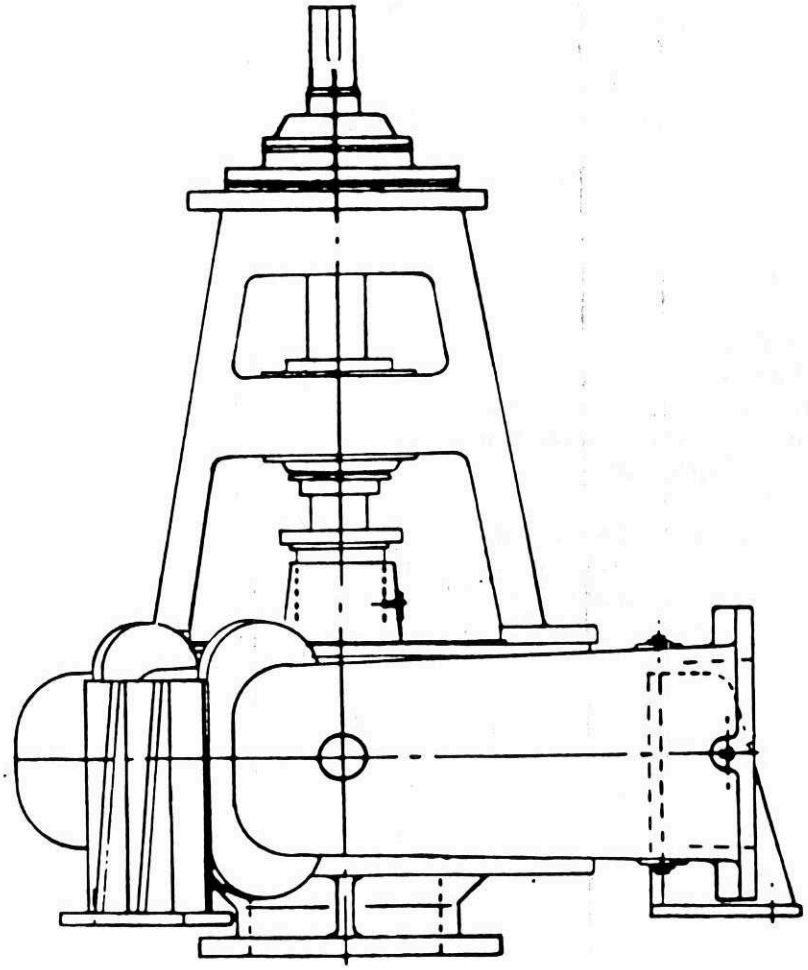
EXISTING PUMP 1 (M100PP)

GOULDS PUMPS

SLURRY PUMP DIVISION

Installation, Operation and Maintenance Instructions



Manual No
300

MODEL NCD

*** 3806**

DEALER NOTHAM MAR 06 204-452-6411

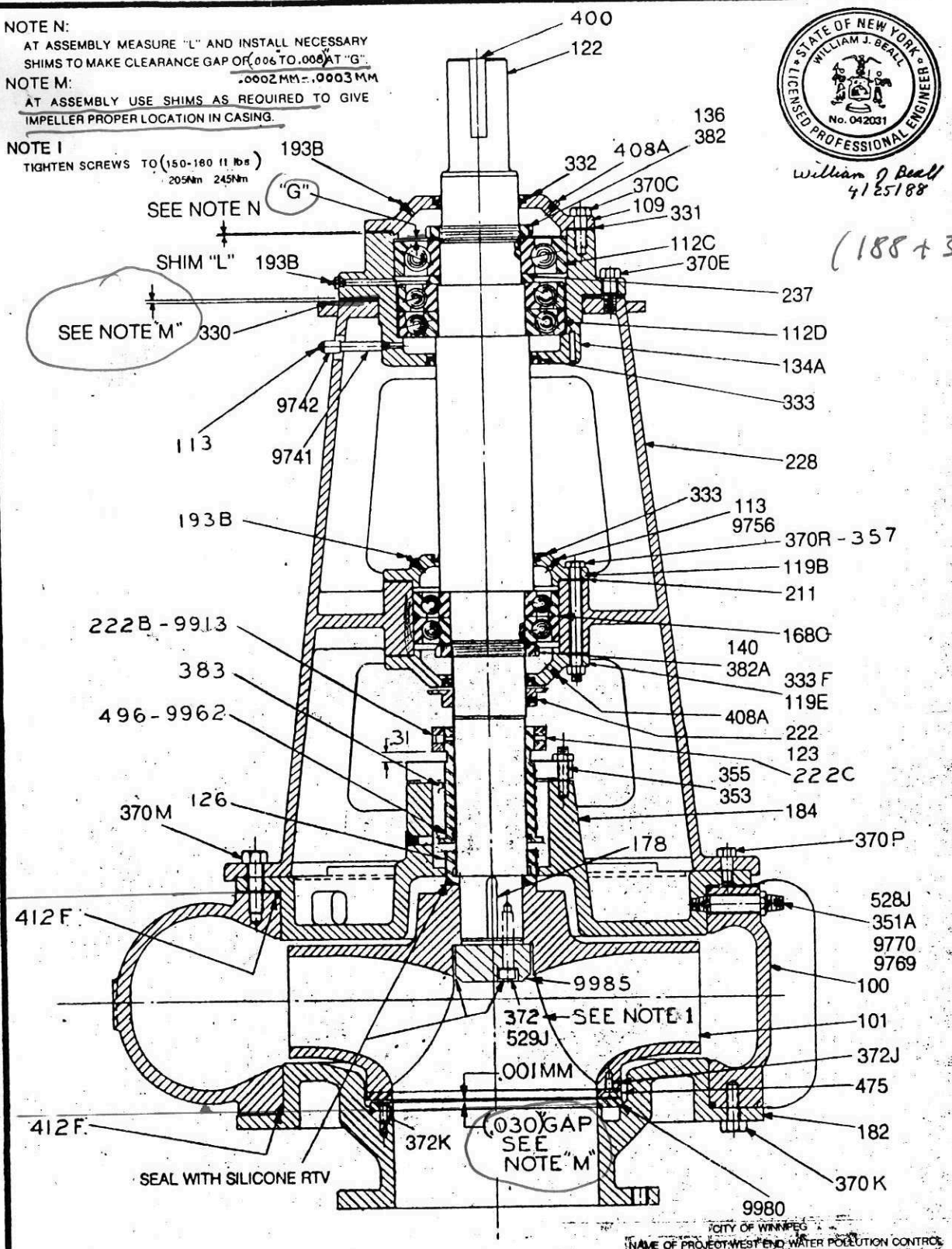
NOTE N:
AT ASSEMBLY MEASURE "L" AND INSTALL NECESSARY SHIMS TO MAKE CLEARANCE GAP OF .006 TO .008 AT "G". .0002 MM = .0003 MM

NOTE M:
AT ASSEMBLY USE SHIMS AS REQUIRED TO GIVE IMPELLER PROPER LOCATION IN CASING.

NOTE I
TIGHTEN SCREWS TO (150-160 ft lbs) 205Nm 245Nm

STATE OF NEW YORK · WILLIAM J. BEALL · No. 042031 · LICENSED PROFESSIONAL ENGINEER ·
William J Beall 4/25/88

(188 + 30 = 218)



6.920"

GAP 0.040"
DEC. 29.08 R. ZILLMAN

CITY OF WINNIPEG
NAME OF PROJECT: WEST END WATER POLLUTION CONTROL CENTRE EXPANSION PERIMETER ROAD PUMPING STATION
CITY PROJECT NUMBER: TA (RAW SEWAGE PUMP)
SPECIFICATION SECTION NUMBER: SP 16

GOULDS SERIAL NO. M-34762
CUSTOMER GOULDS CANADA
CUSTOMER P.O. NO. P89001
ITEM NO.
SERVICE RAW SEWAGE
BRG. IAB MOD. GREASE LUBE

DRAWING IS NOT TO SCALE

CERTIFIED:
☐ FOR APPROVAL
☒ FOR RECORD
BY: D.A. Skinner 4-25-88
SIGNATURE DATE

16" Model NCD SECTIONAL ASSEMBLY

GOULDS PUMPS, INC. SLURRY PUMP DIVISION

DRAWN	APPROVED	DATE
DAS		2-22-88

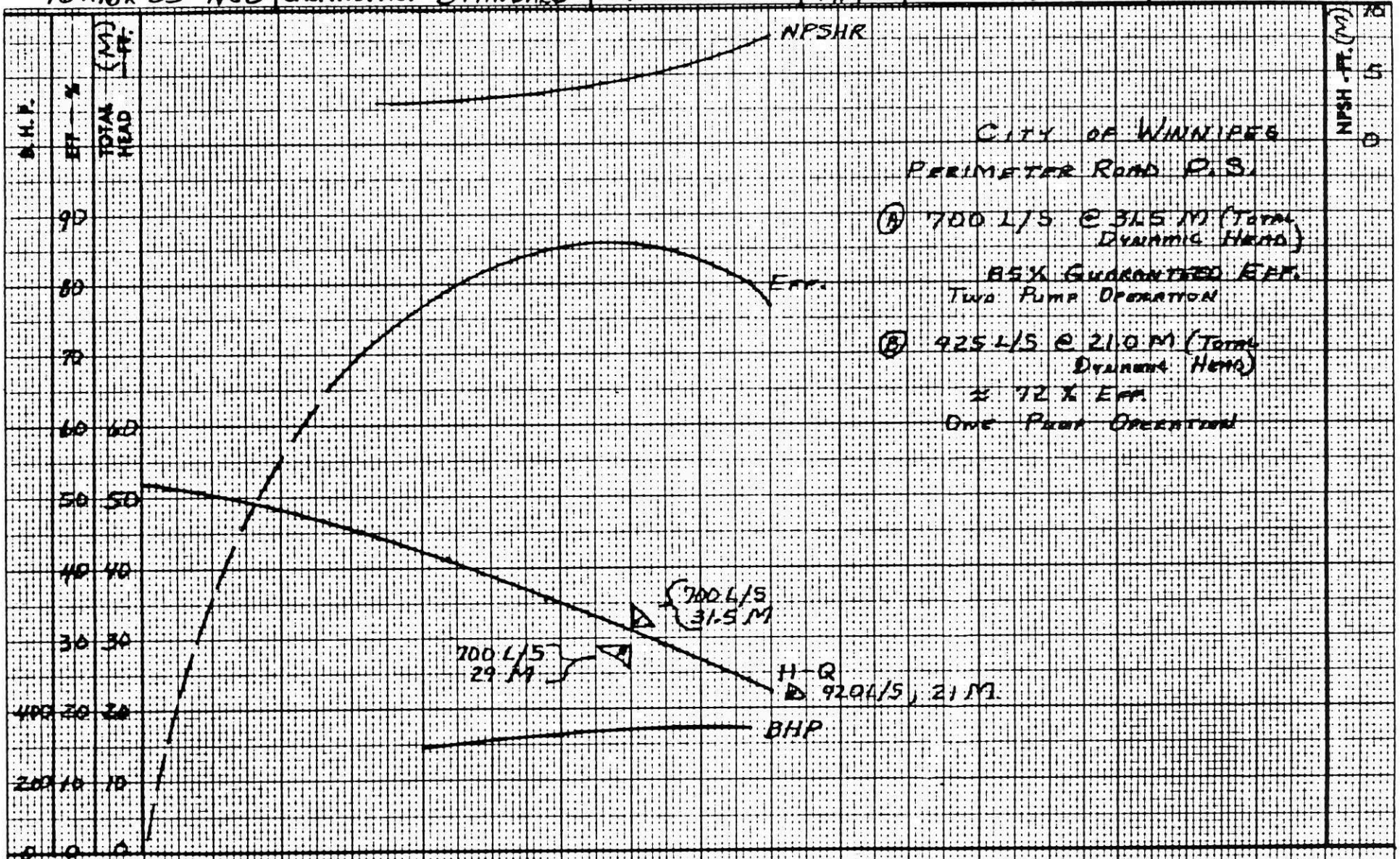
DRAWING M34762-2 REV 1

*3805

NO. 340R-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH

DIETZGEN CORPORATION
MADE IN U.S.A.

PUMP	IMP. HYD. NO.	IMP. DIA.	SPHERE		NO.
16 x 16 x 33 NCD	CAS. HYD. NO. STANDARD	NO. VANES 2	170 MM IN.	700 R.P.M.	DATE 23 Nov 87



CITY OF WINNIPEG
PERIMETER ROAD P.S.

(A) 700 L/S @ 31.5 M (Total Dynamic Head)
85% Guaranteed Eff.
Two Pump Operation

(B) 925 L/S @ 21.0 M (Total Dynamic Head)
≈ 72 % Eff.
One Pump Operation

LIQUID TEMP.	S.G. =	DRAWN =	ORDER NO.
Water 68°F (16°C)	1.0 H_s = 29.9	DBH	

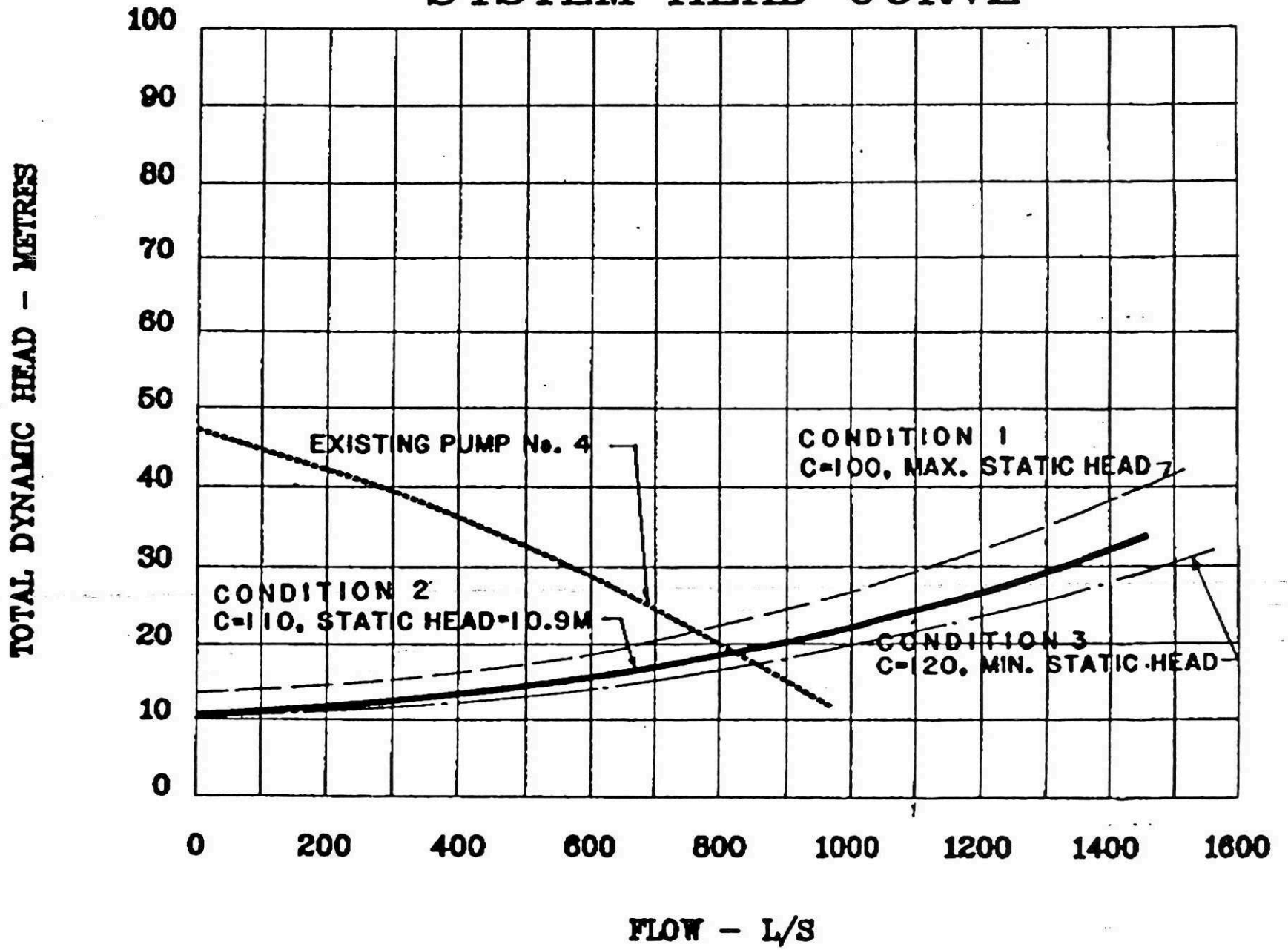
GOULDS PUMPS, INC.
A LUBY PUMP DIVISION

REF. DRAWING NO. BM 9766

*3804

FIGURE 1

SYSTEM HEAD CURVE



*3809

INSTALLATION AND OPERATING INSTRUCTIONS

TABLE OF CONTENTS

INTRODUCTION

This instruction manual is intended to assist those involved with the installation, operations and maintenance of Goulds SPD slurry pumps. It is recommended that this manual be thoroughly reviewed prior to installing or performing any work on the pump or motor.

IMPORTANCE OF INSTRUCTIONS

The design, material and workmanship incorporated in the construction of Goulds' pumps makes them capable of giving long, trouble-free service. The life and satisfactory service of any mechanical unit, however, is enhanced and extended by periodic inspection and careful maintenance. This Instruction Manual was prepared to assist operators in understanding the construction and correct methods of installing, operating and maintaining these pumps.

Study and follow the instructions for installation and operation. Keep this instruction manual handy for reference. Further information can be obtained by contacting the Slurry Pump Division, P.O. Box 419, Baldwinsville, New York 13027.

SPECIAL WARNINGS

Goulds' Slurry Pump Division will not be liable for any damages or delay caused by failure to comply with the provisions of this Instruction Manual. This pump is not to be operated at speeds, working pressure, discharge pressures, or temperatures higher than, nor used with liquids other than stated in the original order acknowledgement, without written permission of the Slurry Pump Division, Goulds Pumps, Inc.

Any modifications to the procedures or requirements covered in this manual should be in accordance with good engineering and shop practice.

RECEIVING INSPECTION - SHORTAGES

Care should be taken when unloading pumps. If shipment is not delivered in good order and in accordance with the bill of lading, note the damage or shortage on both receipt and freight bill. MAKE ANY CLAIMS TO THE TRANSPORTATION COMPANY PROMPTLY.

PRESERVATION AND STORAGE

Goulds' Slurry Pump Division's normal domestic shipping and storage preparation is suitable for protecting the pump during shipment. It also provides protection during covered storage at the jobsite and for a short period between installation and start-up. If the pump is to be idle and exposed to the elements for an extended period, either before or after installation, special precautions are required. One approach is to provide special preservatives and wrapping before shipment; however, after installation, the protective wrappings will have been removed. Therefore, application of preservatives after installation is considered good practice. Hand rotation of the shaft is recommended every 30 days to prevent damage to bearings.

-- SPECIAL NOTICE --

ORDERING SPARES

When ordering spare parts for this pump, always refer to the pump serial number and part number. This will avoid delays in identification. In certain cases where pumps are furnished with special metals, deliveries are quite lengthy. It is therefore advisable to anticipate your requirements several months in advance so that possible long deliveries will not handicap your operation.

INSTALLATION INSTRUCTIONS

VERTICAL DRY PIT PUMPS

LOCATION OF UNIT

The pump should be located in an area free from flooding, with sufficient overhead height for ease of installation and removal. There should also be access space around the pump for the required maintenance.

FOUNDATION

The pump foundation must be sufficiently substantial to give rigid support to the pump and to absorb vibration. The pump casing is typically supported above the floor with a metal pump support or reinforced concrete piers. Lateral rigidity is required to minimize vibration in the horizontal plane. Strong attachment of the piers to the foundation is important to prevent rocking of the piers. Any movement at the base of the piers results in a larger movement at the pump.

An anchor bolt assembly has a sleeve to allow lateral movement of the bolt after it has been cast in the concrete. Anchor bolts should be located in the concrete by a template dimensioned from the pump installation drawing. The top of the sleeve should be temporarily sealed with waste material to prevent concrete from entering during the concrete pouring operation.

DISCHARGE PIPE

The pipe must be supported independently near the pump to prevent any strain being transmitted to the pump.

It is recommended that a check valve be used in the discharge line to protect the pump from reverse flow and excessive pressure during a shut down when there is a high static head.

SUCTION PIPE

The suction pipe should also be supported near the pump and must not have a flow regulating valve. (A shutoff valve is acceptable.)

Air leaks may cause a reduction in performance or a complete loss of prime if the pump operates with a suction lift. Excessive friction losses will cause cavitation.

INSTALLING PUMP ON FOUNDATION

The pump unit is placed on the foundation and leveled with shims at the proper height to match the piping. Grout under the pads and tighten the anchor bolts after the grout has hardened. Using nuts under the pads on the anchor bolts to level and support the unit will not allow the top side nuts to push the pads tight onto the grout. If the pump unit is not tight on the foundation, there may be problems with vibration.

An illustration page shows a typical support pad installed on a pier.

OPERATING AND MAINTENANCE INSTRUCTIONS

DRIVE ALIGNMENT

DIRECT CONNECT MOTORS

Check parallel alignment by placing a straight edge across the two coupling flanges or using a dial indicator. Check angular alignment with a micrometer or feeler gauge. Measure from the outside of one flange to the outside of the other at intervals around the periphery of the coupling. Alignment of drive and pump should be within .003" or within the coupling manufacturers specifications. See illustration at the end of these instructions.

DRIVE SHAFTS

A drive shaft is used when the motor is not direct connected to the pump. Depending on the choice, the drive shaft may use flexible couplings or universal joints.

Flexible couplings require the same alignment limits as close coupled applications, but the longer distance between the couplings gives more allowable parallel offset between the motor and pump for the same angular misalignment at each coupling. Coupling life depends on good alignment.

Universal joint drive shafts require some parallel offset to cause proper lubrication of the needle bearings in joints. It is important to have the motor shaft parallel with the pump shaft.

The manufacturers instructions for the couplings or complete drive shaft must be followed for proper operation and service life.

LUBRICATION AND SHAFT SEALS

GREASE LUBRICATION

The bearing housing is properly filled before shipment. Under normal conditions, grease should be added as required at regular intervals and care should be taken not to over-lubricate. Use Shell Alvania No. 2, Mobile Mobilux No. 2, Texaco Multifak No. 2, Sun Oil Company Prestige No. 42, American Oil Company Amolith Grease No. 2 or equal. When it becomes necessary to replace the bearing housing seals, the housing and the bearings should be flushed clean with a solvent and repacked with new grease. Over-lubrication results in excessive bearing temperatures.

SHAFT SEALS

Exposed shaft seals, for the bearing housing, should be given a few drops of oil before the initial start up to insure lubrication. The area around the shaft seals should be kept clean to avoid excessive wear at the seal lip and dirt entering the bearing housing.

STUFFING BOX

LUBRICATION

A clear liquid such a water must be supplied at a pressure 10-15 PSI higher than the liquid pressure inside the pump where the shaft exits the stuffing box to keep abrasive pumpage out of the sealing surfaces. Grease is used for the lubricant when water is not available.

General purpose and process pumps have two (2) taps. The second tap is usually plugged but can be used for an outlet when cooling is required for high temperature application. The outlet has to be restricted to maintain pressure inside the stuffing box. Double mechanical seals also require in and out connections; one or both may be in the gland.

If the stuffing box is on the suction side of the impeller, the lubricant supply pressure is based on the suction pressure. This also applies for pumps with expellers when the pump is not operating. Assume the pressure at the shaft for all other pumps is the discharge pressure.

PACKING AND ADJUSTMENT

A significant amount of lubricating liquid should leak from gland side of stuffing box. Operate pump for at least 15 minutes before tightening gland nuts. Make small, even gland nut adjustments to reduce leakage. Allow adequate run-in time between adjustments. Acceptable leakage may be from 30 drops per minute to a small stream to keep the temperature of the leakage below 130°F.

NOTE: Do not overtighten gland nuts. Packing may set permanently and require removal. Overtightened packing causes excessive friction between packing and sleeve, and will result in damaged components. A noticeable temperature increase in stuffing box would indicate insufficient lubrication.

Periodic maintenance is required for all packed stuffing boxes.

Normal shaft runout should be under .005 inch to avoid pounding of stuffing box packing. With excessive shaft runout, shaft straightening or replacement is necessary.

When repacking the stuffing box, be sure the packing ends are staggered and the seal cage is located as shown on the liquid end drawing. Each packing ring should be formed and cut on a mandrel to obtain the correct size with a minimum gap at the ends.

PUMP START UP AND OPERATION

Check the following items before the initial pump startup:

1. The driver rotation for being correct before the driver is connected to the pump. Some pumps have parts that could unscrew, causing considerable damage, if the pump was started in the reverse direction.

2. The shaft turns free by hand with due consideration for normal bearing and sealing drag.

3. All foundation, piping and coupling bolts have been properly tightened.

4. The required lubrication has been supplied to all components; bearings, couplings and stuffing box.

5. The pump is completely primed, i.e. no air in the impeller.

WARNING: DO NOT OPERATE THE PUMP WITHOUT PROPER DRIVE GUARD IN PLACE.

After the pump has been started monitor the operation for any sign of developing problems.

Do not continuously operate the pump against a closed discharge valve.

WARNING: OPERATING A PUMP WITH A CLOSED SUCTION AND DISCHARGE VALVE PRESENTS A GREAT DANGER OF A VIOLENT FAILURE BECAUSE THE HORSEPOWER OF THE DRIVER IS DIRECTLY CONVERTED TO HEAT INSIDE THE CASING.

MAINTAINED CAPACITY

Pumps having a suction liner or suction wear ring are provided with a method for repositioning the impeller to restore the proper clearance on the suction side of the impeller. Wear at this gap will lessen the amount of liquid being pumped because of excessive leakage through the gap.

Instructions of resetting the impeller clearance are given in the Bearing Assembly Instructions. The normal clearance is shown on the Liquid End Assembly drawing or in the liquid end instructions.

LOCATING PROBLEMS

1. Conditions Causing Insufficient or No Discharge

   a. Pump not primed

      The pump generally cannot be primed with the shaft turning. Air leaks may cause pump to lose prime especially at low flow rates while discharge valve is being opened.

   b. Excessive head requirements

      Extra pipeline length and increases in pipe elevation require the pump to develop more head for the same flow rate.

   c. Insufficient NPSH available

      Extra suction pipe length and pump elevation above the water level reduce the NPSH available to the pump.

   d. Worn pump components

      Wear at the impeller ring gap increases the internal leakage and is correctable without disassembly.

   e. Insufficient pump speed

f. Pipeline or pump clogged or partially clogged.

g. Wrong direction of rotation

2. Conditions Causing Excessive Power Consumption

a. Pump speed too high

b. Pump not operating at design capacity

Pump is operating at higher HP point of its performance curve.

c. Mechanical rubbing or binding of rotating parts

Rubbing at the impeller can cause considerable power loss in the pump. The equivalent power loss in a bearing or stuffing box would produce high temperature.

3. Conditions Causing Excessive Bearing Temperatures

a. Misalignment of the bearings

This should be checked first if the problem developed immediately after any work was done that could have changed the bearing alignment.

b. Insufficient amount of lubricant

c. Excessive amount of lubricant

The problem is noticed a short time after lubricant is added to the bearings.

d. Deteriorated lubricant

A gradual, over a period of days, temperature rise above the ambient temperature indicates a deterioration of the lubricant around the rolling elements provided the bearing is not generating unusual noise.

e. Bearing failing

This will cause an increase in its noise.

4. Conditions Causing Excessive Vibration

a. Partially clogged impeller

b. Foundation not properly supporting pump

c. Misalignment

d. Mechanical defects

Bent shaft, failed bearing, impeller out of balance.

5. Conditions Causing Water Hammer

Water hammer is a high pressure surge through a pipeline resulting from an event that forces all the liquid in the line to rapidly change velocity.

a. Rapid valve closing

b. Lack of a vacuum breaker in pipeline going over a hill

c. Full speed filling a pipeline that has a sudden pipe friction increasing section down stream from the pump.

PUMP LIQUID END

IMPELLER WEAR RING CLEARANCE

The following tabulation gives the wear ring clearance for the pump based on the size of the discharge:

Pump Discharge Size	Clearance
6"-10"	.025"
12"	.030"
16"	.035"
20"-30"	.040"
36"-48"	.045"

LIQUID END DISASSEMBLY

Any step requiring removing or separating components also means removal of the fasteners securing the parts together.

1. Close the valves to the pump and drain the liquid from the pump casing.

2. Remove any equipment, such as drives or drive shaft, above the pump to allow lifting the rotating element free of the casing.

3. Remove lubricant lines to the stuffing box and the stuffing box cover drain line. If the drain pipe goes through the casing and into the stuffing box cover, it must be removed.

4. Mark the flanges, frame, stuffing box cover, and casing for parts orientation at reassembly.

5. Remove the pump rotating assembly from the casing. The wear rings, #475 and #9980, can be removed and replaced if required.

6. Remove impeller plate #9985.

7. Pull the impeller, #101, off the shaft. If wedges are used behind the impeller, they should be located behind the vanes rather than in the middle of an unsupported shroud area.

