales Department, Goulds Pumps, Vertical Pump Division, Inc., City of Industry, California.

Returning Parts

All materials returned to factory must have a Return Material Order (R.M.O.) tag attached.

Consult the nearest factory representative or Sales Office for shipping instructions and an R.M.O. tag.

Articles being returned should be adequately packed to prevent damage in handling.

SECTION VI TROUBLE CHECK LIST

VI-A No Liquid Delivered

1. Lack of prime or break suction.
   Fill pump to a point above first stage impeller.
   Check for vapor bind.
   Plugged suction.

2. Speed too low.
   Check whether motor is directly across-the-line and receiving full voltage.

3. Discharge head too high.
   Check pipe friction losses. Larger piping may correct condition. Are valves wide open?

4. Suction lift too high.
   If no obstruction at inlet, check for pipe friction losses. However, static lift may be too great. Measure with mercury column or vacuum gauge while pump operates. If static lift is too high, liquid to be pumped must be raised or pump lowered.

5. Impeller completely plugged.
   Dismantle pump and clean impeller.

VI-B Not Enough Liquid Delivered

1. Speed too low.
   See item 2 above.

2. Discharge head too high.
   See item 3.

3. Suction lift too high.
   See item 4.

4. Impeller partially plugged.
   See item 5.

5. Incorrect rotation.

6. Cavitation.
   Insufficient NPSH available. Depending on installation, increase the positive suction head on the pump by lowering the pump, raising liquid level, increasing pressure on suction side or by lowering temperature of the liquid.

   Entrained air.

   Vortexing.

VI-C Not Enough Pressure

1. Speed too low.
   See item 2.

2. Air or gases in liquid (test in laboratory, reducing pressure on liquid to pressure in suction line. Watch for bubble formation.)
   May be possible to over rate pump to point where it will provide adequate pressure despite condition. Better to provide gas separation chamber on suction line near pump, and periodically exhaust accumulated gas.

3. Obstruction in liquid passages.
   Dismantle pump and inspect passages of impeller and bowl. Remove obstruction.

4. Too small impeller diameter.
   Check with nearest sales office to see if a larger impeller can be used. Otherwise, cut pipe losses, or increase speed, or both as needed. Be careful that driver is not overloaded.

5. Entrained air.
   NPSH. See VI-B6.

VI-D Pump Works for a While and Quits

1. Head lower than rating, pumping too much liquid.
   Turn down impeller outside diameter to size advised by nearest sales office.

2. Excessive required horsepower.
   Pump being used with a higher viscosity or specific gravity liquid then designed for.
   Use larger driver. Consult sales office for recommended size. Test liquid for viscosity and specific gravity.

3. Wrong direction of rotation.

4. Casing distorted by excessive strains from suction or discharge piping.
   Examine pump for friction between impellers and bowls; replace damaged parts.

5. Shaft bent due to thermal distortion, damage while overhaul, or improper assembly of rotating element.
   Check deflection by turning between lathe centers. Average total runout, should not exceed .002" on all pumps.

6. Mechanical failure of critical pump parts.
   Check bearings and impellers for damage. Any irregularity in these parts will cause a drag on the shaft.

7. Speed may be too high. (Brake horsepower of pump varies as the cube of the speed; therefore, any increase in speed means considerable increase in power demand).
   Check voltage on motor.

8. Misalignment.
   Realign pump and driver.

9. Electrical defects.
   The voltage and frequency of the electric current may be lower than that for which the motor was designed, or there may be defects in the motor. The motor may not be ventilated properly due to a poor location.

10. Mechanical defects in turbine, engine, or other type. If trouble cannot be located, call in factory service engineer.

VI-E Pump Takes Too Much Power

1. Defective impeller.
   Inspect, replace if damaged or vane sections badly eroded.

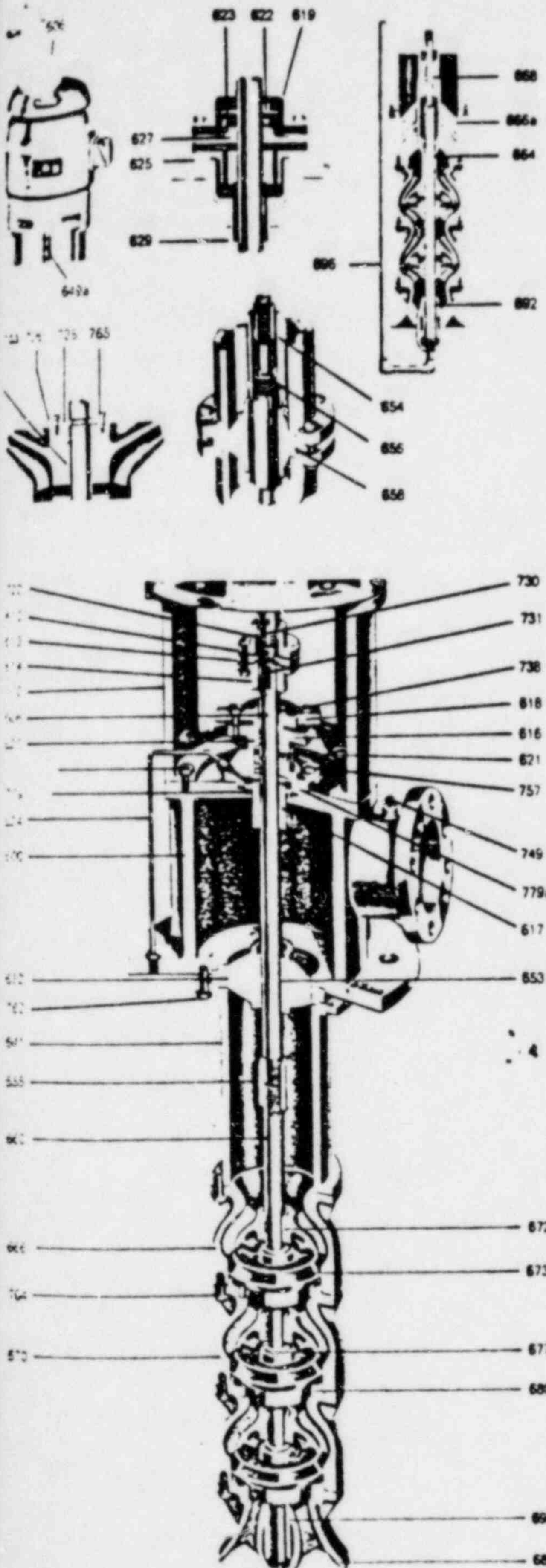
2. High specific gravity.

3. Head lower than rating — pumps too much liquid.
   See item 1, section VI-D.

4. High viscosity, partial freezing of pumped liquid.
   Check. Both can cause high drag on the impeller.

5. Defective bearing.
   Replace bearing. Check shaft or shaft sleeve for scoring.

SECTION VII PARTS LIST



Materials of Construction and Parts List

ITEM NO.	NO. REQ'D. PER PUMP	PART NAME	MATERIAL CONSTRUCTION: BRONZE FITTED	MATERIAL CONSTRUCTION: ALL IRON
600	1	Discharge head	FAB. STL	
602	1	Motor stand	FAB. STL	
604	1 (n)	Adjusting nut	SAE-1018	
606	1 (n)	Drive shaft	SAE-1045	
608	1	Headshaft	416 SS	
610	1 (k)	Upper half coupling	SAE-1018	
613	1 (k)	Adjusting plate	SAE-1018	
614	1 (k)	Lower half coupling	SAE-1018	
616	1	Stuffing box	CI	
617	1	Throttle bushing	Brz #15	CI
618	2	Split stuffing box gland	Brz #15	CI
619	1 (m)	Bonnet	CI	
620	1 set	Packing	Graphitized asbestos	
621	1	Lantern ring	Brz #15	CI
622	1 (m)	Slinger	Brz #15	
623	1 (m)	Bushing retainer	CI	
624	1	Bypass pipe	Copper Tub	Steel Tub
625	1 (m)	Tube tension plate	CI	
627	1 (m)	Bushing	Brz #15	
629	1 (m)	Tube tension nipple	STL. #37	
641	(g)	Column pipe	STL. #37	
649a	1 (n)	Headshaft coupling	416 SS	
652	(g)	Bearing retainer	Cast Steel	
653	(g)	Lineshaft bearing	Brz #15	CI
654	(g) (m)	Shaft enclosing tube	STL. #37	
655	1	Pump shaft coupling	416 SS	
656	(g) (m)	Tube shaft bearing	Brz #15	Brz #15
658	(g) (m)	Tube stabilizer	Cast Steel	
660	1	Pump shaft	416 SS	
664	1 (m)	Dischg bowl throttle bushing	Brz #15	CI
666	1 (p)	Discharge bowl	CI	
666a	1 (m)	Discharge bowl w/ports	CI	
668	1 (m)	Tube adapter bushing	Brz. #15	Brz #15
670	1 (a) (p)	Intermediate bowl	CI	
672	1 (b)	Bowl bearing	Brz. #15	CI
673	1 (b) (p)	Impeller	Brz. #11	CI
677	1 (b) (e)	Taper lock	SAE-1018	
680	1 (b) (c)	Bowl wear ring	Al. Brz.	CI
689	1	Suction bell	CI	
690	1	Suction bell bearing	Brz. #15	CI
692	1	Sand collar	Brz. #15	CI
696	1 (m)	Flush line	Galv. Steel [illegible]	
722	2 (k)	Split ring—upper half cplg	SAE-1018	
725	2 (b) (f)	Split ring—impeller	416 SS	
726	2 (b) (f)	Split ring collar	416 SS	
730	1 (k)	Key motor shaft	SAE-1018	
731	1 (k)	Key, headshaft	SAE-1018	
733	1 (b) (f)	Impeller key	416 SS	
738	2	Gland stud	SAE-1018	
749	1	Pipe plug	Galv. Steel	
756	(q)	Capscrew—motor stand	SAE-1018	
757	(q)	Capscrew—stuffing box	SAE-1018	
762	(g)	Column flange bolt	SAE-1018	
764	(q)	Bowl stud	SAE-1018	
765	4 (b) (f)	Cap screw, split ring collar	416 SS	
779	1	Gasket, stuffing box	Flexitallic 316 SS	
779a	1	Stuffing box gasket	Vellumoid	

Material Specification

Code	Specification
CI	ASTM A278-64 CL30
BRZ #11	ASTM B145-52-4A (SAE40)
BRZ #15	ASTM B144-52-3B (SAE660)
AL. BRZ	ASTM B148-52-9A (SAE68E)
CAST STEEL	ASTM A216 Gr. WCB
STL. #37	ASTM 120 Gr. B

(a) 1 each additional stage
(b) per stage
(c) optional
(e) standard 3x3 through 12x11 sizes
(f) standard on 12x13 size and above
(g) dependent upon pump length
(k) standard on VSS drive only
(m) enclosed lineshaft only
(n) standard on VHS drive only
(p) C.I. Bowls and C.I. enclosed impellers through 12x13 are glass lined
(q) dependent upon pump size

Vertical Pump Division Offices and Plant, City of Industry, California

SPECIALISTS IN PUMPS

Goulds Pumps built its first pumps 121 years ago and has grown to the largest independent manufacturer of pumps exclusively in the world.

[illegible]

GOULDS PUMPS
VERTICAL PUMP DIVISION City of Industry, California 91747
Goulds Pumps, Inc. Main Plant and Headquarters, Seneca Falls NY 13148

ALLIS-CHALMERS

INSTRUCTIONS

LARGE FRAME
VERTICAL
INDUCTION MOTORS

51X4232

TABLE OF CONTENTS

NOTE: The illustrations, descriptions and instructions in this book include the standard designs of the equipment and any common deviations when possible. This book *does not cover all design details and variations* nor does it provide for all contingencies which may be encountered. When information cannot be found herein, contact the nearest Allis-Chalmers office. For a listing of these offices and Certified Service Centers, see directory 25x8109.

This manual is furnished to provide some of the practical ways to install, operate, and maintain your equipment. Keep it handy for future reference. Additional information may be obtained from the nearest Allis-Chalmers representative, or standards of the National Electrical Manufacturers Association (NEMA).

WARRANTY

See your sales contract for coverage.

RECEIVING

Common dangers during unpacking are mechanical damage and moisture condensation.

The unit should be unpacked with these checks in mind:

1. Unload and handle the unit carefully.
2. Check for shortage and damage immediately. (A prompt report, with *notations on the freight bill*, should expedite adjustments by the carrier.)

CAUTION

Use lifting lugs, NOT attachments. Do not lift by flanges. Check drawings for construction.

Motors with grease-lubricated bearings are shipped with the bearings pre-lubricated and ready for operation.

Motors with oil-lubricated bearings (sleeve or anti-friction) are shipped *without oil* in the bearing reservoir. Bearings and journal surfaces are protected during shipment by a film of rust-inhibiting oil.

Immediately upon receiving a motor with oil lubricated bearings:

1. Check for moisture accumulation. Remove any traces of oxidation before putting the motor in service.
2. Fill bearing reservoirs to normal level with a non-foaming, non-detergent turbine oil (see Maintenance).
3. Rotate the shaft several turns, by hand, to distribute the oil over bearing parts.

HANDLING

Any motor lifting device provided, either eye bolts or lugs, must be used for lifting the motor only, and not additional equipment.

Never attempt to lift an assembly by attachments or sub-assembly lifting devices.

CAUTION

Check weight before lifting: weight is usually indicated on freight bill. Lift only with lifting devices. Apply tension vertically and gradually; do not jerk cables, attempt to move motor suddenly, or scrape sides of fabricated assemblies with cables.

Motor Weights (In Pounds)

The following weight variations, Table 1-1, are based on motor frame sizes and types of enclosure.

TABLE 1-1 MOTOR WEIGHTS

FRAME SIZE	TYPE OF ENCLOSURE		WEIGHT (LBS)
	SOLID SHAFT	HOLLOW SHAFT	MIN. /MAX.
500	GV	HSHG	1,300 / 3,575
580	GV	HSO	3,000 / 5,500
30	GV	HSO	4,500 / 7,000
23	AZV	HSZ	3,200 / 4,100
26	&	&	4,500 / 6,500
30	AZZV	HSZZ	6,000 / 10,500

TEMPORARY STORAGE

Consider a unit in storage when:

1. It has been delivered to the job site, and is awaiting installation.
2. It has been installed, but operation is delayed pending completion of plant construction.
3. There are long (30 day) periods between operating cycles.
4. The plant or department is shut down.

If the equipment is not to be installed or operated soon after arrival, provide a clean, dry well-ventilated place, free from vibration and rapid or wide variations in temperature.

1. Energize space heaters to prevent condensation on internal parts.

2. Fill oil reservoirs to proper level.

3. Rotate the shaft several revolutions each month to: coat the bearings with lubricant, retard oxidation or corrosion, and prevent possible false brinelling.

CAUTION

High speed (3600 RPM) vertical motors with oil lubricated bearings are lubricated by an oil mist. Each month, during storage periods, these motor bearings must be coated with oil – by running the unit several minutes or by disassembly and coating bearings with oil by hand.

Storage requirements vary depending on the length of storage and the climate environment. For storage periods longer than 3 months or special conditions consult factory instructions 51X3963.

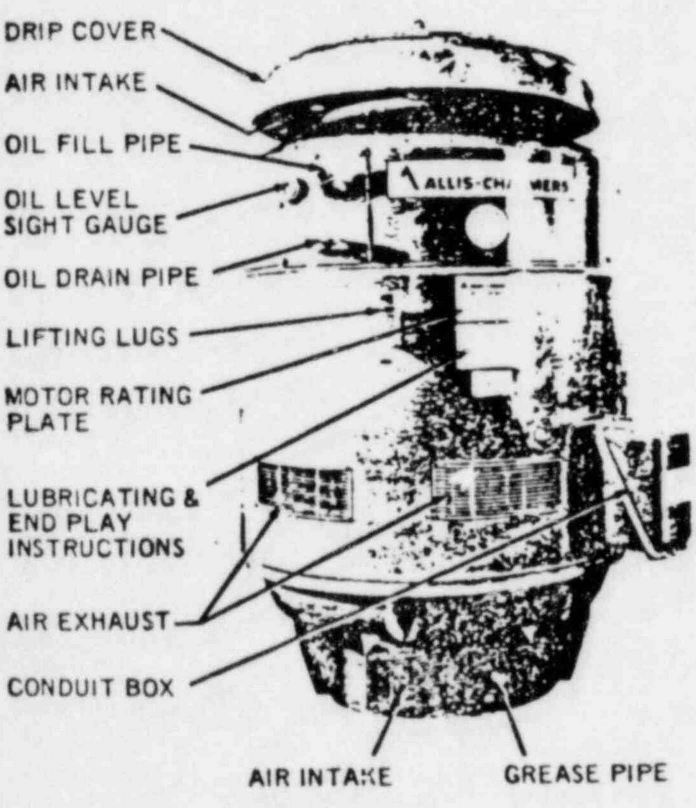


Figure 1.1 – HSO, 30 frame - oil lube top bearing, grease lube bottom bearing.

DESCRIPTION

"P" flanged, vertical type motors above NEMA frame 445TP are the subjects of this manual. The instructions include:

1. Normal thrust motors with grease lubricated deep-groove ball bearings capable of accepting small values of up and down thrust.

2. Medium thrust type motors in which angular contact thrust bearings are substituted for the deep-grooved bearings. Angular contact bearings are capable of taking higher down-thrust.

3. High thrust, oil lubricated bearings, hollow and solid shaft motors.

Values of thrust, *normal* and *high*, are published in the Allis-Chalmers price book. *Medium* thrust values are usually one-half of the *high* thrust values.

Many variations exist within these classifications. Check motor name plate for your particular type of construction.

Motor Type Designations

Motor type designation consists of a basic letter, or letters, indicating the general construction, to which are added other letter(s) denoting specific mechanical and electrical modifications.

GZZV	Basic type, TEFC - Explosion-proof, vertical motor.
HSHG	Hollow shaft, high thrust, open motor.
HSZ	Hollow shaft, high thrust, totally-enclosed, fan-cooled (TEFC).
RGVS	NEMA rerate general purpose, open type, vertical motor, with Super-Seal construction.

Some of the mechanical and electrical modifications are listed below.

AZ Tube type, totally-enclosed, fan cooled, (TEFC)

ZZ (TEFC), explosion-proof.

S *Super-Seal®* construction with *Silco-Flex®* or MiClad® (V.P.I.) insulation.

V Solid shaft vertical motors of normal, medium and high-thrust type with drip covers.

G Open Motor

HSO Hollow shaft, high thrust, vertical motor.

CAUTION

The information contained in this book is intended to assist operating personnel by providing information on the general characteristics of the purchased equipment. *It does not* relieve the user of the responsibility of using accepted engineering practices in the installation, operation and maintenance of this equipment.

LOCATION

Select a location for the unit that will:

1. Be clean, dry, well ventilated, properly drained, and provide accessibility for inspection, lubrication, and maintenance (see dimensions). Out-door installations may require protection from the elements.

2. Provide adequate space for motor removal without shifting the driven unit.

3. Permit the motor to safely deliver adequate power. Temperature rise of a standard motor is based on operation at an altitude not higher than 3,300 feet above sea level.

FOUNDATION

A foundation is required to support the unit to which the flanged motor attaches. Concrete (reinforced as necessary or required) makes the best foundation, particularly for large units. In sufficient mass, concrete provides rigid support that minimizes deflection and vibration. Location may be on: soil, structural steel, or building floors, provided the total weight (motor, driven unit, and foundation) – does not exceed the allowable bearing load of the support. Allowable bearing loads of structural steel and floors can be obtained from Engineering Handbooks; Building codes of local communities give the recommended bearing loads allowable for different types of soil.

NOTE: If normal vibration or noise will be objectionable (as in office buildings), it may be advisable to use vibration dampeners between the motor or driven unit, and the foundation.

MOTOR MOUNTING

Mount the machine securely and align accurately with the driven equipment.

1. Direct mounted to driven equipment: the two units must be firmly secured and the driven equipment placed on an adequate foundation.

2. Floor plate mounted: equipment must be very rigid and free from vibration.

Any excessive vibration of either method will cause loss of alignment, premature bearing wear and eventual break down.

NOTE: If motor is driving a pump and the back pressure is maintained after shut-down, protect the motor with quick-acting check valves.

FLANGE MOUNTING (Solid-Shaft Motors)

To mount round frame motor to driven unit, proceed as follows:

NOTE: Round frame motors can be rotated within flange mounting bolt spacing to gain a satisfactory position for grease fittings, conduit attachments, and mate run-out differences to avoid shimming flange fits. Conduit box can be turned to four equally spaced positions for access to conduit system; arrange the system so that water will not accumulate and drain into motor connection box.

1. Use a hoist; rig a sling around the lifting lug.

2. Position motor (per note above) and move toward driven unit – engaging cleaned flange surfaces.

3. Insert flange mounting bolts and snug.

4. Secure attachments between motor shaft and load (i.e. set screws tightened against shaft key).

5. Turn shaft by hand; check for free rotation; binding; scraping; sticking.

6. Tighten all flange bolts. (Avoid warping or springing the flange).

7. Turn shaft again to check for free rotation.

HOLLOW SHAFT - (Type HS Motors)

The motor should be set on its base first, and the driven shaft inserted through the hollow shaft. There are times, however, when these motors are lifted and lowered over the driven shaft. In either case, do not cause damage to the shaft by bending or scraping the threads. (Refer to hollow shaft nomenclature pg. 27, for term identification).