8. Remove the stuffing box cover, #184, from the shaft assembly.

9. Remove the shaft sleeve from the shaft. This could be done after step 7.

10. Remove the gland, packing and lantern ring from the stuffing box.

LIQUID END REASSEMBLY

Reassembly is the reverse sequence of disassembly. The following notes apply:

1. Silicone RTV is used to seal the impeller hub at the shaft sleeve and impeller plate.

2. If heat is used to facilitate installation of the impeller on the shaft, be careful to apply heat gradually to the impeller hub. Hard irons are also brittle and more likely to crack from thermal shock than cast iron impellers.

3. Tighten the impeller locking screws, #372, to the torque given below:

Screw Size	Lb. - Ft.
5/8 - 11	60 - 80
3/4 - 10	90 - 120
7/8 - 9	150 - 180
1 - 8	240 - 300

4. Be sure O-ring, #412F, is in place before the rotating assembly is lowered into the casing.

5. If the impeller or wear rings were replaced, loosen the screws fastening the thrust bearing housing, #134A, to the frame to prevent damage to the outboard bearing if there is no ring clearance gap when the stuffing box cover is tightened to the casing.

PUMP BEARING ASSEMBLY

CLEARANCE ADJUSTMENT

To adjust the impeller wear ring gap:

1. Loosen the cap screws fastening the thrust bearing housing, #134A, to the frame.
2. Uniformly turn jack screws to lift the thrust bearing housing enough for removing the shims, #330.
3. Uniformly back off the jack screws, while turning the pump shaft by hand, until the impeller rubs.
4. Use feeler gauges and a block to measure the gap between the thrust bearing housing and frame where the shims were. If the gap is not uniform around the thrust bearing housing, readjust the jack screws until it is uniform.
5. To the measured gap, add the required ring gap found in the liquid end section or on the liquid end assembly drawing. This is the required shim stack thickness.
6. Make up shim stacks. They must have the same thickness to prevent thrust bearing misalignment.
7. Jack screw up the thrust bearing housing, install the shims, lower the housing onto the shims, and secure with cap screws.
8. Check for uniform gap between the shim stacks to be sure there isn't any bearing misalignment.

BEARING DISASSEMBLY

The bearing illustration shows ball bearings. Application requirements may have required roller bearings at one or more of the locations, however that does not affect these instructions.

1. Remove the inboard bearing covers and the inboard slinger (deflector).
2. Remove the cap screws securing the thrust bearing housing to the frame. Slide the shaft assembly out of the frame.
3. Remove the outboard bearing cover, #109.
4. Remove the bearing locknuts and lockwashers. There may be one or two sets.

5. Slide the thrust bearing housing towards the radial bearing. Press the thrust bearing stack off the shaft by pushing against the inner race of the thrust bearing.

6. Press the inboard bearing off the shaft. There may be one or two bearings at the inboard end.

7. Remove and replace shaft seals as required.

BEARING ASSEMBLY

1. Make sure the shaft and parts are clean and free from nicks or burrs.

2. Slide the inboard bearing cover and thrust bearing housing to the middle of the shaft between the bearing seats.

3. Heat the bearings to 200°F and slide into position against the shaft shoulders.

   Note: If there are two (2) separate inboard bearings, #168C, mounted together, they have to be "Universal Ground" or installed with a .010" thick spacer shim between the inner races to prevent possible preload at the outer races.

4. Install lockwashers and locknuts, tightening as the bearings cool. Set lockwasher tangs.

5. Hand pack each bearing envelope one-third full of grease.

6. Temporarily install the outboard end cover with two cap screws, partially tight.

7. Measure the gap between the cover and thrust bearing housing.

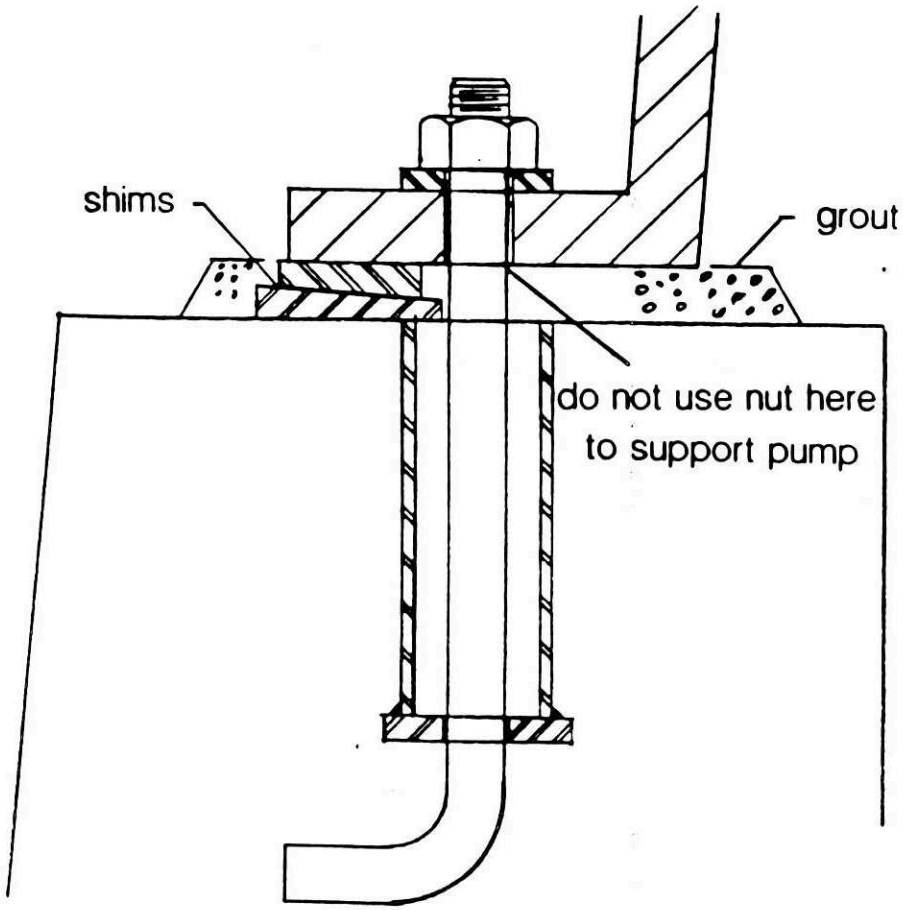
8. Make a shim stack .008" thicker than the measured gap. Remove the cover and reinstall with the shim.

   Note: The object is to have enough end play in the thrust bearing stack to prevent bearing axial preload from thermal expansion without having excessive end play.

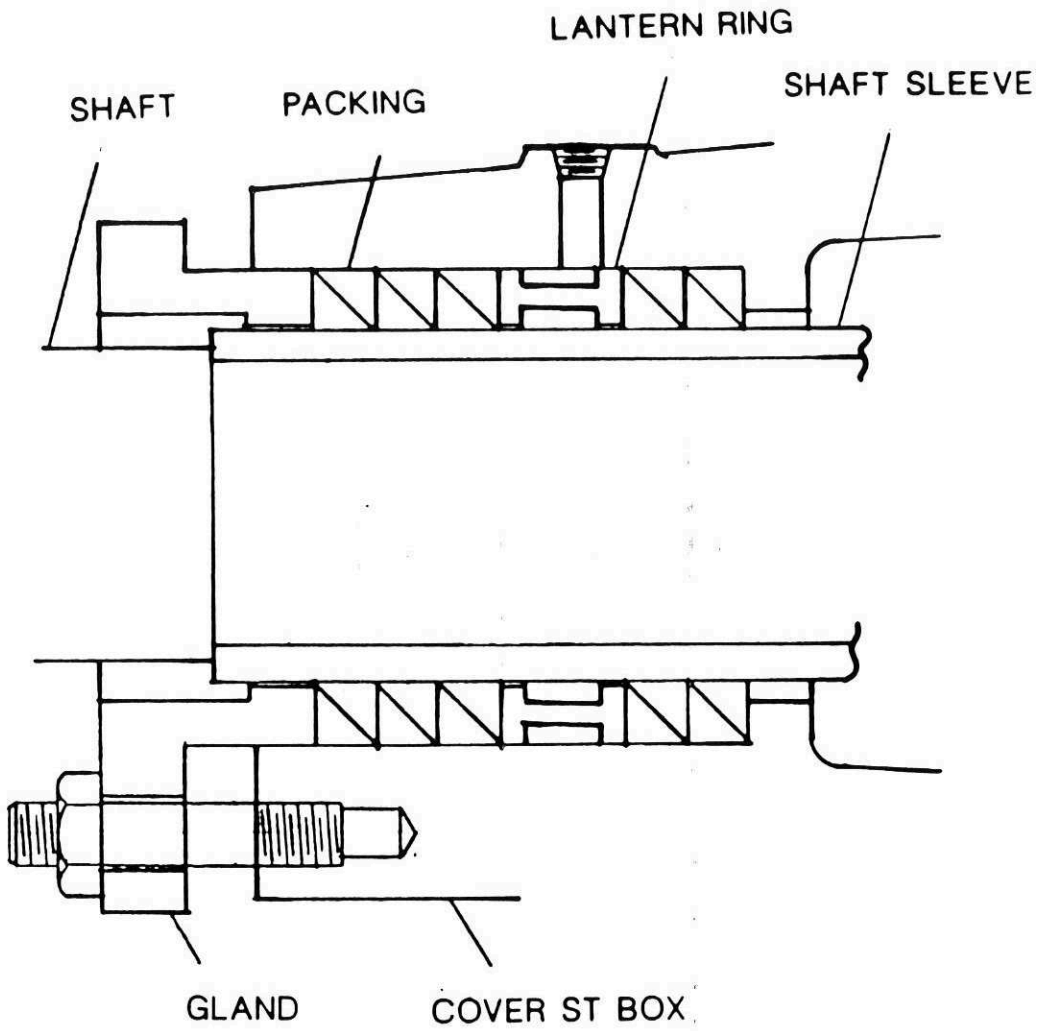
9. Install the shaft assembly in the frame. Leave the cap screws which fasten the thrust bearing housing to the frame loose until the shims have been made for the impeller clearance.

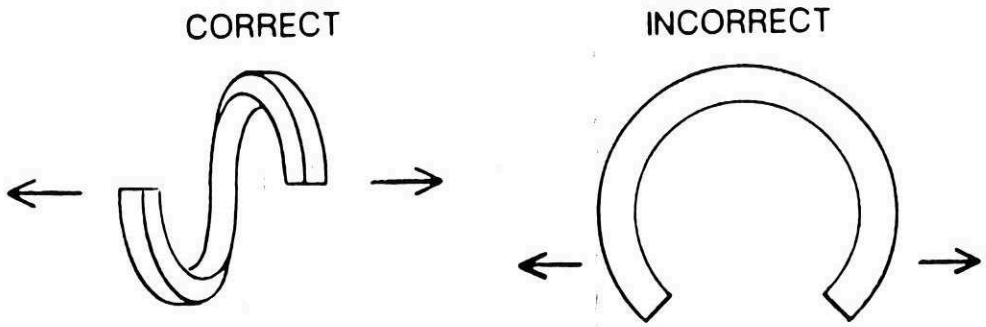
10. Install the inboard bearing covers and deflector.

11. Continue the pump assembly. Refer back to the liquid end assembly notes.



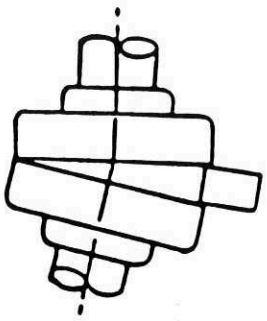
TYPICAL INSTALLATION ON THE FOUNDATION



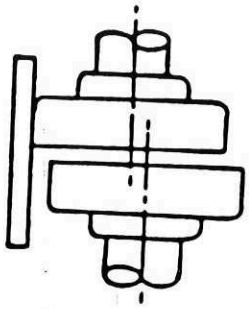


STUFFING BOX PACKING

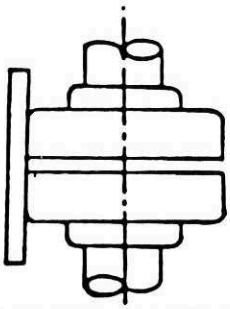
INSTALLATION AND OPERATING INSTRUCTIONS



ANGULAR MISALIGNMENT

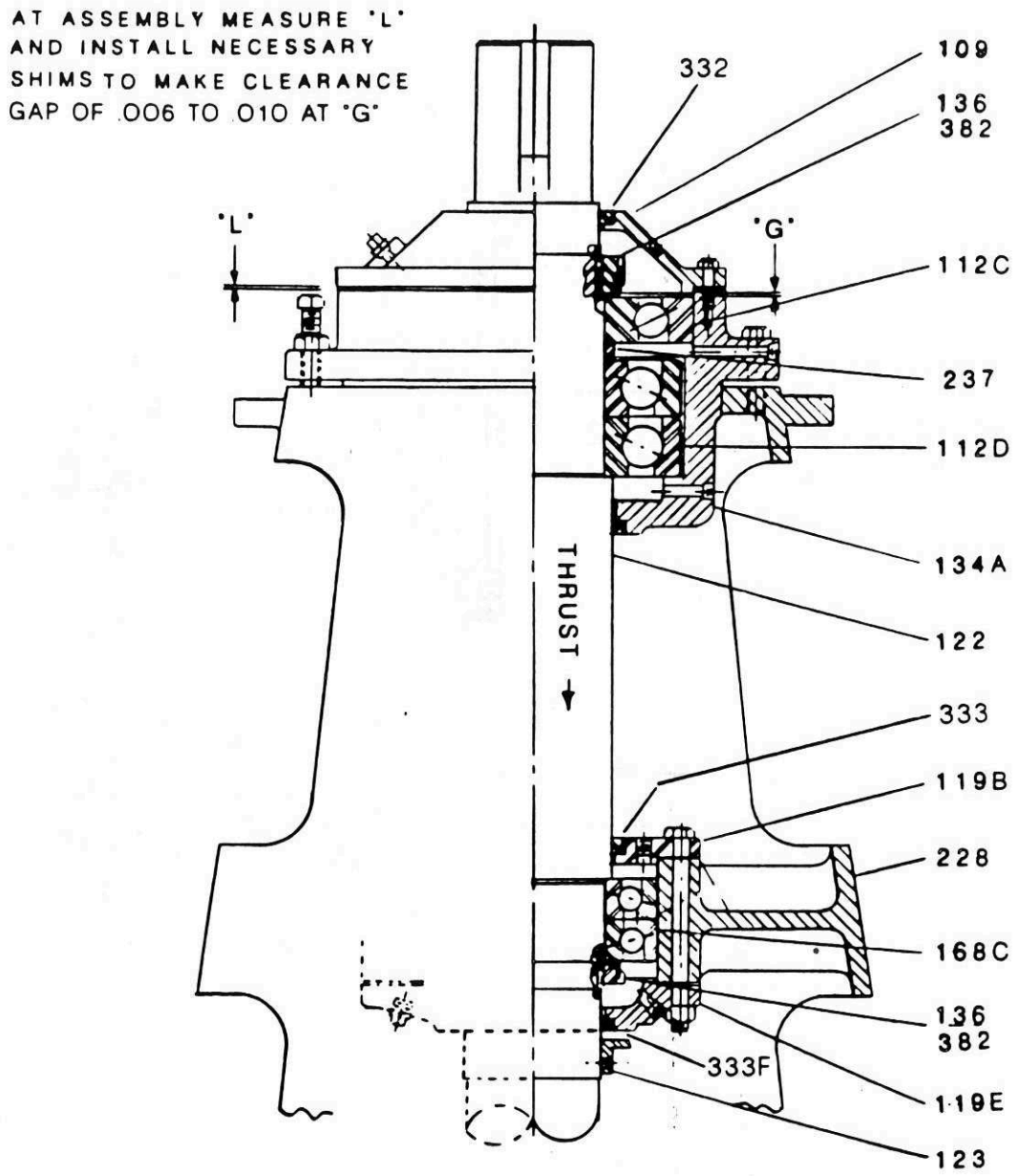


PARALLEL MISALIGNMENT

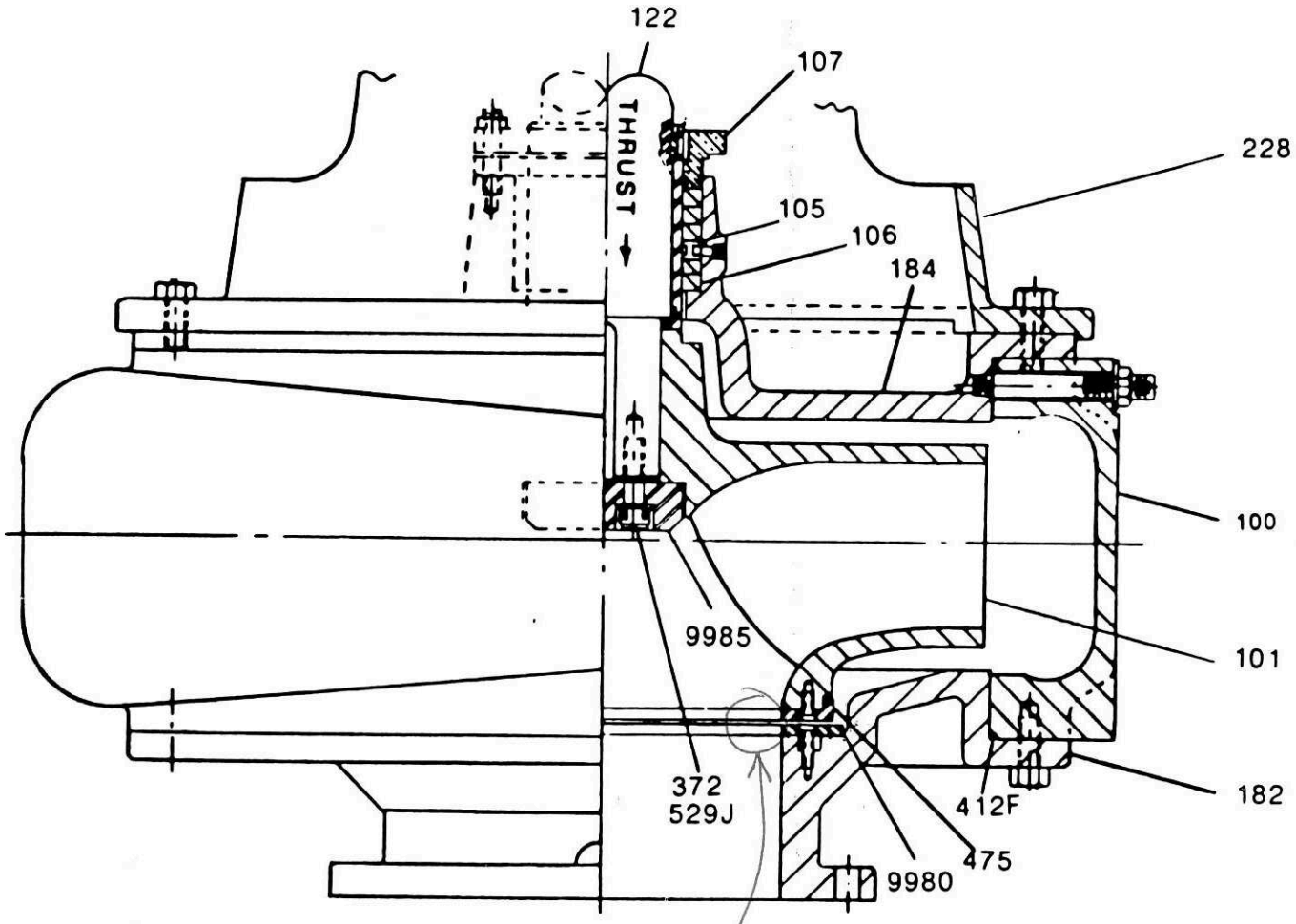


PERFECT ALIGNMENT

COUPLING ALIGNMENT



BEARING ASSEMBLY


122
107
228
THRUST
105
106
184
100
9985
101
372
529J
412F
182
475
9980
TIGHTEN ITEM # 372
TO TORQUE GIVEN
IN THE INSTRUCTIONS
0.035"
WEAR
RING
CLEARANCE.

LIQUID END

TYPICAL RECOMMENDED SPARE PARTS LIST

ITEM	QTY./PUMP	PART NAME
101	1	Impeller
105	1	Lantern Ring
106	1 set	Packing
107	1	Gland
126	1	Shaft Sleeve
351A	1	Gasket
360B	1	Gasket
412F	2	O-Ring
475	1	Ring, Impeller
9980	1	Ring, Suction Cover
9985	1	Plate, Impeller Lock
112C	1	Bearing, Thrust
112D	2	Bearing, Thrust
168C	2	Bearing, Radial
330	12	Shim, Impeller Adjustment
331	1	Shim, Bearing Cover
332	1	Seal, Outboard Grease
333	2	Seal, Inboard Grease
333F	1	Seal, Inboard Grease

GOULDS PUMPS INC.
SLURRY PUMP DIV.

BILL OF MATERIAL SERIAL NO: PM34762

CUST NO:3926 SERIAL NO:M34762 QTY: 1

CUSTOMER:GOULDS PUMPS CANADA INC. MODEL : NCD 16X16-33

CUST PO:P89001/83112 MATERIAL : 3% NICKEL

END USER: CITY OF WINNEPEG ROTATION:CW

DIMENSION DWG:M34762-1 REV.2 CONFIG:COUPLED

SECTIONAL DWG:M34762-2 REV.1 DISCH POS:SIDE

INSTRUCTION MANUAL: 300 SUCT. POS. : BOTTOM

WRITTEN:D. SKINNER DATE: 3/14/88 BEARING:1AB MOD. - GREASE

*3812

SECTION 1 ACCESSORIES AND REQUIREMENTS SECTION 1

* INDICATES QUANTITY AS SHOWN.

ITEM	PART NAME	MATERIAL	QTY/ PUMP	PART NUMBER DRAWING	MAIL	REMARKS

HYDROSTATIC TEST: 195 PSIG - HOLD FOR FIVE MINUTES

PERFORMANCE TEST: REQUIRED - WITNESSED
(SPECIAL PENALTY FOR EFF.)

PAINT: SPD-STANDARD SURFACE PREPARATION AND PRIMER

NAME PLATE DATA:
S.G.: 1.0, CAPACITY: 11,096 GPM, BHP: 342.8,
TOTAL HEAD: 104 FT., SPEED: 705 RPM

MOTOR: U.S.E.M., FR. #5810P, 400 HP, 705 RPM
BY CUSTOMER - COMING FOR TEST

VFD: BY CUSTOMER - COMING FOR TEST

QUALITY ASSURANCE PROCEDURE: SPD-MORRIS STANDARD

PUMP - BEARING LIFE: B10, 100,000 HOURS

3230

BILL OF MATERIAL SERIAL NO: PM34762

SECTION 1 ACCESSORIES AND REQUIREMENTS SECTION 1

* INDICATES QUANTITY AS SHOWN.

ITEM	PART NAME	MATERIAL	QTY/ PUMP	PART NUMBER DRAWING	MAIL	REMARKS
		WATSON FLEXIBLE SHAFTING FOR VERTICAL APPLICATION WITH 400 HP, 705 RPM ELECTRIC MOTOR (OR EXACT EQUAL)				
122A	SHAFT		1			LOWER SHAFT, WVA-150 5.62 X .313 WALL TUBE X 64.75" LG., DYNAMIC BALANCED.
122B	SHAFT	STEEL	1	A00049G002	3230	(122A) PUMP FLANGE
122C	SHAFT	STEEL	1		3230	UPPER SHAFT, WVB-150 5.62 X .313 WALL TUBE X 120.00" LG., DYNAMIC BALANCED.
122D	SHAFT	STEEL	1	A00079G002	3230	(122C) MOTOR FLANGE
122E	SHAFT	STEEL	1	A00006G016	3230	(122D) & CUSTOMER MOTOR AT FINAL ASSEMBLY (CIRCULAR KEY)
122F	SHAFT		1			(122C) H.S. WATSON STEADY BRG. W91-17-1 FOR 3.19 DIA. SHAFT
383	MECH SEAL		1			(9962)(184) JOHN CRANE SINGLE, MATERIAL 1B1D1 S.G. 1.0, SHAFT SPEED 705 RPM. ALL IN ACCORDANCE WITH SPEC. PARA 16.3.9 AND PER ADVNACE REQUISITION BY S. FITZGERALD, 2/19/88.
9551	MISC		1			(9852) MECHANALYSIS IRD TYPE 544M SHIELDED VIBRATION PICK UP.
9715	DET-TEMP		1			(134A) CONEX R.T.D. 100 OHM PLATINUM 3 WIRE PART NO. 43Y3-SS25-T8-MK250A-L = 6.00" 0 DEG. C = (32 DEG. F.).

BILL OF MATERIAL SERIAL NO: PM34762

SECTION 2 PUMP WET END SECTION 2

* INDICATES QUANTITY AS SHOWN.

ITEM	PART NAME	MATERIAL	QTY/ PUMP	PART NUMBER DRAWING	MAIL	REMARKS
100	CASING	3% NICKEL	1	056041G590	1053	
101	IMPELLER	3% NICKEL	1	056163G470	1053	
		IMPELLER DIA. : 31.625				
		2V, DYNAMIC BALANCE TO WITHIN 28 OZ. INCHES				
122	SHAFT	1141 STEEL	1	056162G980	2211	
126	SHAFT SLEEVE (122-101)	304SS CAST	1	B00638G000	1284	
175	COVER-HAND H (315A)	3% NICKEL	1	049696G010	1053	
175A	COVER-HAND H (100)	3% NICKEL	1	052304G000	1053	
178	KEY-IMPELLER (101-122)	STEEL	1	A00123G001	3230	
182	COVER-SUCT. (100)	3% NICKEL	1	052147G010	1053	
184	COVER-ST BOX (100)	3% NICKEL	1	056004G100	1053	
222B	SCR-SOC SET (9962-122)	18-8 SS 1/4" X 1-1/2" LG.	3	A00104G212	2367	
222C	SCR-SOC SET (9913-9962)	18-8 SS 1/4" X 3/8" LG.	3	A00104G204	2367	
315A	ELBOW-SUCT (100-315A)	3% NICKEL	1	049677G000	1053	
340	MOTOR MOUNT (CUST. MOTOR)	STEEL	1	W00146G000	3230	
351	GASKET	RUBB CLOTH	1	A00152G008	5120	

BILL OF MATERIAL SERIAL NO: PM34762

SECTION 2 PUMP WET END SECTION 2

* INDICATES QUANTITY AS SHOWN.

ITEM	PART NAME	MATERIAL	QTY/ PUMP	PART NUMBER DRAWING	MAIL	REMARKS
		(182-315A)				
351A	GASKET	RUBB CLOTH	1	A00128G001	5120	
		(100-528J)				
353	STUD-GLAND	BRONZE-40	2	A00118G257	1102	
		(184-383) 3/4" X 3-3/4" LG.				
355	NUT-GLAND	BRONZE-40	2	A00102G010	1102	
		(353) 3/4"				
357F	NUT-HEX	STEEL	16	A00102G013	3230	
		(370W) 1"				
357G	NUT-HEX	STEEL	4	A00102G010	3230	
		(370X) 3/4"				
357H	NUT-HEX	STEEL	16	A00102G004	3230	
		(370Y) 3/8"				
357J	NUT-HEX	STEEL	2	A00102G004	3230	
		(370Z) 3/8"				
360B	GASKET	RUBB CLOTH	1	A00057G001	5120	
		(100-175A)				
360L	GASKET	RUBB CLOTH	1	A00152G007	5120	
		(175-315A)				
370K	SCREW-HEXCAP	STEEL	24	A00100G401	3230	
		(100-182) 1" X 2-1/4" LG.				
370L	SCREW-HEXCAP	STEEL	8	A00100G303	3230	
		(100-175A) 3/4" X 1-3/4" LG.				
370M	SCREW-HEXCAP	STEEL	24	A00100G410	3230	
		(100-184-228) 1" X 3-1/4" LG.				
370P	SCREW-HEXCAP	STEEL	4	A00100G400	3230	
		(184-228) 1" X 2" LG.				

BILL OF MATERIAL SERIAL NO: PM34762

SECTION 2 PUMP WET END SECTION 2

* INDICATES QUANTITY AS SHOWN.

ITEM	PART NAME	MATERIAL	QTY/ PUMP	PART NUMBER DRAWING	MAIL	REMARKS
370U	SCREW-HEXCAP	STEEL (9551-9852)	4	A00100G003	3230	1/4" X 1" LG.
370V	SCREW-HEXCAP	STEEL (175-315A)	8	A00100G302	3230	3/4" X 1-1/2" LG.
370W	SCREW-HEXCAP	STEEL (315A-182)	16	A00100G407	3230	1" X 4-1/2" LG.
370X	SCREW-HEXCAP	STEEL (340-CUST. MOTOR)	4	A00100G310	3230	3/4" X 3-1/4" LG.
370Y	SCREW-HEXCAP	STEEL (501)-(340)	16	A00100G102	3230	3/8" X 1" LG.
370Z	SCREW-HEXCAP	STEEL (228-9852)	2	A00100G108	3230	3/8" X 2-1/2" LG.
372	SCR-HEX SOC	STEEL (9985-122)	4		3230	7/8"-9 NC2 X 3-1/4" LG.
372J	SCR-FLAT HD	18-8 SS (101-475)	8		2367	1/2"-13 NC2 X 1-1/4" LG.
372K	SCR-FLAT HD	18-8 SS (182-9980)	8		2367	1/2"-13 NC2 X 1-3/4" LG.
400	KEY-COUPLING	STEEL	1	A00121G400	3230	
408B	PLUG-PIPE	CAST IRON (315A)	1	A00113G008	1000	1-1/2", DRAIN CONN. ELBOW
408F	PLUG-PIPE	CAST IRON (100)	1	A00113G005	1000	3/4"
408G	PLUG-PIPE	CAST IRON (100)	1	A00113G009	1000	2", DRAIN CONN.
408K	PLUG-PIPE	CAST IRON	2	A00113G003	1000	

BILL OF MATERIAL SERIAL NO: PM34762

SECTION 2 PUMP WET END SECTION 2

* INDICATES QUANTITY AS SHOWN.