Proceed as follows:

1. Remove coupling cover and raise motor with sling and hoist.

2. Slowly lower motor; carefully engage stud(if used) and rabbet. (Position motor to allow access for power connection and lubrication.) Install flange nuts (bolts, if used) and snug.

3. Insert pump drive shaft into hollow motor shaft; arrange coupling and driven shaft in line with Gib Key Slot.

4. Insert Gib Key, connect driven shaft to coupling and adjust pump nut for proper impeller clearance. (Remove Locking Bar - if provided.)

5. Turn shaft by hand to check for free rotation and shaft alignment (pg. 7). There must be no binding, scraping, or sticking.

6. If used, check the operation of the non-reverse device; also check action of self-release coupling, if that type of coupling is used.

NOTE: A self-release coupling is shipped with three bolts holding it in place. These bolts must be removed to allow coupling to operate.

7. After alignment (pg. 7), uniformly and securely tighten all motor flange nuts (bolts).

8. Turn shaft by hand again; check for free rotation.

9. Replace coupling cover.

CAUTION

Vertical shaft motors with angular contact bearings, arranged either singular or in tandem, must not be subjected to continuous upthrust.

EXTERNAL WIRING

Starting and over-load control devices must be matched to motor rating. For safety or convenience they may need to be installed some distance from the motor. Follow the control manufacturer's instructions to make proper installations and connections.

Observe the following:

1. Connect electrical power supply to conform with National Electrical Code and any local regulations. Line voltage and wire capacity must match motor rating stamped on the name plate.

CAUTION

Check oil reservoir for proper oil grade and level before starting or storing machine.

---

2. With the driven equipment disconnected, (disconnect coupling and remove Gib Key on HS motors) momentarily energize the motor and check rotation.

3. Reverse rotation as follows: Three-phase motors, change any two of the three power leads. Two phase motors, inter-change stator power leads of either phase; be careful not to inter-change leads between phases.

CAUTION

If the direction of rotation of fan cooled motors is changed, it may be necessary to replace the fan or fans with one of opposite pitch.

Look for rotation plates usually mounted on fan housing or top housing of the motor.

Enclosed Motors. Two- and four-pole motor external fans are directional type and should be replaced. The internal fans of *two-pole* motors should be interchanged, end for end. The internal fans on *four-poles* are non-directional and need not be disturbed.

Open Motors. Some internal fans of *two-pole* motors, have directional fans. Check for rotation plates.

NOTE: It may be necessary to rebalance the rotor if the fans are changed.

VIBRATION

After flange mounting bolts have been tightened, check end play (pg. 18). Run the motor at minimum load and check vibration.

The standard vibration limits (NEMA-MGI-12.05) for an UNMOUNTED motor are:

SPEED (RPM)	MAXIMUM AMPLITUDE
3500 and above	.001 inches
1700 – 3499 incl.	.0015 inches
Less than 1700	.002 inches

If vibration is excessive, loosen flange mounting bolts and shift within mounting flange clearance. If this shifting does not reduce vibration to acceptable limit, and motor is coupled to load, check shaft alignment and system reed frequency.

SYSTEM FREQUENCY (Resonance)

To achieve reasonable vibration levels when a motor, pump, and support are operating together, the responsibility is with the system designer.

Calculation of the probable vibration characteristics of a system before construction begins can often reduce trouble by design, before it becomes a costly reality. The effect of most pump heads because of the access openings for coupling, bearing, and pump adjustments, will lower the system reed frequency.

Generally, the reed frequency of the motor alone mounted on an infinite mass is at least 25% above, or 15% or more below the motor operating speed. If the system reed frequency is at or near operating speed, a decision must be made to raise or lower the system reed frequency by altering the rigidity of the motor-support structure.

ALIGNMENT PROCEDURE (Solid Shaft)

The following checking procedure applies to a unit consisting of motor, coupling, and a driven component. Although applicable to most types of couplings, it is primarily intended for the rabbet-fit type. For other types, where the procedures differ, refer to the coupling manufacturer's Installation and Maintenance Instructions.

Check in one plane at a time and test for parallel or angular alignment with a dial indicator mounted as shown in Figure 2-1. Proceed as follows:

1. Set indicator dial to zero, at starting point.
2. Slowly turn BOTH coupling halves a complete turn.
3. Observe dial reading at 90° increments from starting point.
4. Acceptable parallel alignment occurs when the total indicator readings do not exceed 0.004 inch. Acceptable angular alignment occurs when the total indicator readings do not exceed 0.004 in./ft. radius to dial indicator.

Small excess misalignment may be corrected by inserting shims between flange faces. Such shims may also compensate for flanges being out of plane. (Fig. 2-3)

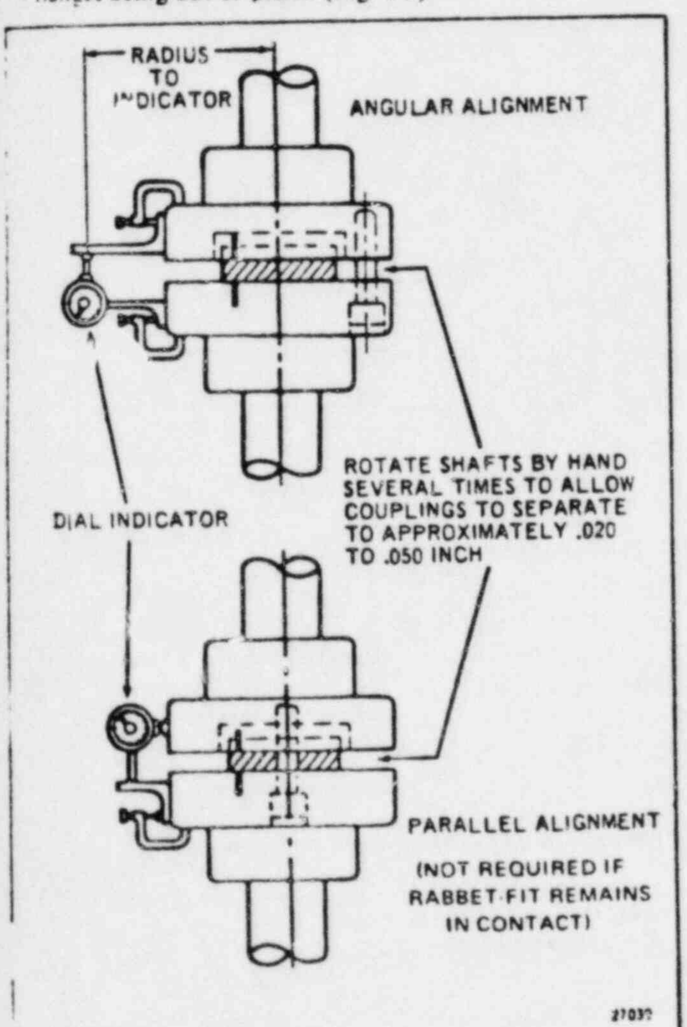


Figure 2-1 – Test allignment with dial indicator (solid coupling)

ALIGNMENT PROCEDURE (Hollow Shaft)

Hollow shaft motors require accurate alignment with respect to the motor shaft and the pump shaft. The pump shaft acts as a pendulum supported by the top coupling and motor bearing.

Align the unit as follows:

1. Clamp dial indicator to pump shaft, align with base-bolt plane and set dial indicator to zero (Fig. 2-2).

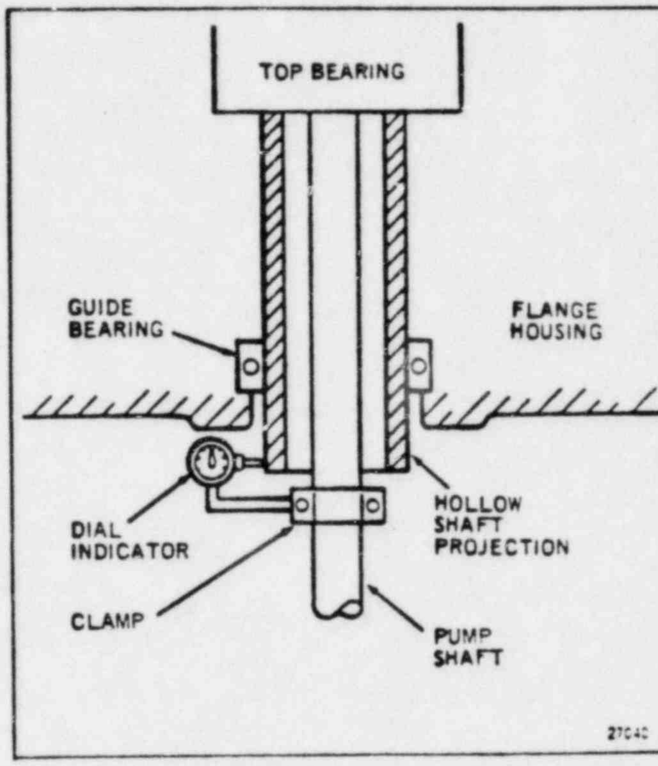


Figure 2-2 – Hollow-shaft alignment.

2. Remove top cover and rotate both motor and pump shafts.
3. Read dial indicator at 90° increments from starting point.
4. Acceptable allignment occurs when indicator readings do not exceed 0.0005 inches.
5. Shim flange faces if necessary (Fig 2-3)

When alignment and vibration of motor are within limits, engage drive. Run unit at minimum load and check for vibration - continue to increase load and checking vibration until full load is obtained.

CAUTION

Do not operate unit with excessive vibration. If shaft alignment is acceptable, and vibration exceeds the limit, investigate for other causes. See Trouble Chart.

SHIMMING TECHNIQUE

To avoid the possibility of twisting the flange when shimming between the flanges, minor shims should be one-half the thickness of the major shim. Shims should not penetrate deeper than the bolt hole circle and not be wider than twice the penetration distance. (Fig. 2-3)

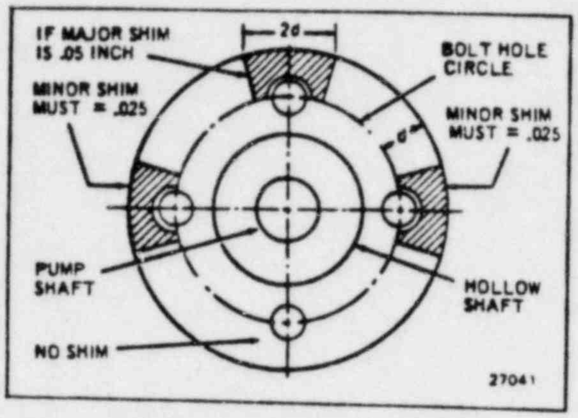


Figure 2-3 – Shimming flange face.

GROUTING

Grout compensates for unevenness in the foundation and base, distributes the weight of the unit uniformly over the foundation, and prevents the unit from shifting after mounting and alignment. The unit must be expertly grouted by use of non-shrinking grout. The mix required varies with the type of unit to be grouted, location and amount of grout. The instructions included with the non-shrinking grout package will provide the required information for the proper mix for individual applications.

Grout the unit as follows:

1. Build a form of plywood or thin planking around the foundation to contain the grout. Support the planking to prevent deformation.

2. Soak the top of the concrete pad thoroughly with water before grouting. Remove all surface water before pouring.

A recommended mix of grout that is satisfactory for applications is as follows:

> **Dry Mix.** One sack Portland Cement. Two parts well graded, clean, dry sand. One-pound bag grout additive.

This additive is one way to counteract the plastic shrinkage and settlement of a cement-sand mix.

To make grout additive, add 2 grams of unpolished aluminum powder (Merck Co. No. 0770, or equivalent available at local pharmacists) to 1 lb. of clean dry flint sand (50 mesh screen passing 25% preferred). Mix thoroughly and seal in a plastic bag. Keep additive dry until ready for use.

NOTE: The effect of the aluminum powder is lost if the mix is allowed to stand, uncast, for 45 minutes after adding water to the dry mix.

3. Pour the grout through the openings in the base. While pouring, tamp liberally to fill all cavities and prevent air pockets. The grout thickness under the base must be a minimum of 1 inch. To prevent the base from shifting, fill under the base-plate at least 4 inches in from all four edges. Prevent grout from interfering with motor or driven unit mounting bolts, to allow shifting of bolts as necessary.

NOTE: If pouring and tamping the grout will trap air in some places, temporarily place small diameter tubes (thick-walled rubber hose) to provide venting. Remove the tubes after grout has filled the cavity, and pour the remainder.

4. After the grout has thoroughly hardened retighten foundation bolts and check alignment.

Approximately fourteen days after the grout has been poured or when the grout has thoroughly dried, apply an oil base paint to the exposed edges of the grout to prevent air and moisture from contacting the grout.

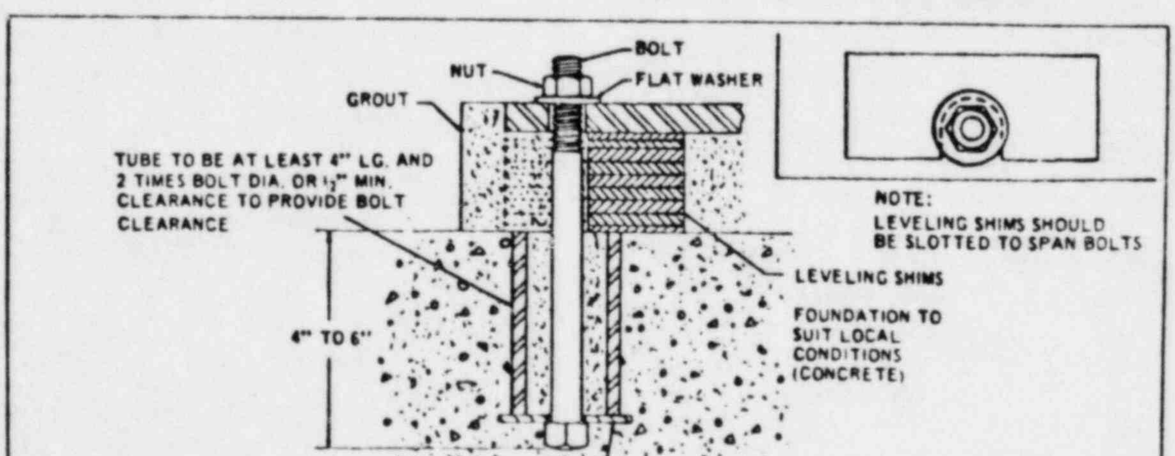


Figure 2-4 – Typical base mounting.

TESTS BEFORE OPERATION

INSULATION RESISTANCE

Check insulation resistance prior to connecting motor to power supply. A hand cranked megger, not over 500 volts d.c. is usually used (see Maintenance).

DIELECTRIC TESTS

All motors receive a factory dielectric test in accordance with ASA and IEEE standards.

CAUTION

Additional dielectric testing can be detrimental to the insulation system.

If a dielectric test is made on an old or repaired winding, to evaluate service reliability, the test voltage applied may vary from the rated terminal voltage to some higher value. The factory should be consulted when establishing the test voltage and procedure for testing old or repaired equipment.

WINDING RESISTANCE (Temperature)

The change in resistance of a winding provides an accurate measure of the average temperature of a winding, and is generally used to determine the temperature of the stator windings. The measurements must be made carefully with instruments known to be accurate, and preferably with the same instruments for both hot and cold measurements.

NOTE: Instruments that operate on the principle of the unbalanced Wheatstone Bridge or the Kelvin Bridge are preferred. (See "Temperature Measuring Devices" - IEEE Publication No. 119; formerly AIEE Pub. 551).

The cold resistance, or the resistance at normal room temperature, must be measured after the machine has been idle for some time, usually before starting, or cold resistance value may be obtained from the factory. The cold temperature of the coils should be measured, because coil temperature may not be the same as the surrounding air.

The average temperature of the winding is obtained by taking resistance measurements, at the motor load terminals and using the following equation:

$$T = \frac{R}{r}(234.5 + t) - 234.5$$

where
- T = hot temperature in degrees C
- R = hot resistance
- r = cold resistance at temperature t
- t = cold temperature of winding in degrees C

As an example, assume the cold resistance is 0.50 ohms at 25C, and the hot resistance (taken immediately after motor is de-energized, and has stopped rotating) is 0.61 ohms. Then:

$$T = \frac{0.61}{0.50}(234.5 + 25) - 234.5$$

$$T = 82C$$

The temperatures measured by imbedded detectors or by the change in resistance are generally higher than thermometer measurements and are closer to the true hottest spot temperature in the machine. For this reason, the Standards permit higher observable temperatures when measurements are taken in this manner.

MOTOR OPERATION

WARNING

Do not operate equipment in excess of the values given on nameplate or contrary to the instructions contained in this manual.

The equipment (or a prototype) has been shop tested and found satisfactory for the conditions for which it was sold, but operating in excess of these conditions can cause stresses beyond design limitations.

Failure to heed this warning may result in equipment damage and possible personal injury.

INITIAL START

After installation is completed, but before motor is put in regular service, make an initial start as follows:

Check connections of motor, starting, and control devices; connections must agree with wiring diagrams.

Check voltage, phase, and frequency of line circuit; power supply must agree with motor nameplate.

If motor has been in storage, either before or after installation, refer to storage instructions to prepare for service.

Check motor service record and tags accompanying motor to be certain bearings have been properly lubricated. (When shipped from the factory, ball bearings have been grease lubricated to give 6 months satisfactory service.)

Oil lubricated bearings are shipped without oil, reservoirs must be filled. (see Maintenance)

If possible, remove external load (disconnect drive) and turn shaft by hand to insure free rotation. This may have been done during installation procedure; if so, and conditions have not changed since, this check may not be necessary.

Start motor at minimum load long enough to check rotation and to be certain that no unusual condition exists. Listen and feel for excessive noise, vibration, clicking, or pounding. If present, de-energize motor immediately. Carefully observe for unusual conditions as motor coasts to a stop. Investigate the cause and correct before putting motor in service.

CAUTION

Repeated trial starts can overheat the motor. Starting currents are several times running current; heating varies as the SQUARE of the current. Allow time between starts so that windings cool.

When checks are satisfactory, operate motor at minimum load and look for any unusual condition. Increase load slowly to maximum, checking unit for satisfactory operation.

NORMAL OPERATION

Start the motor in accordance with standard instructions for the starting equipment used. Sometimes the load should be reduced to the minimum, particularly for reduced voltage [illegible] and/or high inertia connected loads.

Operating Temperatures

All Allis-Chalmers electrical machines will operate in accordance with the rating and temperature rise stamped on the nameplate unless the machine has been damaged or the ventilation impaired. Temperature rise is best measured by resistance. Measure the full load operating temperature by the resistance method discussed previously.

The temperature rise at the rated load is determined mainly by the design of the machine. However, any accumulation of foreign material in the vent ducts and on the coils will decrease the air flow through the machine and the rate of heat transfer from the machine to the ventilating air. Both of these effects will increase the temperature rise above the normal value. The rarified air at altitudes greater than 3300 feet has somewhat the same effect, and excessive temperature rises at normal load are possible unless this factor has been considered during the design of the machine.

Overload is the usual cause of excessive temperature rise. Operating currents should not continuously exceed the full load values unless the rating of the machine provides for such operation. Voltage and frequency other than normal, also will affect the temperature rise.

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:

1. If the variation in voltage does not exceed 10% above or below normal, with all phases balanced.
2. If the variation in frequency does not exceed 5% above or below normal.
3. If the sum of the voltage and frequency variations does not exceed 10% above or below normal (provided the frequency variation does not exceed 5%).

The curves below show the approximate effects of variations in voltage and frequency on motor characteristics. These values should in no way be considered as guarantees. DATA SHOWS GENERAL EFFECTS; IT WILL VARY FOR A SPECIFIC MOTOR.

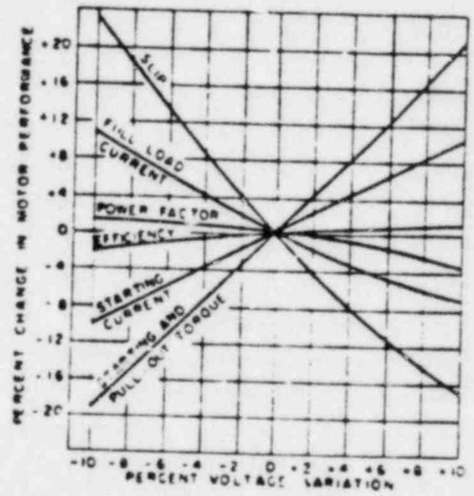


Figure 3-1 – Effect when voltage varies.

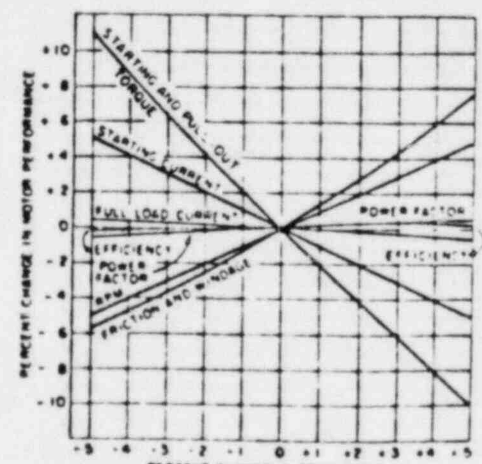


Figure 3-2 – Effect when frequency varies.