ITEM	PART NAME	MATERIAL	QTY/ PUMP	PART NUMBER DRAWING	PART NUMBER MAIL	REMARKS
		(184-9753) 3/8"				
412F	O RING	BUNA N (100-182 & 184)	2	A00125G601	5156	
475	RING-IMP	420SS CAST BRINELL 350-400	1	056018G770	1525	
496	O RING	BUNA N (9962)-(122)	1	A00125G203	5156	
501	GUARD-CPLG	STEEL	4	C00147G000	3230	(340) USE GUARD AS TEMPLATE, DRILL MTG. HOLES AT ASSEMBLY.
528J	WASHER	STEEL	1		3230	(351A-9770) 1-1/8" ID X 2-1/2" OD STD.
529J	WASHER-LOCK	STEEL	4		3230	(372-9985) 7/8" STD. HELICAL TYPE
9616	PAINT		1			(GAL.) CHLORINATED RUBBER GOYNE PAINT, MIXED TO MATCH 933 FEDERAL SAFETY GREEN AS MANUFACTURED BY RUSTOLEUM
9617	PAINT		1			(GAL.) THINNER #641 FOR ABOVE PAINT (ITEM 9616)
9723	SCREW-DRIVE	18-8 SS	2	A00127G001	2367	
9725	NAME PLATE	18-8 SS	1	056203G410	2367	
9750	FITTING-PIPE	STEEL	2		3230	(100-315A) HEXAGON BUSHING, 3/4"-14 NPT X 3/8"-18 NPT
9751	FITTING-PIPE	STEEL	2		3230	(9750) PIPE NIPPLE, 3/8"-18 NPT X 2" LG.
9752	FITTING-PIPE		2			(9751) BRONZE, GAUGE COCK APOLLO BALL VALCE #70-102-01

BILL OF MATERIAL SERIAL NO: PM34762

SECTION 2 PUMP WET END SECTION 2

* INDICATES QUANTITY AS SHOWN.

ITEM	PART NAME	MATERIAL	QTY/ PUMP	PART NUMBER DRAWING	MATL	REMARKS
						3/8"-18 NPT CONN'S. FOR CUST. SUCTION & DISCH. GAUGES
9753	FITTING-PIPE	STEEL	1		3230	
	(100) HEXAGON BUSHING, 1-1/2"-11-1/2 NPT X 3/8"-18 NPT					
9769	FITTING-PIPE	STEEL	1		3230	
	(100-184) PIPE NIPPLE, 10" LG. 3/4"-14 NPT BOTH ENDS, 3/4"-14 NPSL X 5" ONE END					
9770	FITTING-PIPE	CAST IRON	1	040500G050	1000	
	(9769-528J) PIPE LOCKNUT, 3/4"-14 NPSL					
9852	BRACKET	STEEL	1	X00646G000	3230	
	(228)					
9913	SPACER-SEAL	304 SS	1	B00640G000	2361	
	(9962)					
9962	SLEEVE	304SS CAST	1	B00639G000	1284	
	(122-383)					
9980	RING-SUC COV	420SS CAST	1	056027G190	1240	
	(182) BRINELL 450 MIN.					
9985	PLATE-IMP LK	1045 STEEL	1	056135G060	2358	
	(101)					

BILL OF MATERIAL SERIAL NO: PM34762

SECTION 5 BEARING FRAME SECTION 5

* INDICATES QUANTITY AS SHOWN.

ITEM	PART NAME	MATERIAL	QTY/ PUMP	PART NUMBER DRAWING	MAIL	REMARKS
109	END COVER OB	CAST IRON	1	052876G000	1000	
112C	BEARING-THR		1	9001240304		
	SKF #6324 OR EQUAL					
112D	BEARING-THR		2	9001287203		
	MRC 7228 PDU OR EQUAL, DT MOUNTING					
113	FIT-RELIEF		2			
	(9742)(9756) ALEMITE #47200, 1 TO 5 LBS., 1/8"-27 NPT					
119B	END COVER IB	CAST IRON	1	056004G150	1000	
119E	END COVER IB	CAST IRON	1	053794G000	1000	
123	DEFLECTOR	CAST IRON	1	056004G180	1002	
134A	HOUS-OB BRG	CAST IRON	1	056170G720	1000	
136	LKNT-OB BRG		1	9141024104		
	AN-24					
140	LKNT-IB BRG		1	9141026104		
	AN-26					
168C	BEARING-RAD		2	9001260203		
	MRC 226 RDU OR EQUAL, DB MOUNTING					
193B	FITTING-GR		3			
	(134A-109-119B) ALEMITE #1627-B, 1/4"-18 NPT					
211	GASKET	VELLUMOID	2	A00152G038	5130	
	(119B & 119E-228)					
222	SCR-SOC SET	18-8 SS	3	A00104G253	2367	
	(122-123) 3/8" X 3/8" LG.					
222F	SCR-SQHD SET	STEEL	2		3230	
	(134A) 3/4"-10 NC2 X 3-1/2" LG.					

BILL OF MATERIAL SERIAL NO: PM34762

SECTION 5 BEARING FRAME SECTION 5

* INDICATES QUANTITY AS SHOWN.

ITEM	PART NAME	MATERIAL	QTY/ PUMP	PART NUMBER DRAWING	MAIL	REMARKS
228	FRAME	CAST IRON	1	056004G140	1000	
237	COLLAR-OBBRG 1020-1018		1	052869G000	2201	
330	SHIM-IMP ADJ ALUM (LAM) (228-134A)		12	056044G020	3124	
331	SHIM-BRG CAP PLASTIC (109-134A)		1	046957G240	6310	REQUIRES: 3-.005, 2-.0075 & 2-.020 THK.
332	SEAL-OB GR (109) J-M #9170 LUP, OR EQUAL 4.50 ID X 5.50 OD X .500 WD.		1	9241114071		
333	SEAL-IB GR (119B & 134A) J-M #8511 LUP, OR EQUAL 6.00 ID X 7.25 OD X .500 WD.		2	9241152093		
333F	SEAL-SB (119E) J-M #7234*LPD, OR EQUAL 4.875 ID X 6.25 OD X .500 WD.		1	9241124079		
357	NUT-HEX (370R) 1/2"	STEEL	6	A00102G007	3230	
357A	NUT-HEX (222F) 3/4"	STEEL	2	A00102G010	3230	
370C	SCREW-HEXCAP (109-134A) 3/4" X 1-1/2" LG.	STEEL	6	A00100G302	3230	
370E	SCREW-HEXCAP (134A-228) 3/4" X 2-1/4" LG.	STEEL	8	A00100G305	3230	
370R	SCREW-HEXCAP (119B-119E-228) 1/2" X 6" LG.	STEEL	6	A00100G218	3230	
382	LKWH-OB BRG W-24		1	9389024104		

BILL OF MATERIAL SERIAL NO: PM34762

SECTION 5 BEARING FRAME SECTION 5

* INDICATES QUANTITY AS SHOWN.

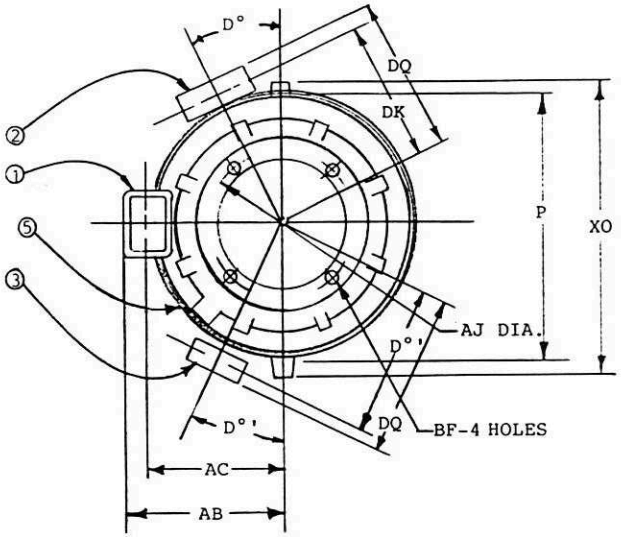
ITEM	PART NAME	MATERIAL	QTY/ PUMP	PART NUMBER DRAWING	MAIL	REMARKS
382A	LKWH-TB BRG W-26		1	9389026104		
408A	PLUG-PIPE (109)(119E)	CAST IRON 1/4"	2	A00113G002	1000	
9741	FITTING-PIPE (134A-9742) 1/8"-27 NPT BOTH ENDS X 4" LG.	STEEL PIPE NIPPLE	1		3230	
9742	FITTING-PIPE (9741-113)	STEEL PIPE COUPLING, 1/8"-27 NPT STD.	1		3230	
9756	FITTING-PIPE (119B-113)	STEEL BUSHING, 1/4"-18 NPT X 1/8"-27 NPT	1		3230	

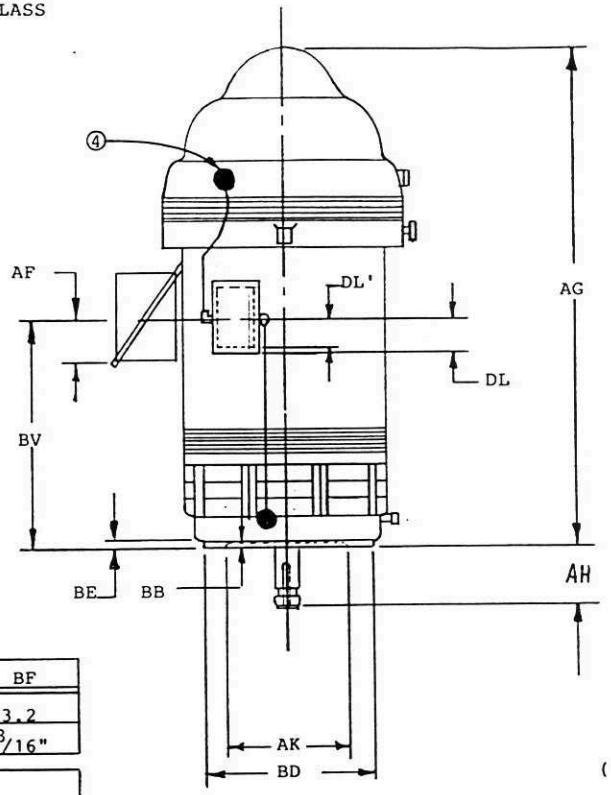
NOTE : ALWAYS REFER TO PART NUMBER, SERIAL NUMBER AND MODEL WHEN ORDERING PARTS OR CORRESPONDING WITH FACTORY.

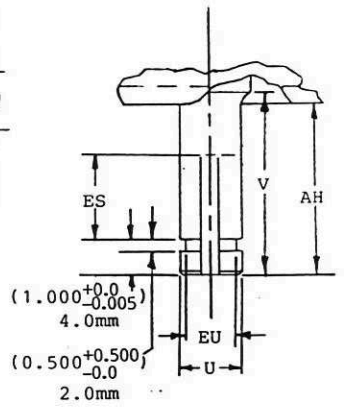
*** END OF BILL ***

FEATURES:

1 MAIN CONDUIT BOX WITH REMOVABLE BOTTOM CONDUIT PLATE (3/8" GLASS REINFORCED PLASTIC). 2 SEPARATE ACCESSORY BOX FOR WINDING AND BEARING DETECTOR LEADS (IRD 544, QTY. 2) 1" CONDUIT. 4 BEARING RTD (QTY. 2). 5 VIB. DETECTOR (2).







ALL DIMENSIONS ARE IN INCHES

FRAME		P	AA	AB	AC	AF	AG	AJ DIA	AK	BB	BD	BE	BF
5810 P TYPE HV	mm	133.6	--	130.7	--	41.3	297.0	102.4	86.6	1.0	120.1	4.0	3.2
	in.	34"	--	33 3/16	--	10 1/2	75 7/16	26"	22"	1/4"	30 1/2"	1"	13/16"

FRAME		BV	AH	U	V MIN	XO	SQ.KEYxES	EU			
5810 P TYPE HV	mm	11.2	27.6	12.3	--	155.5	2.0 x 19.7	10.3			
	in.	28 3/4"	7"	3 1/8"	--	39 1/2"	3/4" x 5"	2 5/8"			

FRAME		DK	DQ	DL	D°	DK'	DQ'	DL'	D°'
5810 P TYPE HV	mm	71.9	86.4	19.7	98.4	70.9	76.0	13.3	98.4
	in.	18 1/4"	21 15/16"	5"	25"	18"	19 5/16"	3 3/8"	25"

NOTE: Mfg. TOLERANCES TO IMPERIAL MEASURE

CITY OF WINNPIEG
WEST END WATER POLLUTION CONTROL CENTER
PERIMETER PUMP STATION
SECTION SP-17 CONTRACT 1A

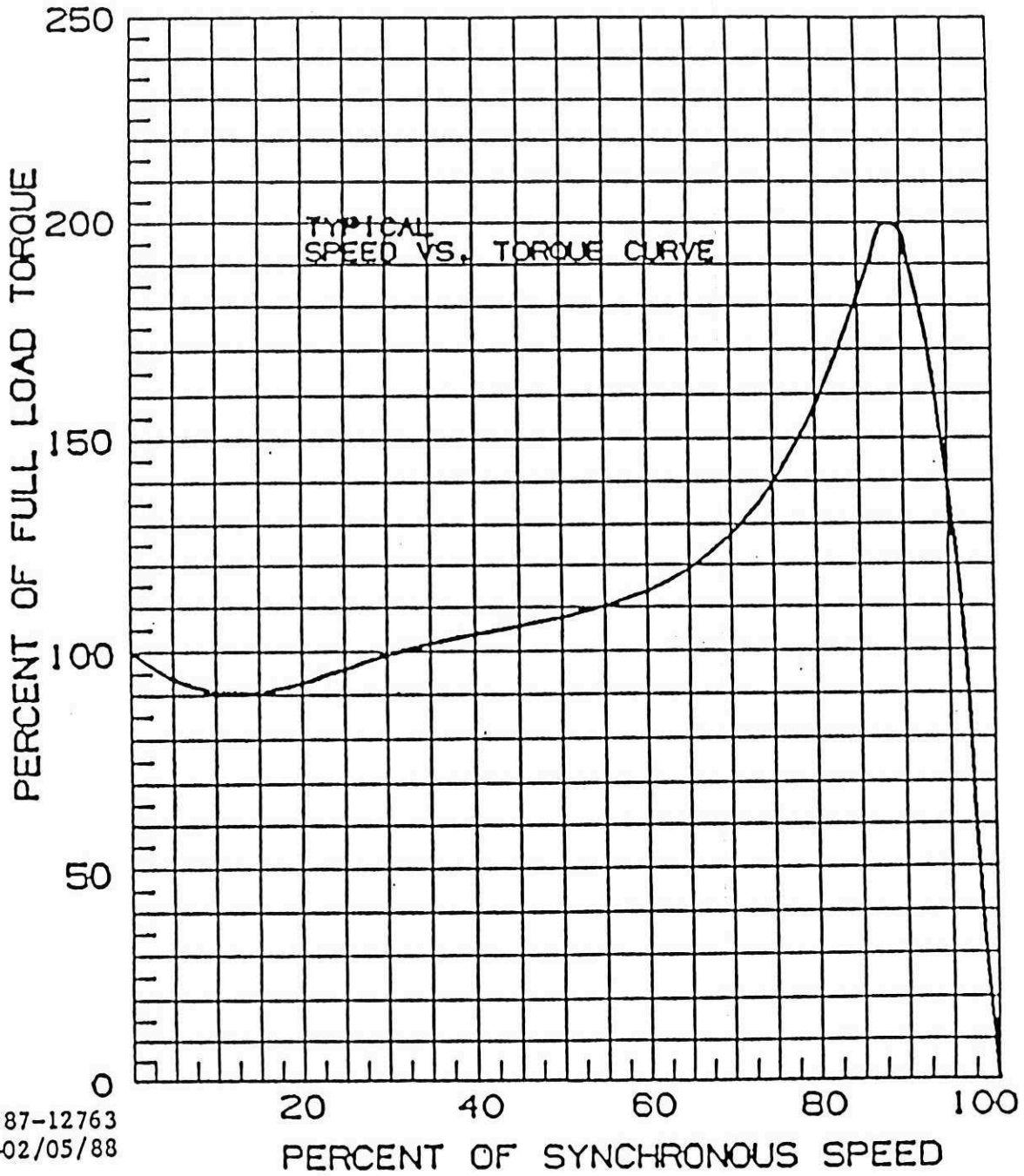
PRITCHARD ENGINEERING COMPANY LIMITED WINNIPEG MANITOBA

SCALE: NONE
DRN: DOS CHK'D: APP'D: DOS
DATE: 2-29-88
FIRST USED ON:
NEXT ASS'Y:
DWG: * 3815 REV.

TITLE U.S. ELECTRICAL MOTORS 20-C-625

CUSTOMER: EMERSON ELECTRIC CANADA
CUSTOMER P O: PE41902
USEM ORDER NO: R0320148
FULL LOAD TORQUE: 2980 LBFT

RATINGS: 400 HP, 10 POLE
3/60/575
5810 FRAME, TYPE HV



DR #587-12763
RHF--02/05/88

CITY OF WINNIPEG
WEST END WATER POLLUTION CONTROL CENTER
PERIMETER PUMP STATION
SECTION SP-17 CONTRACT 1A

DWG. * 3816

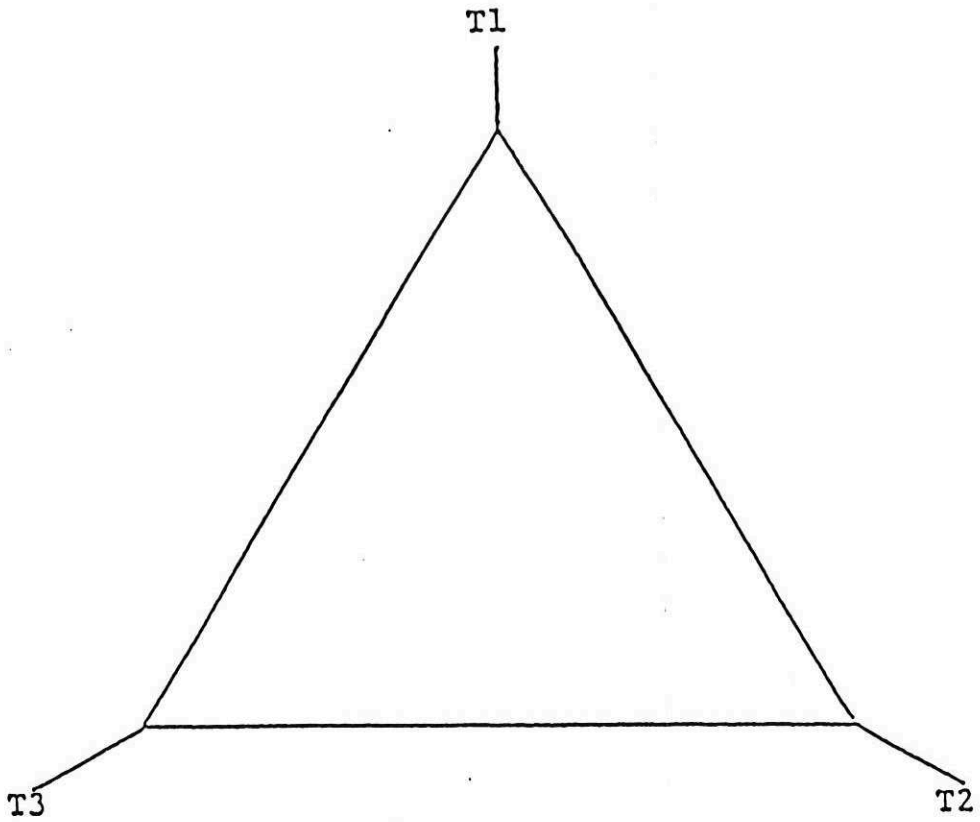
CUSTOMER: EMERSON ELECTRIC CANADA
CUSTOMER NO: PE41902

USEM NO.: R0320148
MARKS: TAG: PRITCHARD

F83114/448661

MOTOR WIRING DIAGRAM

DELTA CONNECTED, SINGLE VOLTAGE



L1	L2	L3
T1	T2	T3

TO REVERSE DIRECTION OF ROTATION INTERCHANGE CONNECTIONS OF L1 AND L2.

EACH LEAD MAY HAVE ONE OR MORE CABLES COMPRISING THAT LEAD. IN SUCH CASE EACH CABLE WILL BE MARKED WITH THE APPROPRIATE LEAD NUMBER.

CITY OF WINNIPEG
WEST END WATER POLLUTION CONTROL CENTER
PERIMETER PUMP STATION
SECTION SP-17 CONTRACT 1A

DWG. * 3817

PRODUCT

SECTION:

PAGE: 20-C-625 (C)

CUSTOMER NAME EMERSON ELECTRIC CANADA

CUSTOMER ORDER NO. PE41902 USEM NO. R0320148

MARKS: TAG: PRITCHARD F83114/448661 TAG NOS.

DESCRIPTION

QUANTITY 1 HP 400 FRAME 5810 P TYPE HV

PHASE 3 HERTZ 60 RPM 720 VOLTS 575 ASSY.POS. F1

FEATURES: VERTICAL SOLID SHAFT, NORMAL THRUST WPI, INVERTOR DUTY SIX STEP PULSE WITH MODULATION, CLOCKWISE ROTATION, NON-REVERSE RATCHET, 1.15 SERVICE FACTOR, CLASS "F" WITH "B" RISE, 100 OHM WINDING RTD'S, Q-2 100 OHM BEARING RTD'S TO SEPARATE ACCESSORY BOX, IRD 544 VIBRATION DETECTOR LEADS TO SEPARATE ACCESSORY BOX, SPECIAL MAIN OUTLET BOX, FIT BI-LINQUAL NAME-PLATE (P/N 369386), Q.A. #X299378-A, U=3-1/8, AH=7, BD=30-1/2, CLOCKWISE, BEARING SET POINTS: 90 DEGREE "C" ALARM 100 DEGREE "C" SHUTDOWN

EXCEPTIONS & CLARIFICATIONS (IF ANY):

WHEN SIGNED BELOW, THE PRINT(S) AND/OR DATA ATTACHED IS(ARE) CERTIFIED CORRECT FOR MOTOR(S) DESCRIBED ABOVE.

BY B.R. Bennett DATE 3/9/88

CITY OF WINNIPEG

WEST END WATER POLLUTION CONTROL CENTER

PERIMETER PUMP STATION

SECTION SP·17 CONTRACT 1A

DWG. * 3818

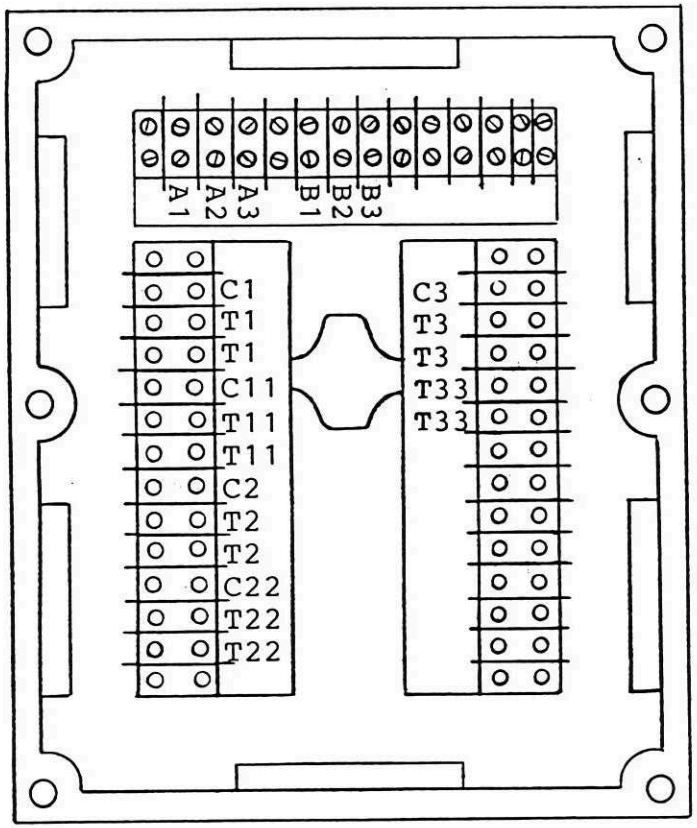
1. THERE ARE QTY-6 RESISTANCE TYPE TEMPERATURE DETECTORS (RTD) INSTALLED IN THE STATOR WINDING. REFER TO NAMEPLATE ATTACHED TO THE MOTOR ADJACENT TO ACCESSORY OUTLET BOX FOR RATING OF THE RTD'S.

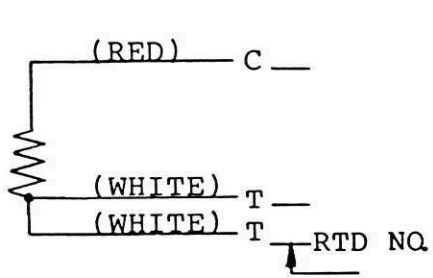
2. DETECTORS ARE INSTALLED IN PHASES AS SHOWN.

PHASE	A	B	C
RTD NO.	1,11	2,22	3,33

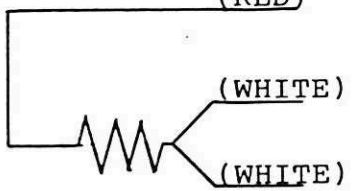
3. THERE ARE QTY-2 BEARING RTD'S INSTALLED, ONE PER BEARING. RTD RATING IS ON NAMEPLATE ATTACHED TO MOTOR ADJENT TO ACCESSORY OUTLET BOX.

   A. - UPPER BEARING
   B. - LOWER BEARING





BEARING RTD'S



	UPR	LWR
	A1	B1
	A2	B2
	A3	B3

CITY OF WINNIPEG

WEST END WATER POLLUTION CONTROL CENTER

PERIMETER PUMP STATION

SECTION SP-17 CONTRACT 1A

PRITCHARD ENGINEERING COMPANY LIMITED WINNIPEG MANITOBA

SCALE: NONE

DRN: | CHK'D: | APP'D:

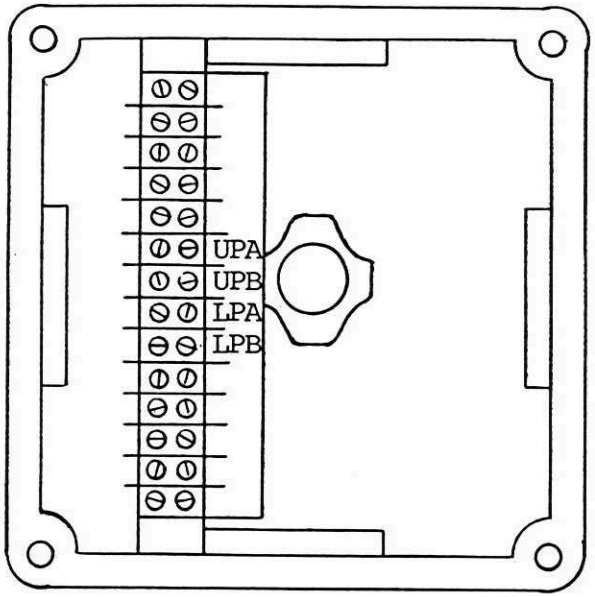
DATE: 8.30.88

FIRST USED ON:

NEXT ASS'Y:

TITLE U.S. ELECTRICAL MOTORS X886620 B

DWG: *3819A REV.



TERMINAL LUGS P/N 541420

TERMINAL IDENTIFICATION

TYPE ON CENTER MARKING STRIP THE IDENTIFICATION SYMBOLS AS SHOWN IN SKETCH (MARKING STRIPS ARE REMOVABLE).

INSTRUCTIONS (UPPER & LOWER PICKUPS)

1. MEASURE AND CUT THE IRD CABLE INTO TWO DIFFERENT LENGTHS TO REACH FROM EACH PICKUP TO THE SEPARATE OUTLET BOX AS NOTED ON DIMENSION PRINT. LEAVE ENOUGH LEADWIRE LENGTH TO REACH TERMINAL STRIPS FOR INSTALLATION.
2. INSTALL IRD RIGHT ANGLE CONNECTOR TO LOWER PICKUP AND IRD CONNECTOR TO UPPER PICKUP. BLACK LEAD (GROUND) GOES TO "PIN A" AND WHITE LEAD (SIGNAL) TO "PIN B".
3. INSTALL ONE CABLE CONNECTOR (KILLARD 2Y SERIES) TO EACH OPEN CABLE END AND SECURE TO SEPERATE OUTLET BOX SIDE OPENINGS.
4. CONNECT LEADWIRES TO TERMINAL STRIP
5. ATTACH THE LOWER PICKUP CABLE TO FRAME WITH A CONDUIT CLAMP.