TROUBLE SHOOTING

Between regular maintenance inspections, be alert for signs of motor trouble. Common symptoms are listed in the following table. Correct any trouble immediately and AVOID COSTLY REPAIR AND SHUT DOWN.

TROUBLE CHART

TROUBLE	POSSIBLE CAUSES	CORRECTION
Motor won't start.	Usually line trouble – single-phasing at starter.	Check source of power supply. DON'T check with motor energized! Check over loads, controls and fuses. Check voltage, compare with name plate rating.
	Improper connection.	Check connections with diagram
	Load too heavy.	Disconnect motor from load to see if it starts without load. Reduce load – or replace motor with unit of greater capacity.
Excessive hum.	High voltage.	Check input voltage, and for proper connections.
	Unbalanced rotor.	Balance with weight attached by cap screw and lock washer.
	Excessive wear of sleeve bearings. (uneven air gap)	Replace bearings before rotor rubs stator. Check alignment and lubrication.
Regular clicking.	Foreign matter in air gap.	Take out rotor; clean air gap.
Rapid knocking.	Bad bearing; dirt in lubricant.	Replace bearing; clean wells and renew lubricant.
Vibration	1. Misalignment	Realign units.
	2. Accumulation of dirt on fan.	Clean Motor.
	3. System natural frequency(resonance).	Alter rigidity of base structure.
	4. Vibration in driven machine.	Run motor disconnected for check. Eliminate source in machine, if possible.
	5. Twisted Base or flange.	Check flange alignment and shims.
	6. Excessive end-play.	Adjust end play.
	7. Shaft bent or flange face run out.	Straighten or replace shaft: Peen and turn flange face-or-replace housing.
Vibration – *following motor repair.*	Rotor out of balance; from holes drilled, balance weights or fans shifted on new rotor.	Balance rotor. (Remove motor from installation, if necessary.)
Motor over-heating. (Check with thermometer, thermocouple; or by resistance don't depend on hand).	Overload.	Measure load; compare with name-plate rating; check for excessive friction in motor, drive or machine. Reduce load, or replace motor with unit of greater capacity.
	Single phase.	Check current all phases.
	Dirt in motor.	Check flow of air – or ventilating tubes.
		Blow out motor and ventilating tubes. Use solvent on wound section if necessary – use "ram rod" in tubes of tube-type motors.

TROUBLE CHART

TROUBLE	POSSIBLE CAUSES	CORRECTION
Motor over-heating. (Check with thermometer, thermocouple, or by resistance don't depend on hand). Continued.	Unbalanced voltage.	Check voltage, all phases.
	Rotor rubbing on stator.	Clean air gap – Check alignment. Replace bearings, if necessary.
	Open stator windings.	Disconnect motor from load. Check idle amps for balance in all three phases. Check stator resistance in all three phases for balance.
	Over voltage/under voltage.	Check voltage and compare to rating plate.
	Ground.	Locate with test lamp or megger and repair.
	Improper connections.	Recheck connections.
Fine dust under coupling using rubber buffers or pins.	Misalignment.	Realign unit.
Bearing over-heating.	Misalignment.	Realign unit. (check mounting and flange alignment.)
	Insufficient end play.	Adjust end play.
	Excessive end thrust.	Reduce thrust from drive or machine. Recheck mounting and alignment.
	Too much grease (ball or roller bearing).	Relieve supply; (open grease drain, operate unit one (1) hour.)
	Oil level too high or low.	Add or reduce as indicated on sight gauge.
Oil leakage or excessive oil usage.	Excessive pressure or vacuum in bearing cavity.	
	1. Heat exchange tubes blocked. (Enclosed Motor)	Clean tubes.
	2. Oil Stand-Pipe Eccentric or out of round.	Straighten or replace pipe and reseal fits.
	3. Parts not sealed properly.	Seal parts: Drains: condensate and/or breather vent. Conduit boxes (auxiliary and motor leads) Partings; joints and oil guards.
	4. Loose heat exchange tubes. (Enclosed Motor)	Roll tubes expanding tube inside diameters using proper expansion tool.
Excessive oil foaming.	Improper Oil used. High Oil Level Moisture in oil.	Use non-foaming oil. Correct oil level as indicated on sight gauge. Clean and replace oil.

GENERAL

Routine, regular maintenance is the best assurance of trouble-free, long-life operation. It prevents costly shutdown and repairs. Two major elements of a controlled maintenance program are:

Trained personnel who KNOW the work.

Systematic records, containing at least the following.

Complete nameplate data (Service Record).

Prints (Wiring diagrams, certified outline, sectional view).

Parts list (see rear of this section).

Stock of essential parts.

List of spare units in storage.

Alignment data (departures from perfect alignment, allowance for high temperature).

Results of regular inspection (Service Record).

Repairs (Service Record).

Lubrication data:

Method of application

Types of grease for wet, dry, hot or adverse locations.

Stock of lubricants.

Maintenance cycle by locations (Some require more frequent lubrication).

Record for each unit (Service Record).

PREVENTIVE MAINTENANCE

Several of the more important items of good maintenance are discussed in the following paragraphs. Others should be added when adverse or unusual conditions exist.

Inspection. Each machine should be inspected at regular intervals. The frequency and thoroughness will depend on the amount of operation, nature of service, and the environment. Inspect for:

CLEANLINESS. The exterior should be kept free of oil, dust, dirt, water, and chemicals. For a fan-cooled machine it is particularly important to keep the air openings free of foreign material. Do not block air outlet.

MOISTURE. On non-explosion proof TEFC motors, a removable plug permits removal of any accumulated moisture. Drain regularly.

NOTE: If equipment is operated intermittently in very damp locations, it should be protected by space heaters. To retard corrosion, grease all machined fits when the unit is reassembled after a maintenance check.

LOADING. Guard against improper loading. Overloading causes overheating and overheating will shorten insulation life. A winding subjected to a 10° temperature rise above the maximum limit for its class will have its insulation life reduced.

While somewhat less serious, underloading a motor is improper. It does lower the power factor which results in higher power cost. Any motor consistently under loaded should be replaced by one of lower power rating.

The amount of work a motor can safely produce is not easy to measure. A rule of thumb for most cases would be: If the input terminal voltage agrees with the rating plate, the amps are equal to, or *less* than, the rating plate value; and the speed (R.P.M.) is equal to, or *more* than rating plate specification, then the motor is not overloaded and is probably developing its rated horsepower.

DUTY is also part of the H.P. relationship. Motors have a time requirement, which is specified as duty at a given ambient temperature and, horsepower being work, produces heat. This "work-heat" added to the ambient heat, then becomes the environment temperature of the motor. Duty is therefore expressed in time at a given starting temperature.

NOTE: Duty and the ambient temperature cannot be exceeded without exposing the motor to the hazards of overheating. If the starting temperature (ambient) is greater than the rating plate specification the motor output H.P. should be reduced to compensate; refer to the factory for instructions if this problem occurs.

TEMPERATURE. Electrical apparatus operating under normal conditions becomes quite warm. Although some places may feel hot to the touch the unit will be within guaranteed limits, if it is operating within rating plate limits and ventilation is not restricted. Check temperature with a recording device, thermometer, thermocouple or by resistance.

The Total Temperature – not the temperature rise, is the measure of safe operation. Investigate the operating conditions if the *Total Temperature* measured exceeds:

194° F (90° C)	Class "A" insulation
230° F (119° C)	Class "B" insulation
275° F (135° C)	Class "F" insulation
302° F (150° C)	Class "H" insulation

LOW INSULATION RESISTANCE (see Corrective Maintenance.)

CORRECTIVE MAINTENANCE

Two factors that usually cause corrective maintenance are electrical failure or mechanical failure. The first sign of electrical failure is usually indicated by low insulation resistance. Mechanical failures are usually preceded by excessive bearing noise, heat, and/or vibration.

Vibration

Most problems can be detected when inspected visually. Often, more important than the actual vibration itself, is the *change of vibration* over a period of time.

Check for:

Loose or missing parts, such as - fan blades, nuts, bolts, screws, couplings, etc.

Accumulation of dirt on fan or rotor.

Foundation construction – Base, grouting and associated equipment supporting drives. Vibration can be amplified by weak construction.

Associated equipment – Disconnect equipment to determine where the vibration is being generated.

History – When was vibration first noted? Was there a change in loading and/or duty of equipment? Has ambient vibration changed?

Low Insulation Resistance

Factors that usually cause low insulation readings are:

1. Dirty windings (oil, dust, grease, salt, etc.).
2. Excessive moisture.
3. Mechanically damaged insulation.
4. Heat deterioration

Factors three and four require extensive repairs by a Certified Service Center. Dirty windings can be cleaned and moisture laden windings can be dried.

Cleaning

Clean the motor, inside and outside, regularly. Actual conditions existing around the motor dictate the frequency of cleaning operations. Use the following procedures as they apply:

Wipe off – dust, dirt, oil, water, etc. from external surfaces of the machine. These materials can work into, or be carried into, the windings, or coat the heat radiating surfaces and cause overheating or insulation breakdown.

Remove dirt, dust, other debris from ventilating air inlet. Do not permit such matter to accumulate near the inlet. Do not operate motor with air outlet blocked, or restricted. Clean open motors internally by blowing with clean, dry compressed air at 40 to 60 psi. If conditions warrant, use a vacuum cleaner.

When dirt and dust are solidly packed, or windings are coated with oil or greasy grime, disassemble the motor and clean with solvent. Use only high-flash naptha, mineral spirits, or Stoddard solvent. Wipe with solvent dampened cloth, or use suitable soft bristle brush. DO NOT SOAK. Oven dry (150 ° F) solvent-cleaned windings thoroughly before reassembly.

Windings of *SUPER-SEAL* (GVS or RGVS) motors may be rinsed or sprayed with solvent, and immediately wiped dry with a cloth. These windings may be cleaned with water and a fugitive detergent (ammonium oleate), or common household detergents. Rinse with clean, clear water to remove all detergent. Hot water or low-pressure steam may be used. Wipe excess water from metal surfaces and oven dry at 200 ° F.

After cleaning and drying windings, always check the insulation resistance.

WARNING

EXPLOSION-PROOF MOTORS:
These motors are constructed to comply with the U/L Label Service Procedure Manual. When reassembling a motor that has the Underwriters' label, it is imperative that the unit is reinspected and:

1. The original fits and tolerances are maintained.
2. All plugs and hardware are securely fastened.
3. Any part replacements are accurate duplicates of the original.

To violate any of the above will invalidate the significance of this label.

Insulation Resistance

Check and record insulation resistance regularly. Usually, the best time to check insulation resistance is during normal shut-down periods.

A hand cranked megger, not over 500 volts, is the most convenient and safest device to use.

CAUTION

Semi-conductors, small transformers, voltage regulators and other devices that may be injured by the high voltage, must not be in the circuit.

The standards of the Institute of Electrical and Electronic Engineers (IEEE) No. 43 * is an excellent reference for the testing of insulation resistance. Very briefly, the publication recommends that stator winding insulation resistance, (at ... C) measured with 500 volts d.c. – after one minute, should not be less than;

$$\frac{\text{Rated Voltage} + 1000}{1000} = \text{Resistance in Megohms}$$

This formula is satisfactory for most checks.

*Allis-Chalmers reprint of publication 43 is 05R7728.

DRYING INSULATION

If the megger reading is less than satisfactory, and the cause is excessive moisture in the windings: dry the windings by applying heat from:

1. A warm air oven.
2. Electric strip heaters.
3. Circulating currents through the coils.

The heat should be applied slowly so the desired temperature will not be obtained before six hours.

TABLE 4-1

INSULATION DRYING TEMPERATURES*			
CLASS "A"	CLASS "B"	CLASS "F"	CLASS "H"
167° F 75° C	200° F 94° C	245° F 118° C	275° F 135° C

*Class "F" and "H" Insulated Units should be baked at 70% specified temperature (to avoid steam inside winding) for about six hours, before temperature is raised to drying temperature.

Insulation resistance should be measured before the heat is applied, and every six to eight hours thereafter.

NOTE: Insulation resistance will decrease as the machine warms up; but will begin to increase shortly as the dryout continues.

A uniform temperature must be maintained in the machine to obtain constant resistance readings. When the megger readings reach a constant value, the drying out process is complete and may be discontinued. If readings are not satisfactory (high enough), check for other causes.

Warm Air Oven Drying

1. Remove bearing housings.
2. Remove rotor.

Bake in oven at temperatures specified in Table 4-1 and follow procedures described for drying insulation.

CAUTION

Temperatures must be carefully controlled. Avoid hot spots. Avoid radiant type heat because some parts may become scorched before remote parts reach desired temperature.

Strip Heat Drying

1. Remove bearing housings.
2. Remove rotor.
3. Direct a fan on stator to carry away the moisture.
4. Attach temperature indicators to winding and apply heat as specified in Table 4-1. Follow procedures described for drying insulation.

Circulating Current Drying

1. Remove bearing housings.
2. CENTER the rotor in the stator core.
3. WEDGE fiber strips into the lower part of the air gap, so that rotor is not touching stator.
4. Direct fan on unit to blow away excessive moisture.
5. Attach temperature indicators to windings and follow the procedures prescribed for drying insulation. Do not exceed the drying temperatures in table 4-1.

CAUTION

Insulation resistance will decrease as the machine warms up; but will begin to increase as the drying process continues. Use oven drying method if megohm reading is less than 25% of value determined by the resistance - megohm formula

6. Apply a controlled current of the same number of phases, and the same, or less than rated frequency to the windings. The voltage used should not be more than 10% of normal, nor should it cause more than 60% of normal full load current to pass through the windings.

When the insulation resistance has reached one-half of the minimum value determined by the formula, a voltage of 15% of normal may be applied.

NOTE: For more detailed information about insulation maintenance, see factory instructions 05X7391.

BEARINGS

Long life of bearings is assured only by maintaining proper alignment, and good lubrication at all times. Some factors that can cause excessive bearing noise and heat are:

1. Incorrect alignment of couplings.
2. Excessive, or wrong direction of thrust.
3. Improper lubrication.

BEARING LUBRICANTS – Grease: Prior to shipment, motor bearings are lubricated with the proper amount and grade of grease to provide six months of satisfactory service under normal operation and conditions. It is good practice, however, to check bearings of newly installed motors for proper lubrication.

For best results, grease should be compounded from a lithium soap base and a good grade of petroleum oil and stabilized against oxidation.

Grease should "Channel" under all operating conditions and should not be "Soft" (high penetration) or whip into a liquid during operation.

It should be of No. 2 consistency for double-shielded, No. 3 consistency for open or single-shielded bearings. Operating temperature range should be from – 15° to + 250 ° F for Class "B" insulation, and to + 300° F for Class "F" and "H". Most leading oil companies have special bearing greases that are satisfactory.

For specific recommendations, consult the factory.

BEARING LUBRICANTS – Oil: Motors with oil-lubricated bearings are shipped without oil. A rust inhibiting film protects the bearing surfaces during shipment. Before attempting to operate or store a motor with oil-lubricated bearings, fill oil reservoirs as follows:

1. Use an oxidation inhibited, non-foaming turbine oil having a pour point of about 20 ° F.
2. Viscosity, *at operating temperature* should be:

SSU	BEARING TYPE
70 – 100	Ball Bearings
150 – 200	Spherical Roller Thrust
150 – 200	Kingsbury Thrust

Oil Lubrication. (See Nameplate 51-674-230 or 51-436-840 on motor.) *Before starting the motor,* fill the bearing chamber to the center of the oil gauge. Always fill through the fill pipe or plug at the side of the motor. Do not overfill, as the oil may then escape along the shaft and enter the motor. Oil should be replaced whenever it shows signs of contamination. Oil must be free from grit and other injurious substances; if protected adequately against contamination, good oil will remain usable for many years.

Always correct oil or water leaks and replace evaporated lubricant promptly.

CAUTION

Oil level will rise above center of gauge while unit is running. Avoid adding lubricant to bearings while running.

Grease Lubrication

The frequency of relubricating bearings and the amount added each time, depends on two factors – speed and service. As a guide the following is recommended.

SPEED (RPM)	RELUBRICATING FREQUENCY*
3600	6 Months (4,000 Hours)
1800 or Less	12 Months (8,000 Hours)

*Operating environment may dictate more frequent lubrication.

NOTE: A serious mistake is daily lubrication of bearings. As well as being wrong, it is a dangerous practice, particularly when grease is added without removing the drain plug. The excess grease must go somewhere and usually it is forced into and through the inner bearing cap and is then thrown into the windings. Proper lubrication is desired, but some under-lubrication is less dangerous than over-lubrication.

Relubricate bearings with the proper grade of grease as follows:

1. Stop the motor and lock out the switch.
2. Thoroughly clean off and remove grease inlet plug, drain pipe and plug from the outer bearing caps.

NOTE: Drain pipes do not always permit satisfactory escape for displaced grease. It is a good practice to remove drain pipes, if practical, and visually check the drain outlet for grease. Use a wire to remove caked grease.

3. Add grease to inlet with hand gun until small amount of new grease is forced out drain. Catch used grease in suitable container.
4. Remove excess grease from parts and replace inlet plug.
5. Replace cleaned drain pipe and run unit at least one hour to expel any excess grease.
6. Replace drain plug.
7. Put unit back in operation.

NOTE: Avoid adding lubricant grease to bearings while unit is running.

If it is mandatory to add grease while the unit is running, the correct amount of grease must be predetermined. The object is to avoid overgreasing. Since a bearing acts as a pump when running, the initial measurements must be made with the unit at a stand still. Take measurements as follows:

1. Stop the unit, lock out the switch, remove inlet pipe plug and outlet drain, as previously described.

2. Add small, *measured amounts* of grease to inlet until it is evident that new grease is entering the drain opening.

3. Insert the inlet pipe plug, run the unit one hour to expel excessive grease.

4. Replace clean drain pipe and plug.

Subsequent regreasings with the unit running, the grease added should be not more than 2/3 the amount needed to make the grease come out the drain when the unit was stationary.

BEARING REPLACEMENT

Replacement bearings may be of a different manufacturer; but must be equal to the originals used in the motor. When ordering bearings specify as follows:

1. Identifying numerals and manufacturer stamp on the bearing (number is also on motor name plate).

2. Bearing Tolerance Class, *i.e.* (A.B.E.C.-1) Annular Bearing Engineers' Committee – Tolerance Class One.

3. Electric motor quality.

4. If deep groove bearings, specify the internal radial clearance, *i.e.* (A.F.B.M.A.-3) Anti-Friction Bearing Manufacturers Association, Clearance Class Three.

CAUTION

Never use A.F.B.M.A.-O bearings on **enclosed** motors with Class "F" or "H" insulation.

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5. Angular contact type bearing replacements must be equivalent in angle of contact. Following is an interchangeability table.

MRC	SKF	New Departure	Fafnir
7300 P	7300 G	30300	7300 PW
7300 P DB	7300 G	30300 DB	7300 PW DB
7300 P DT	7300 G	30300 DT	7300 PW DT

Note: For 3600 rpm motors using bearing sizes 7312 and larger, it is most desirable to use bearings with machined bronze retainers.

DUPLEX BEARINGS

External thrust transmitted from the driven unit is normally carried by the top bearing, or bearings. If replacement is necessary, the new bearing must be the same type as the original. Duplex bearings must be the proper type and mounted in the identical manner.

When thrust loading is in both directions, these bearings are mounted back-to-back (see Figure 4-1), rather than face-to-face because of simplicity of mounting and angular rigidity. For high down thrust loads, these bearings will be mounted in tandem.

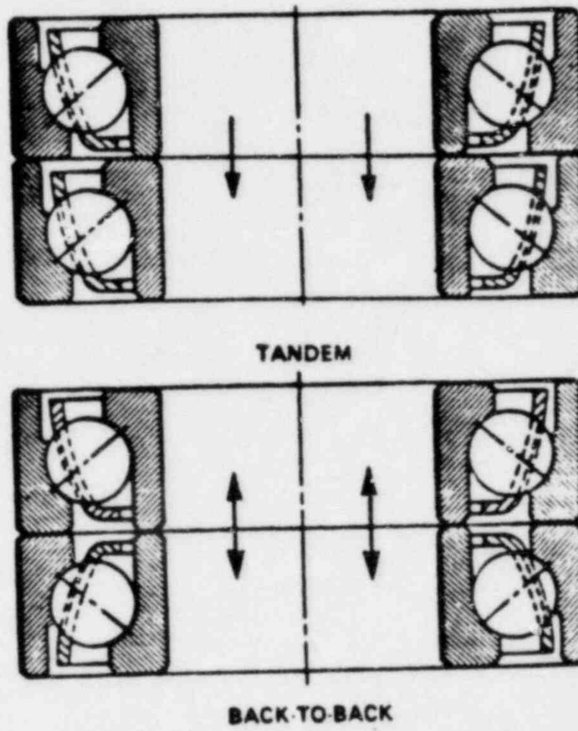

Figure 4-1 – Types of mounting for angular contact ball bearings.

To Replace Bearings:

1. Remove bolts holding bearing housings to yoke.

2. Remove bolts holding end caps to housings.

3. Remove end housings. Observe location of bearing shims, and remove shims if necessary.

4. Remove snap ring or locknut in front of bearing.

5. Use bearing puller and exert force only on inner race to remove bearing from shaft.

NOTE: Protect the shaft end with a cap (Figure 4-2).

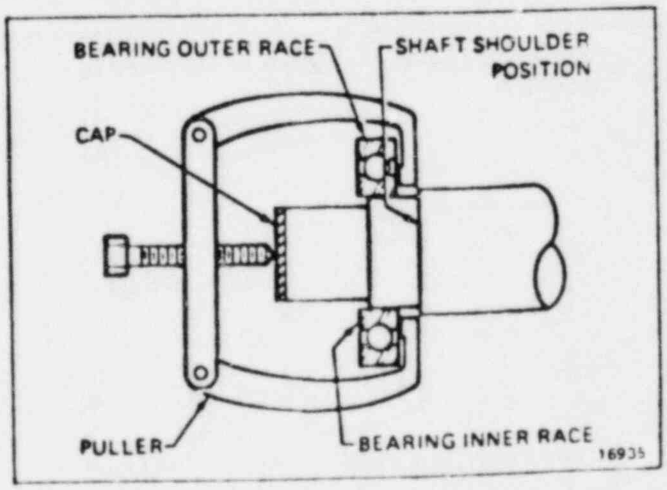

Figure 4-2 – Removing Bearings with a Puller.

6. Che. . shaft diameter for proper size with micrometer. Clean or replace inner bearing cap, and slide cap onto shaft.

7. Heat the new bearing in an oven (200 ° F). While hot, slide the bearing onto shaft (high thrust motors using angular contact bearings have a slip-fit on shaft and need not be heated). Make certain the inner race makes a firm even contact with shaft shoulder.

NOTE: Do not subject bearing to impact.

8. Let bearing cool – pack bearing caps per table (4-2) with proper grade of grease. Pack all open bearings full between balls or rollers, but remove excess grease from the outside of the retainers. Full packing of a cap or bearing housing cavity should be done with a grease gun.

GREASE REPACKING TABLE 4-2

Type of Bearing	Operating Position	Front or Top		Rear or Bottom	
		Outer Cap	Inner Cap	Inner Cap	Outer Cap
Open Deep Groove	Vertical	2/3 Full	1/3 Full	2/3 Full	Full
Angular Contact	Vertical	2/3 Full	1/3 Full	2/3 Full	Full

Check Bearing Installation. Before reassembling the top end cap after installing new bearings, check the top edges of the inner and outer races, with a dial indicator, for squareness of mounting. To assure quiet operation and good bearing life, total indicator reading in each case must be within 0.001 in.

8a *Indicate the outer race,* attach the indicator body to the shaft, allow the button to bear on the outer race, and then rotate the shaft slowly by hand.

8b *Indicate the inner race,* attach the indicator body to the bearing bracket, allow the button to bear on the top edge of the inner race, and then rotate the shaft slowly by hand.

9. Re install bearing shims, reassemble end caps and end housings.

END PLAY

Motors designed for applications involving primarily continuous heavy downthrust but having momentary values of upthrust are equipped with angular contact bearings that are *not* preloaded. The end play is limited to .003 to .008 in. (.010 to .015 in. for spherical roller bearings). The bottom bearing takes the momentary upthrust and prevents reverse loading of the top bearings.

End play is limited by means of shimming. Depending upon construction, the shims are located either between the bearing and the inside cap, or between the inside of the housing hub and the bottom inside end cap. On other models the end play is limited by tightening the locknut on the shaft above the bearing mounting sleeve. See (Fig 4-3) and Nameplate 51-436-840 on motor.

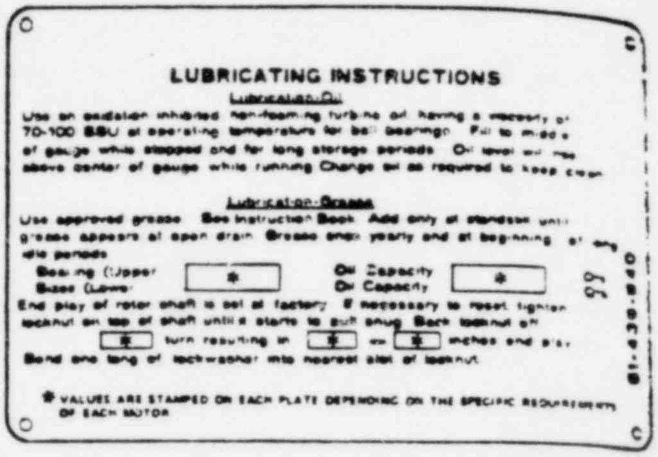

Figure 4-3 – Lubrication & End Play Instruction Plate

"KINGSBURY" BEARINGS

Thrust Bearing. Principal elements of a "Kingsbury" thrust bearing are the rotating runner and the stationary pivotal shoes (see Fig. 4-4). The runner receives the load, usually through a massive nut or hub called a "Thrust Block." This runner, made of cast iron or steel, has a highly polished and lapped surface. The pivotal thrust shoes are faced with tin-hard babbitt, machined, then scraped to form an accurate surface plate.

During operation, the thrust bearing revolves in an oil bath, which covers the bearing. Each shoe, being free to tilt slightly in any direction, sets itself by pivoting at a minute angle, thereby causing a wedge-shaped film of oil to form between the shoe and the runner. An end play of .013 is preset at the factory by the machining or shimming of the guide bearing baffle ring. (Fig 4-4)

Guide Bearings: Designed to center the rotor with respect to the stator, these bearings are normally made in two sections to simplify assembly or disassembly.

The upper guide bearing, located just above the thrust runner, bears on a ground and polished surface of the shaft sleeve. The lower guide bearing rides on another polished shaft sleeve.

The thrust bearing, baffle ring, and two-thirds of both guide bearings are immersed in oil. The remaining third receives lubricant through the helical grooves that are cut into both guide bearing surfaces.

Oil Operating Temperature. The normal temperature of the oil should be about 50° to 65° C. The maximum safe temperature for most bearings is 85 ° C *AT THE BABBITT.*

NOTE: Bearing temperature should not be judged by feeling the bearing with the hand; temperature should be measured by a thermometer or thermocouple placed as close to the babbitt as possible.

Thrust bearing is cooled by water passing through the heat exchanging copper tubes in the bearing oil bath. The rate of water flow is dependent on water temperature, volume of oil, and the total friction losses (load) of the bearing. Supply the necessary amount of water required to cool the bearing.

To test the tubing for water-tightness – empty the oil reservoir, and if possible raise water pressure 50% above normal. Another way – leave oil in reservoir; pressurize tubes with air and look for bubbles.

hot bearing is discovered, or if the oil temperature climbs abnormally fast, the cause must be found and corrected immediately. The most common causes of hot bearings, in the order of probability, follow:

1. Stoppage or reduction of cooling water.

2. Lack of oil (low oil level).

3. Contaminated (dirty) oil.

4. Misalignment (couplings or bearings).

5. Plugged oil passages.

6. Rough spots on shaft or bushings.

7. Improper internal clearances.

INSTALLATION OR INSPECTION OF "KINGSBURY" THRUST BEARINGS

Rotor Removal

1. Drain oil. Unbolt and lift off bearing cover plate.

2. Remove housing bolts and lift rotor from stator by slinging under thrust bearing housing; use the openings provided in the housing.

Thrust Bearing Removal

1. Unbolt and lift off drip cover and cap.

2. Unbolt thrust block collar and remove two-piece split guide bearing.

3. Unbolt bearing mounting sleeve from shaft and lift out sleeve.

4. Lift bearing from pot by grasping or hooking to outside diameter of runner.

Cleaning. All parts of the bearing and housings must be thoroughly cleaned before assembly.

Remove anti-rust coatings with an approved solvent. Use non-linting rags or cloths for cleaning. Remove all burrs, bruises or nicks, and rust from bearing surfaces. Bruises or dents on shoe faces should be removed with a scraper.

Slight rusting of the runner face may be removed with a fine oil-stone. If deep rusting occurs, refinishing will be necessary.

CAUTION

Never use a coarse-grained stone, scraper, or a file on the runner face.

ASSEMBLY NOTES: Dowels, keys and bolts must not bottom or bind. Each shoe should be free to tilt in any direction. Oil the runner face. Seal, with Permatex or equivalent, all housing joints previously sealed.

Start Up. Make sure oil is up to the proper level (check sight gauge). After the bearing has been turned a few times under load, inspect the shoe faces – high spots should be removed by scraping.

CAUTION

Repeated trial starts can overheat the motor. Starting currents are several times running current: heating varies as the SQUARE of the current. Allow time between starts for the windings to cool.

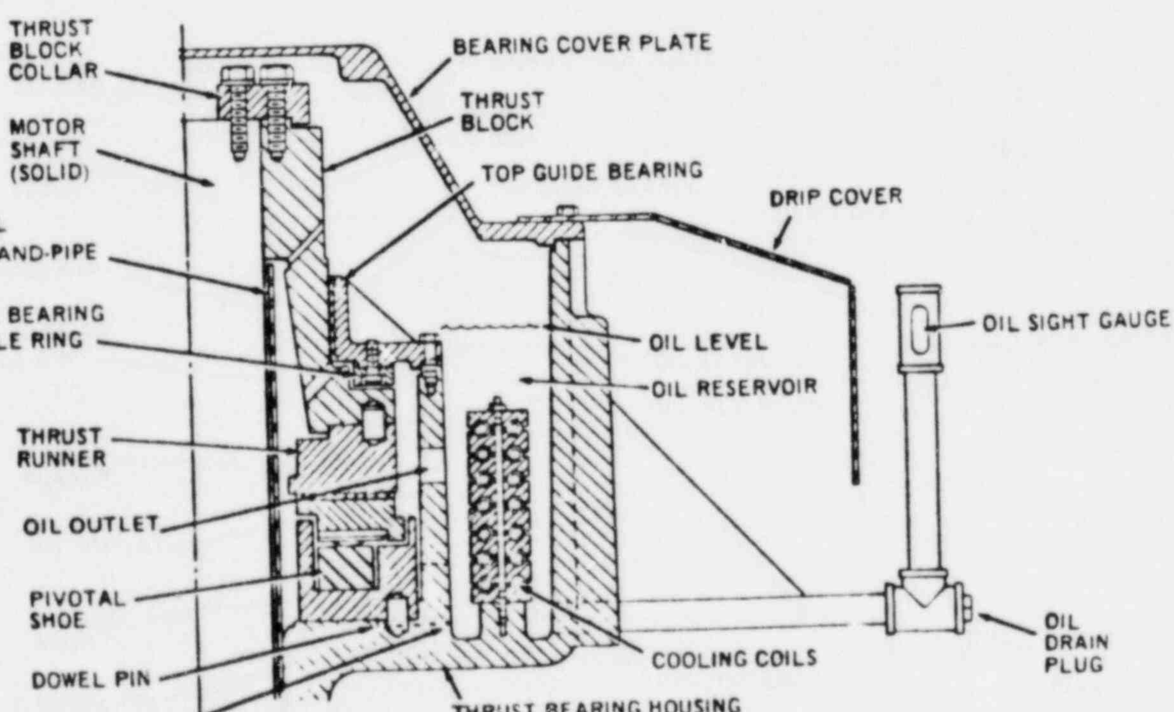

Figure 4-4 Typical Kingsbury Thrust Bearing

WARNING

EXPLOSION-PROOF MOTORS:
These motors are constructed to comply with the U/L Label Service Procedure Manual. When reassembling a motor that has the Underwriters' label, it is imperative that unit is reinspected and:

1. The original fits and tolerances are maintained.
2. All plugs and hardware are securely fastened.
3. Any part replacements are accurate duplicates of the original.

To violate any of the above will invalidate the significance of this label.

SHAFT OR FLANGE FACE RUNOUT

Because inspection of flange faces, eccentricity and shaft runout is rigorously enforced at the factory, vibrations caused by this alignment problem are rare and usually if shaft runout, face runout, or eccentricity are excessive; the equipment has been mistreated in some way.

The method for checking shaft and flange faces is as follows:

NOTE: On ball-bearing motors, it is recommended that the test be made with the shaft vertical to minimize the effect of bearing clearances.

Shaft Runout

The shaft runout is measured with the indicator stationary with respect to the motor and with its point at the end of the end surface of the shaft. See Fig. 4-5 for typical fixture.

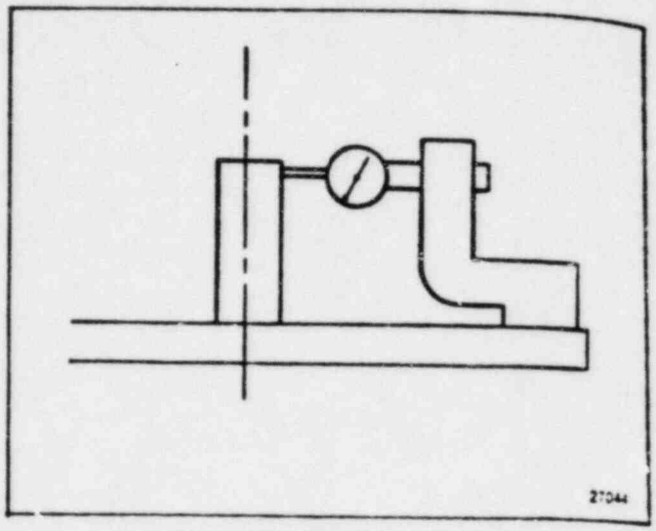

Figure 4-5 – Shaft Runout Check.

Read the maximum and minimum values on the indicator as the shaft is rotated slowly through 360 degrees. The difference between the readings shall not exceed 0.003 inches.

Eccentricity And Face Runout Of Mounting Surfaces

The eccentricity and face runout of the mounting surfaces is measured with indicators mounted on the shaft extension. The point of the eccentricity indicator shall be at approximately the middle of the rabbet surface, and the point of the face runout indicator shall be at approximately the outer diameter of the mounting face. See Fig. 4-6 for typical fixture.

Read the maximum and minimum values on the indicators as the shaft is rotated slowly through 360 degrees. The difference between the readings shall not exceed: .007 inches.

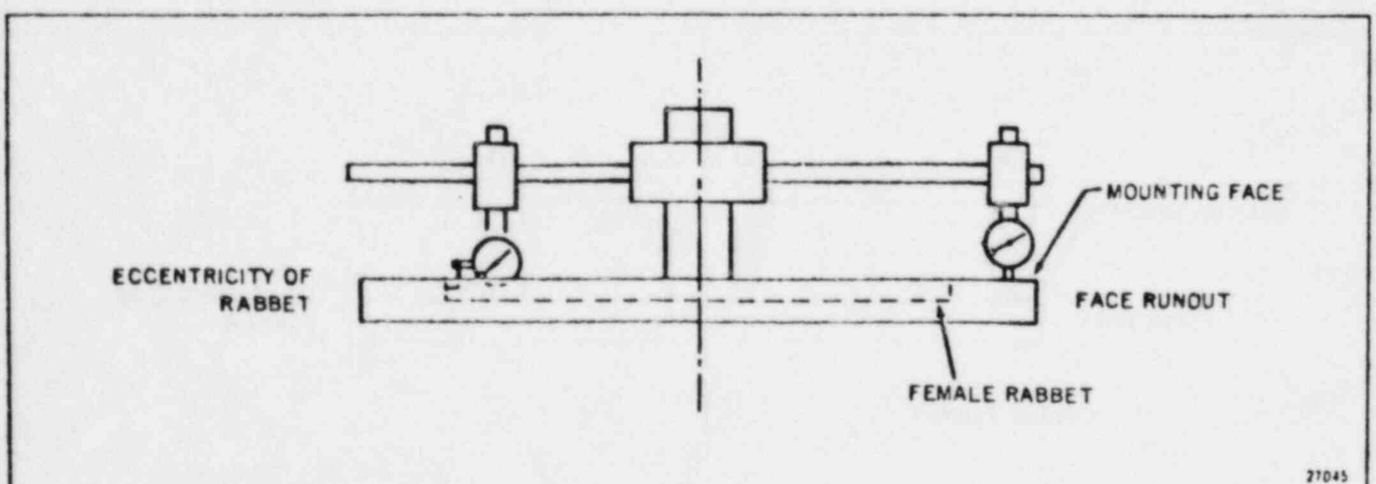

Figure 4-6 – Eccentricity and face runout check.

PARTS IDENTIFICATION

The drawings in this book are of the standard design. Most of the parts should be easy to identify. If however, there is some deviation from your machine, consult the factory or the drawings supplied with your unit.

A recommended list of stock parts follows. Order these and other parts, as required, from Allis-Chalmers Manufacturing Company, 4620 Forest Avenue, Norwood, Ohio or through the nearest sales office. (For a list of these offices and certified service centers, see directory 25X8109.)

RECOMMENDED PARTS LIST

Item	Description of Part	Recommended Minimum Stock Number of Units in Operation			
		1 to 4	5 to 9	10 to 20**	10 to 20
1	Motor Complete	0	0	0	1
2	Stator Coils with Winding Supplies*	1 Set	1 Set	2 Sets	1 Set
3	Bearings	1 Set	2 Sets	2 Sets	1 Set
4	Bearing Lock Nut & Washer	1 Set	1 Set	2 Sets	1 Set

*For MiCLAD insulated stator motors Item 2 does not apply. Instead, stocking of one (1) MiCLAD stator is recommended.

** This column to be used when complete machine is not stocked.

IDENTIFICATION PLATE

All units have an identification (name) plate affixed to the frame (Fig 5-1). All the necessary information pertaining to the machine can be found on this plate. Permanent records are kept by the factory and filed by:

1. Serial number.
2. Type and frame size.
3. Horsepower and speed.
4. Model number

It is important when ordering spare parts or referring to your machine to record as much data from this plate as possible. ALWAYS include the serial number.

NOTE: IF MOTOR HAS MORE THAN THREE LEADS, THE CONNECTION DIAGRAMS ARE USUALLY STAMPED ON THE NAME PLATE © OR ON A SEPARATE CONNECTION PLATE

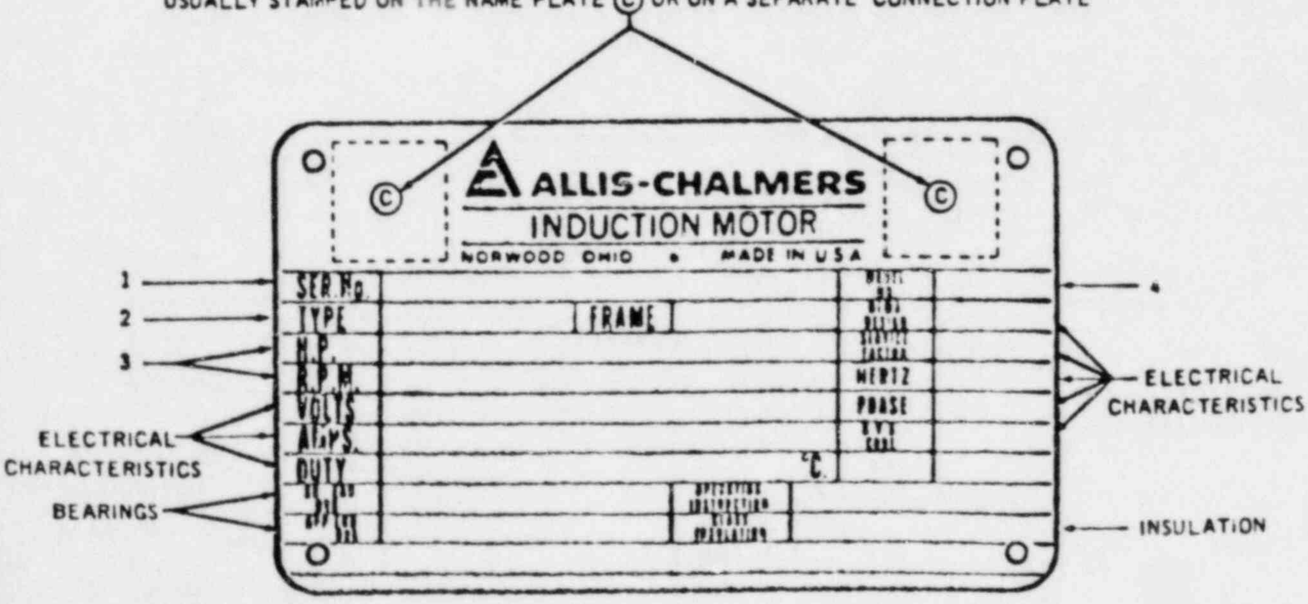

Figure 5-1 – Identification Plate.

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SECTIONAL VIEW DRAWING

NOTE: Bearing stacking varies, depending on thrust requirements.