VIBRATION PICKUP (IRD MODEL 544M)

1. INSURE THAT LEADS ARE TAGGED AS SHOWN. EACH PICKUP SHOULD HAVE 1 BLACK LEAD (GROUND) AND 1 WHITE LEAD (SIGNAL).
2. TERMINATE LEADS WITH SPECIFIED LUGS.
3. ROUTE LEADS BENEATH TERMINAL STRIP AND ATTACH TO STRIP ALONG OUTER EDGE. ATTACH BLACK LEADS TO TERMINALS UPA & LPA, AND WHITE LEADS TO TERMINALS UPS & LPS. U - UPPER BEARING, L - LOWER BEARING.

CITY OF WINNIPEG

WEST END WATER POLLUTION CONTROL CENTER

PERIMETER PUMP STATION

SECTION SP-17 CONTRACT 1A

PRITCHARD ENGINEERING COMPANY LIMITED WINNIPEG MANITOBA

SCALE: NONE

DRN: | CHK'D: | APP'D:

DATE: 08-30-88

FIRST USED ON:

NEXT ASS'Y:

TITLE U.S. Electrical motors X388016 B

DWG: *3819B | REV.

PRITCHARD ENGINEERING CO. LTD.

WINNIPEG SASKATOON EDMONTON CALGARY

SHEET 1 OF 1

DATE Mar. 89

QUOTE

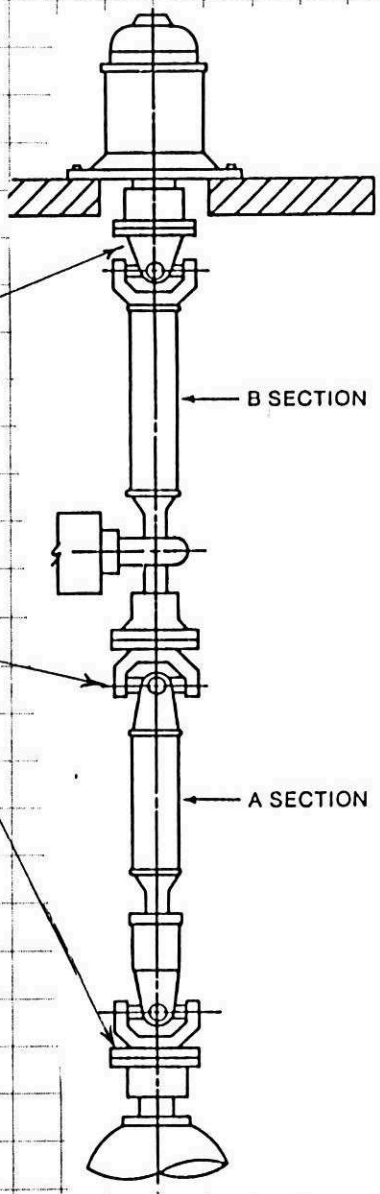
JOB ORDER

APPLICATION DATA

TITLE: **INSTALLATION INSTRUCTIONS**

FOR: WATSON SPICER SHAFTING

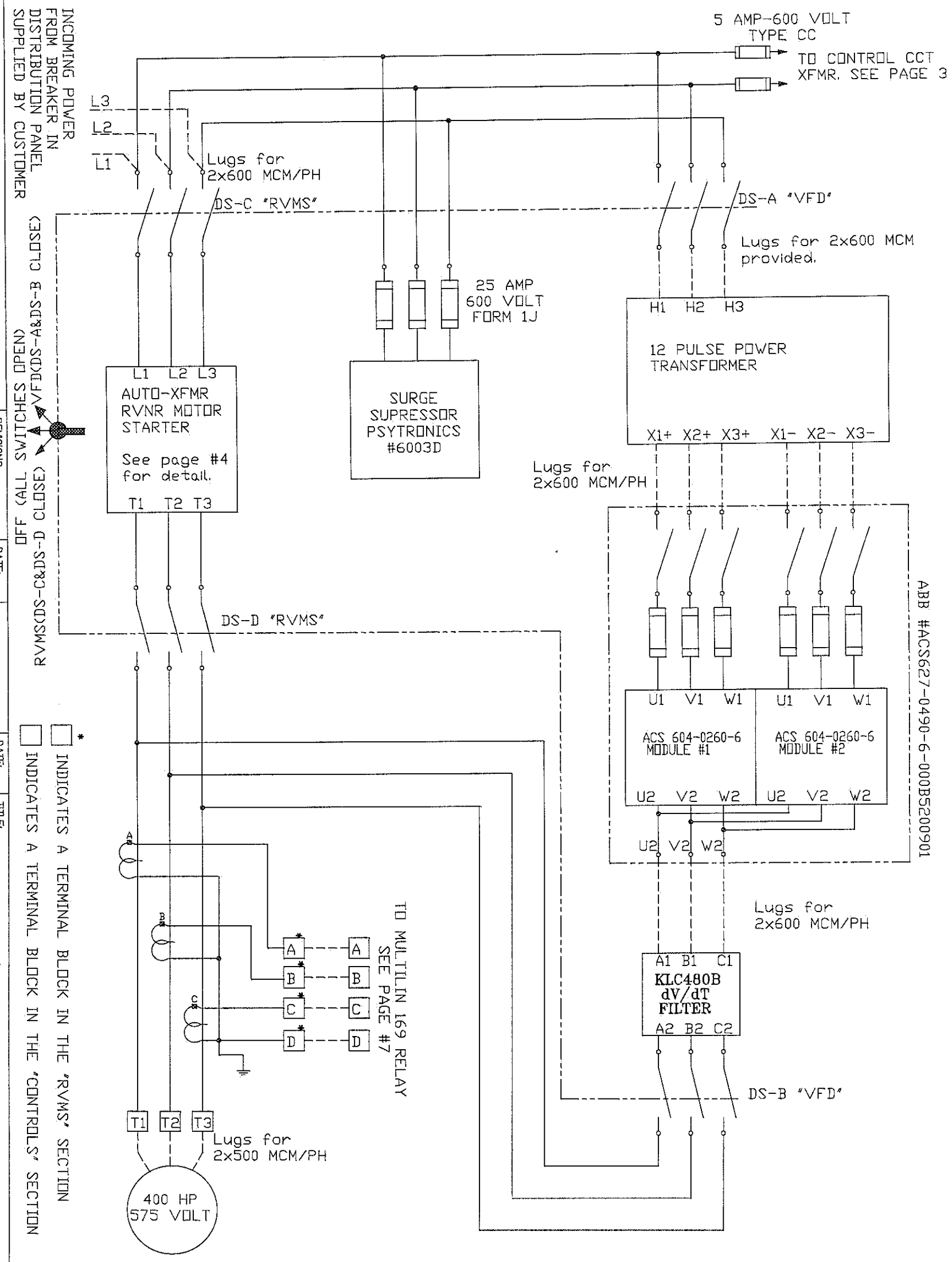
POSITIONING YOKES ON DRIVE SHAFT TO PHASE.



MOTOR OR GEAR MUST BE LEVEL TO WITHIN ±1°

PREPARED BY	BRANCH	APPROVED BY	DATE APPROVED
I. Smail	Wpg.		

NOTE: SUGGESTED MAIN BREAKER TO BE 1,000 AMP FRAME
ADJUSTABLE FROM 400-1,000 AMP, DELAY OF 3-18 SEC.
INSTANTANEOUS TRIP ADJUSTABLE FROM 1.5-12 x FRAME RATING



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REVISIONS:	DATE:
REVISION #1	00/12/13
AS BUILT	01/01/29

DESIGN: BERNIE DA SILVA	00/11/10
DRAWN: BERNIE DA SILVA	00/11/10
CHECK: DON WILSON	00/11/22

TITLE: 400HP VFD/RVMS STARTER CONNECTIONS

PROJECT: PERIMITER PUMP STATION

DWG. NO: 00-4383 (page 1 of 11)

CUSTOMER: City of Winnipeg / P.O.:

SCALE: N.T.S.

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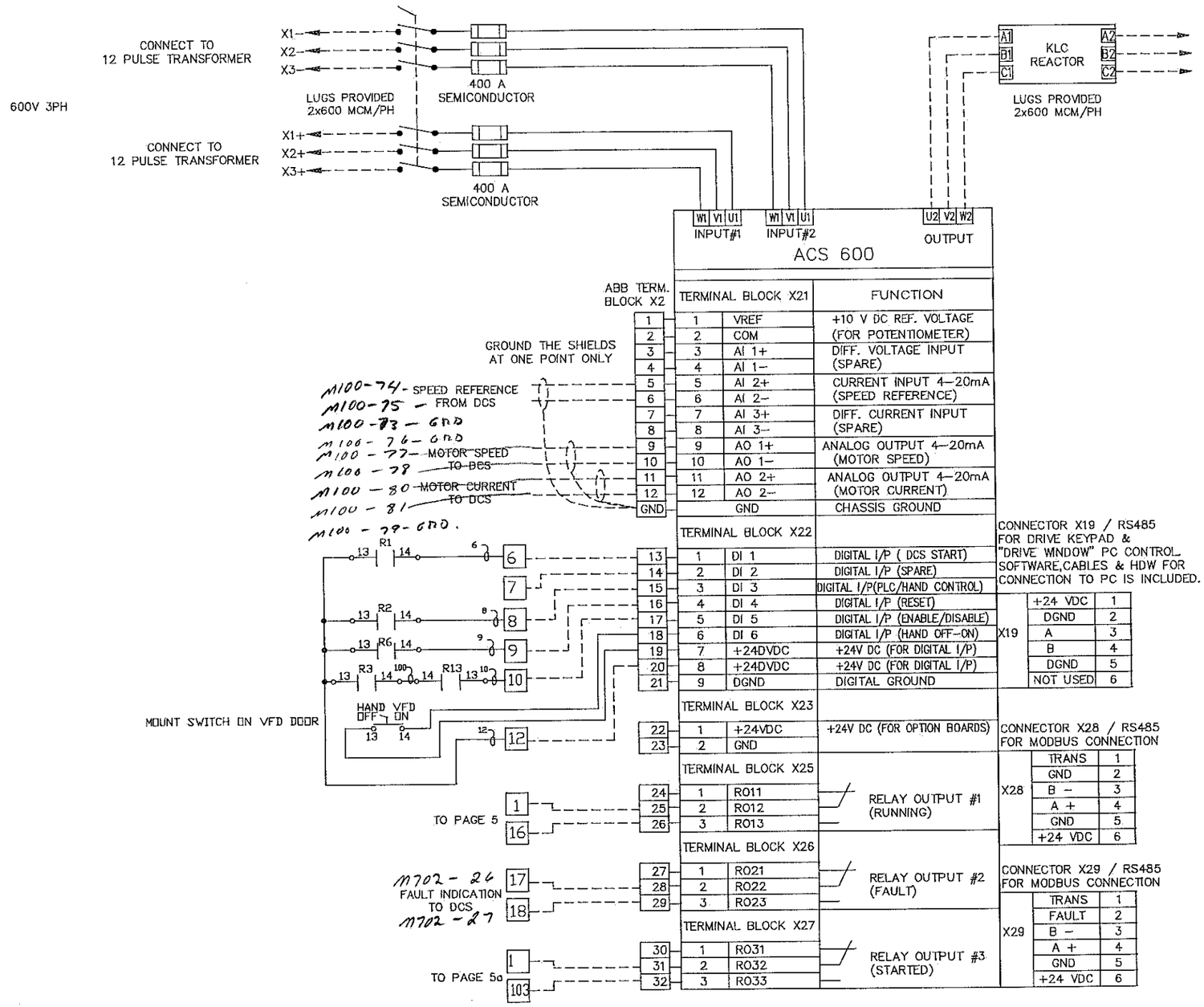

ABB TERM. BLOCK X2	TERMINAL BLOCK X21		FUNCTION
1	1	VREF	+10 V DC REF. VOLTAGE (FOR POTENTIOMETER)
2	2	COM	
3	3	AI 1+	DIFF. VOLTAGE INPUT (SPARE)
4	4	AI 1-	
5	5	AI 2+	CURRENT INPUT 4-20mA (SPEED REFERENCE)
6	6	AI 2-	
7	7	AI 3+	DIFF. CURRENT INPUT (SPARE)
8	8	AI 3-	
9	9	AO 1+	ANALOG OUTPUT 4-20mA (MOTOR SPEED)
10	10	AO 1-	
11	11	AO 2+	ANALOG OUTPUT 4-20mA (MOTOR CURRENT)
12	12	AO 2-	
GND	GND		CHASSIS GROUND
	TERMINAL BLOCK X22		
13	1	DI 1	DIGITAL I/P (DCS START)
14	2	DI 2	DIGITAL I/P (SPARE)
15	3	DI 3	DIGITAL I/P(PLC/HAND CONTROL)
16	4	DI 4	DIGITAL I/P (RESET)
17	5	DI 5	DIGITAL I/P (ENABLE/DISABLE)
18	6	DI 6	DIGITAL I/P (HAND OFF-ON)
19	7	+24DVDC	+24V DC (FOR DIGITAL I/P)
20	8	+24DVDC	+24V DC (FOR DIGITAL I/P)
21	9	DGND	DIGITAL GROUND
	TERMINAL BLOCK X23		
22	1	+24VDC	+24V DC (FOR OPTION BOARDS)
23	2	GND	
	TERMINAL BLOCK X25		
24	1	RO11	RELAY OUTPUT #1 (RUNNING)
25	2	RO12	
26	3	RO13	
	TERMINAL BLOCK X26		
27	1	RO21	RELAY OUTPUT #2 (FAULT)
28	2	RO22	
29	3	RO23	
	TERMINAL BLOCK X27		
30	1	RO31	RELAY OUTPUT #3 (STARTED)
31	2	RO32	
32	3	RO33	

CONNECTOR X19 / RS485 FOR DRIVE KEYPAD & "DRIVE WINDOW" PC CONTROL SOFTWARE,CABLES & HDW FOR CONNECTION TO PC IS INCLUDED.

X19	+24 VDC	1
	DGND	2
	A	3
	B	4
	DGND	5
	NOT USED	6

CONNECTOR X28 / RS485 FOR MODBUS CONNECTION

X28	TRANS	1
	GND	2
	B -	3
	A +	4
	GND	5
	+24 VDC	6

CONNECTOR X29 / RS485 FOR MODBUS CONNECTION

X29	TRANS	1
	FAULT	2
	B -	3
	A +	4
	GND	5
	+24 VDC	6

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TITLE: 400HP VFD/RVMS STARTER CONNECTIONS
PROJECT: PERIMITER PUMP STATION
DWG. NO: 00-4383 (page 2 of 11)
CUSTOMER: City of Winnipeg / P.O.:
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00/11/10	
00/11/22	

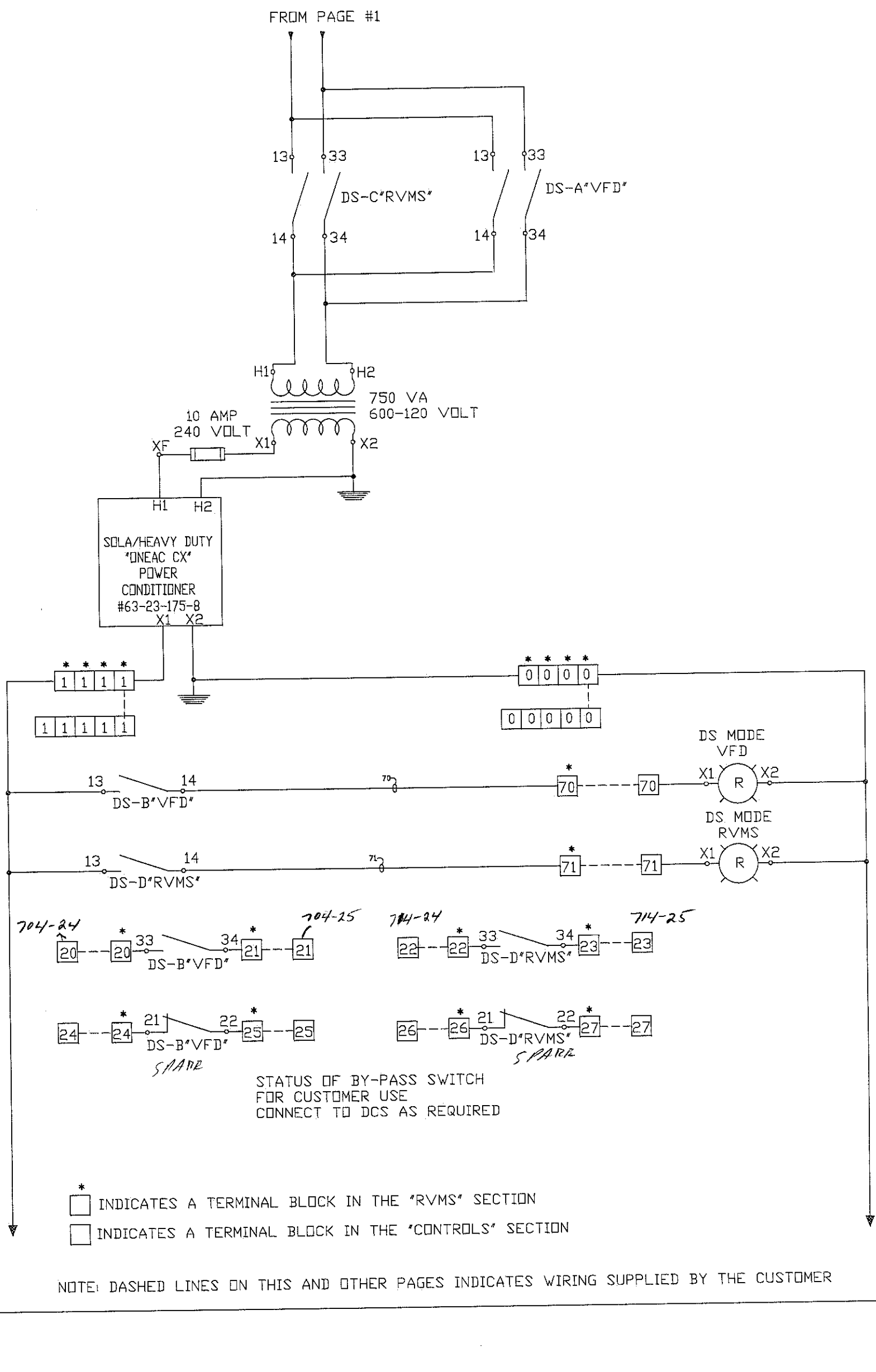
TITLE: 400HPVFD/RVMS STARTER CONNECTIONS

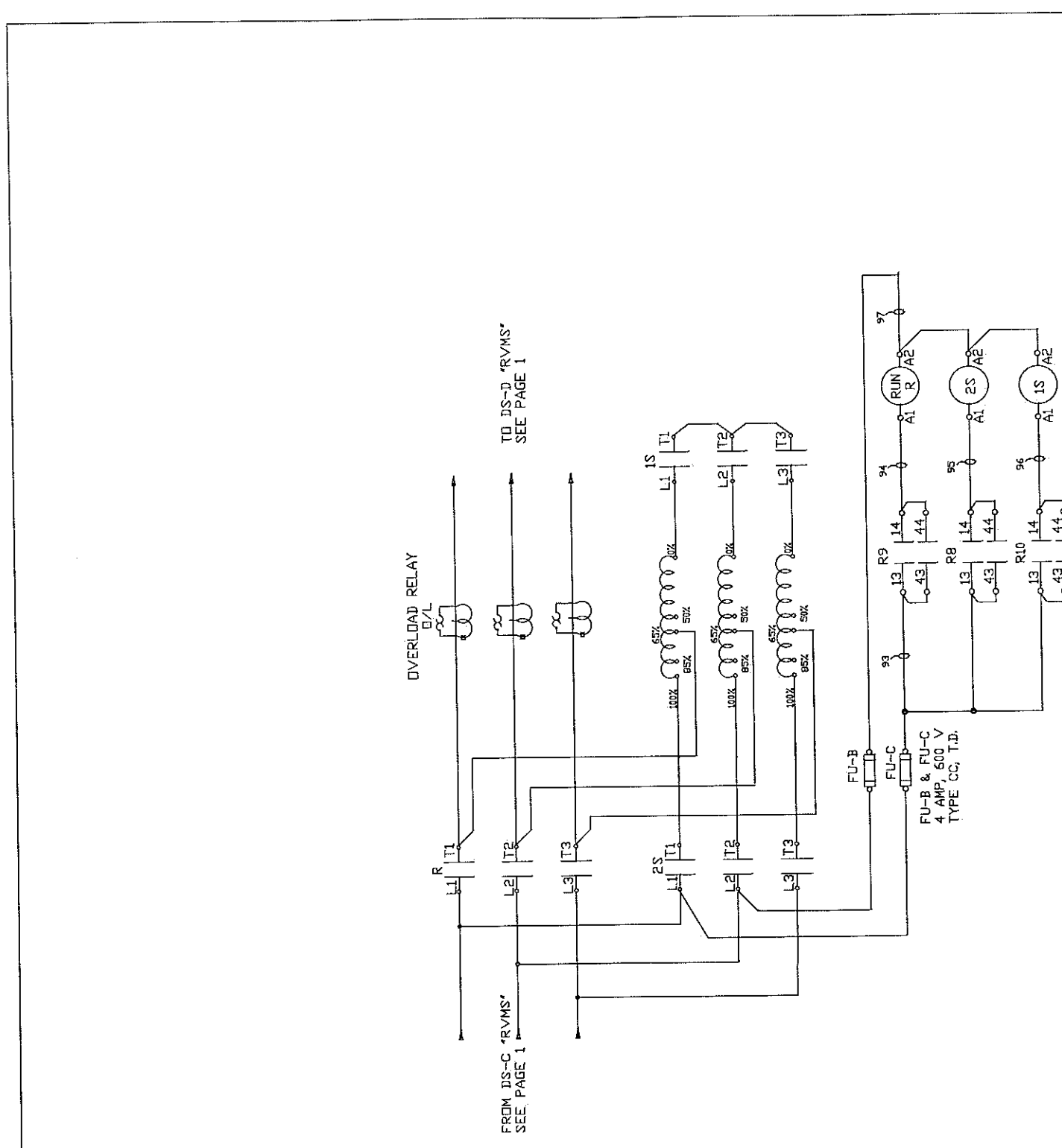
PROJECT: PERIMITER PUMP STATION

DWG. NO: 00-4383 (page 3 of 11)

CUSTOMER: City of Winnipeg / P.O.:

SCALE: N.T.S.





* ☐ INDICATES A TERMINAL BLOCK IN THE "RVMS" SECTION

☐ INDICATES A TERMINAL BLOCK IN THE "CONTROLS" SECTION

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TITLE: 400HP VFD/RVMS STARTER CONNECTIONS

PROJECT: PERIMITER PUMP STATION

DWG. NO: 00-4383 (page 4 of 11)

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TITLE: 400HP VFD/RVMS STARTER CONNECTIONS

PROJECT: PERIMITER PUMP STATION

CUSTOMER: City of Winnipeg / P.O.:

DWG. NO: 00-4383 (page 4a of 11)

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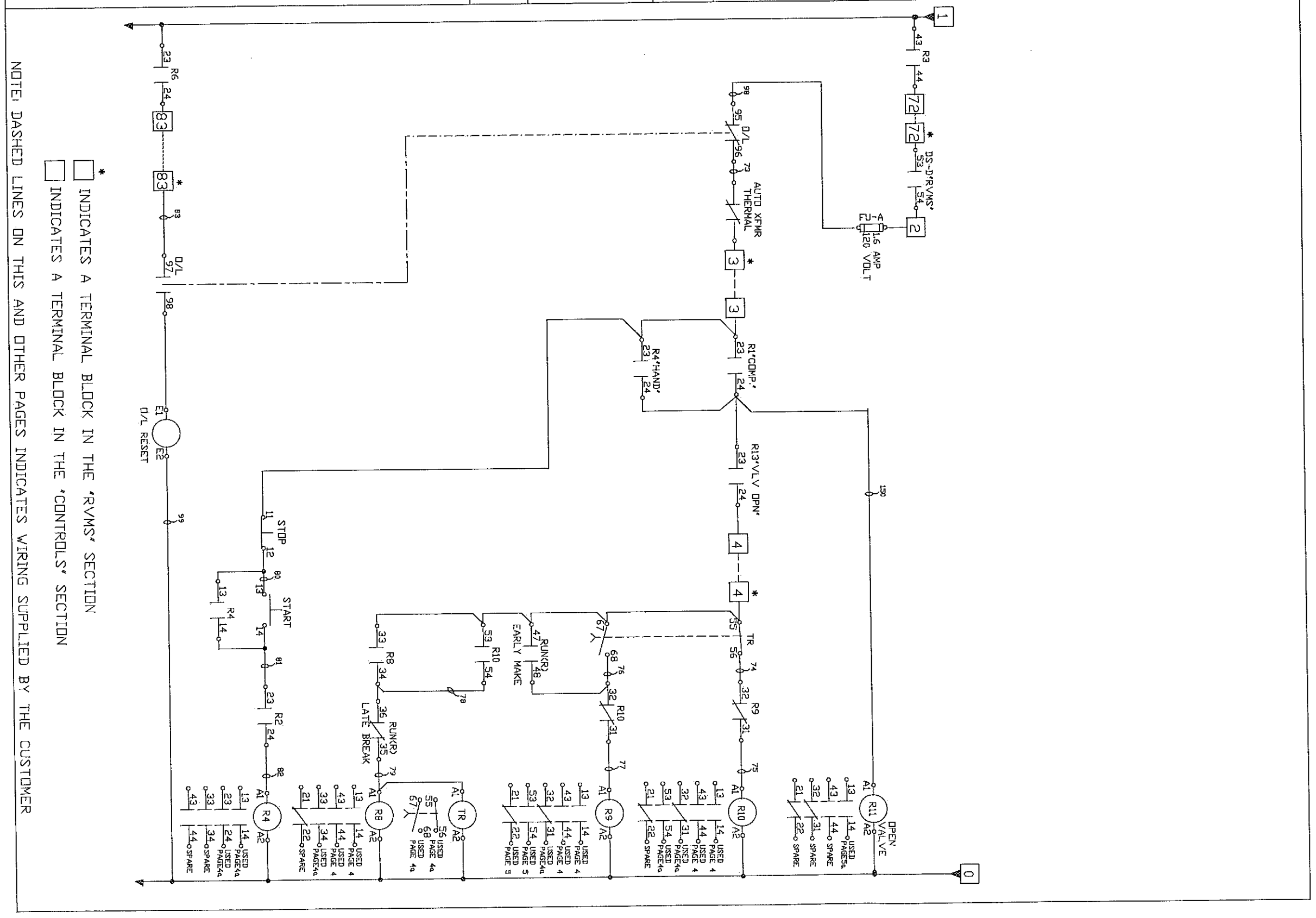
INDICATES A TERMINAL BLOCK IN THE 'CONTROLS' SECTION

INDICATES A TERMINAL BLOCK IN THE 'RVMS' SECTION



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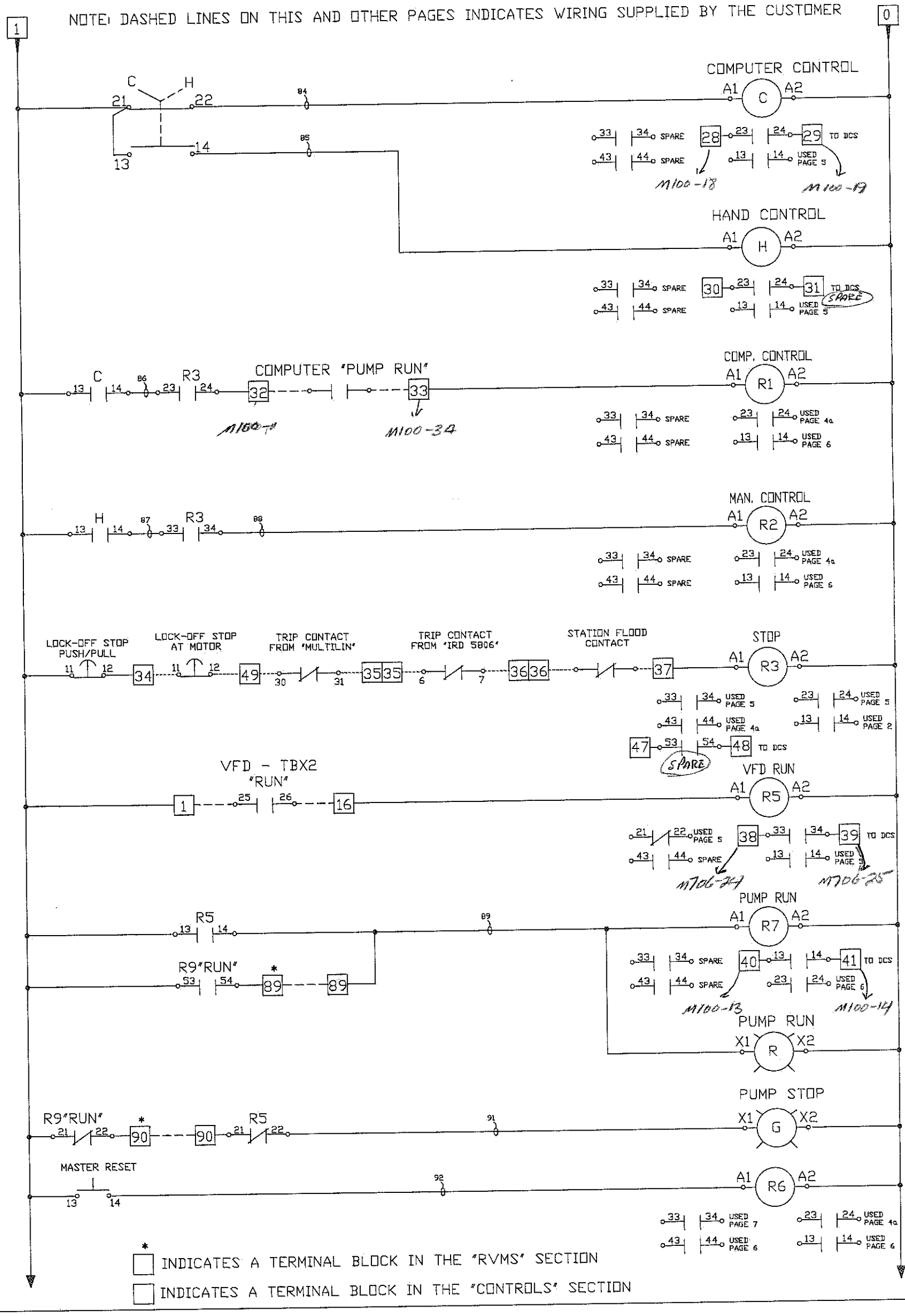

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TITLE: 400HP VFD/RVMS STARTER CONNECTIONS

PROJECT: PERIMITER PUMP STATION

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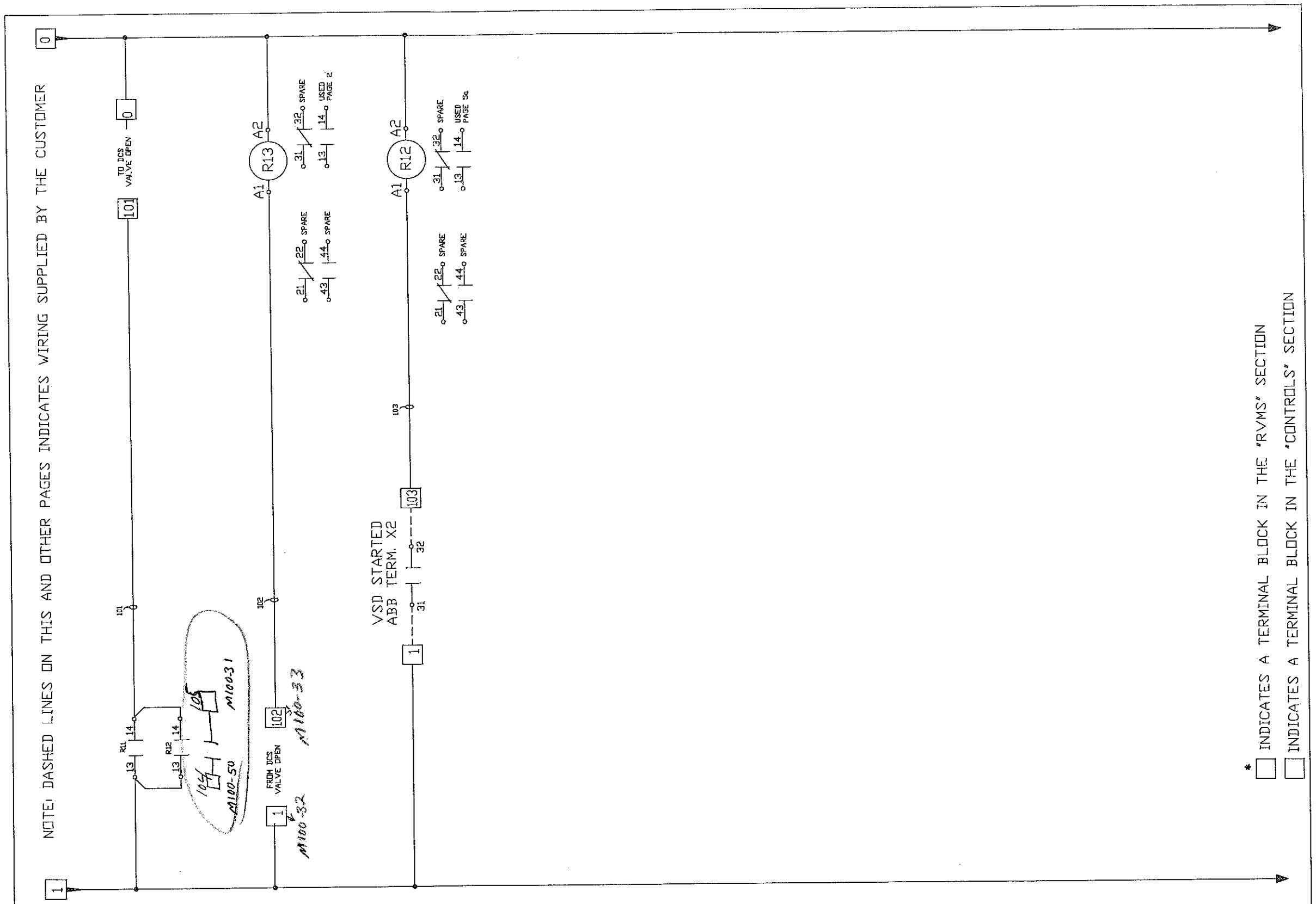

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TITLE: 400HP VFD/RVMS STARTER CONNECTIONS
PROJECT: PERIMITER PUMP STATION
DWG. NO: 00-4383 (page 5a of 11)
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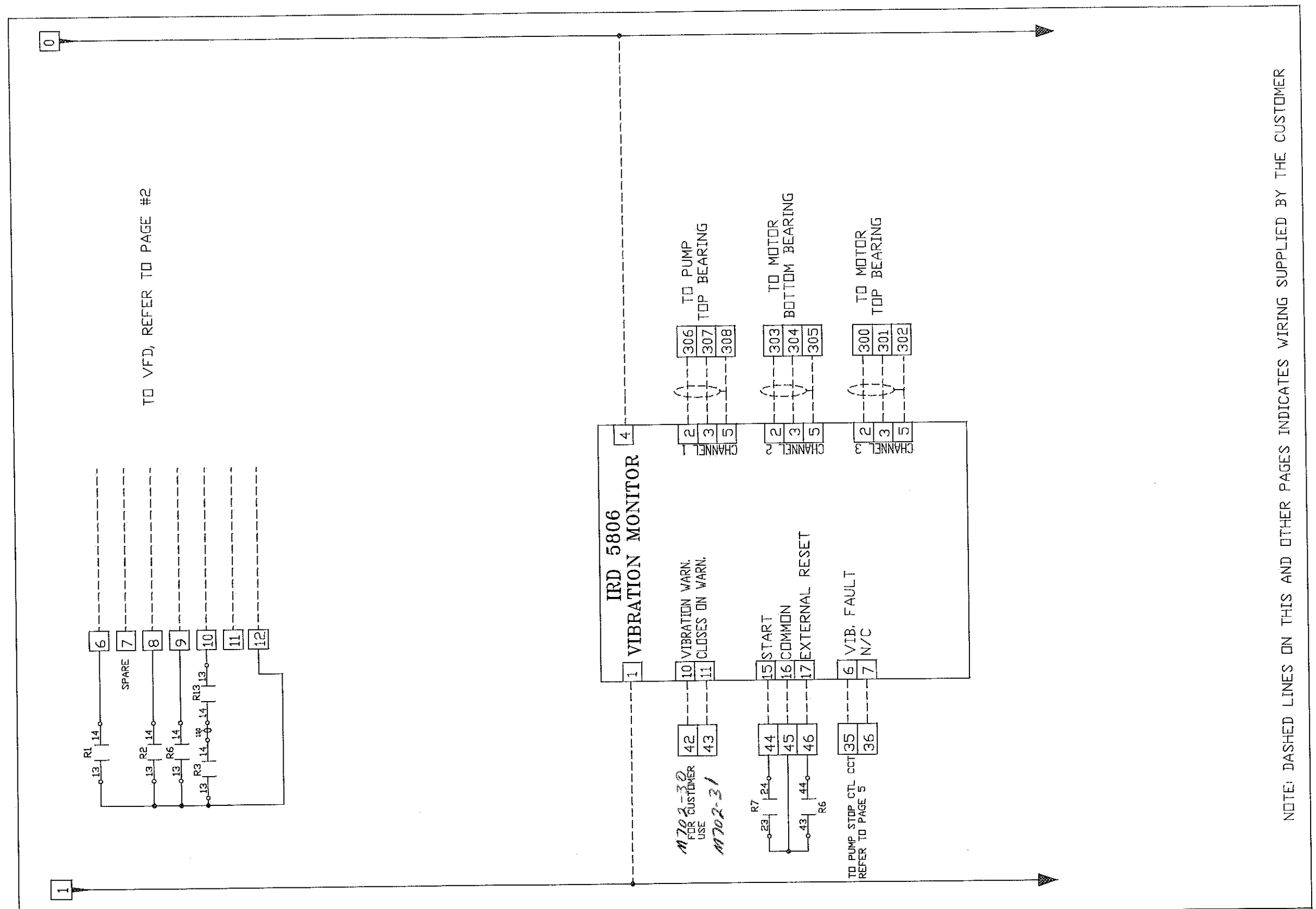

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TITLE: 400HP VFD/RVMS STARTER CONNECTIONS
PROJECT: PERIMITER PUMP STATION
DWG. NO: 00-4383 (page 6 of 11)
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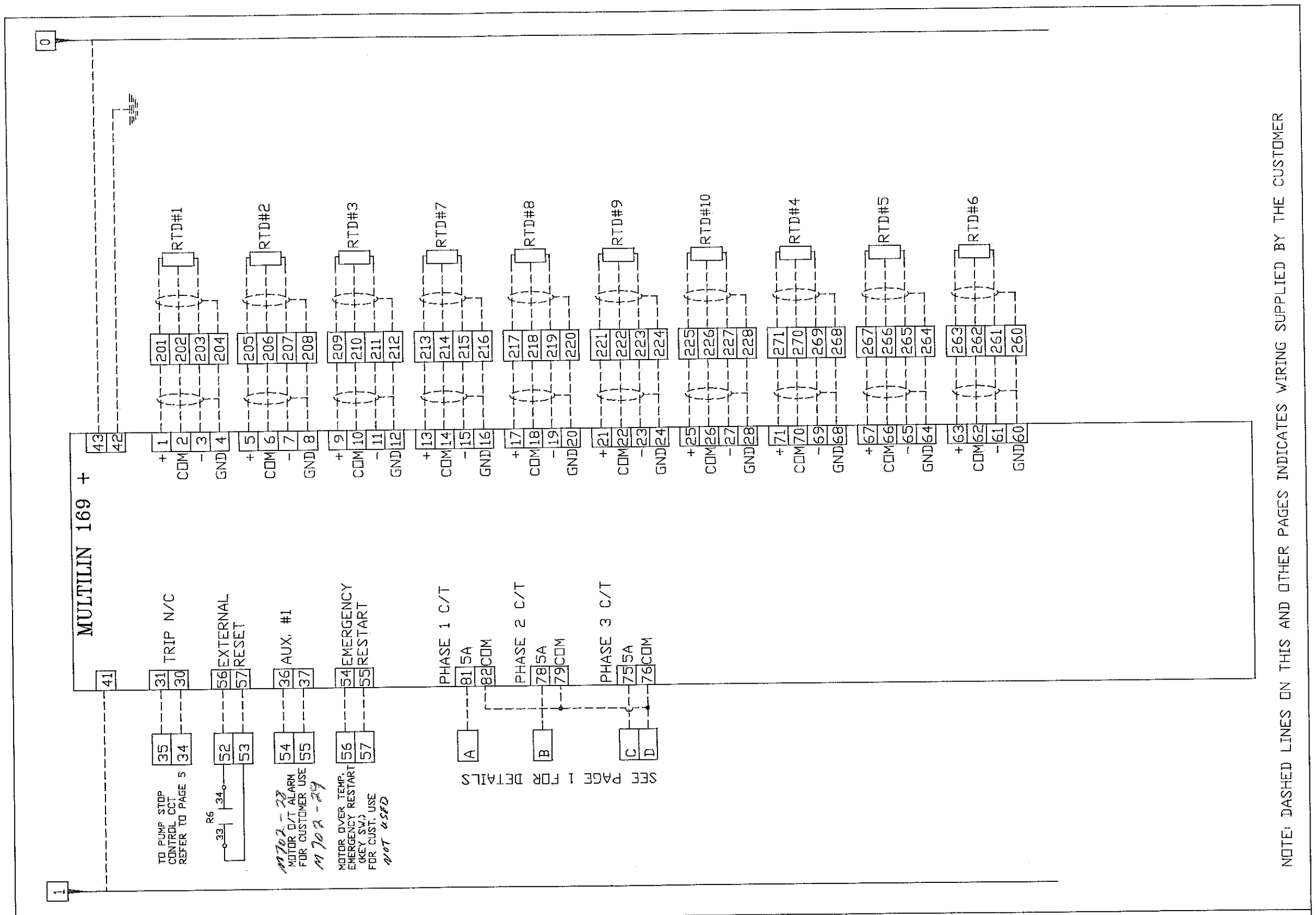

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TITLE: 400HP VFD/RVMS STARTER CONNECTIONS
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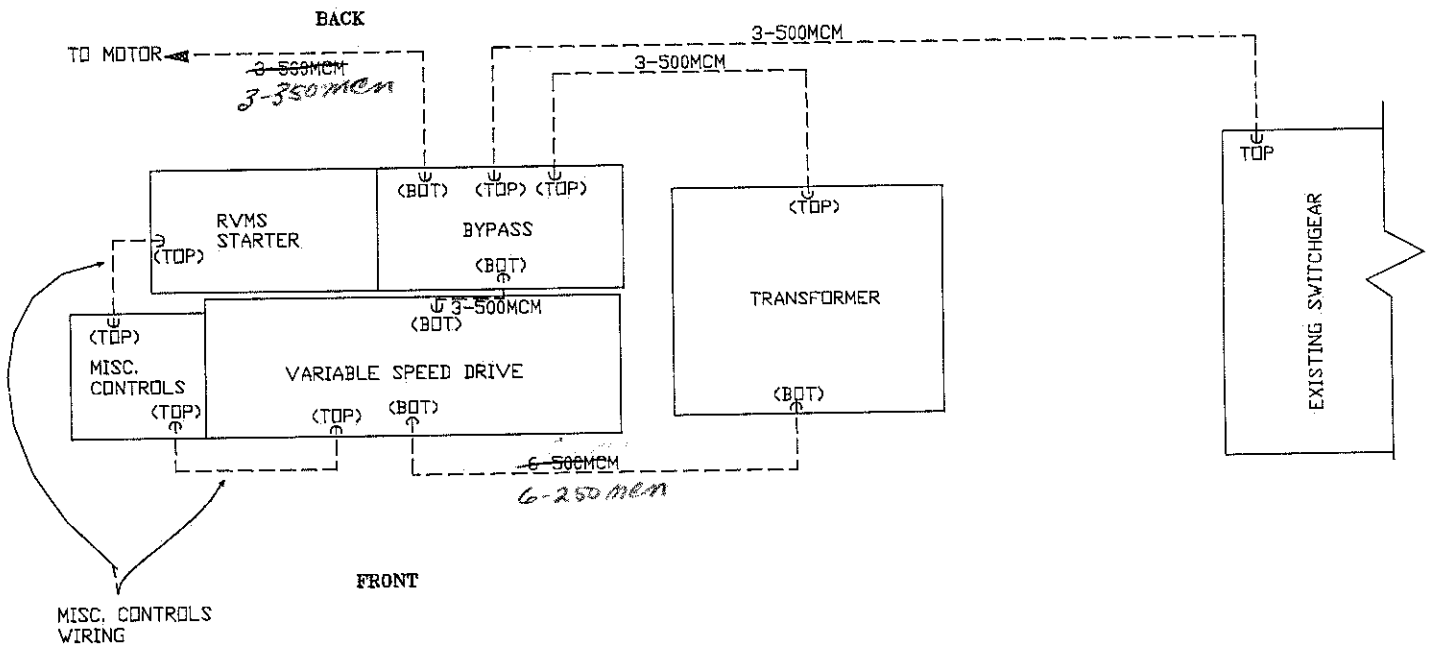
NOTE:

BELOW IS THE LAYOUT, CABLE ROUTINGS AND CABLE SIZES AS PER OUR MEETING OF NOVEMBER 28, 2000. THE LAYOUT AND CABLE SIZES ARE AS SUGGESTED BY THE CUSTOMER. THE SELECTION OF EXTERNAL CABLES, SIZING AND ROUTING IS THE RESPONSIBILITY OF THE CUSTOMER.



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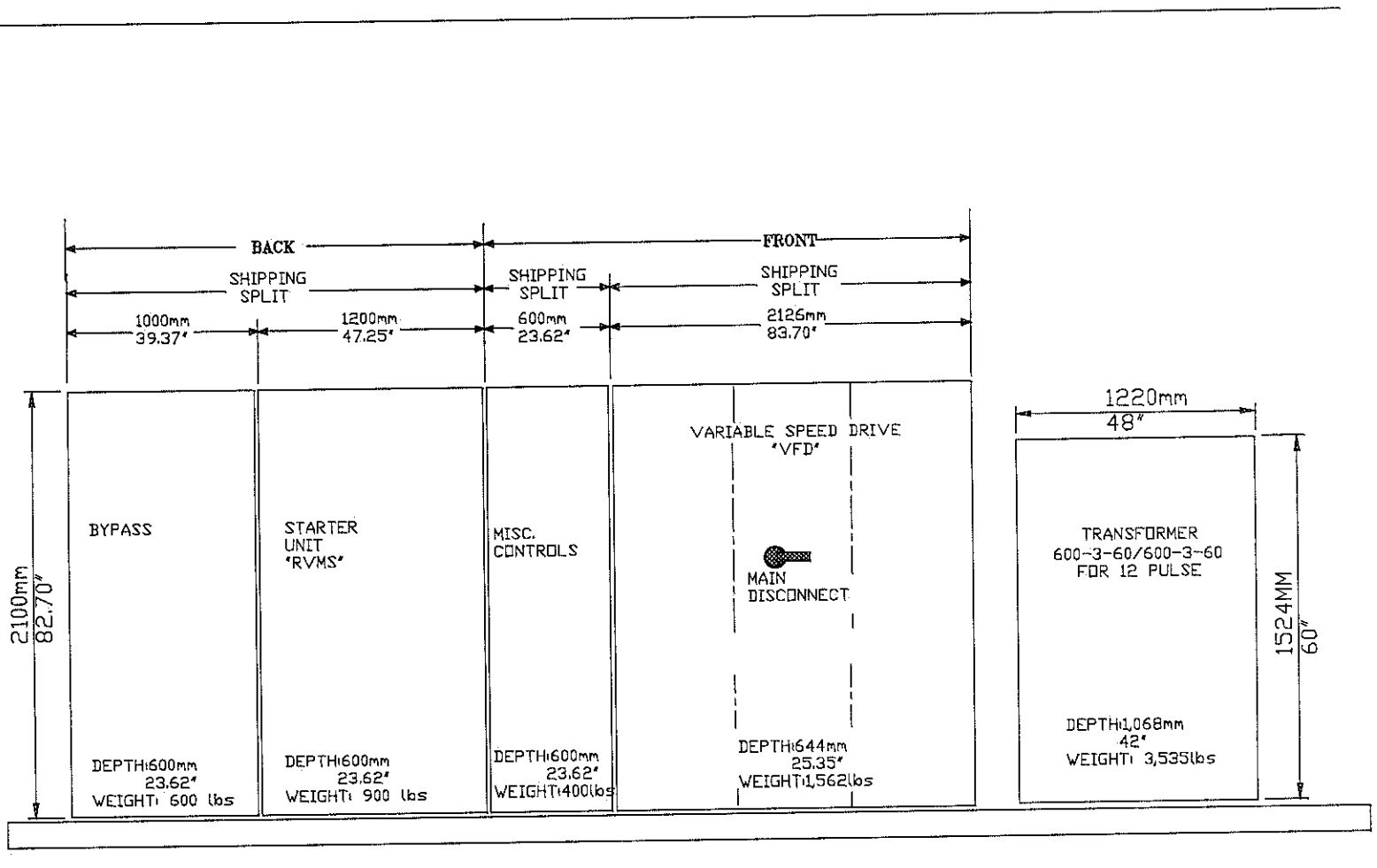

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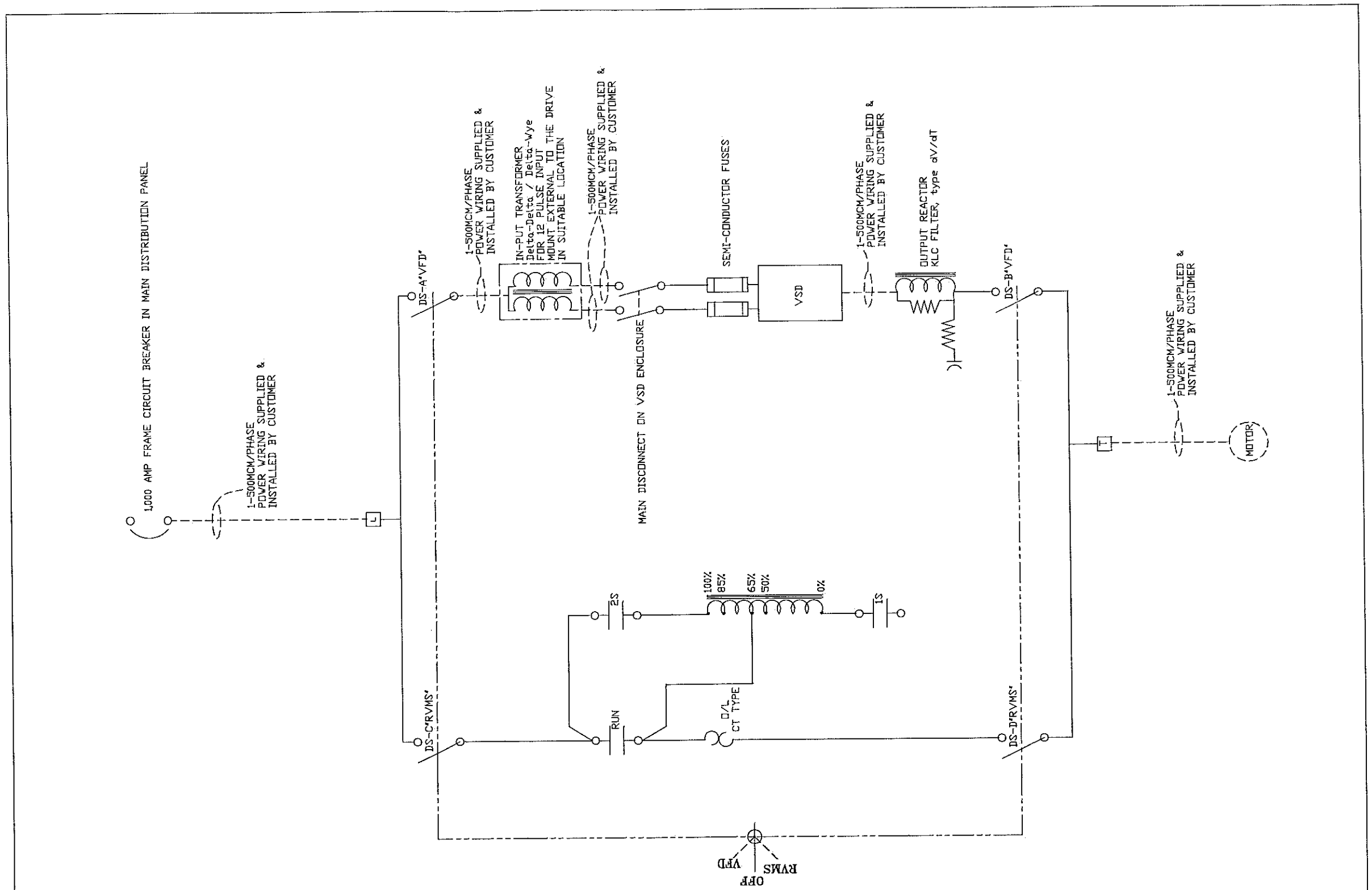
TITLE: 400HP VFD/RVMS STARTER LAYOUT/DIMENSIONS

PROJECT: PERIMITER PUMP STATION

CUSTOMER: City of Winnipeg / P.O.:

DWG. NO: 00-4383 (page 8a of 11)

SCALE: N.T.S.



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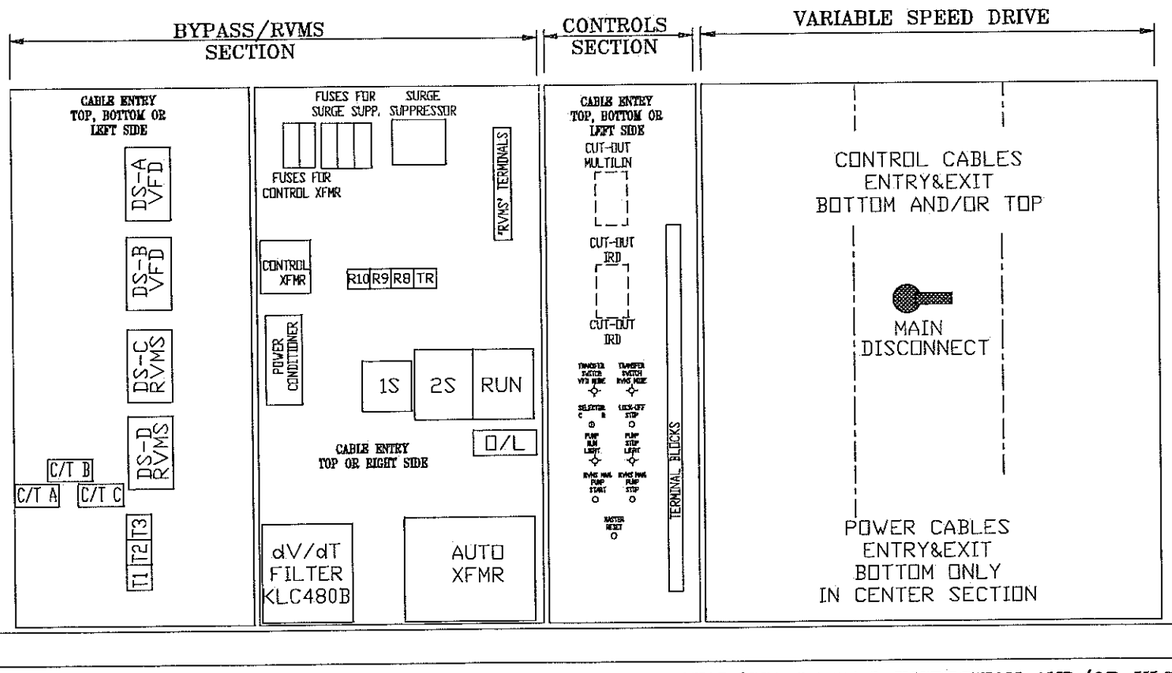
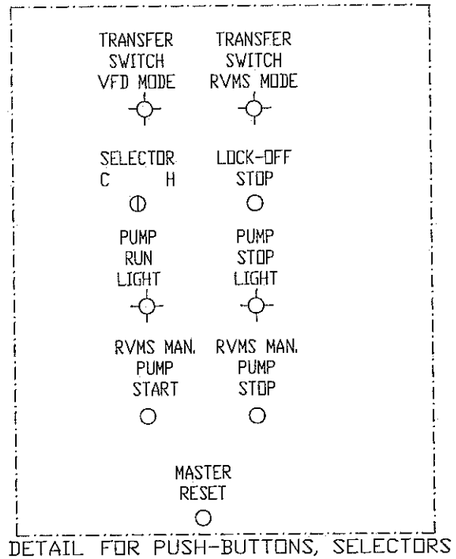
TITLE: 400HP VFD/RVMS STARTER POWER SINGLE LINE
PROJECT: PERIMITER PUMP STATION
DWG. NO: 00-4383 (page 8b of 11)
CUSTOMER: City of Winnipeg / P.O.:
SCALE: N.T.S.





DETAIL FOR PUSH-BUTTONS, SELECTORS AND PILOT LIGHTS

ALL ASSEMBLIES WILL HAVE EITHER CSA APPROVAL/CSA SPECIAL INSPECTION AND/OR ULC APPROVAL

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TITLE: 400HP VFD/RVMS STARTER LAYOUT
PROJECT: PERIMITER PUMP STATION
DWG. NO: 00-4383 (page 9 of 11)
CUSTOMER: City of Winnipeg / P.O.:
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TITLE: 400HP VFD/RVMS STARTER-CONTROL SECTION TERMINALS			
PROJECT: PERIMITER PUMP STATION			
CUSTOMER: City of Winnipeg / P.O.:	DWG. NO: 00-4383 (page 10a of 11)		
SCALE: N.T.S.			