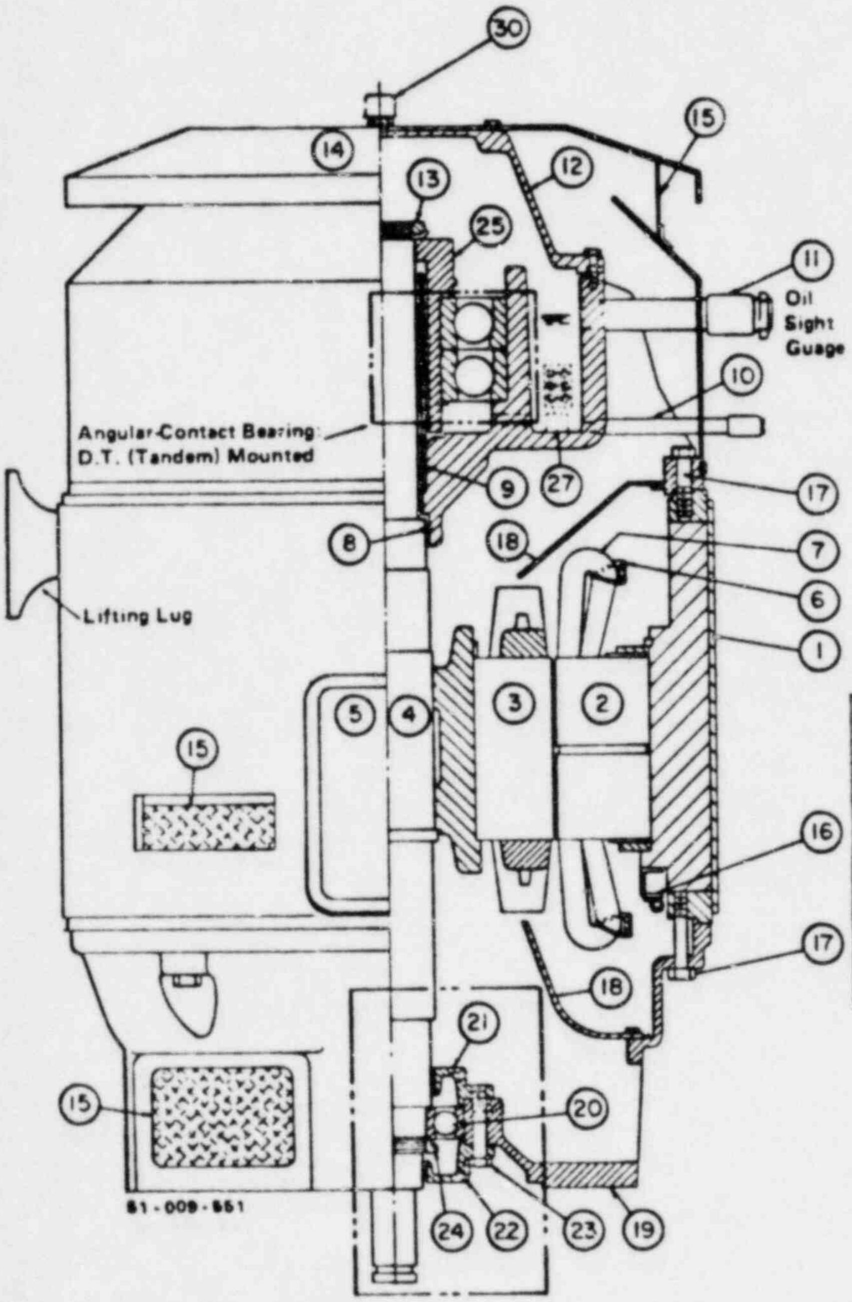
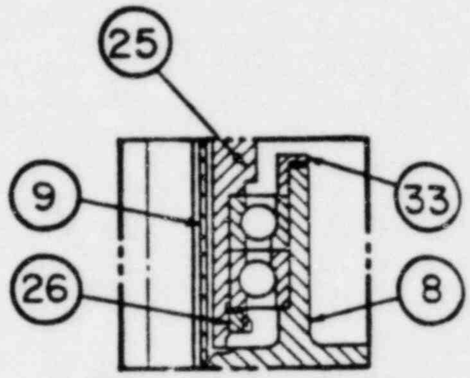
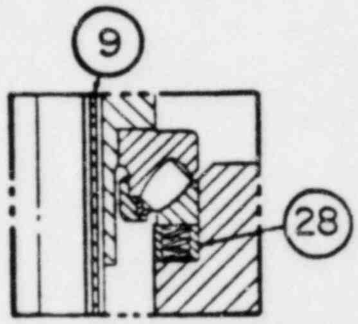


FIGURE 5-2: VERTICAL SOLID-SHAFT MOTOR
TYPICAL GV CONSTRUCTION (580/30 FRAME)



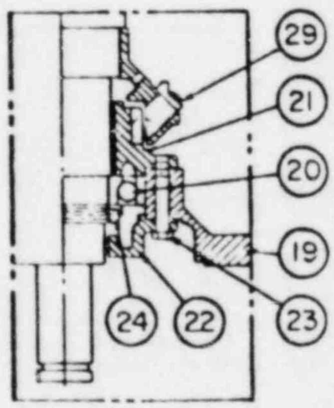
ANGULAR CONTACT BEARINGS; DB MOUNTED



SPHERICAL ROLLER BEARING

PARTS LIST

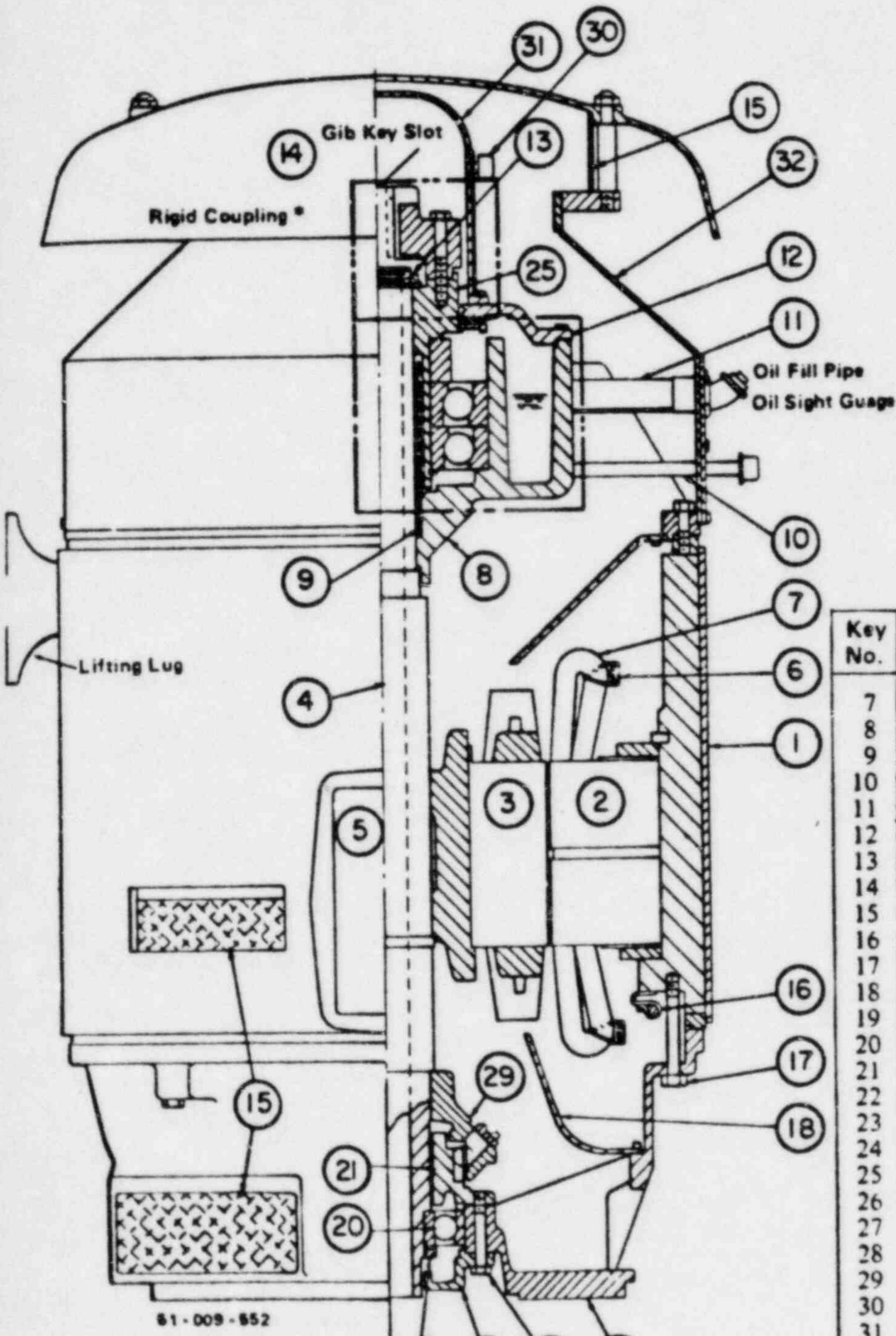
Key No.	Part Name
1	Stator Yoke
2	Stator Core Assembly
3	Rotor Assembly
4	Rotor Shaft
5	Conduit Box
6	Coil Supports
	(Parts list continued, pg. 23.)

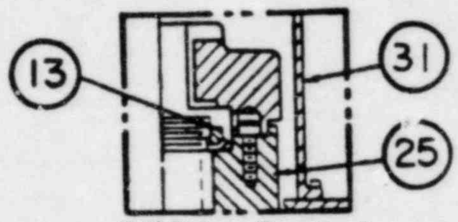


SOLID SHAFT CONSTRUCTION WITH NON-REVERSE STOP.

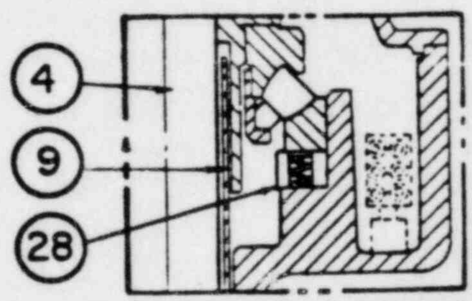
SECTIONAL VIEW DRAWING

NOTE: Bearing stacking varies, depending on thrust requirements.





Self-Release Coupling *



SPHERICAL - ROLLER BEARING

PARTS LIST (Continued)

Key No.	Part Name
7	Stator Coils
8	Bearing Housing
9	Oil Stand - Pipe Tube
10	Oil Drain Pipe
11	Oil Fill Pipe
12	Bearing Cover Plate
13	Locknut & Lockwasher +
14	Drip Cover
15	Screens
16	Space Heaters •
17	Housing Bolts
18	Air Deflectors
19	End Housing ("P" Flange)
20	Guide Bearing (Grease Lube)
21	End Cap (Internal)
22	End Cap (External)
23	End Cap Bolts
24	Locknut & Lockwasher
25	Thrust Block
26	Locknut & Lockwasher
27	Cooling Coils & Support =
28	Spring Loaded =
29	Non-Reverse Stop •
30	Breather
31	Coupling Cover
32	Top Cover Assembly
33	Bearing Clamp

FIGURE 5-3; VERTICAL HOLLOW-SHAFT MOTOR
TYPICAL HSO CONSTRUCTION (580/30 FRAME)

+ End Play Adjustment
• Optional - Specified By Customer
= Spherical Roller Bearing Only

SECTIONAL VIEW DRAWING

NOTE: Bearing stacking varies, depending on thrust requirements.

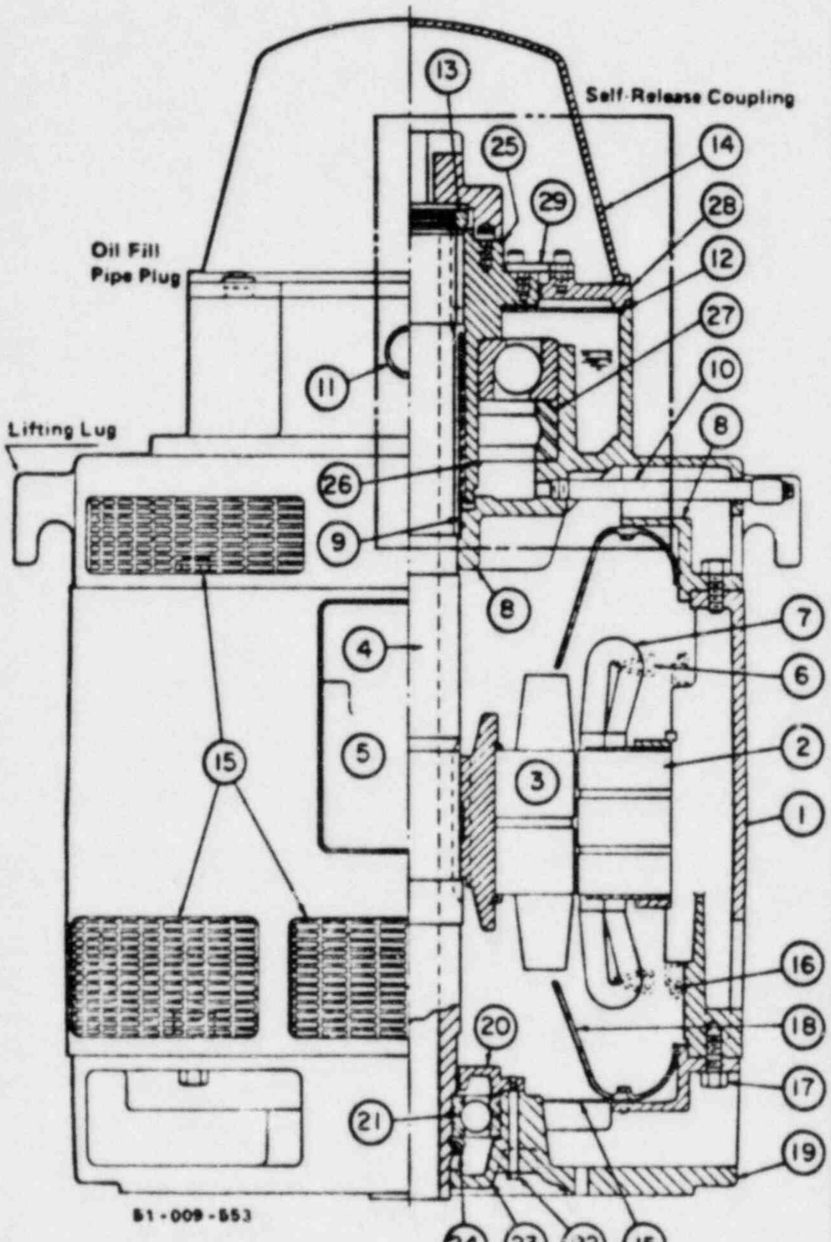
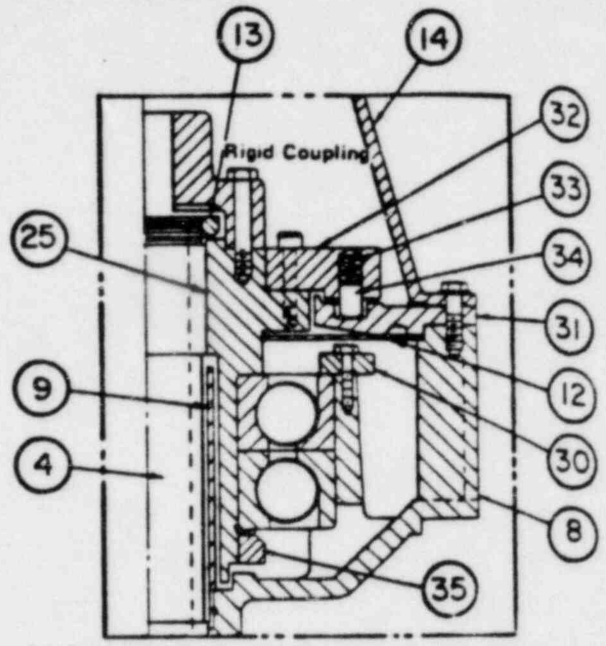


FIGURE 5-4; VERTICAL HOLLOW-SHAFT MOTOR TYPICAL 500 FRAME; TYPE HSHG



ANGULAR-CONTACT BEARINGS; D.B. MOUNTED WITH NON-REVERSE RATCHET.

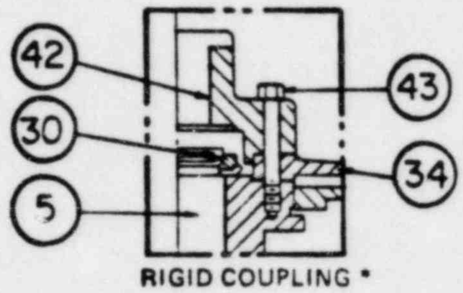
PARTS LIST

Key No.	Part Name
1	Stator Yoke
2	Stator Core Assembly
3	Rotor Assembly
4	Rotor Shaft (Hollow)
5	Conduit Box
6	Coil Supports
7	Stator Coils
8	Bearing Housing
9	Oil Stand-Pipe Tube
10	Oil Drain Pipe
11	Oil Sight Gauge
12	Oil Baffle Ring
13	Locknut & Lockwasher +
14	Drip Cover (Coupling Cover)
15	Screens
16	Space Heaters *
17	Housing Bolts
18	Air Deflectors
19	End Housing ("P" Flange)
20	End Cap (Internal)
21	Guide Bearing (Grease Lube)
22	End Cap Bolts
23	End Cap (External)
24	Locknut & Lockwasher
25	Thrust Block
26	Snap Ring
27	Bearing Spacer (When Used)
28	Cover Plate
29	Shaft - Locking Bar Assembly
30	Thrust Plate
31	Ratchet Plate =
32	Pin Carrier Plate =
33	Spring =
34	Pin =
35	Locknut & Lockwasher

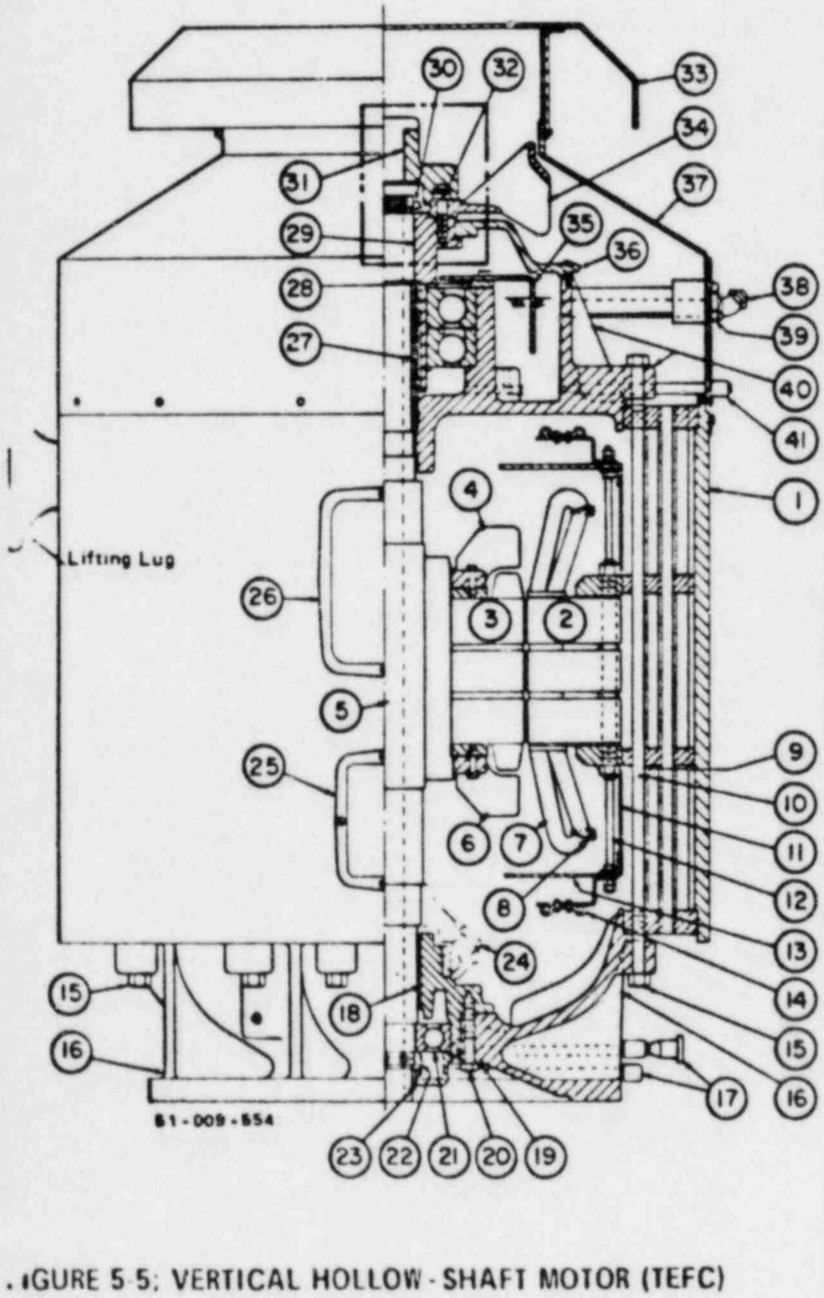
\+ End Play Adjustment
* Optional - Specified By Customer
= Non-Reverse Ratchet Assembly

SECTIONAL VIEW DRAWING

NOTE: Bearing stacking varies depending on thrust requirements.