0		120 VAC NEUTRAL CONNECT TO 'RVMS' TERM. #0
0		TO 'IRD' TERM.#4 SEE PAGE 6
0		
0		TO 'MULTILIN'TERM.#43 SEE PAGE 7
0		
1		120 VAC POWER CONNECT TO 'RVMS' TERM. #1
1		
1		TO 'VSD', TERM. #25 SEE PAGE 2
1		TO 'IRD' TERM.#1 SEE PAGE 6
1		TO 'MULTILIN'TERM.#41 SEE PAGE 7
2		TO 'RVMS' TERM. #2
3		TO 'RVMS' TERM. #3
4		TO 'RVMS' TERM. #4
5		SPARE
6	R1 13-14	TO 'VFD' TERM. #X2-13
7		TO 'VFD' TERM. #X2-14
8	R2 13-14	TO 'VFD' TERM. #X2-15
9		TO 'VFD' TERM. #X2-16
10	R3 13-14	TO 'VFD' TERM. #X2-17
11	R6 13-14	TO 'VFD' TERM. #X2-18
12		TO 'VFD' TERM. #X2-20
13		ADD 702-24 — ~~SPARE~~ -- TO IRD TERM # 12
14		702-25 — ~~SPARE~~ -- TO IRD TERM # 13
15		SPARE
16		TO 'VFD' TERM. #X2-26
17		M702-26 — TO 'VFD' TERM. #X2-28
18		M702-27 — TO 'VFD' TERM. #X2-29
19		SPARE
20		M704-24 DS-A'VFD' STATUS TO DCS SEE PAGE #3 — TO 'RVMS' TERM. #20
21		M704-25 — TO 'RVMS' TERM. #21
22		M714-24 DS-C'RVMS' STATUS TO DCS SEE PAGE #3 — TO 'RVMS' TERM. #22
23		M714-25 — TO 'RVMS' TERM. #23
24		DS-A'VFD' STATUS TO DCS SEE PAGE #3 — TO 'RVMS' TERM. #24
25		TO 'RVMS' TERM. #25
26		DS-C'RVMS' STATUS TO DCS SEE PAGE #3 — TO 'RVMS' TERM. #26
27		TO 'RVMS' TERM. #27
28		M100-18 — TO 'DCS' SEE PAGE 5
29		M100-19 —
30		TO 'DCS' SEE PAGE 5
31		
32		M100-1 — FROM 'DCS' SEE PAGE 5
33		M100-3A —
34	30-31	'MULTILIN' SEE PAGE 7
35		
35	6-7	'IRD' SEE PAGE 6
36		
36		'STATION FLOOD' SEE PAGE 5
37		
38		M706-24 — TO 'DCS' SEE PAGE 5
39		M706-25 —
40		M100-13 — TO 'DCS' SEE PAGE 5
41		M100-14 —
42		702-30 — TO 'IRD' TERM.#10 SEE PAGE 6
43		702-31 — TO 'IRD' TERM.#11
44	R7 23-24	TO 'IRD' TERM. #15
45		TO 'IRD' TERM. #16
46	R6 43-44	TO 'IRD' TERM. #17
47		TO 'DCS' SEE PAGE 5
48	R3 53-54	
49		SPARE
50		SPARE
51		SPARE
52		TO 'MULTILIN' TERM.#56
53	R6 34-33	TO 'MULTILIN' TERM.#57

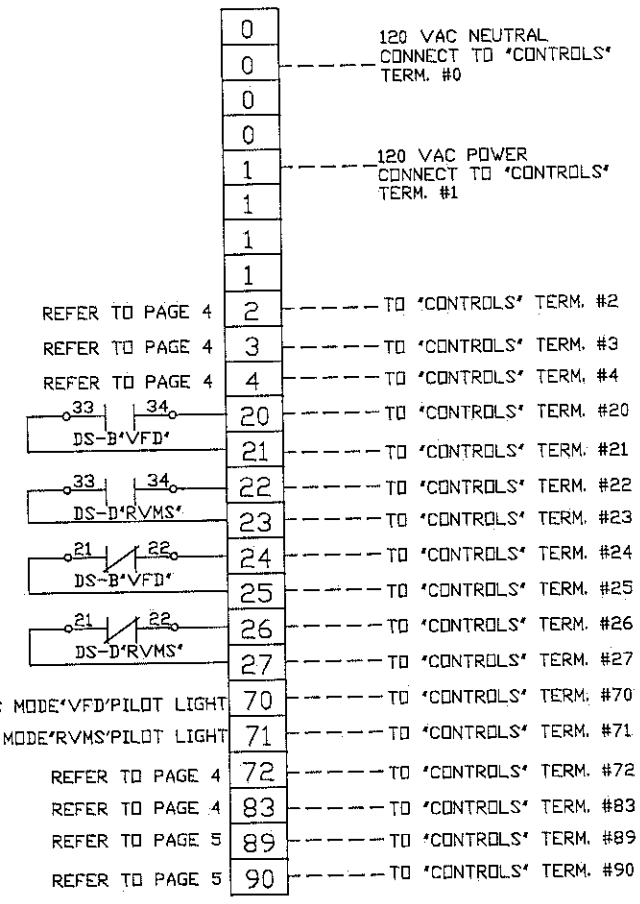
702-22 / 702-29 — 54		TO 'MULTILIN'TERM.#36 SEE PAGE 7
55		TO 'MULTILIN'TERM.#37 SEE PAGE 7
56		TO 'MULTILIN'TERM.#54 SEE PAGE 7
57		TO 'MULTILIN'TERM.#55 SEE PAGE 7
58		SPARE
59		SPARE
60		SPARE
70		TO 'RVMS' TERM. #70
71		TO 'RVMS' TERM. #71
72		TO 'RVMS' TERM. #72
83		TO 'RVMS' TERM. #83
89		TO 'RVMS' TERM. #89
90		TO 'RVMS' TERM. #90
A		CONNECT TO 'RVMS' TERM. #A — TO 'MULTILIN'TERM.#81 SEE PAGE 7
B		CONNECT TO 'RVMS' TERM. #B — TO 'MULTILIN'TERM.#78 SEE PAGE 7
C		CONNECT TO 'RVMS' TERM. #C — TO 'MULTILIN'TERM.#75 SEE PAGE 7
D		CONNECT TO 'RVMS' TERM. #D — TO 'MULTILIN'TERM.#76 SEE PAGE 7
201		CONNECT TO 'MULTILIN' TERM. #1
202		CONNECT TO 'MULTILIN' TERM. #2 — TO MOTOR RTD#1 SEE PAGE 7
203		CONNECT TO 'MULTILIN' TERM. #3
204		CONNECT TO 'MULTILIN' TERM. #4
205		CONNECT TO 'MULTILIN' TERM. #5
206		CONNECT TO 'MULTILIN' TERM. #6 — TO MOTOR RTD#2 SEE PAGE 7
207		CONNECT TO 'MULTILIN' TERM. #7
208		CONNECT TO 'MULTILIN' TERM. #8
209		CONNECT TO 'MULTILIN' TERM. #9
210		CONNECT TO 'MULTILIN' TERM. #10 — TO MOTOR RTD#3 SEE PAGE 7
211		CONNECT TO 'MULTILIN' TERM. #11
212		CONNECT TO 'MULTILIN' TERM. #12
213		CONNECT TO 'MULTILIN' TERM. #13
214		CONNECT TO 'MULTILIN' TERM. #14 — TO MOTOR RTD#7 SEE PAGE 7
215		CONNECT TO 'MULTILIN' TERM. #15
216		CONNECT TO 'MULTILIN' TERM. #16
217		CONNECT TO 'MULTILIN' TERM. #17
218		CONNECT TO 'MULTILIN' TERM. #18 — TO MOTOR RTD#8 SEE PAGE 7
219		CONNECT TO 'MULTILIN' TERM. #19
220		CONNECT TO 'MULTILIN' TERM. #20
221		CONNECT TO 'MULTILIN' TERM. #21
222		CONNECT TO 'MULTILIN' TERM. #22 — TO MOTOR RTD#9 SEE PAGE 7
223		CONNECT TO 'MULTILIN' TERM. #23
224		CONNECT TO 'MULTILIN' TERM. #24
225		CONNECT TO 'MULTILIN' TERM. #25
226		CONNECT TO 'MULTILIN' TERM. #26 — TO MOTOR RTD#10 SEE PAGE 7
227		CONNECT TO 'MULTILIN' TERM. #27
228		CONNECT TO 'MULTILIN' TERM. #28
271		CONNECT TO 'MULTILIN' TERM. #71
270		CONNECT TO 'MULTILIN' TERM. #70 — TO MOTOR RTD#4 SEE PAGE 7
269		CONNECT TO 'MULTILIN' TERM. #69
268		CONNECT TO 'MULTILIN' TERM. #68
267		CONNECT TO 'MULTILIN' TERM. #67
266		CONNECT TO 'MULTILIN' TERM. #66 — TO MOTOR RTD#5 SEE PAGE 7
265		CONNECT TO 'MULTILIN' TERM. #65
264		CONNECT TO 'MULTILIN' TERM. #64
263		CONNECT TO 'MULTILIN' TERM. #63
262		CONNECT TO 'MULTILIN' TERM. #62 — TO MOTOR RTD#6 SEE PAGE 7
261		CONNECT TO 'MULTILIN' TERM. #61
260		CONNECT TO 'MULTILIN' TERM. #60
300		CONNECT TO 'IRD' CH#3 TERM. #2 — TO MOTOR TOP BRG VIBRATION SENSOR SEE PAGE 6
301		CONNECT TO 'IRD' CH#3 TERM. #3
302		CONNECT TO 'IRD' CH#3 TERM. #5
303		CONNECT TO 'IRD' CH#2 TERM. #2 — TO MOTOR BOT BRG VIBRATION SENSOR SEE PAGE 6
304		CONNECT TO 'IRD' CH#2 TERM. #3
305		CONNECT TO 'IRD' CH#2 TERM. #5
306		CONNECT TO 'IRD' CH#1 TERM. #2 — TO PUMP TOP BRG VIBRATION SENSOR SEE PAGE 6
307		CONNECT TO 'IRD' CH#1 TERM. #3
308		CONNECT TO 'IRD' CH#1 TERM. #5

M100-32 — 1
102
M100-33 — 103
M100-50 — 104
M100-31 — 105

101	TO DCS "OPEN VALVE"
102	FROM DCS "VALVE IS OPEN"
103	TO VFD-SEE PAGE 5a & 2
104	SPARE
105	SPARE
106	SPARE
107	SPARE
108	SPARE
109	SPARE
110	SPARE
111	SPARE
112	SPARE
113	SPARE
114	SPARE
115	SPARE
116	SPARE
117	SPARE
118	SPARE
119	SPARE
120	SPARE

CHANGED

TERMINALS IN "RVMS" STARTER SECTION



FROM CURRENT XFMR "A"	A	TO "CONTROLS" TERM. #A
FROM CURRENT XFMR "A"	B	TO "CONTROLS" TERM. #B
FROM CURRENT XFMR "A"	C	TO "CONTROLS" TERM. #C
CURRENT XFMR COMMON	D	TO "CONTROLS" TERM. #D

REFER TO PAGE 1 FOR CURRENT XFMR DETAILS

NOTE: DASHED LINES ON THIS AND OTHER PAGES INDICATES WIRING SUPPLIED BY THE CUSTOMER

KING'S ELECTRIC MOTORS LTD.
633 TYNE AVENUE
WINNIPEG, MB R2L 1J5
PHONE: (204) 663-5332
FAX: (204) 663-4059
http://www.kings.mb.ca

REVISIONS:	DATE:
AS BUILT	01/01/29

DESIGN: BERNIE DA SILVA	DATE: 00/12/13
DRAWN: BERNIE DA SILVA	00/12/13
CHECK: DON WILSON	

TITLE: 400HP VFD/RVMS STARTER-CONTROL SECTION TERMINALS

PROJECT: PERIMITER PUMP STATION

CUSTOMER: City of Winnipeg / P.O.:

DWG. NO: 00-4383 (page 10b of 11)

SCALE: N.T.S.

BILL OF MATERIALS

VFD	ABB	#ACS627-490-6-000B5200901
BY-PASS DISCONNECTS	ABB	#DETL-NF600AP+DETL-ZW9+DETL-ZW12 PADLOCKABLE IN ALL POSITIONS
"RVMS" STARTER	ABB	EHN550C-1 "RUN" NEMA RATED @ 400 HP/600 V EHN550C-1 "2S" EHN260C-1 "1S" N22E-84+TP40DA "TR" T900SU500 "D/L" + DR25-A-1 ABB (REX) # RS400J // B42838 AUTO XFMR
FUSES FOR SURGE SUPPRESSOR	GOULD	US3J3I HOLDER + A4J25 FUSES
FUSES FOR CONTROL TRANSFOMER	GOULD	USCC2I HOLDER + ATDR5 FUSES
SURGE SUPPRESSOR	PSYTRONICS	#6003D
12 PULSE TRANSFORMER	TRANS-COIL	#KMP12CC550IE
dV/dT OUTPUT FILTER	TRANS-COIL	#KLC480B
CONTROL TRANSFORMER	HAMMOND	PH1000AJ
POWER CONDITIONER	SOLA/HEAVY DUTY	#63-23-175-8 750VA RATED
CONTROL RELAYS	ABB	#N40E-84 C, H, R1, R2, R3, R4, R6, R7
CONTROL RELAYS	ABB	#N31E-84 R5, R8
CONTROL RELAYS	ABB	#N22E-84+CA5-10 R10, R9
"C - H" SELECTOR SWITCH	ABB	#CBK-C2AMK+CB11
LOCK-OFF STOP	ALLEN BRADLEY	#800T-FX6A+N314 PADLOCKING
PILOT LIGHTS	ABB	#CBK-KLF1R(G) 120 VOLT
STOP BUTTON	ABB	#CBK-CPER+CB01
START BUTTON	ABB	#CBK-CPG+CB10
ENCLOSURE FOR VSD	ABB	NO SPECIFIC NUMBER (CUSTOM MADE FOR ABB)
ENCLOSURE FOR "BYPASS"	EUROBEX	#ETA AR9215
ENCLOSURE FOR "RVMS"	EUROBEX	#ETA AR9219
ENCLOSURE FOR "CONTROLS"	EUROBEX	#ETA AR9207
CONTROL TERMINAL BLOCKS	ACI	#102732 (WIRE SIZE RANGE #20-10 AWG)

WARNING STICKER TO BE PLACED ON THE "BYPASS" & "RVMS" SECTIONS. THE COLOUR IS RED WITH WHITE LETTERS AND IS SELF ADHESIVE.

W A R N I N G

600 VOLT FROM MAIN DISTRIBUTION PANEL
TURN OFF CIRCUIT BREAKER AT MAIN PANEL
BEFORE OPENING THESE DOORS
ALWAYS VERIFY THAT POWER IS OFF BEFORE
WORKING ON ANY EQUIPMENT
SEE DRAWINGS FOR ADDITIONAL INFORMATION

KING'S ELECTRIC MOTORS LTD.
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REVISIONS:	DATE:
REVISION #1	00/12/13
AS BUILT	01/01/29

DESIGN:	BERNIE DA SILVA	DATE: 00/11/10
DRAWN:	BERNIE DA SILVA	00/11/10
CHECK:	DON WILSON	00/11/22

TITLE: 400HP VFD/RVMS BILL OF MATERIALS

PROJECT: PERIMITER PUMP STATION

DWG. NO: 00-4383 (page 11 of 11)

CUSTOMER: City of Winnipeg / P.O.:

SCALE: N.T.S.

ACS 600 Series
Adjustable Frequency AC Drives

Submittal - REV #1

Project: PERIMETER ROAD PUMPING STATION VFD

Specification Section: 95I-2000 Architect: _____

Submitted By: KING'S ELECTRIC Contractor: _____

Engineer: REID CROWTHER Customer: CITY OF WINNIPEG

Date: DECEMBER 21, 2000

Reid Crowther Consulting Ltd.

Reviewed for general conformance with the design intent. Responsibility for detailed design is with the shop drawing preparer with the Contractor.

Responsibility for verification and correlation of field dimensions, fabrication processes, techniques of construction, installation and coordination with all parts of the work rests with the Contractor.

Reviewed _____

Reviewed as Modified _____

Revise and Resubmit _____

Proj. #: 60910.07

Date: JAN 8, 2001 By: _____

SUBMITTAL SCHEDULE

MOTOR DATA					DRIVE DATA		
TAG #	SERVING	HP	RATED AMPS	VOLTAGE	MODEL #	RATED AMPS	RATED VOLTAGE
	PUMP	400	438	575	ACS627-0490-6 000B5200901	428	600 (525-690 ± 5%)

SPECIFICATIONS

Input Connection

Input Voltage (U_1): 208/230/240 VAC 3 phase ±10 % for 240 VAC units
380/400/415 VAC 3 phase ±10 % for 400 VAC units
380/400/415/440/460/480/500 VAC 3 phase ±10 % for 500 VAC units
525/550/575/600/660/690 VAC 3 phase ±10 % for 690 VAC units
690 VAC 3 phase ± 5% (ACS 607 only)
Input Frequency: 48 ... 63 Hz, maximum rate of change 17 %/s
Line Imbalance: Max. ±3 % of nominal phase to phase input voltage
Fundamental Power Factor (cos φ1): 0.97 (at nominal load)
Connection: U_1, V_1 and W_1

Output Power

Output Voltage: 0 ... U_1, 3 phase symmetrical
Output Frequency: -300 ... +300 Hz, in DTC mode $\left(0\text{-}3.2 \left(\frac{U_1 \text{ input voltage}}{U_N \text{ Motor}} \cdot f_N \text{ motor}\right)\right)$
Frequency Resolution: 0.01 Hz
Continuous Current: 1.0 * I_N(normal use)
1.0 * I_{Nhd} (heavy duty use)
Short Term Overload Capacity (1 min/10 min): $I_{Nmax} = 1.1 * I_N$
$I_{Nhdmax} = 1.5 * I_{Nhd}$
Peak Overload Capacity (2 s/15 s): 1.5 * I_N (400 VAC and 500 VAC)
2.0 * I_{Nhd} (400 VAC and 500 VAC)
1.5 * I_{Nhd} (690 VAC)
Overcurrent Trip (peak value): 3.5 * I_{Nhd} , min. 2.3 * I_N for R2-R7, min. 2.6 * I_N for R8&R9
Field Weakening Point: 8 ... 300 Hz
Switching Frequency: 3 kHz (average) @ 400 VAC and 500 VAC
2 kHz (average) @ 690 VAC
Acceleration Time: 0 ... 1800 s
Deceleration Time: 0 ... 1800 s
Efficiency: 98 % at nominal power level
Output Protections: Motor Overload, Overcurrent, Short circuit, Ground fault, Missing motor phase, Overfrequency
Short Circuit Withstand Rating: 65,000 AIC (UL) R2-R9; 50,000 AIC (2xR8, 2xR9)
Connection: Six-pulse drives: U_2, V_2 and W_2
Twelve pulse drives (2XR8 & 2XR9): L1, L2, L3, L4, L5, L6 from Y/Δ and Δ/Δ transformer windings

Ambient Conditions, Operation

Air Temperature: 0 ... +40°C (104°F), above +40°C the maximum output power is derated 2.5 % for every additional 1°C (up to +50°C (122°F) maximum limit).
Relative Humidity: 5 ... 95 %, no condensation allowed.
Contamination Levels:
Chemical gases: IEC 721-3-3, Class 3C2
Solid particles: IEC 721-3-3, Class 3S2
Installation Site Altitude: 0 ... 1000 m (3300 ft.) above sea level. At sites over 1000 m above the sea level the maximum power is derated 1% for every additional 100 m (330 ft.). If the installation site is higher than 2000 m above sea level, please contact your local ABB distributor or representative for further information.
Vibration: Max. 0.3 mm (2 ... 9 Hz), max. 1 m/s^2 (9 ... 200 Hz) sinusoidal (IEC 68-2-6)

Ambient Conditions, Storage

Temperature: -40 ... +70°C. (-40 ... 158°F)
Relative Humidity: Less than 95 %, no condensation allowed.
Atmospheric Pressure: 70 ... 106 kPa (10.2 ... 15.4 PSI)
Vibration: Max. 1.5 mm (2 ... 9 Hz), max. 5 m/s2 (9 ... 200 Hz) sinusoidal (IEC 68-2-6)
Shock: Max. 100 m/s^2, 11 ms (IEC 68-2-27)

Ambient Conditions, Transportation

Temperature: -40 ... +70°C (-40 ... 158°F)
Relative Humidity: Max. 95 %
Atmospheric Pressure: 60 ... 106 kPa (8.7 ... 15.4 PSI)
Vibration: Max. 3.5 mm (2 ... 9 Hz), max. 15 m/s^2 (9 ... 200 Hz) sinusoidal (IEC 68-2-6)
Shock: Max. 100 m/s^2, 11 ms (IEC 68-2-27)
Bump: Max. 300 m/s^2, 6 ms (IEC 68-2-29)
Free Fall: 250 mm (weight under 100 kg)
100 mm (weight over 100 kg)

Cooling Information

Power Losses: Approximately 3 % of rated output power
Cooling Method: Internal fan

Auxiliary Power Supply

Voltage: 24 VDC ±10 %
Maximum Current: 250 mA
Protection: Short circuit proof
Terminal Block Size: Cables 0.5 ... 1.5 mm^2 (16 ... 20 AWG)

Analog Inputs

Two Programmable Differential Current Inputs:
- Signal Level: 0 (4) ... 20 mA
- Input Resistance: R_i = 100 Ω
- Optional Isolation (via external module)

One Programmable Differential Voltage Input:
- Signal Level: 0 (2) ... 10 VDC
- Input Resistance: R_i > 200 kΩ
- Optional Isolation (via external module)
- Common Mode Voltage: ±15 VDC, max.
- Common Mode Rejection Ratio: > 60 dB at 50 Hz
- Resolution: 0.1 % (10 bit)
- Accuracy: ±0.5 %
- Input Updating Time: 12 ms max. (Standard Application Software)
- Terminal Block Size: Cables 0.5 ... 1.5 mm^2 (16 ... 20 AWG)

Reference Power Supply

- Voltage: 10 VDC ±0.5 % (25°C)
- Maximum Load: 10 mA
- Applicable Potentiometer: 1 kΩ ... 10 kΩ
- Terminal Block Size: Cables 0.5 ... 1.5 mm^2

Analog Outputs

Two Programmable Current Outputs:
- Signal Level: 0 (4) ... 20 mA
- Resolution: 0.1 % (10 bit)
- Accuracy: ±1 %
- Maximum Load Impedance: 700 Ω
- Output Updating Time: 100 ms, max. (Standard Application Software)
- Terminal Block Size: Cables 0.5 ... 1.5 mm^2 (16 ... 20 AWG)

Digital Inputs

Six Programmable Digital Inputs (Common Ground):
- Isolation: Group isolated
- Isolation Test Voltage: 500 VAC, 1 minute
- Terminal Block Size: Cables 0.5 ... 1.5 mm^2 (16 ... 20 AWG)
- Signal Level: 24 VDC, -15 % ... +20 %
- Logic Thresholds: < 8 VDC @ "0", > 12 VDC @ "1"
- Input Current: 10 mA, typical
- Filtering Time Constant: 1 ms
- Motor Thermistor Input:
  - Input Levels: 1.5 kΩ @ "1" - normal temperature
> 4 kΩ @ "0" - high temperature
Open Circuit @ "0" - high temperature
  - Thermistor Current: 5 mA, typical
  - Connector: X22:6

Internal 24 VDC Supply For Digital Inputs:
- Voltage: +24 VDC
- Maximum Current: 100 mA
- Connector: X22:7
- Protection: Short circuit proof

An external 24 VDC supply may be used instead of the internal supply.

Relay Outputs

Three Programmable Relay Outputs:
- Switching Capacity: 8 A at 24 VDC or 250 VAC, 0.4 A at 120 VDC (non-inductive)
- Maximum Continuous Current: I_C = 2 A rms
- Contact Material: Silver Cadmium Oxide (AgCdO)
- Isolation Test Voltage: 4 kVAC, 1 minute
- Terminal Block Size: Cables 0.5 ... 2.5 mm^2 (14 ... 20 AWG)

Protections

- Overcurrent trip limit: 3.5 x I_{NHD} instantaneous
- Single Phase: Protected (input & output)
- Overvoltage trip limit: 1.3 x V_{1max}
- Undervoltage trip limit: 0.65 x V_{1min}
- Overtemperature (heatsink): 120°C
- Auxiliary voltage: Short Circuit Protected
- Ground fault: Protected
- Microprocessor fault: Protected
- Motor stall protection: Protected
- Motor overtemperature protection (I^2t): Protected

Specifications are subject to change without notice.

DEFINITIONS

U_1=Input Voltage
U_N=Nominal Motor Voltage
f_N=Nominal Motor Frequency
I_N=Nominal Current Normal Duty
I_{Nmax}=Maximum Current Normal Duty
S_N=Power Normal Duty (kVA)
P_N=Power Normal Duty (kW)
P_N= Power Normal Duty (HP)
I_{Nhd}=Nominal Current Heavy Duty
I_{Nhdmax}= Maximum Current Heavy Duty
S_{Nhd}=Power Heavy Duty (kVA)
P_{Nhd}=Power Heavy Duty (kW)
P_{Ndh}= Power Heavy Duty (HP)

ACS 600 in Brief

ACS 600 is a new generation AC drive that achieves the ultimate in AC motor control performance. The first AC drive to utilize Direct Torque Control (DTC), the ACS 600 accurately controls the speed and torque of any standard squirrel cage motor - without encoder or tachogenerator feedback.

The ACS 600 product family includes models to suit virtually any application or operating environment, with a complete selection of voltage, power and enclosure ratings, combined with highly flexible control and communication capabilities.

- Motor power range from 3 HP to 700 HP
- Supply voltages from 380 VAC to 500 VAC
- Enclosure classes IP 00 (chassis), IP 21 (NEMA 1), IP 54 (NEMA 12).

Each ACS 600 type has two ratings, normal use and heavy-duty use. The normal use rating is specified so that the overload capacity requirements of most applications - both the constant torque and variable torque - are met. Heavy-duty use rating fulfills high overload capacity requirements.

The ACS 600 features a multilingual alphanumeric control panel that displays messages to the operator in plain phrases, greatly simplifying set-up, operation, and fault diagnostics. The panel can be mounted on the ACS 600 enclosure or remotely. The parameter copy feature allows all drive parameters to be copied from one drive to another.

The standard control connections include three analog inputs, two analog outputs, six digital inputs and three digital outputs. With optional I/O Extension Modules and Communication Adapter Modules, the communication capabilities can be extended. Optional modules mount on standard DIN rail and connect via a high speed fiber optic link.

The ACS 600 comes equipped with an extensive library of preprogrammed application macros, which, at a touch of a button, allow rapid configuration of inputs, outputs and drive parameters. This maximizes convenience and minimizes start-up time.

■ Suitable for Any Application

ACS 600 AC drives meet the needs of any application - from the simplest to the most critical and highly demanding.

- Pumps - centrifugal, positive displacement, dosing
- Fans - forced draft, induced draft, centrifugal, axial
- Mixers
- Conveyors, bottling lines, palletizers and other materials handling applications
- Lifts, elevators, cranes, hoists
- Winders - films, paper, wire
- Centrifuges
- Extruders - melt pumps, pelletizers.

General Part Number Description

Type Code: A C S 607 -0490 -6-000B5200901

Input Bridge
0 = 6 Pulse
2 = 12 Pulse (2xR9, 2xR9 only)

Enclosure Type
1 = Wall mounted (ACS 601)
4 = Module (ACS 604)
7 = Std cabinet (ACS 607)

Rated output power in kVA (approx.)

Supply voltage
3 = 380/400/415 VAC 2 = 208/230/240 VAC
4 = 380/400/415/440/460/480/500 VAC
5 = 380/400/415/440/460/480/500 VAC (2xR8 & 2xR9 only)
6 = 525/550/575/600/660/690 VAC

Option # 1 (ACS 601 only)
0 = None
* = Option # 1 included

Option # 2 (ACS 607 only)
0 = None
* = Option # 2 included

Option # 3 (ACS 607 only)
0 = None
* = Option # 3 included

Software version
B = Standard Software (3-wire start) w/(English, French, Spanish, Portuguese)
M = Lead – Follower Macro
L = Lead – Follower Macro (2-wire start) w/(English, French, Spanish, Portuguese)
C = Standard Software (2-wire start) w/(English, German, Italian, Dutch)
D = Standard Software (2-wire start) w/(English, Danish, Finnish, Swedish)
E = Standard Software (2-wire start) w/(English, French, Spanish, Portuguese)
H = Pump, Fan, Control (R2 - R9 only)

Control Panel
0 = None (See Control Panel Options for ACS 604)
1 = CDP 311 Control Panel included
4 = Customer I/O Terminal Block (ACS 607; R7 to 2xR9)
5 = Option 1 and 4

Enclosure class
0 = IP 00 (chassis)
A = IP 21 (TYPE 1; ACS 607, R7 - R9)
2 = IP 22 (TYPE 1; ACS 601, R2 - R7, ACS 607, 2xR8 - 2xR9)
4 = IP 42 (meets and exceeds TYPE 1 filtered; for ACS 607 drives only)
5 = IP 54 (TYPE 12)
6 = IP 00 With Conformal Coated Circuit Boards (ACS 604, R8 - R9)
7 = IP 22 With Conformal Coated Circuit Boards (ACS 601, R7)
9 = IP 54 With Conformal Coated Circuit Boards (ACS 601, R2 - R6, ACS 607 R7 - 2xR9)
(NOTE: Not all enclosure classes available in all units.)

Line input and protection options
0 = Standard options (ACS 607 only disconnect switch, fuses)
* = Line contactor and Coast stop devices

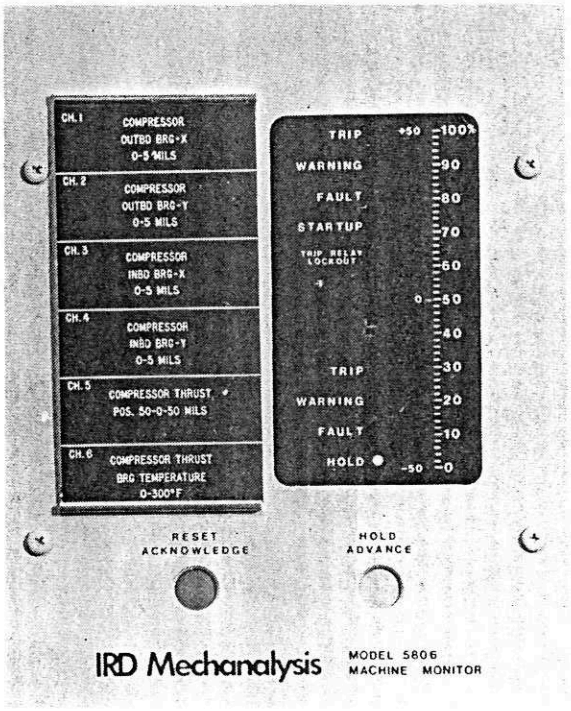
Starter for Auxiliary Motor Fan (ACS 607 only, voltage same as the unit U_1)
0 = None
* = Starter included

External filters
0 = CE with EMC filters (internal R2-R7 and 607; not for 690 VAC)
3 = Output dv/dt filters and option '0' - ACS 607 only (not for 690 VAC)
5 = Output dv/dt filters and option '9' - ACS 607 only
8 = No CE, no EMC filters, US conduit, (ACS 607 only, 115 VAC transformer secondary; compliant with NFPA 90)
9 = CE low voltage, machine directive; No EMC (ACS 607 only, secondary of all transformers 220 VAC)

Braking chopper and Cabling Direction
0 = No Brake Chopper - Bottom Entry / Bottom Exit (BE/BE)
1 = Brake Chopper (BE/BE)
3 = Input Power Top Entry / Output Power Bottom Exit (ACS 607 only)
4 = Input / Output Power Top Entry/Exit (ACS 607; R7 to R9 only)
5 = Option 1 and 3
6 = Option 1 and 4

Other options
0 = None

IRD Mechanalysis



INSTALLATION AND OPERATION MANUAL FOR MACHINE MONITOR MODEL 5806

APPLICATION DATA

TITLE:

FOR:

RTD AND IRD SETTINGS

RELCON CONTROL

MULTILIN 169 MOTOR MANAGEMENT MONITOR

	ALARM	SHUTDOWN
Upper Motor Bearing	90°C	100°C
Lower Motor Bearing	90°C	100°C
Windings	130°C	140°C
Pump Upper Thrust Bearing	85°C	93°C

IRD MECHANALYSIS MONITOR

	ALARM	SHUTDOWN
Motor Upper	24%	32%
Motor Lower	44%	54%
Pump Upper	20%	30%

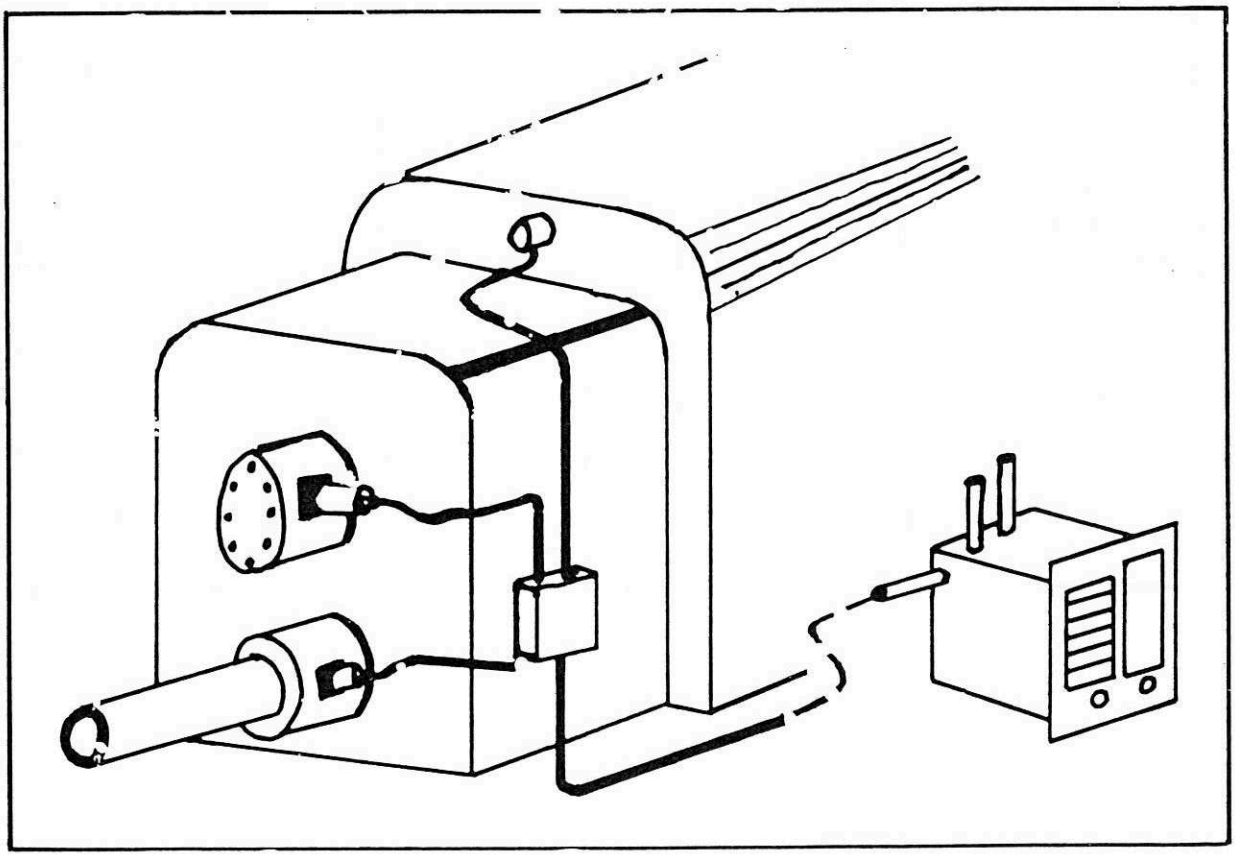
SYSTEM DESCRIPTION

The concept of machinery monitoring is quite simple. During normal operation, the machine's "vital signs" remain within relatively narrow ranges. If a mechanical problem develops, it will be reflected as a change in one or more of these vital signs. This change will be sensed by the monitor instrument and cause an alarm.

The monitor system consists of a number of TRANSDUCERS connected to the MONITOR. Transducers installed on the machine convert the "vital signs"- various mechanical parameters such as vibration, temperature, axial movement, and others - to electrical signals that are transmitted to the monitor instrument.

The monitor is usually installed in the control room with other machine instrumentation. It receives signals from the transducers, processes and measures the signals, and closes electrical relay contacts if one of the signals increases too much. The relays can be connected to annunciators or to automatic machine controls.

The monitor also provides signal-proportional electrical outputs that can be used with strip chart recorders, data loggers, or computers.



TRANSDUCERS

The effectiveness of the monitor system will depend on the selection of proper transducers and their location on the machine.

The transducers supplied with this monitor are those specified by the purchaser. The installation section of this manual covers the details of proper transducer mounting and wiring. Because of the great variety of machine configurations, the manual does not attempt to instruct the installer as to exact placement of the transducers. IRD engineers will be pleased to offer advice and recommendations relative to the selection and/or installation of transducers, upon request.

(In most cases, the transducers have been selected by system engineers to guard against the most commonly encountered failure modes of the machine. It is important to recognize that some machine faults can occur that would not result in a significant change in the monitored parameters, therefore would not cause an alarm.)

NOTE: The term "pickup" is commonly used interchangeably with the term "transducer".

The chart below summarizes the various types of pickups used with Model 5806 Monitor.

MEASURED PARAMETER	PICKUP TYPE	IRD PICKUP MODEL	MONITOR READOUT IN TERMS OF ...
VIBRATION	VELOCITY	544B, 544M, 544R, 540, OR 580	VELOCITY IN IN/S OR MM/S DISPLACEMENT IN MILS OR μM
	ACCELEROMETER	960M, 910M	ACCELERATION IN g's VELOCITY IN IN/S OR MM/S
	NON-CONTACT	403	DISPLACEMENT IN MILS OR μM
AXIAL POS'N THRUST	NON-CONTACT	403	DISPLACEMENT IN MILS OR MM
TEMPERATURE	THERMOCOUPLE	* TYPE J, K, OR T	TEMPERATURE IN °F OR °C
	RTD	* 100-OHM POT.	TEMPERATURE IN °F OR °C
SPIKE ENERGY	ACCELEROMETER	960M	SPIKE ENERGY, gSE
SPEED, RPM	NON-CONTACT	403	SPEED, REV./MINUTE
ROTOR ECCENTRICITY	NON-CONTACT	403	ECCENTRICITY IN MILS
VALVE POSITION	CAM POT.	I/N 15629 OR 16282	POSITION PERCENT, %
	LVDT	I/N 15383	DISPLACEMENT IN MILS OR INCHES
SHELL EXPANSION	LVDT	I/N 15383	MILS OR INCHES
DIFFERENTIAL EXPANSION	NON-CONTACT	I/N 26450, 26400, OR 26401	DISPLACEMENT IN MILS
	G.E. COILS	I/N 18605	MILS
	NON-CONTACT	I/N 27860	MILS

* NOT SUPPLIED BY IRD MECHANALYSIS

INSTALLATION

SELECTING A LOCATION FOR THE MONITOR

The monitor is designed for panel mounting in a control room for ready access by operating personnel. If it is necessary to install the monitor outdoors, a NEMA-4 Weatherproof Enclosure must be used to prevent rain from entering the monitor.* If the anticipated minimum temperature is below 32°F (0°C) the enclosure must be equipped with a heater. Shade from direct sunlight must be provided to prevent excessive heat buildup in the enclosure (which could result in an equipment failure). Maximum temperature for the monitor unit is 140°F.

When selecting a location for the monitor, keep in mind that it is a complex electronic device. It is designed and manufactured to withstand quite severe environmental conditions BUT ---- as with any electronic instrument it will give the longest, trouble-free service if treated with some care. In general, any location that is comfortable for people is best.

The selected panel location should not subject the monitor to dripping water from above, or to heat from equipment installed beneath it.

*Refer to Spec Sheet 71-01

HAZARDOUS LOCATIONS

Due to the proximity of some control rooms to process machinery, the control room interior may be designated as a hazardous area within the definition of Article 500 of the (U.S.) National Electrical Code, or similar codes in other countries.

If the control room is classified as a Division 2 area (N.E.C.), present interpretation of the code usually permits the operation of electrical equipment if two conditions are met during normal operation:

(1) Arcing or sparking contacts must not be exposed, and
(2) No surface temperature may exceed 80% of the ignition temperature (in °C) of the hazardous gas or vapor.

The Model 5806 Monitor meets the first requirement since all relay contacts are hermetically sealed. The second requirement is met if ignition temperature of the hazardous gas or vapor is above 200°C.

CAUTION

BEFORE INSTALLING OR OPERATING THIS MONITOR IN A HAZARDOUS LOCATION, OBTAIN SPECIFIC APPROVAL TO DO SO FROM THE LOCAL APPROVING AUTHORITY.

PURGING

Some airborne gases (such as chlorine) are so corrosive that over an extended period of time even the best protected instrument will be damaged. If this situation exists in the proposed monitor location, consideration should first be given to selecting another location! If that is not possible, the NEMA-4 Enclosure should be used, with a continuous flow of clean instrument air to exclude the corrosive gas.

NOTE: Purging in this manner is NOT recommended in explosion-hazardous areas, such as discussed in the preceding paragraph.

GROUNDING AND SHIELDING

Electrical signals from the transducers are quite small, and therefore susceptible to interference from electrical "noise". Noise can be generated by power cables near the transducers or wiring, by walkie-talkies, by electrical static discharges or lightning, or by large electrical equipment (motors, transformers, controllers) in the vicinity.

To minimize the possibility of interference- which can cause erroneous monitor readings and false alarms - it is essential to follow the recommendations on these pages with respect to grounding and shielding.

Radio-frequency interference (RFI) can result from open wiring. If walkie-talkies are used in the plant, it is strongly recommended that ALL wiring be run in thin-wall metallic electrical tubing (conduit). Conduit, fittings, and junction boxes should be electrically bonded to a good earth ground.

INSTALLATION DETAIL DRAWINGS

The following pages show installation details, dimensional data, and wiring instructions.

Use Pages 4-1 through 4-6 for installing the monitor unit and wiring it to power, control circuits, and recorders.

Pickup installation, and wiring between pickups and the monitor are covered in the installation drawings starting on Page 4-7. Select the appropriate drawing(s) for the pickups being used.

CAUTION

DO NOT APPLY POWER TO THE MONITOR UNTIL ALL WIRING HAS BEEN CAREFULLY CHECKED.

IRD

Vibration Pickup P/N 9712

—Model 544M

SPEC SHEET 41-02

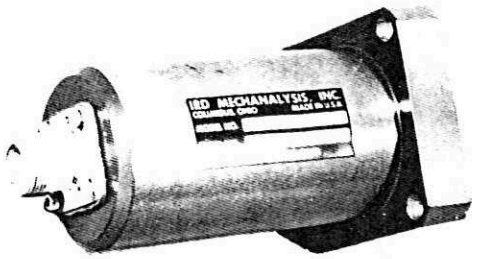
EFFECTIVE 9-1-82

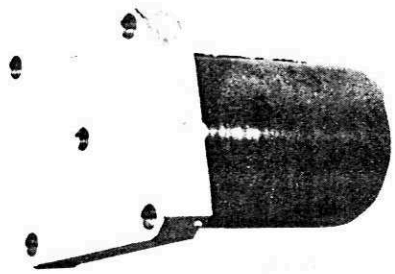
SUPERSEDES 8-1-80

DESCRIPTION

The IRD Model 544M Vibration Pickups is a seismic, velocity type transducer with a moving coil in a permanent magnetic field. The 544M mounts permanently on a flat surface at the bearing housing or other critical points on a machine and provides reliable continuous performance under a variety of adverse environmental conditions.

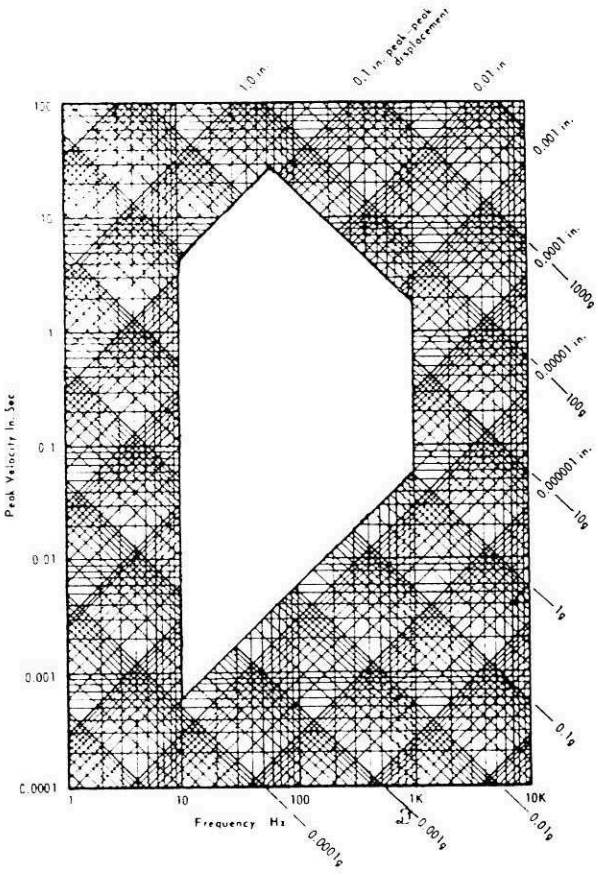
Its high output and low impedance, wide frequency response and rugged construction make the 544M suitable for all types of machinery monitoring applications. In addition, a hard anodized aluminum case insulates the signal coil from the housing to eliminate false monitor alarms often encountered from ground loops and power surges in many field installations. The 544M is waterproof and acceptable for use in Division 2 hazardous areas.



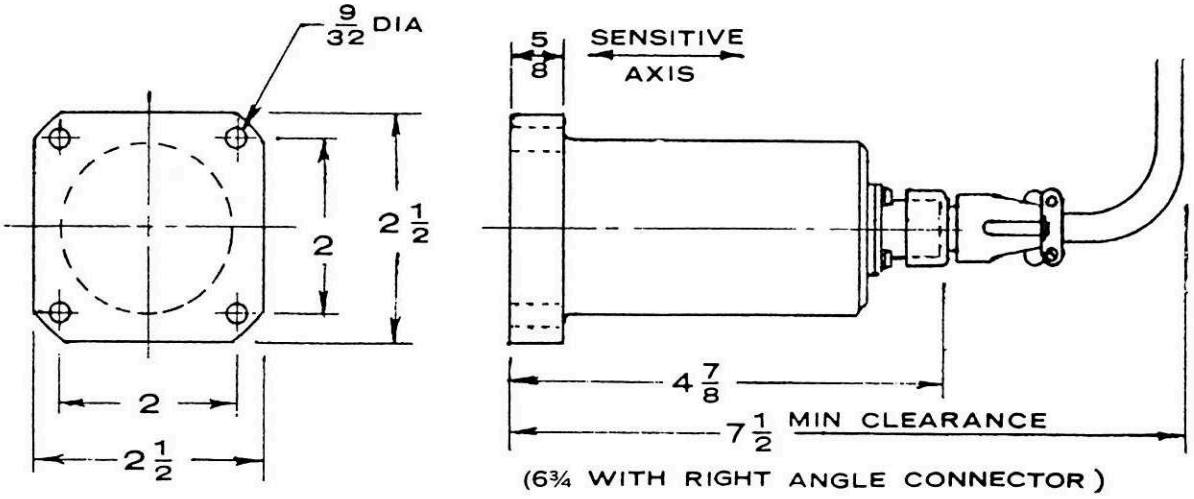


SPECIFICATIONS

Frequency Response:	14 Hz - 1000 Hz ± 8% 10 Hz: -20% (Avg.) Measured at 70°F (21°C)
Sensitivity:	764 ± 10% mV RMS/in/sec (peak)
Temperature Range:	-40°F to +500°F (-40°C to +260°C)
Impedance:	R = 2K ohms; L = 0.7 at 70°F (21°C)
Damping Factor:	0.7 (critical) at 70°F (21°C)
Mounting Orientation:	Any - horizontal or vertical
Transverse Response:	Less than 5% (average) between 10 Hz and 1000 Hz
Magnetic Field Sensitivity:	0.15 inches/sec/gauss (0.0015 in/sec/gauss with optional shield)
Housing:	Waterproof, dustproof
Connector:	2-pin GS-02-10SL-4P
Weight:	24 oz.
Isolation:	Floating signal coil insulated from case
Mounting:	(4) holes 9/32 dia. on 2 x 2 centers
Max amplitudes:	125 mils pk-pk; to 70 Hz; 30g above 70 Hz



OUTLINE DIMENSIONS



ACCESSORIES (see Spec Sheets for detailed information)

1. Explosion-proof Enclosure - for installations in Division 1 Class I, Group D or Class II Groups E, F, G Hazardous Areas P/N 4224 (See Spec Sheet 72-01)

2. Safety Barrier - for intrinsically safe installations in Division 1, Class I, Groups B, C, D Hazardous Areas P/N 7685 (See Spec Sheet 43-03)

3. Straight Cable Connector P/N 4366 (up to 250°F, 120°C) P/N 15039 (up to 500°F, 260°C)

4. Right Angle Connector P/N 14797 (up to 250°F, 120°C)

5. Magnetic Shield to reduce magnetic field sensitivity by 100:1 P/N 10140

ORDERING INFORMATION

(qty) P/N 9712 Model 544M Vibration Pickup

IRD Mechanalysis, Inc.
Subsidiary of H.H. Robertson Company

6150 Huntley Road
Columbus, Ohio 43229
614/885-5376

IRD Mechanalysis, Limited
333 Barton Street East
Stoney Creek, Hamilton
Ontario, Canada
416/662-7577

IRD Mechanalysis, (U.K.) Limited
Sealand Industrial Estate
Chester, England
44/244/374-914

IRD Mechanalysis, S.A.
Avenue Winston Churchill 98
Brussels, Belgium
32/2/344.70.58

IRD Mechanalysis, (Australia) Pty. Ltd.
337 Pacific Highway
Crows Nest, Australia
(02) 929-8122

IRD Mechanalysis, (India) Limited
47-48 Jolly Maker Chambers II
Nariman Point
Bombay 400-021
India
244136

Signal Conditioning Card for Velocity Pickups

—for use in 5800 Series Machine Monitors

SPEC SHEET 62-13
EFFECTIVE 8-1-86
SUPERSEDES 8-1-83

DESCRIPTION

These signal conditioners are for use in 5800 Series Machine Monitors. They connect to a single case or bearing mounted velocity type pickup to condition the pickup signal for use by the monitor. Solid state components, 100 hour functional heat run and multipoint quality control tests assure troublefree performance.

SPECIFICATIONS

Input: One 544B, 544M, 544R, or 580

Nominal Full Scale: See Table below.

Range: Adjustable ± 50%

Frequency Response: (544B, 544M, 544R) 5 Hz-2500 Hz, flat within 5% band (10% if integrated).

6 dB/octave rolloff (minimum) outside passband.

Frequency Response: (580) 2 Hz to 2500 Hz, flat within 5% band (10% if integrated).

Linearity: Linear within ± 2% F.S. measured between 10%-100% F.S. @ 100 Hz at recorder output.

Power Output: +24 Vdc current-limited @ 20mA for 580 type cards

Detection: RMS-proportional

Time Delay: (544B, 544M, 544R) Approximately 3 seconds time constant in detector.

Time Delay: (580) Approximately 15 seconds time constant in detector

Recorder Output: 0-5 Vdc, 1K ohm output impedance, negative ground. Optional 4-20mA current output, 300 ohm maximum load resistance, negative ground.

Analyzer Output: Connected to sensor through 5K isolation resistor. Screw terminal output on signal conditioner (rear of monitor) and Output at monitor front panel analyzer jack.

Construction: Glass epoxy circuit board, varnish coated
Gold over nickel plated edge connector
Solid state components

Pickup Type	Range*	0-5 Vdc Rec. Output Card Part No.	4-20mA Rec. Output Card Part No.
544	10 mils pk-pk, integrated (250 µm pk-pk)	23383	24149
544	1 in/s pk, not integrated (25 mm/s pk)	23540	24153
580	10 mils pk-pk, integrated (250 µm pk-pk)	24055	24327
580	1 in/s pk, not integrated (25 mm/s pk)	24056	24328

EXISTING PUMP 2 (M200PP)

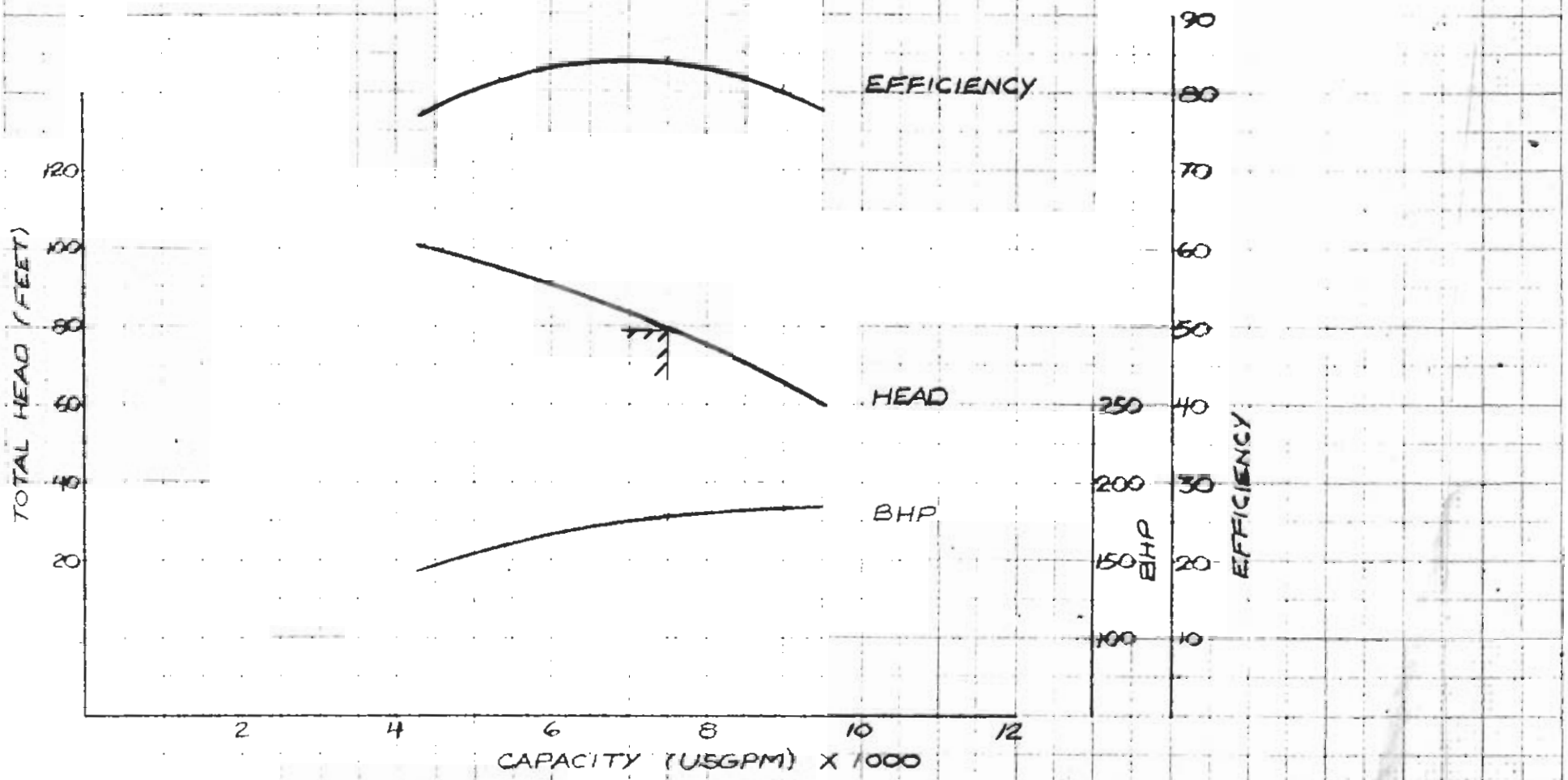
FOR 16CFC PUMP, S/N .....

TESTED ON ...MAY 6/76.....

Pembina Rd. Pump Sta.

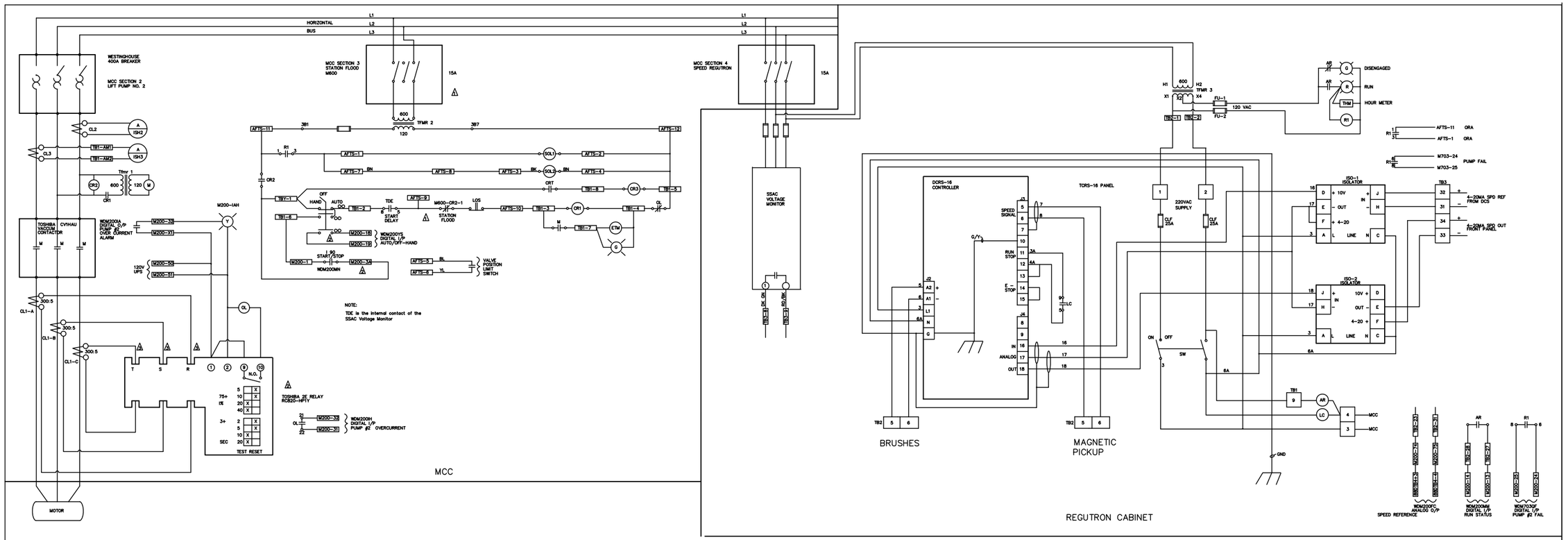
PRPS M200

THIS CURVE SHOWS IN ADDITION, THE EXPECTED HEADS AND EFFICIENCIES AT OTHER CAPACITIES BUT ONLY THE CONDITION POINT IS GUARANTEED.