RIGID COUPLING *



.IGURE 5-5; VERTICAL HOLLOW-SHAFT MOTOR (TEFC)

TYPICAL 23, 26 & 30 FRAME; TYPE HSZ

PARTS LIST

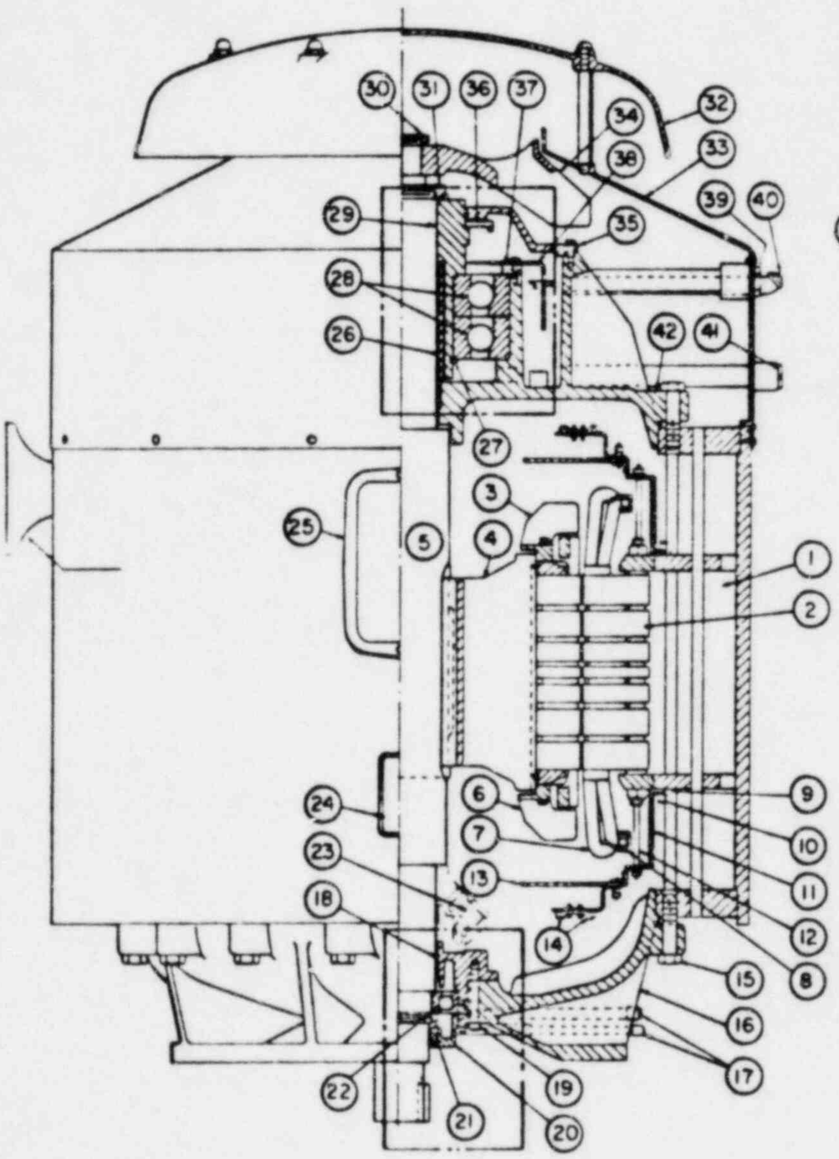
Key No.	Part Name
1	Stator Yoke & Tube Assembly
2	Stator Core Assembly
3	Rotor Assembly
4	Rotor Fan (Front)
5	Rotor Shaft
6	Rotor Fan (Rear)
7	Stator Coils
8	Coil Supports
9	Stator Retaining Link
10	Soc. Hd. Cap Screw & Lockwasher
11	Air Deflector
12	Stud
13	Air Deflector
14	Space Heaters *
15	Housing Bolts
16	End Housing ("P" Flange)
17	Grease Pipes
18	End Cap (Internal)
19	Retaining Ring
20	End Cap Bolt
21	Guide Bearing (Grease Lube)
22	Slinger Locknut & Lockwasher
23	End Cap (External)
24	Non-Reverse Stop Assembly *
25	Aux. Conduit Box *
26	Motor Conduit Box
27	Oil Stand-Pipe Tube
28	Thrust Plate
29	Thrust Block
30	Locknut & Lockwasher +
31	Coupling (Self-Release) *
32	Soc. Hd. Cap Screw (Self-Release)
33	Drip Cover
34	Fan (External)
35	Oil Baffle Ring
36	Bearing Cover Plate
37	Fan Housing Assembly
38	Oil Fill Pipe
39	Oil Sight Gauge
40	Bearing Housing (Top)
41	Oil Drain Pipe
42	Coupling (Rigid) *
43	Bolt (For Rigid Coupling) *

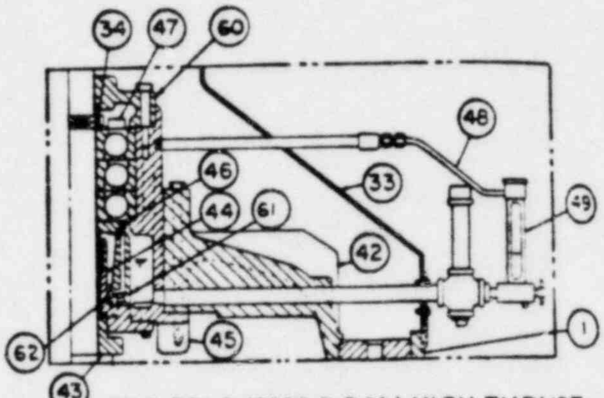
* Optional - Specified By Customer

\+ End-Play Adjustment

SECTIONAL VIEW DRAWING

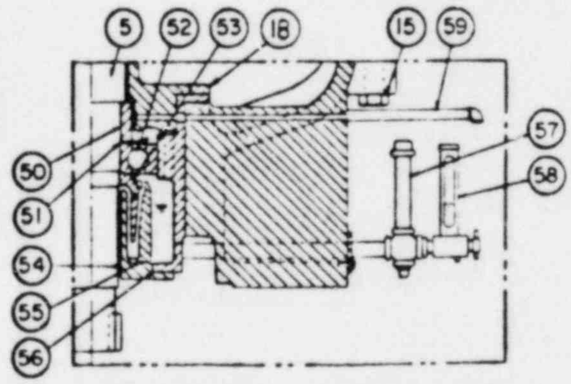
NOTE: Bearing stacking varies depending on thrust requirements.





TWO POLE (3600 R.P.M.) HIGH THRUST, OIL-MIST LUBRICATED BEARING

NOTE: Bearings are located above oil level, and during storage periods, must be coated with a fresh film of oil each month.



OIL-LUBRICATED GUIDE BEARING

FIGURE 5-6; VERTICAL SOLID-SHAFT MOTOR (TEFC)
TYPICAL 23; 26; & 30 FRAME; TYPE AZV

PARTS LIST

Key No.	Part Name
1	Stator Yoke & Tube Assembly
2	Stator Core Assembly
3	Rotor Fan (Front)
4	Rotor Assembly (4 Pole & Slower)
5	Rotor Shaft
6	Rotor Fan (Rear)
7	Stator Coils
8	Coil Supports
9	Stator Retaining Link
10	Soc. Hd. Cap Screw & Lockwasher
11	Air Deflector
12	Stud
13	Air Deflector
14	Space Heaters *
15	Housing Bolts
16	Bearing Housing ("P" Flange)
17	Grease Pipes
18	End Cap (Internal)
19	End Cap Bolt
20	End Cap (External)
21	Slinger-Locknut & Lockwasher
22	Guide Bearing (Grease Lube)
23	Non-Reverse Stop Assembly *
24	Aux. Conduit Box *
25	Motor Conduit Box
26	Oil Stand-Pipe Tube
27	Snap Ring
28	Angular Contact Bearing (Oil Lube)
29	Thrust Block
30	Locknut & Lockwasher
31	Locknut & Lockwasher (End Play Adjustment)
32	Drip Cover
33	Fan Housing
34	Fan (External)
35	Bearing Cover Plate
36	Slinger
37	Thrust Plate
38	Oil Baffle Ring
39	Oil Sight Gauge
40	Oil Fill Pipe
41	Oil Drain Pipe
42	Bearing Housing (Top)
43	Bearing Puller Sleeve
44	Oil Well Cap (Inside)
45	End Cap & Baffle Assembly
46	Oil Slinger
47	Oil Vapor Impeller
48	Pressure Equalizing Tube
49	Oil Sight Gauge (Top)
50	Sleeve Bushing
51	Oil Cup
52	Guide Bearing (Oil Lube)
53	Oil Slinger
54	End Cap (External)
55	Oil Baffle
56	End Cap & Baffle Assembly (Bottom)
57	Oil Reservoir
58	Oil Sight Gauge (Bottom)
59	Bearing Vent Pipe
60	End Cap (External)
61	Oil Baffle
62	Oil Baffle Cup

* Optional - Specified By Customer's Order.

HOLLOW SHAFT NOMENCLATURE

Angular Contact Bearing–A ball thrust bearing capable of taking high thrust in one direction only.

DT Bearings--Two (2) angular contact bearings mounted together to take extra high thrusts in one direction only.

DB Bearings--Two (2) angular contact bearings mounted together such that each one will take high thrust in opposite directions.

End Play–The axial movement of the shaft.

Guide Bearing–The bearing mounted in the housing opposite the thrust bearing and is a deep groove ball bearing.

Thrust Block or Bearing Mounting Sleeve–The member keyed to the motor shaft on which the inner race of the thrust bearing is mounted.

Continuous Down Thrust –The thrust developed by the weight of the pump shaft and hydraulic unbalance. This is the thrust value to which the motor thrust bearings are sized.

Maximum Down Thrust–The momentary thrust that can be developed during shut-down of pump.

Momentary Upthrust–This thrust may develop in some shallow settings during startup. Momentary upthrust is carried by the Guide Bearing.

Rigid Coupling or Bolted Coupling--The member to which the pump shaft is keyed. Coupling is bolted to the Thrust Block so that during start-up the Guide Bearing will carry the momentary upthrust.

Self-Release Coupling-- Similar to Rigid Coupling except that it will release from Thrust Block in the event an accidental reversal begins to unscrew the pump shaft. After being disengaged, the motor is free to revolve without damage to motor or pump.

Coupling Bore or Clutch Bore--That bore or hole in the coupling in which the pump shaft fits.

Non-Reverse Ratchet or Backstop--A device that permits motor to turn in only one direction. It is used mostly in conjunction with Rigid Couplings to prevent turbine pump backspin, caused by water column receding when motor is de-energized.

Pump Adjusting Nut–The nut mounted on the pump shaft above the coupling, used to raise and lower the pump shaft to set the impeller to its proper position. After the impeller is set, the nut is bolted to the coupling. The nut is supplied by the pump company.

Hold Down Bolts for Self-Release Coupling–Bolts used to hold the coupling in place during shipment. They must be removed during installation.

Locking Bar--A bar used to prevent the motor shaft from turning while the pump adjusting nut is being turned. Supplied with motors that do not have non-reverse ratchets.

Pump Shaft Guide Bushing--A bronze bushing pressed in a counterbored hole in the bottom of the hollow shaft. This bushing supports the pump shaft from lateral movement. Supplied only on request.

MOTOR SERVICE RECORD (51X2285)

Serial No. ______ Horsepower ______ Type ______

Speed ______ Volts ______ Amperes ______ Phase ______ Cycles ______

Insulation Class ______ Temperature Rise ______ °C Frame Size ______

Connection Diagram - Rotor ______ Stator ______

Owner Order No. ______ Item No. ______ Date Purchased ______

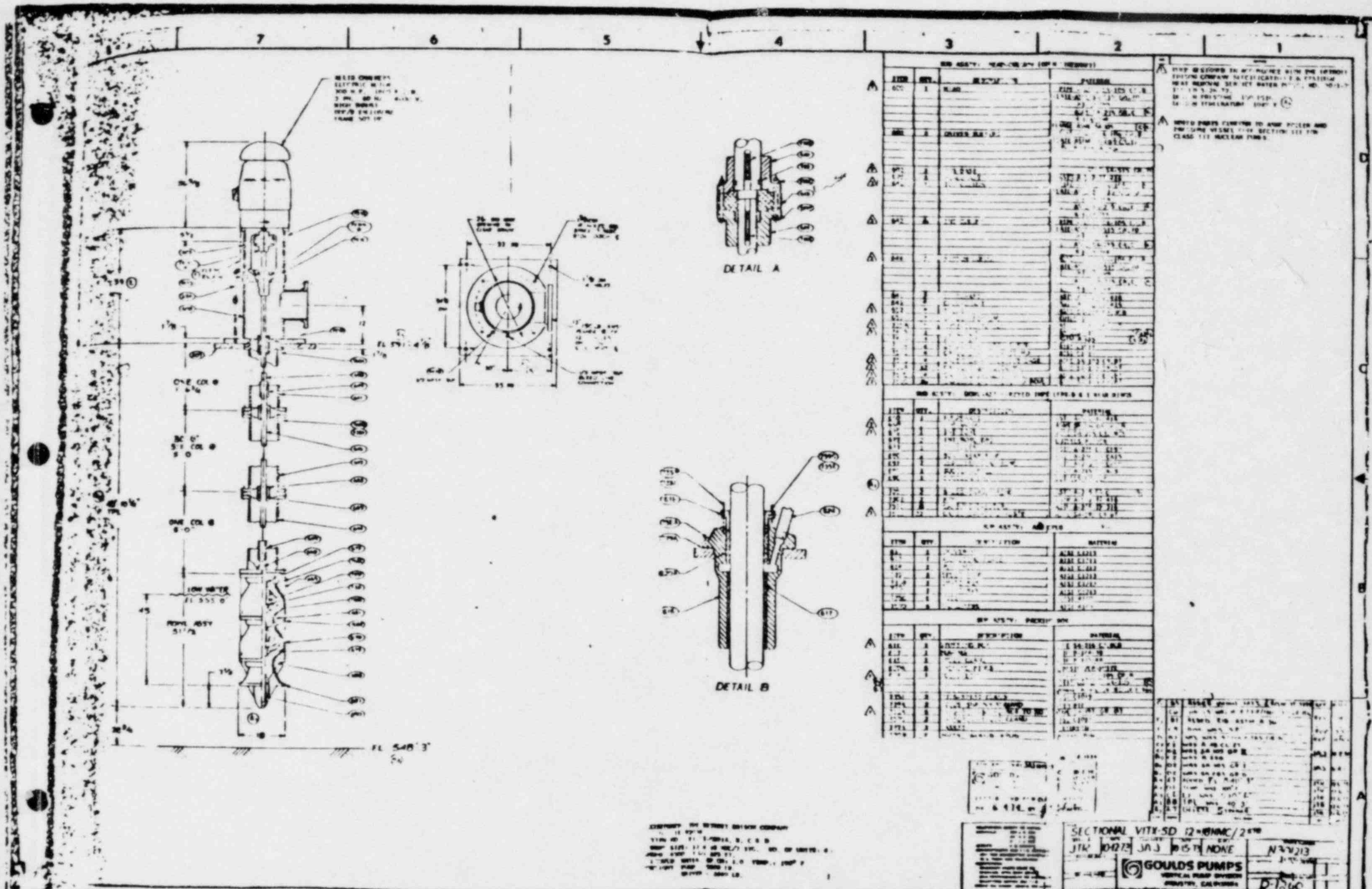
MACHINE TYPE	BEARINGS	SHAFT EXTENSION
☐ Horizontal ☐ Vertical ☐ Moisture-Resistant ☐ Open Drip-Proof ☐ Super-Seal ☐ Totally-Enclosed ☐ Explosion Proof	☐ Ball ☐ Roller ☐ Sleeve Size: Front ______ Rear ______ Lubrication ______	Length ______ Diameter ______ Internal Thread ______ External Thread ______ Keyway ______

Date Installed	Location	Application

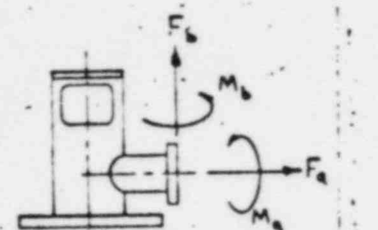
Date Repaired or Replaced	Repairs or Parts Replaced[1]	Fault	Repaired by	Total Cost

[1] Name of Part	No. Per Machine	Manufacturer's No.	Date	Quan. Repl.	Cost	Date	Quan. Repl.	Cost	Date	Quan. Repl.	Cost
Rotor											
Stator Coils											
Bearing, Front											
Rear											
Other											
....											

INSPECTION												
Date Checked												
Bearings												
Lubrication												
Excess Heat												
Excess Noise												
Speed												
Voltage												
Amps												
Insulation												
Clean												
Alignment												
Vibration												
Temperature												



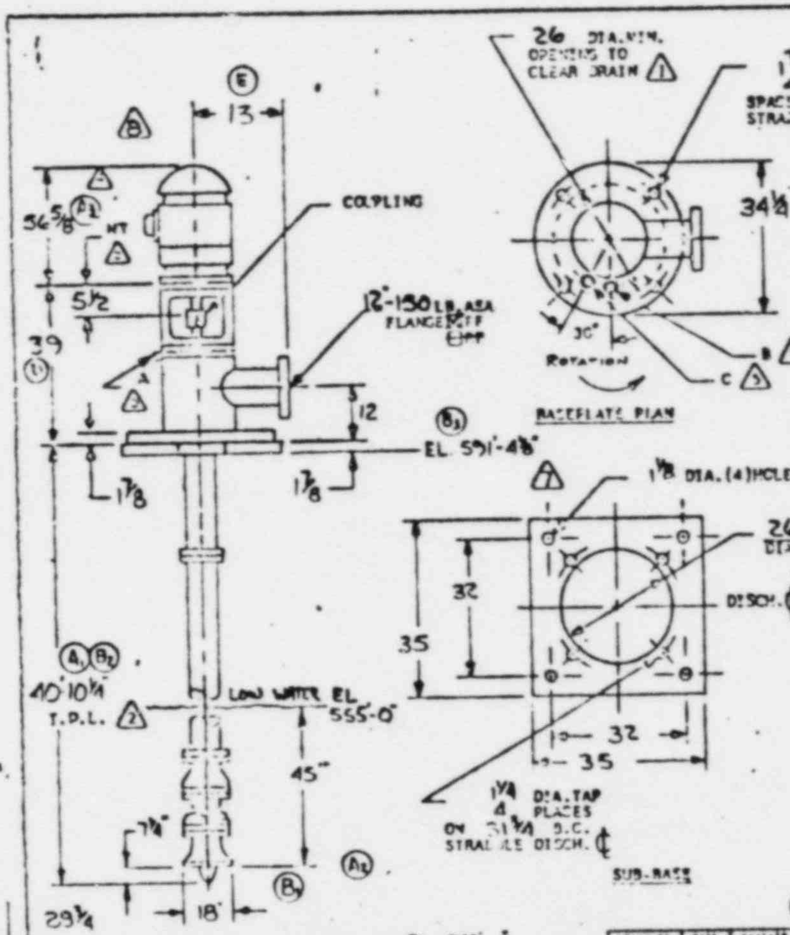
DETAIL A
DETAIL B
ONE COL @
LOW WATER
EL 548'3"
SECTIONAL VITX-SD
NONE
GOULDS PUMPS



© MAXIMUM ALLOWABLE FORCES & MOMENTS

F_a = ±5000 lbs.
F_b = ±5000 lbs.
M_a = 6000 ft-lbs.
M_b = 10000 ft-lbs.

E	13 WAS 19		
D	DIM WAS 33		
LTR	REVISION	BY	DATE



CUSTOMER THE DETROIT EDISON CO.
P.O. 1E 92034
ITEM E1151-C001A-D
NO. OF UNITS 4
PUMP SIZE 12x18 HMC NO. STAGES 2
GPM 4500 T.D.H. 185 FT.
LIQUID WATER
SP. GR. 1.0 TEMP. 104°F VISC. –
COLUMN 12
TUBE –
SHAFT 2 3/16
MAX. BRG. CENTERS 60
SEAL PACKING BOX
COUPLING ADJ. SPACER LTH. –
DRIVER MFG. ALLIS-CHALMERS
H.P. 300 RPM 1800
PH. 3 CY 60 VOLTS 4000
THRUST HIGH
ENCLOSURE ODP/B
FRAME 507 UP

WEIGHT: PUMP 5600 LBS (B5)
(A3) DRIVER 3600 LBS

DESIGN PRES.: 150 PSIG
DESIGN TEMP.: 104°F (B4)

© SPEC. NO. 3071-25

NOTES

1. CLEARANCE MUST BE PROVIDED IN FOUNDATION IF DRAIN CONNECTIONS TO SUMP ARE REQUIRED.
2. T.P.L. – TOTAL PUMP LENGTH IS THE DISTANCE TO ... AND INCLUDES OPTIONAL STRAINER WHEN SPECIFIED.
3. TOLERANCE ON ALL DIMENSIONS IS ± 1/8" or ± 1/4" PER 5 FEET, WHICHEVER IS GREATER.
4. DRIVER MAY BE ROTATED AT 90° INTERVALS ABOUT VERTICAL CENTERLINE. FOR DETAILS REFER TO DRIVER DIMENSION DRAWINGS.
5. A-3/8 NPT-MOTOR BASE DRAIN. B-1/2 NPT-SEALING LIQUID DRAIN. C-1/2 NPT-AIR CONNECTION.
6. MT-DISTANCE DRIVER FACE TO TOP OF HEAD SHAFT.
7. FINAL MOUNTING DIMENSION SUBJECT TO SEISMIC REVIEW.
8. SHAFT REMOVAL CLEARANCE IS 10'-0" ABOVE 591'-4⅞" EL.

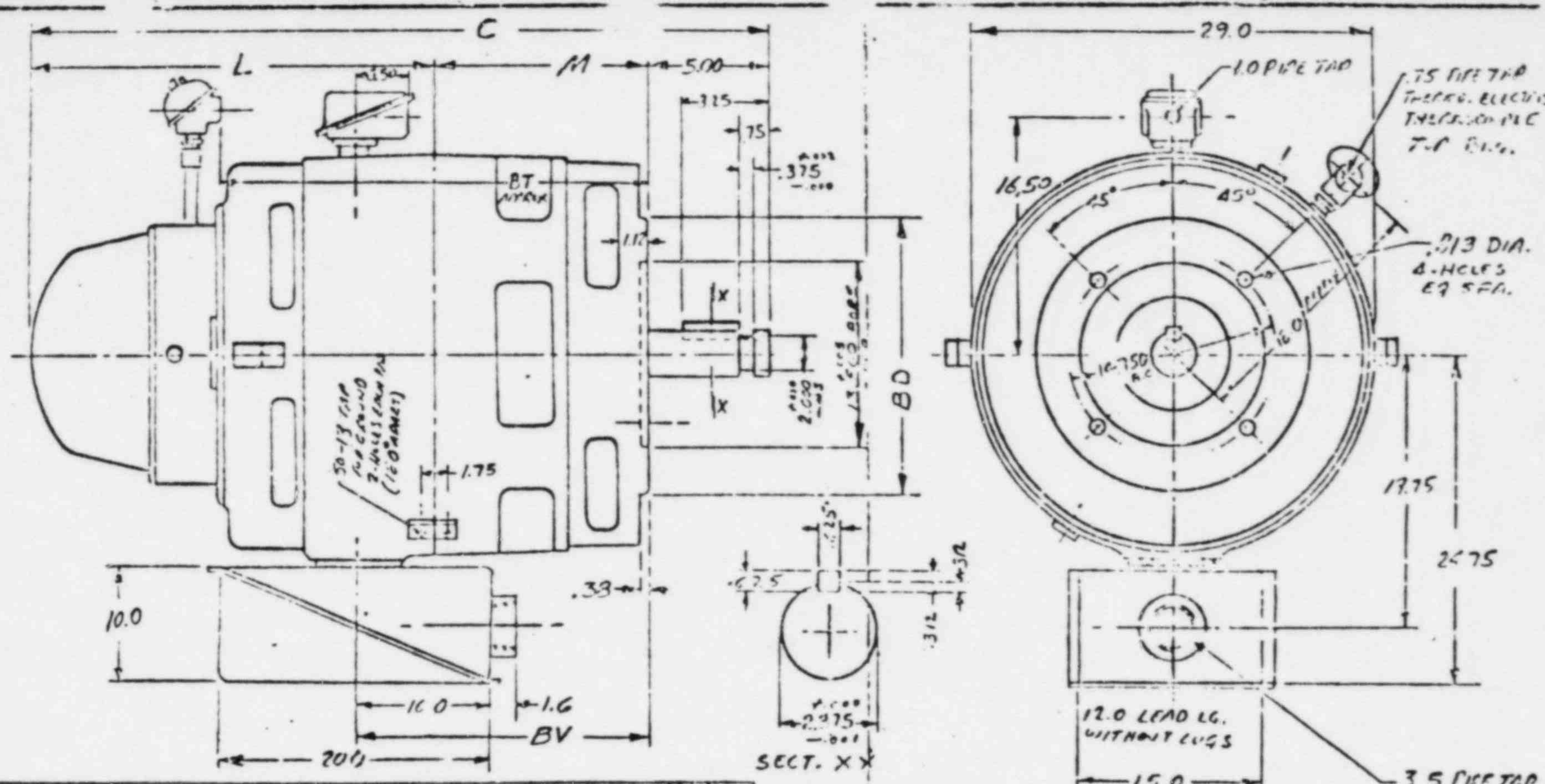
C	ADD	JAJ	6-5-75
B6	WAS 2¼		
B5	WAS 4100 LBS.		
B4	TEMP. WAS 100°F		
B3	EL. WAS 590'-6"		
B2	TPL WAS 40'-3"		
B1	DELETE STRAINER		
A3	ADD MTR. HEIGHT & WT	JAJ	10-3-73
A2	ADD STRAINER		
A1	TPL WAS 37'-6"		
LTR	REVISION	BY	DATE

GOULDS PUMPS
VERTICAL PUMP DIVISION
INDUSTRY, CALIFORNIA

OUTLINE MODEL VITX-SD
12x18 HMC 2 STG

DM-3132A N301213

JAJ 6-5-74



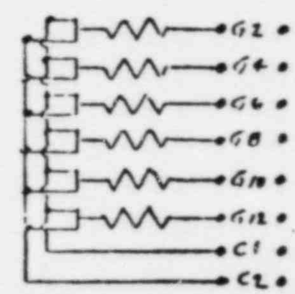
ITEM	NEMA	[illegible]	C	L	M	BD	BV	BT		APPROX. WEIGHT
1	503UP	CV-500	53.62	33.12	15.50	20.0	21.25	31.75		3000
2	504UP	CV-500	55.62	34.12	16.50		23.25	23.75		3100
3	505UP	CV-500	57.62	35.12	17.50		25.25	25.75		3300
4	507UP	CV-500	61.62	37.12	19.50		29.25	29.25		3600
5	503UP	CV-500	53.62	33.12	15.50	24.5	21.25	31.75		3000
6	504UP	CV-500	55.62	34.12	16.50		23.25	33.75		3100
7	505UP	CV-500	57.62	35.12	17.50		25.25	35.75		3300
8	507UP	CV-500	61.62	37.12	19.50		29.25	39.75		3600

CONDUIT BOX MAY BE ROTATED IN STEPS OF 90°
CONDUIT BOX HAS OPENING FOR SIZE OF CONDUIT SHOWN.
FOR SMALLER CONDUIT AIRBUS CONTRACTOR SHOULD FURNISH REDUCING BUSHING
DIMENSIONS ARE SUFFICIENTLY ACCURATE FOR PRELIMINARY INSTALLATION
FOR DIRECT CONNECTIONS SHIMS MAY BE NECESSARY UNDER FEET.
1/32 WHEN FOOT HEIGHT IS LESS THAN 8".
1/16 WHEN FOOT HEIGHT IS GREATER THAN 8"

CERTIFIED PRINT		CUSTOMER INITIATED CHANGES MAY AFFECT PRICE AND DELIVERY			
GOULDS PUMPS					
29312		5117-50233-1			
HP	RPM	FRAME	VOLTS	PHASE	HERTZ
300	1800	5070P	4000	3	60

SO# N301213

INDICATOR READING		
MAX. FACE RUNOUT	PERMISSIBLE SHAFT RUNOUT	PERMISSIBLE ECCENTRICITY OF PILOT RABBET
.007	.003	.007



TERMINAL BOARD ARRANGM'T. IN AUX COND. BOX FOR 10 OHMS RTD'S
△ TWO PER PHASE (25°C)

51-753-718

OUTLINE
OPEN DRIP PROOF - VERTICAL
P FLANGE - 5070 - 300 HP
OIL LUBRICATED TOP BRG.

GV-500-8

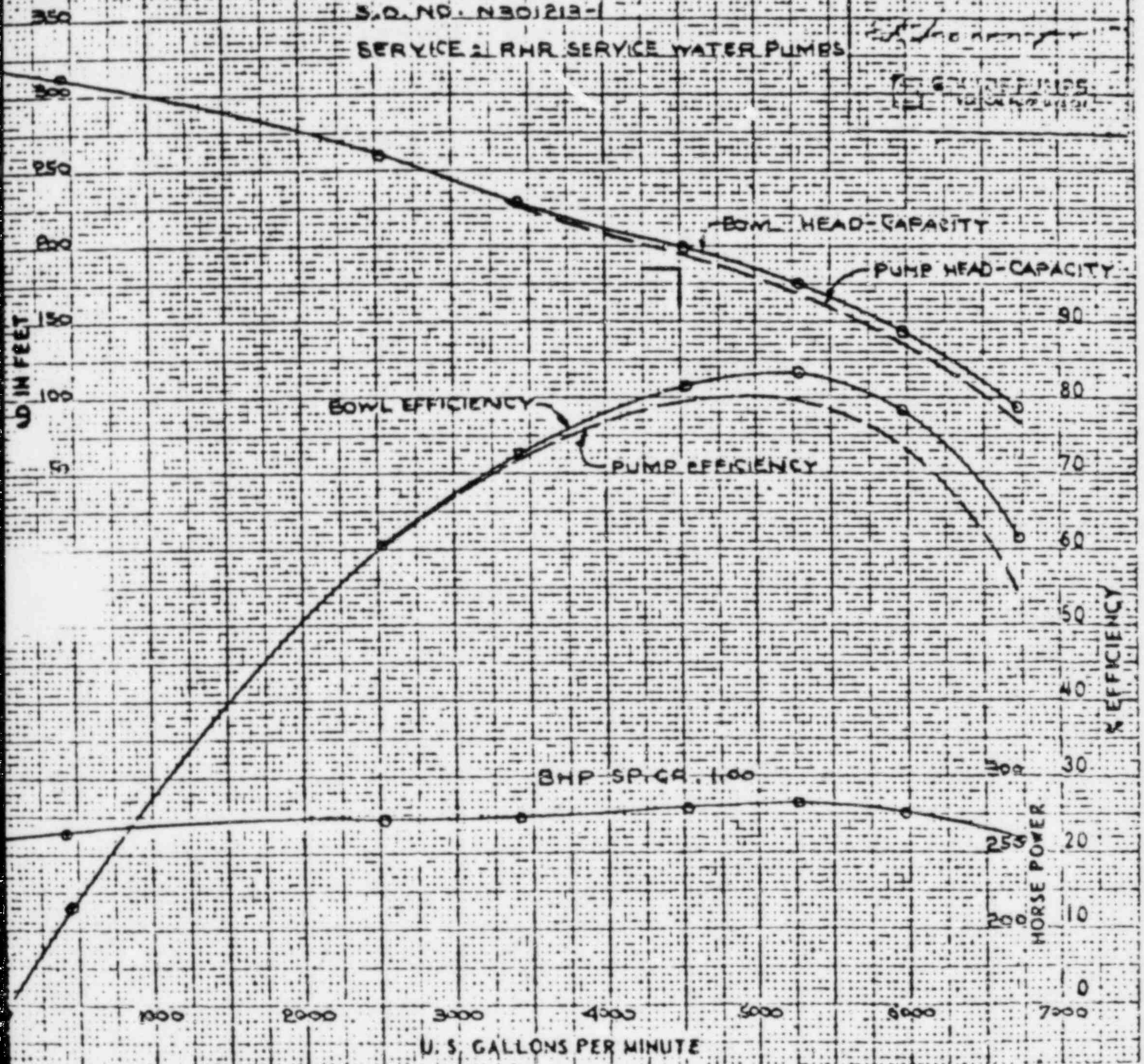
51-753-718

JRVES SHOW APPROXIMATELY THE C .RACTERISTICS WHEN PUMPING CLEAR NON-AERATED WATER. NO GUARANTEE IS MADE EXCEPT FOR THE RATED POINT

NOTE: ALL COLUMN LOSSES ARE I CLUDED

DETROIT EDISON COMPANY
FOR: ENRICO FERMI ATOMIC POWER PLANT, UNIT 2
P.O. NO. EE 92034
ITEM NO. E1151-C0.1A
S.O. NO. N301213-1
SERVICE: RHR SERVICE WATER PUMPS

CERTIFIED



IMPELLER ENCLOSED

10 5/8 D. DIA.

UP 5/16

DATE 6-19-75 BY E

GOULDS PUMPS
VERTICAL PUMP DIVISION
INDUSTRY, CALIFORNIA

PERFORMANCE TWO STAGES

12 x 18 HMC — DEEP WELL TURBINE PUMP

1770 RPM

CURVE SHEET NO. T-75-353

PU TEST DAT

TEST NO. T-75-5-5

TYPE 17X18 HMC STAGES 2	GUARANTEED PERFORMANCE						FOR: DETROIT EDISON COMPANY
SERIAL NO. N301213-1		RPM	GPM	HEAD	HP	SP.GR.	VISC.	ENRICO FERMI ATOMIC POWER PLANT-UNIT 2
2 IMP'S N-F2 DIA. 31 UF b2	LAB							P.O. NO. 1E 92034
IMP'S DIA UF b2	FIELD	1770	4500	185.0	300	1.0	325SU	WATER TEMP START 78.0° FINISH
AXIAL RUNNING CLEARANCE 0.0	TEST MOTOR 300 HP 4 POLES							AMB.
BOWLS STEEL	WATTMETER SCALE MULTIPLIER 320X2 = 640							WITNESSED BY D.P. Cooper Det.
IMPELLERS 31 5/5	LINE 18 " MAGN. ELEMENT d-INVENT C-							TESTED BY T.C. DATE 8-17-75

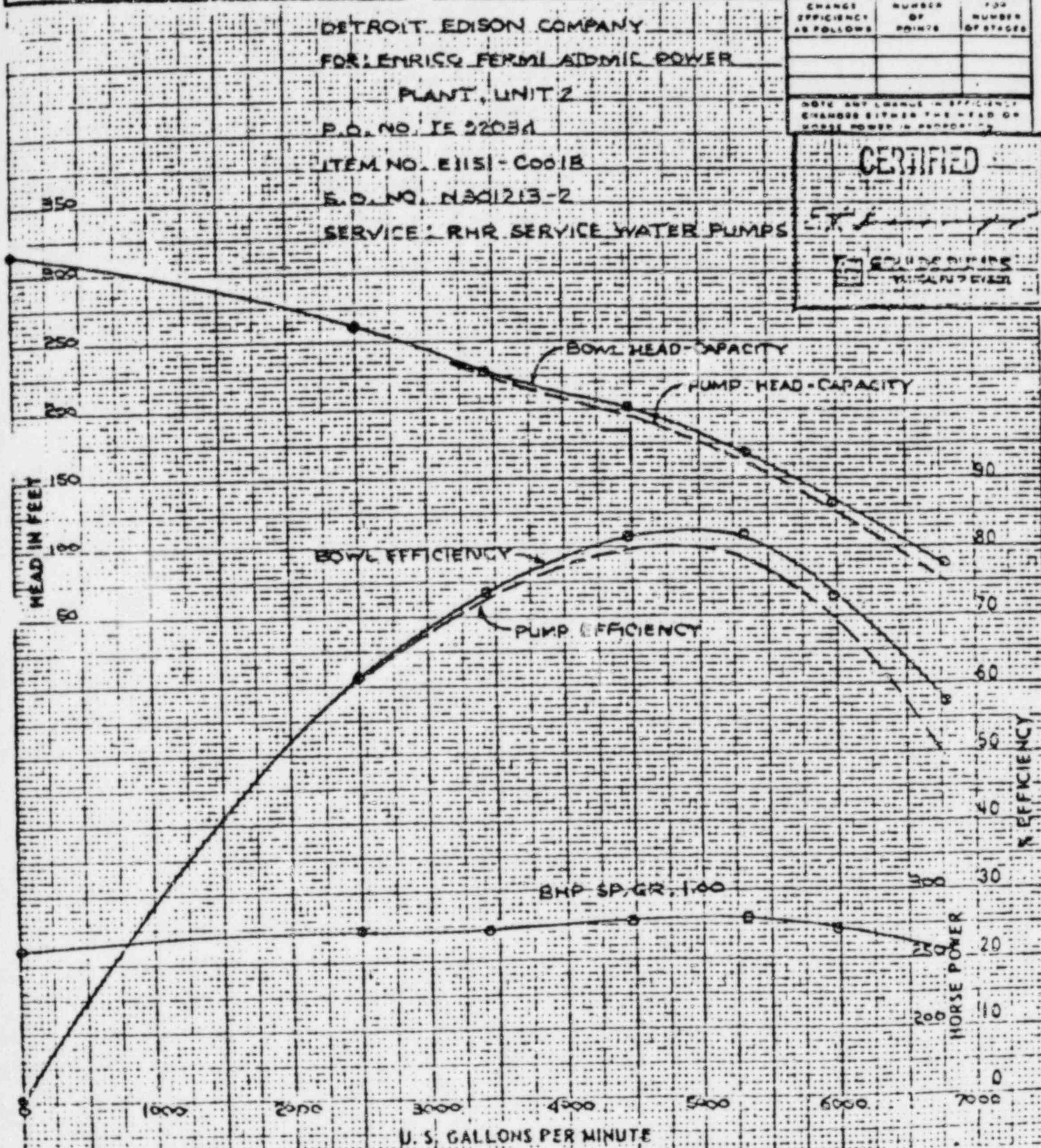
READING	1	2	3	(4)	5	6	7	8	9	10	11	12
RPM	1783	1782	1782	1782	1782	1781	1783					
DISCH. PRESSURE-PSI	135.5	113.2	99.80	86.5	75.80	61.8	39.9					
DISCH. HEAD-FT.	313.0	261.5	230.6	199.8	175.1	142.8	92.16					
ELEVATION CORRECTION-FT.	2.3	—	—	—	—	—	—					
VELOCITY HEAD-FT.	0	.1	0.1	0.2	0.3	0.4	0.5					
TOTAL PUMP HEAD-FT.	315.3	263.9	233.0	202.3	177.7	145.4	94.9					
FLOW ~~VELOCITY-FT/SEC.~~ MANOMETER S.G. 1.75 (BLUE)	0.20	6.70	12.40	21.50	29.65	37.70	48.0					
FLOW-GPM	437.	2533	3446	4537	5328	6008	6720					
WATTMETER READING	.332	.344	.345	.352	.356	.348	.327					
INPUT TO MOTOR-KW	212.5	220.2	220.8	225.3	227.8	222.7	209.3					
BRAKE HORSEPOWER	268.7	278.3	279.1	284.6	287.8	281.4	264.7					
PUMP EFFICIENCY-%	13.0	60.7	72.6	81.44	83.1	78.4	61.4					
FRICTION LOSS	0	1.6	2.9	5.0	6.9	8.8	11.2					
PUMP HEAD	433.8	256.7	226.9	194.6	166.4	134.8	82.3					
PUMP EFFICIENCY	13.0	60.3	71.74	79.4	79.8	73.56	54.04					

PERFORMANCE CONVERTED TO 1770 RPM 1.0 SP.GR.

	1	2	3	4	5	6	7	8	9	10	11	12
TOTAL PUMP HEAD-FT.	310.7	260.3	229.8	199.6	175.3	143.6	93.5					
FLOW-GPM	433.8	2516	3423	4506	5292	5971	6731					
BRAKE HORSEPOWER	262.8	272.7	273.4	278.9	282	276.3	258.9					
PUMP EFFICIENCY-%	13.0	60.7	72.6	81.44	83.1	78.4	61.4					

JRVES SHOW APPROXIMATELY THE C[illegible]RACTERISTICS WHEN PUMPING CLEAR NON-AERATED WATER. NO GUARANTEE IS MADE EXCEPT FOR THE RATED POINT

NOTE: ALL COLUMN LOSSES ARE I[illegible]CLUDED



IMPELLER: ENCLOSED 10 5/8" DIA. UP 5/16	**GOULDS PUMPS** VERTICAL PUMP DIVISION INDUSTRY, CALIFORNIA	PERFORMANCE: TWO STAGES 12×18 HMC — DEEP WELL TURBINE PUMP 1770 R.P.M. CURVE SHEET NO. T-75-350

DATE 08-15-75 BY R.

GOULDS PUMPS - VERTICAL . ? DIVISION

PUMP TEST DATA

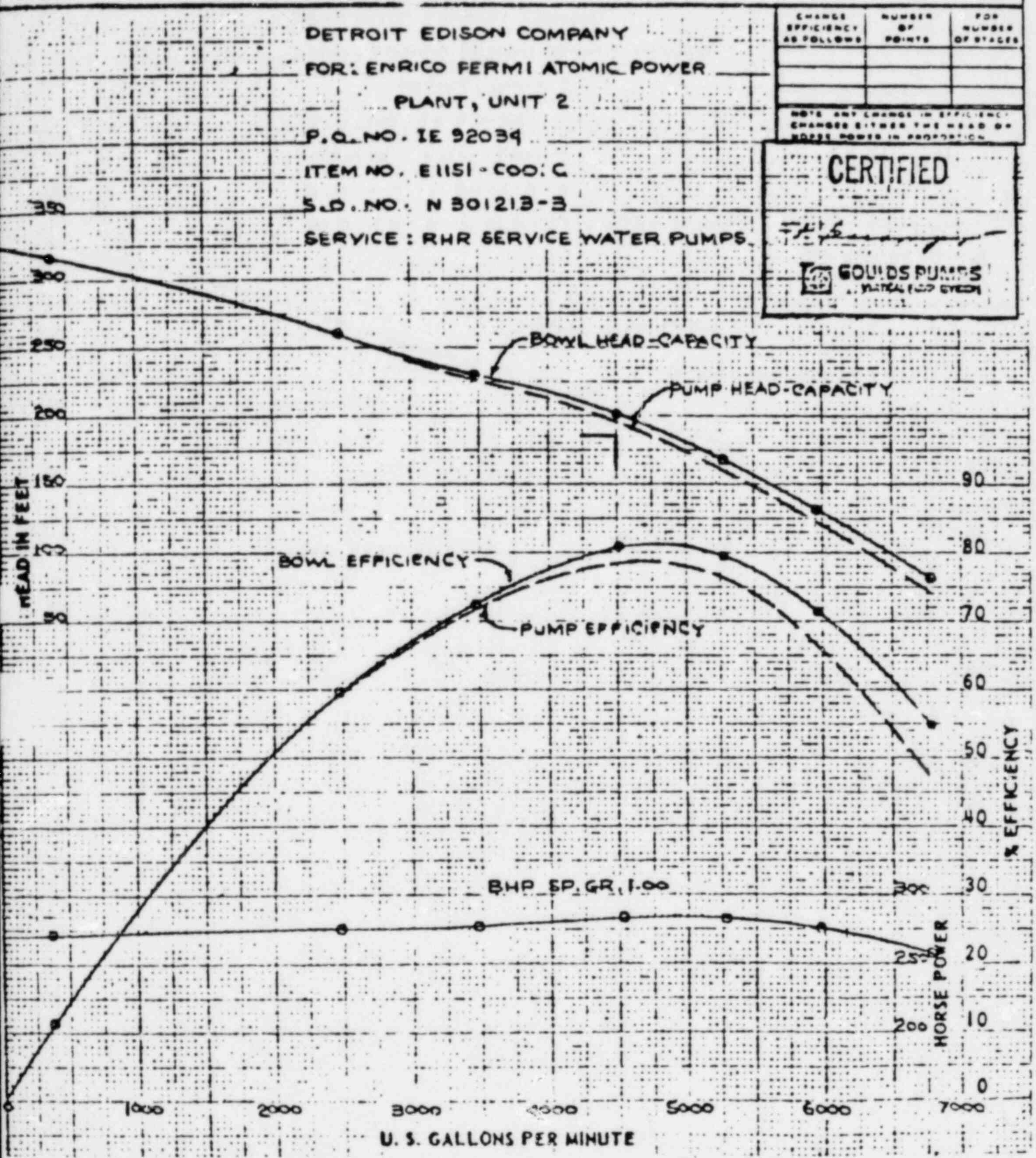
TEST NO. T-75-350

PE 12×18 HMC STAGES 2	GUARANTEED PERFORMANCE						FOR: DETROIT EDISON COMPANY
RIAL NO. N-301213-2		RPM	GPM	HEAD	HP	SP.GR.	VISC.	ENRICO FERMI ATOMIC POWER PLANT- UNIT 2
IMP'S 10 5/8 DIA 5/16 UF b2	LAB							P.O. NO. 1E 32034
IMP'S DIA UF b2	FIELD	1770	4500	155.0	300/1.0	1.0	32554	RHR SERVICE WATER PUMPS.
IAL RUNNING CLEARANCE 0. 100	TEST MOTOR 300 HP 4 POLES							
WLS STEEL	WATTMETER SCALE MULTIPLIER 320×2 = 640							
IPELLERS 316 S/S	LINE 24" MAGN. FLOWMTR d - 18" VERT C -							TESTED BY K. R DATE 8-15-75

READING	1	2	3	(4)	5	6	7	8	9	10	11	12
RPM	1784	1784	1784	1783	1783	1783	1784					
DISCH. PRESSURE-PSI	137.5	114.0	99.5	87.3	73.5	56.5	36.5					
DISCH. HEAD-FT.	317.6	263.3	229.8	201.7	169.8	130.5	84.3					
ELEVATION CORRECTION-FT.	2.3	—	—	—	—	—	—					
VELOCITY HEAD-FT.	0	0.1	0.2	0.2	0.3	0.4	0.5					
TOTAL PUMP HEAD-FT.	319.9	265.7	232.3	204.2	172.4	133.2	87.1					
FLOW ~~[illegible]~~ ,MANOMETER S.G.1.75 (BLUE)	0.00	6.70	12.60	21.20	30.10	37.[illegible]	48.50					
FLOW-GPM	0.0	2533	3473	4501	5347	6016	6815					
WATTMETER READING	.330	.344	.345	.351	.353	.343	.323					
INPUT TO MOTOR-KW	211.2	220.2	220.8	224.6	225.9	219.5	206.7					
BRAKE HORSEPOWER	267.1	278.3	279.1	283.8	285.4	277.5	261.5					
PUMP EFFICIENCY-%	0	61.07	73.0	81.85	81.88	72.91	57.30					
FRICTION LOSSES	0	1.6	2.9	4.9	7.0	8.8	11.3					
PUMP HEAD.	319.9	259.9	225.7	196.1	162.8	122.4	74.4					
PUMP EFFICIENCY	0	60.71	72.47	79.78	78.46	69.32	49.76					
PERFORMANCE CONVERTED TO 1770 RPM 1.0 SP.GR.												
TOTAL PUMP HEAD-FT.	314.9	261.5	22[illegible]	201	169.8	131.2	85.7					
FLOW-GPM	0.0	2513	34[illegible]	4473	5329	5972	6761					
BRAKE HORSEPOWER	260.8	271.7	~~270.7~~ 272.	277.6	279.2	271	255.3					
PUMP EFFICIENCY-%	0.0	61.07	~~73.[illegible]~~ 7[illegible]	81.85	81.28	72.91	57.[illegible]0					

JRVES SHOW APPROXIMATELY THE C RACTERISTICS WHEN PUMPING CLEAR NON-AERATED WATER NO GUARANTEE IS MADE EXCEPT FOR THE RATED POINT

NOTE: ALL COLUMN LOSSES ARE INCLUDED



IMPELLER ENCLOSED 10 5/8" D DIA. UP 5/16" DATE 08-20-75 BY E.D.	GOULDS PUMPS VERTICAL PUMP DIVISION INDUSTRY, CALIFORNIA	PERFORMANCE TWO STAGES 12 x 18 HMC DEEP WELL TURBINE PUMP 1770 R.P.M. CURVE SHEET NO T-75-354

PE 12X18 MMC STAGES 2	GUARANTEED PERFORMANCE							FOR: DETROIT EDISON COMPANY	
RIAL NO. N301213-3		RPM	GPM	HEAD	HP	SP.GR.	VISC.	ENRICO FERMI ATOMIC POWER PLANT-UNIT 2	
' IMP'S 100-2 DIA 5/16 UF b2	LAB							P.O. NO. 1E 92034.	
IMP'S DIA UF b2	FIELD	1770	4500	185.0	300	1.0	3255	WATER TEMP. 78.0 78.5	
IAL RUNNING CLEARANCE 0.100	TEST MOTOR 300 HP 4 POLES							Witness by D. R. Cooper DECo.	
WLS STEEL	WATTMETER SCALE MULTIPLIER 320X2 640								
PELLERS 316 S/S	LINE 16 " MAGN. FLOWMTR d - " C -							TESTED BY T.C.	DATE 8-20-75

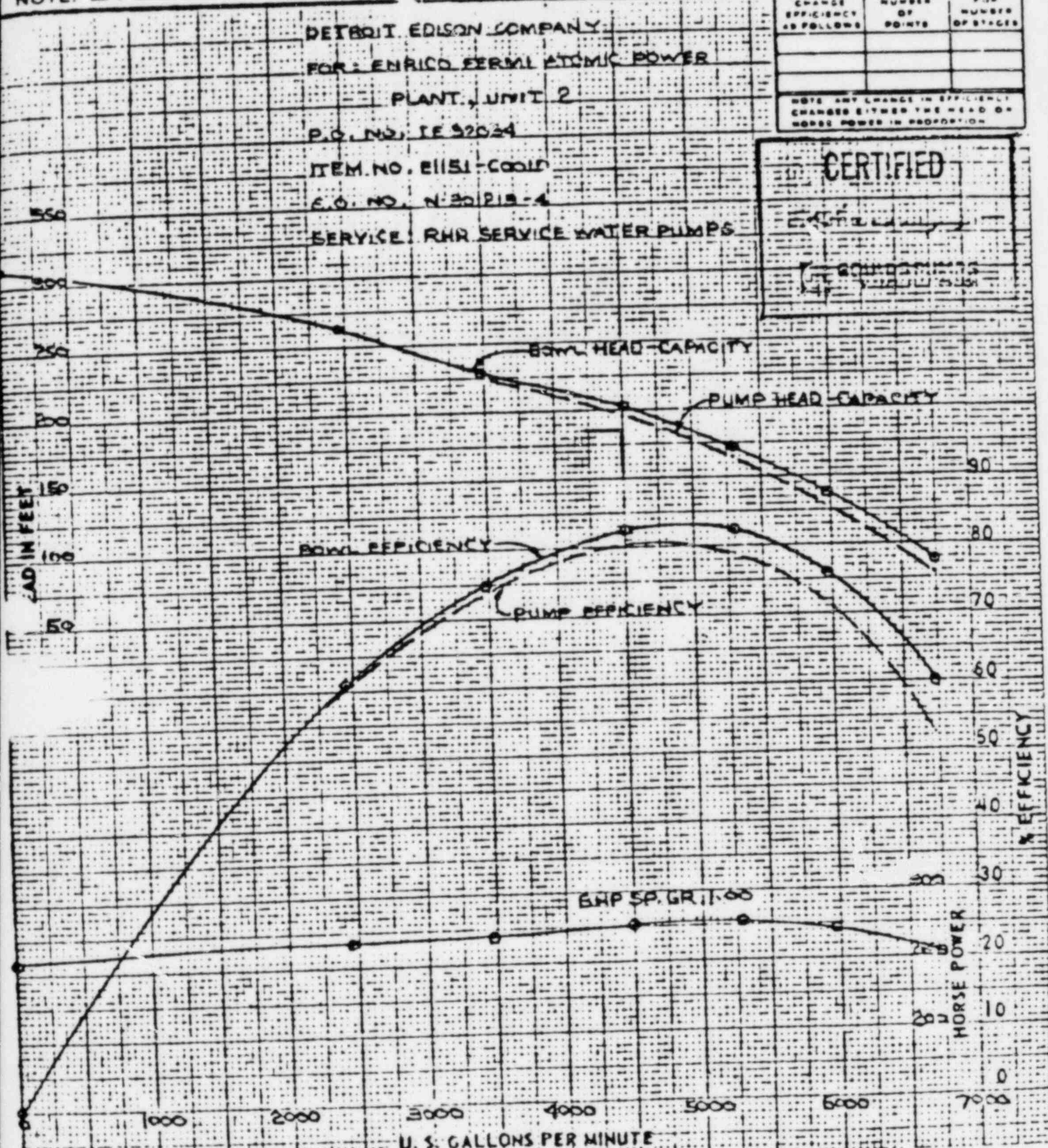
READING		1	2	3	(4)	5	6	7	8	9	10	11	12
RPM	✓	1783	1782	1782	1782	1782	1782	1784					
DISCH. PRESSURE-PSI	✓	138.5	113.6	99.80	87.0	73.1	56.2	35.0					
DISCH. HEAD-FT.		319.9	262.4	230.5	201.0	168.9	129.8	80.9					
ELEVATION CORRECTION-FT.		2.3	–	–	–	–	–	–					
VELOCITY HEAD-FT.		0.0	0.1	0.1	0.2	0.3	0.4	0.5					
TOTAL PUMP HEAD-FT.		322.2	264.8	232.9	203.5	171.4	132.5	83.7					
FLOW ~~VEL-GPM~~-~~FT/SEC~~. MANOMETER	E.C. 1175 (BLUE)	0.15	6.55	12.65	21.50	29.50	37.60	48.70					
FLOW-GPM		379	2504	3480	4537	5315	6000	6829					
WATTMETER READING	✓	.343	.347	.349	.356	.357	.349	.326					
INPUT TO MOTOR-KW		219.5	222.1	223.4	227.8	228.5	223.4	208.6					
BRAKE HORSEPOWER		277.5	280.6	282.2	287.8	288.6	282.2	263.9					
PUMP EFFICIENCY-%		11.11	59.65	72.5	81.00	79.73	71.12	54.63					
FRICTION LOSS		0	1.5	2.95	5.0	6.9	8.8	11.33					
PUMP HEAD		317.5	259.7	226.9	195.7	162.2	121.9	71.0					
PUMP EFFICIENCY		0	59.30	71.60	78.56	76.50	66.36	47.11					

PERFORMANCE CONVERTED TO 1770 RPM 1.0 SP.GR.

		1	2	3	4	5	6	7	8	9	10	11	12
TOTAL PUMP HEAD-FT.		317.55	261.2	229.8	200.7	169.1	130.7	82.30					
FLOW-GPM	a	376	2437	3456	4506	5279	5959	6775					
BRAKE HORSEPOWER		271.4	275.0	276.5	282.0	282.7	276.5	257.74					
PUMP EFFICIENCY-%		11.11	59.65	72.5	81.00	79.7	71.1	54.63					

JRVES SHOW APPROXIMATELY THE C[illegible]RACTERISTICS WHEN PUMPING CLEAR NON-AERATED WATER. NO GUARANTEE IS MADE EXCEPT FOR THE RATED POINT

NOTE: ALL COLUMN LOSSES ARE INCLUDED



PERFORMANCE	TWO	STAGES
IMPELLER ENCLOSED	12 - 18HMC	DEEP WELL TURBINE PUMP
10 5/8 D. DIA	1770	R.P.M.
UP 5/16 in	CURVE SHEET NO.	T-75-349
DATE 08-14-75 BY E.		

GOULDS PUMPS
VERTICAL PUMP DIVISION
INDUSTRY, CALIFORNIA

PUMP TEST DA[illegible]

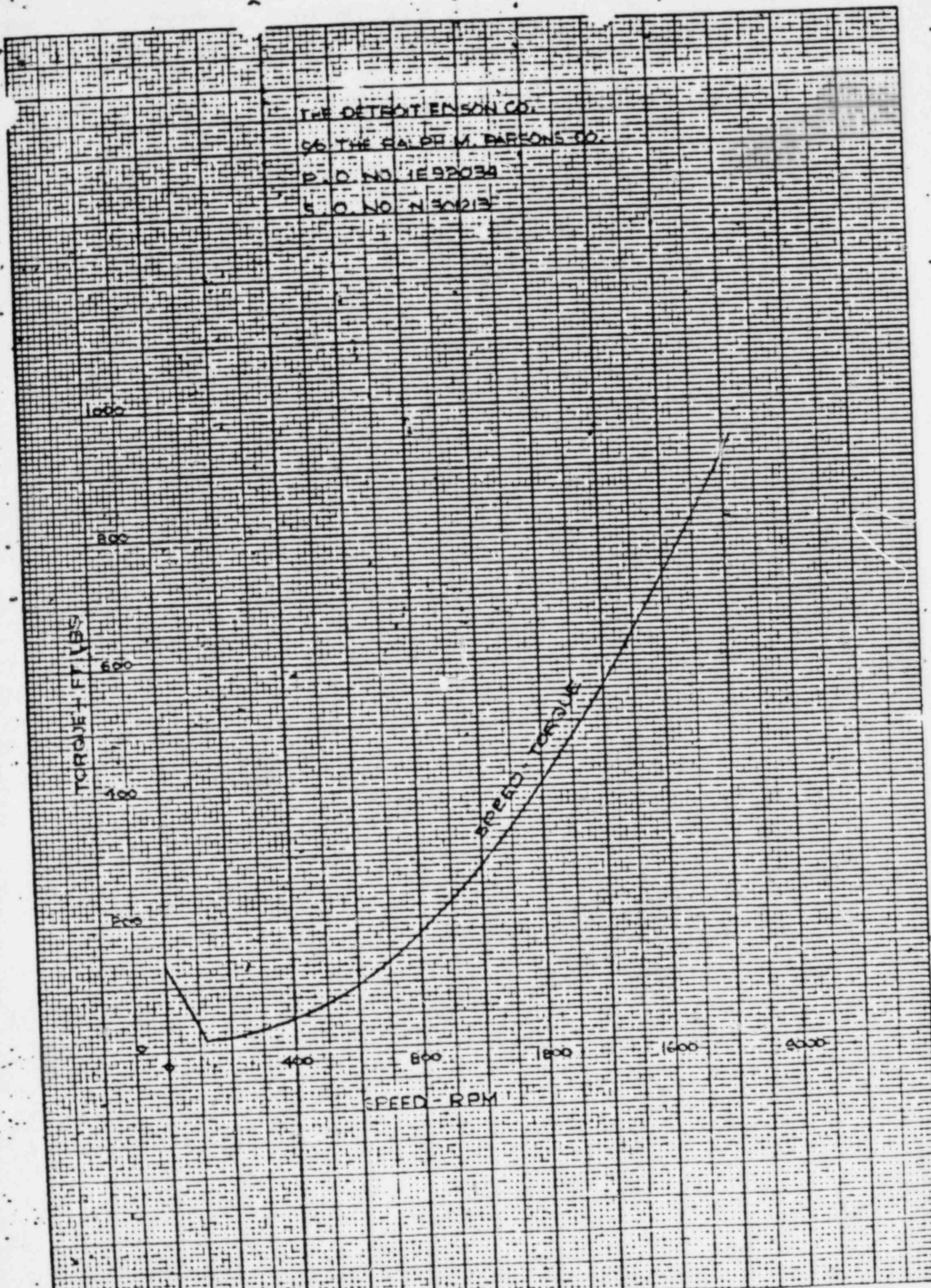
TEST NO. T-75-[illegible] 7

YPE 12×15 HMC STAGES 2	GUARANTEED PERFORMANCE						FOR: DETROIT EDISON COMPANY
ERIAL NO. N-301213-4		RPM	GPM	HEAD	HP	SP.GR. / VISC.	ENRICO FERMI ATOMIC POWER STATION UNIT 2
IMP'S 10⅞ DIA 5/16 UF b2	LAB						P.O. NO. IE 92034
IMP'S DIA UF b2	FIELD	1770	4500	185.0	300/1.0	1.0 / 21 SSU	RHR WATER SERVICE PUMPS
XIAL RUNNING CLEARANCE 0.100	TEST MOTOR 300 HP 4 POLES						
OWLS STEEL	WATTMETER SCALE MULTIPLIER 320×2=640						
MPELLERS 316 S/S	LINE 24" MAGN. FLOWMTR d-18" VENT C-						TESTED BY K.R. DATE 8-14-75

READING	1	2	3	(4)	5	6	7	8	9	10	11	12
RPM	1784	1783	1782	1782	1782	1782	1784					
DISCH. PRESSURE-PSI	137.3	114.8	99.3	87.2	74.0	59.0	38.1					
DISCH. HEAD-FT.	317.2	265.2	229.4	201.4	170.9	136.5	88.01					
ELEVATION CORRECTION-FT.	2.3	-	-	-	-	-	-					
VELOCITY HEAD-FT.	0	0.1	0.1	0.2	0.3	0.4	0.5					
TOTAL PUMP HEAD-FT.	319.5	267.5	231.8	203.9	173.5	138.9	90.8					
FLOW ~~[illegible]~~ FT/SEC. MANOMETER (SP.GR. 1.75 BLUE)	0.0	6.40	12.80	21.50	29.70	37.70	48.20					
FLOW-GPM	0.0	2475	3501	4537	5333	6008	6794					
WATTMETER READING	.327	.339	.345	.349	.351	.343	.320					
INPUT TO MOTOR-KW	209.3	217.0	220.8	223.4	224.6	219.5	204.8					
BRAKE HORSEPOWER	264.7	274.3	279.1	282.2	283.8	277.5	259.1					
PUMP EFFICIENCY-%	0	60.96	73.44	82.78	82.33	75.97	60.10					
FRICTION LOSSES	0	1.5	3.0	5.0	6.9	8.8	11.2					
PUMP HEAD	314.4	262.1	225.6	196.1	164.2	128.2	78.1					
PUMP EFFICIENCY	0	60.96	72.42	80.7	78.96	71.29	52.53					

PERFORMANCE/CONVERTED TO 1770 RPM 1.0 SP.GR.

	1	2	3	(4)	5	6	7	8	9	10	11	12
TOTAL PUMP HEAD-FT.	314.4	263.6	228.6	201.1	171.1	137.0	89.3					
FLOW-GPM	0.0	2456	3477	4506	5271	5967	6740					
BRAKE HORSEPOWER	258.5	268.2	273.5	276.5	278.1	271.	253.0					
PUMP EFFICIENCY-%	0.0	60.96	73.14	82.78	82.33	75.97	60.10					


THE DETROIT EDISON CO.
c/o THE RALPH M. PARSONS CO.
P.O. NO. 1E97034
S.O. NO. N 30213
1000
800
600
400
200
TORQUE - FT LBS
SPEED - TORQUE
0
400
800
1200
1600
2000
SPEED - RPM

73-149

GOULDS PUMPS
VERTICAL PUMP DIVISION
INDUSTRY, CALIFORNIA

COMMENDED SPARE PARTS - PER UNIT

JSTOMER THE DETROIT EDISON COMPANY

.O. NO. 1E 92034 ITEM E1151-C001A, B, C & D

MP SERIAL NO. N301213 MODEL VITX-SD 12x18HMC/2

TEM	PART	MTL.	DWG.	QTY.
)	Suction Bell Brg.	↑	B4988	1
2	Intermediate Bowl Brg.		B4987	2
1	Impeller Wear Ring	ALL	B5073	2
)	Bowl Wear Ring	MATERIALS PER	B5072	2
5	Spirol Pins (Wear Rings)	SECTIONAL DRAWING	91677-8	12
3	Spider Brg.	D1360 REV. G	B4989	8
7	Stuf. Box Brg.		IE361	1
0A	Packing Rings		90855-15	6
9A	Gasket	↓	B2749-4	1