SPEC. CONDITIONS OF SERVICE		WORTHINGTON (CANADA) LTD.	CUSTOMER CITY OF WINNIPEG
USGPM 7500	BHP 181		CUSTOMER REF: 49571
TDH 79	SP. GR. 1.0	DESCRIPTION 16 CFC PERFORMANCE TEST CURVE	OUR REF: B0754021
RPM 854	EFF'CY 82.5		9810835
DATE MAY 4/76	DRAWN RH		

WC-242-1



3B1 & 3B7	POINTS OFF TERMINAL STRIP	120 V	BOTTOM OF MCC SECTION 3	
AFTS	AUX. FIELD TERMINAL STRIP		M.C.C.	
AR	AUXILIARY RELAY	240V COIL	R.C.	ENERGIZED = NORMAL DE-ENERGIZED = STOP/FAIL
CL#	COIL#		MCC	
CR1	START RELAY	120V COIL	MCC	ENERGIZED = RUN DE-ENERGIZED=STOP
CR2	MCC BREAKER ON	600V COIL	MCC	ENERGIZED = ON DE-ENERGIZE = OFF
CR3	REGUTRON START	120V COIL	MCC	ENERGIZED = RUN DE-ENERGIZED = STOP
ETM	ELAPSE TIME METER	120V	MCC	
I/I	4-20ma TO 0-20ma CONVERTER	WITH USE OF RES	R.C.	

LC	LINE CONTACTOR	240V COIL	R.C.	ENERGIZED = RUN DE-ENERGIZED = STOP
M	MOTOR CONTACTOR	120V COIL	MCC	ENERGIZED = RUN DE-ENERGIZED = STOP
OL	OVERLOAD RELAY	120V COIL (UPS)	MCC	ENERGIZED = FAIL DE-ENERGIZED = NORMAL
SOL1	FAIL SAFE CLOSE (2-WAY N.O.)	120V	PUMP FLOOR	ENERGIZED = VALVE CAN OPEN DE-ENERGIZED = CLOSE
SOL2	OPEN/CLOSE VALVE (4-WAY)	120V	PUMP FLOOR	ENERGIZED = OPEN VALVE DE-ENERGIZED = CLOSE VALVE
TB1	TERMINAL BLOCK 1		MCC	
TB2	TERMINAL BLOCK 2		R.C.	
TB3	TERMINAL BLOCK 3		R.C.	
TDE	POWER REGUTRON START DELAY	120V COIL	R.C.	OPEN = NON PERMISSIVE CLOSED = TIMED READY
Tfrm #	TRANSFORMER #	VARIOUS	MCC & RC	
THM	TIME HOUR METER	120V		

NOTES:

1. REFER TO DWG. WEP-680
2. REFER TO DWG. WEP-656
3. HAS TWO (2) TURNS
4. REFER TO ELECTRIC MACHINERY DWGS.
   - 375C182
   - 383C254N
   - 382C257N
   - 382C734N

COLORS

BK = BLACK
BL = BLUE
BN = BROWN
DK GN = DARK GREEN
GN = GREEN
OR = ORANGE
RD = RED
RD/BK = RED/BLACK
YL =YELLOW
YL/BK = YELLOW/BLACK

NO.	REVISIONS	DATE	BY
6	EQUIPMENT CHANGE	19/04/11	SPH
5	REDRAWN	12/96	MBD
4	REVISED TO DATE	05-96	CSN
3	REVISED TO DATE	04-94	MBD
2	REVISED TO DATE	09/92	MBD
1	REVISED & REDRAWN	08/90	MBD

DESIGNED BY
DRAWN BY M.DAHL
HOR. SCALE N.T.S.
VERTICAL
DATE 1990 07 26

CHECKED BY M. JEGUES
APPROVED BY
RELEASED FOR CONSTRUCTION
DATE

PLOT DATE: JANUARY 31, 1997

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER AND WASTE DEPARTMENT

PERIMETER ROAD PUMP STATION
M200-PP CONTROL

SHEET OF

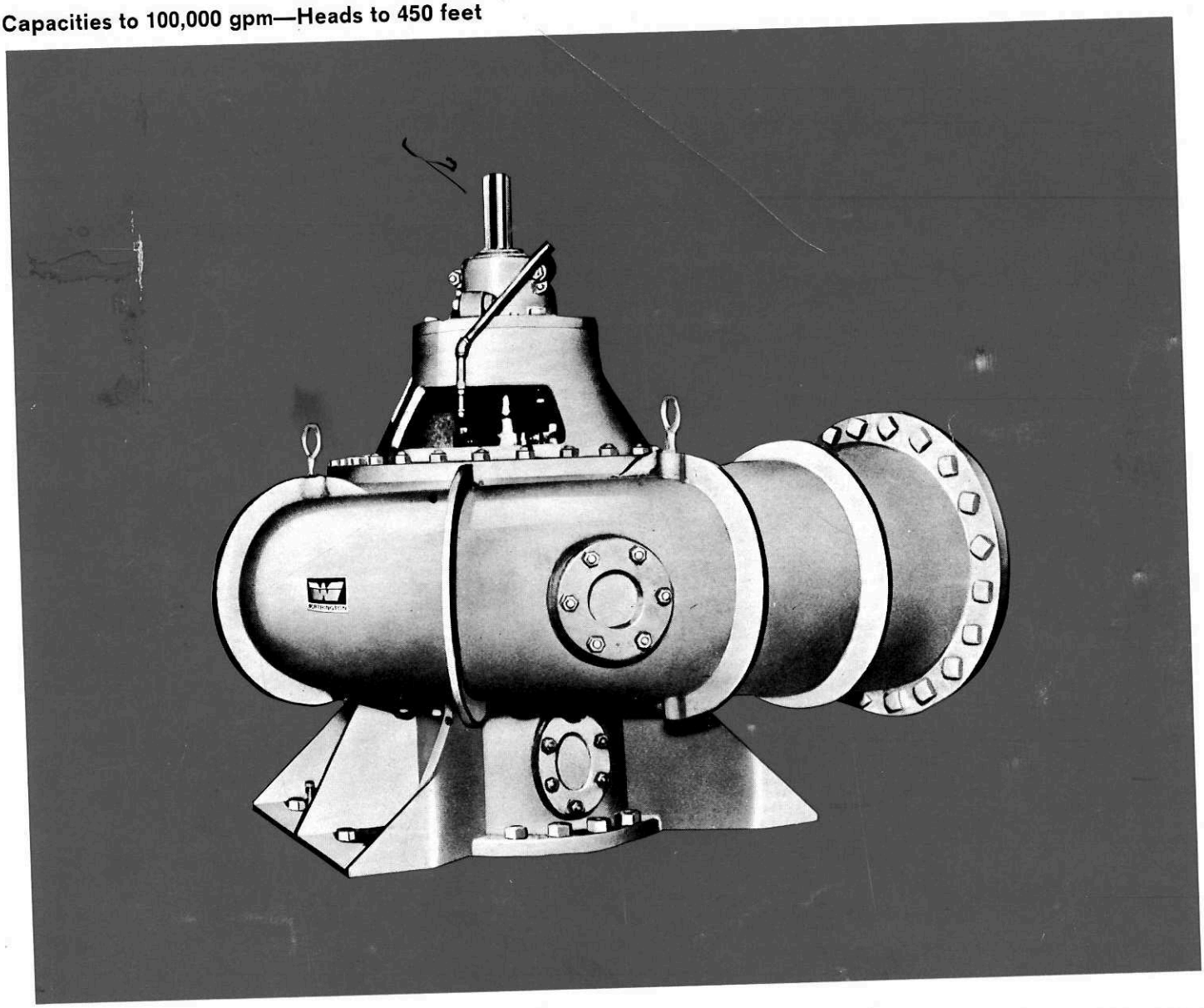
CITY DRAWING NUMBER
PRS-31

Worthington

Volute Centrifugal Pumps

Type FA-FC-NA

Capacities to 100,000 gpm—Heads to 450 feet

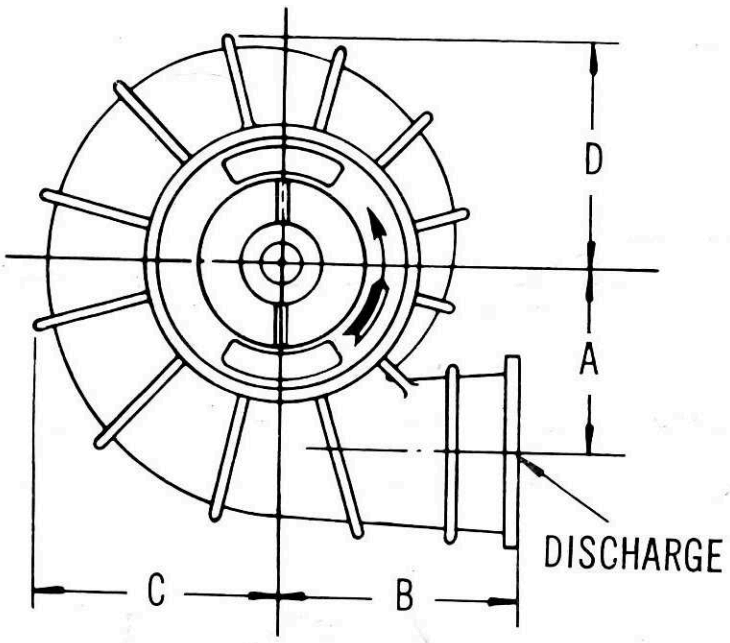


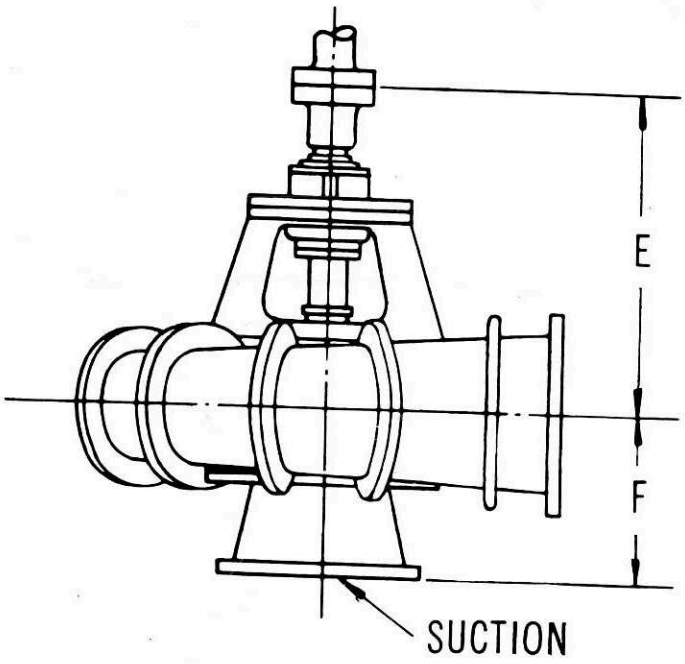
MEMBER HYDRAULIC INSTITUTE USA

A rugged, economical
Single stage, end suction pump

WORTHINGTON

TYPES FA-FC-NA Dimensions





Note: All dimensions are in inches (not to be used for construction purposes).

RX-128436

LINE NO.	SIZE OF PUMP	DISCHARGE DIA.	SUCTION DIA.*	A	B	C	D	E*	F*
1	10 FA-2	10	12	17¾	27	21¾	20⅝	44½	17¼
2	12 FA-2	12	14	17¾	30	23	21¾	32	21
3	16 FC-1	16	16	18	19	20¾	18¾	46	21¼
4	18 NA-25	18	20	16	42	26½	24¾	54	30½
5	18 NA-33	18	20	21	47	30½	28½	54	31½
6	18 NA-37	18	20	23	40	32	30¼	56	32½
7	20 NA-30	20	24	23	27	31	29½	40	24
8	20 NA-37	24	24	23	49	34¾	32¾	54	30½
9	24 NA-30	24	30	23	42	32	28¾	42	24
10	24 NA-37	24	24	23	49	34¾	32¾	54	30½
11	24 NA-38	24	24	23	52	34¾	32¾	57	36
12	26 NA-43	26	30	33½	42	44	39¼	57	29½
13	30 NA-40	30	30	25	64	38½	35½	54	39¾
14	30 NA-44	30	42	33½	66	44	39	59	53¾
15	36 NA-43	36	36	32½	72	44	39	45	35½
16	36 NA-57	36	36	45½	60	63¼	57¼	45	29½
17	42 NA-57	42	42	45½	78	62¾	57	57¼	34
18	42 NA-85	42	42	58⅛	102	70	63	108	54
19	54 NA-80	60	60	57½	63	78¼	69½	73	60
20	60 NA-75	60	72	64	63	83½	73	108	60
21	60 NA-68	60	72	64	63	83½	73	108	60

*These dimensions are typical.

DATA ON FLANGES 125# STANDARD					
DIA. OF OPENING	DIA. OF FLANGE	FLANGE THICKNESS	SIZE OF BOLT	BOLT CIRCLE	NO. OF BOLTS
10	16	1 3/16	⅞	14¼	12
12	19	1¼	⅞	17	12
14	21	1⅜	1	18¾	12
16	23½	1 7/16	1	21¼	16
18	25	1 5/16	1⅛	22¾	16
20	27½	1 11/16	1⅛	25	20
24	32	1⅞	1¼	29½	20
26	34¼	2	1¼	31¾	24
28	36½	2 1/16	1¼	34	28
30	38¾	2⅛	1¼	36	28
36	46	2⅜	1½	42¾	32
42	53	2⅝	1½	49½	36
54	66¼	3	1¾	62¾	44
60	73	3⅛	1¾	69¼	52
72	86½	3½	1¾	82½	60

Worthington Pump International
Harrison, New Jersey 07029
a division of Worthington Corporation

WORTHINGTON

Supersedes 2122-B1
2122-B1A 7110 Bar. P.

Litho in U.S.A.

Bearing Supply (Canada) Ltd.

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Power Transmission Equipment • Hose & Fittings • Automation Technology
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Bearings, Oil Seals & O-Rings • Specialty Lubricants & Adhesives

#2 PUMP

IMP 23.5" ø

R.P.M 954.

PUMP 16 CFL.

S/N 3.07540211.

9864232

CNRIS 694 9300

~~VERNAT. 403 ~~

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impeller

2017910-004 L.H. IMP

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+ TAXES

wear Rings

2017970-001 S.S. WR RINGS

SET $2114.00

+ TAXES

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Paramount Road, Winnipeg, Manitoba R2X 2W6 • Tel: (204) 953-1910 • Toll Free: 1-888-671-0960 • Fax: (204) 489-8542

MP 200.

PRPS # 2

S/N

WORTHINGTON 16CFC # B07540211

BEARINGS:

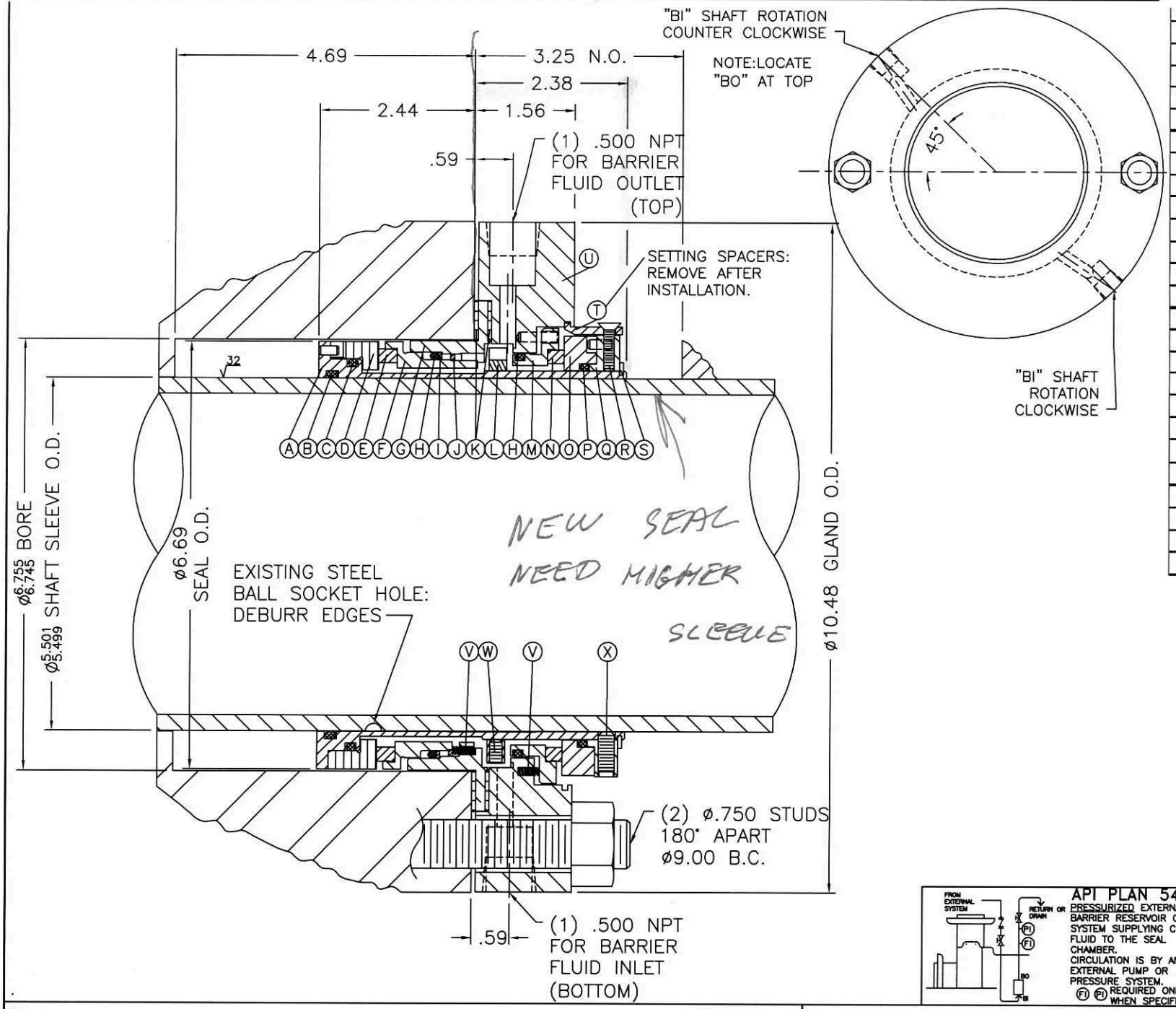
INBOARD — 22220-W33

OUTBOARD — 2x 7319 BECBM.

MECH SEAL - DURAMETALLIC (FLOWSERVE) 379634

LIP SEALS — NATIONAL - 417210
415303

SERIAL # B07540211



ITEM	DESCI
A	SLEEVE
B	O-RING
C	O-RING
D	I.B. ROTARY FACE
E	I.B. STATIONARY IN
F	I.B. STATIONARY IN
G	GLAND ADAPTER
H	O-RING
I	BACK UP RING
J	SPRING DISC
K	GASKETS
L	PUMPING RING
M	O.B. STATIONARY I
N	O.B. STATIONARY I
O	O.B. ROTARY FACE
P	O-RING
Q	COLLAR
R	FLAT HEAD SCREWS
S	RETAINING RING
T	SETTING SPACERS
U	GLAND
V	SPRINGS
W	SET SCREWS
X	SET SCREWS

* ITEMS NO

MFG: WOR
MODEL: 16
SIZE:
SERIAL NO:

CUSTOMER: INDU
END USER:
LOCATION: WINI
STOCK NO: BA-
USER TAG: Q12

PRODUCT:
NOTES:
BARRIER FLUID:
PLAN:

TEMP: AMBIENT
SP GR: 1.0
V P:
VISC:

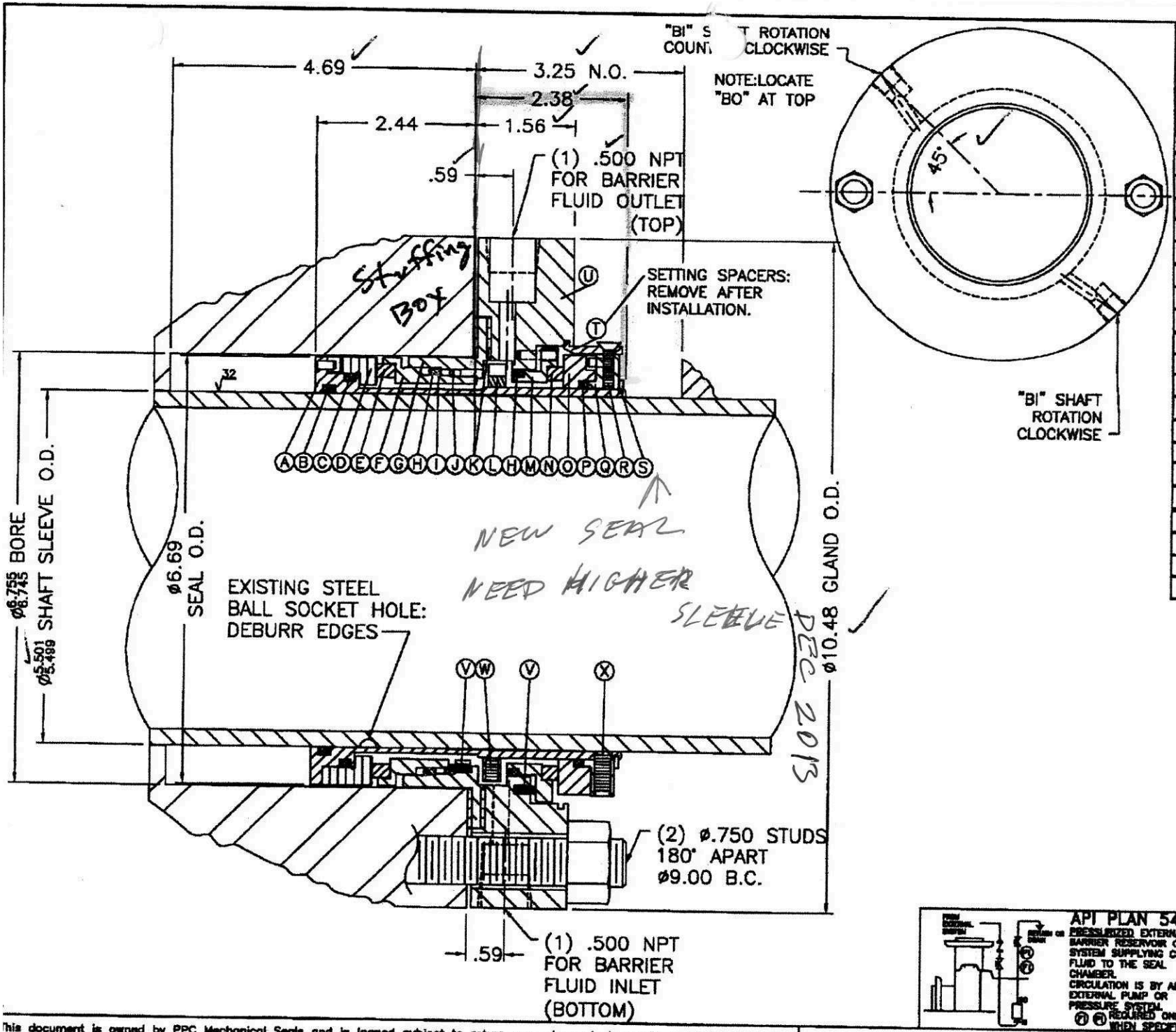
DESC: POWERPUMP
SIZE: 5.500

COMPUTER AIDED DESIGN | SC | D

PPC ME
BATON

API PLAN 54
PRESSURIZED EXTERNAL BARRIER RESERVOIR OR SYSTEM SUPPLYING CLEAN FLUID TO THE SEAL CHAMBER.
CIRCULATION IS BY AN EXTERNAL PUMP OR PRESSURE SYSTEM.
(FI) (PI) REQUIRED ONLY WHEN SPECIFIED

FILENAME: C:\CAD-DWG\INSTALL\00004327.DWG



ITEM	DESC
A	SLEEV
B	O-RIN
C	O-RING
D	I.B. ROT
E	I.B. STAT
F	I.B. STAT
G	GLAND A
H	O-RING
I	BACK UP RI
J	SPRING DIS
K	GASKETS
L	PUMPING RI
M	O.B. STATIONA
N	O.B. STATIONA
O	O.B. ROTARY FA
P	O-RING
Q	COLLAR
R	FLAT HEAD SCR
S	RETAINING RIN
T	SETTING SPACE
U	GLAND
V	SPRINGS
W	SET SCREWS
X	SET SCREWS

* ITEMS

MFG: W
MODEL: 1
SIZE:
SERIAL NO:

CUSTOMER: I
END USER:
LOCATION: W
STOCK NO: B
USER TAG: Q

PRODUCT:
NOTES:
BARRIER FLU
PLAN:

TEMP: AMBIE
SP GR: 1.0
V P:
VISC:

DESC:POWERPU
SIZE: 5.500

COMPUTER AIDED DESIGN

PPC M
RA

API PLAN 54
PRESSURIZED EXTERNAL BARRIER RESERVOIR OR SYSTEM SUPPLYING CLEAN FLUID TO THE SEAL CHAMBER. CIRCULATION IS BY AN EXTERNAL PUMP OR PRESSURE SYSTEM.
(71) (81) REQUIRED ONLY WHEN SPECIFIED

FILENAME: C:\CAD-DWG\INSTALL\00004327.DWG

2013 NEW SEAL PUMP 17200 PAPS

POWERPUMPER
DOUBLE/TANDEM CARTRIDGE SEAL
INSTALLATION INSTRUCTIONS

PREPARE PUMP

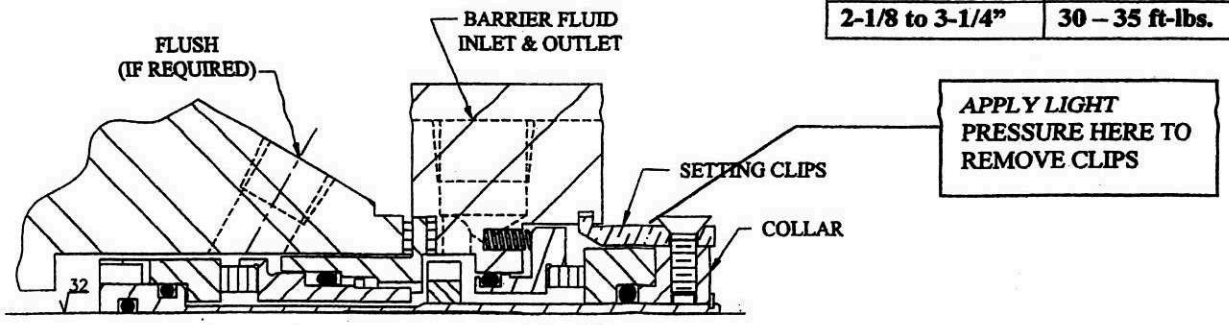
1. Clean and inspect pump parts.
2. Replace shaft or shaft sleeve if worn in secondary sealing areas under o-rings.
3. Check for good starting bevel and remove all burrs that would cut secondary seal o-rings or cause misalignment.
4. Check shaft run out (to be within .001" TIR per inch of shaft dia.), shaft end play (not to exceed .005"), stuffing box face alignment (must be square to shaft within .003" TIR and have good sealing surface, 125 RMS min.), and condition of the pump bearings: Replace if necessary.

INSTALLING SEAL

1. Lubricate shaft or sleeve.
2. Insert seal into stuffing box with barrier fluid ports facing desired location.
3. Loosely thread gland bolts into back plate. **IMPORTANT:** Do not tighten gland bolts at this time. Also, do not remove any setting clips at this time. **NOTE:** For larger pumps with heavy back plates, install the seal on the shaft or sleeve, then slip on the back plate and loosely thread the gland bolts.
4. Install and bolt back plate to pump frame.
5. Install and tighten impeller.
6. Make all necessary impeller adjustments as required. The impeller can be reset at any time, as long as the setting clips are in place and the seal set screws are loosened while the shaft is being moved.
7. Tighten gland bolts evenly.
8. Tighten set screws in collar.
9. Remove setting clips and flat head screws. **NOTE:** Apply pressure to clip at the gland face, as shown, with a screwdriver or flat edge then lift rear of clip to remove. (The setting clips must be removed entirely)
10. Turn shaft by hand to make sure there is no rubbing between rotating and stationary parts.
11. Make all necessary pump connections and alignments.
12. Clean out barrier fluid lines and seal pot.
13. Connect and open barrier fluid lines to seal.
14. If a seal pot is used, fill seal pot with barrier fluid and bleed out air in lines. For API Plan 53 pressurize to 20-30 PSI above stuffing box pressure.
15. Run pump according to normal start up and operating procedures.

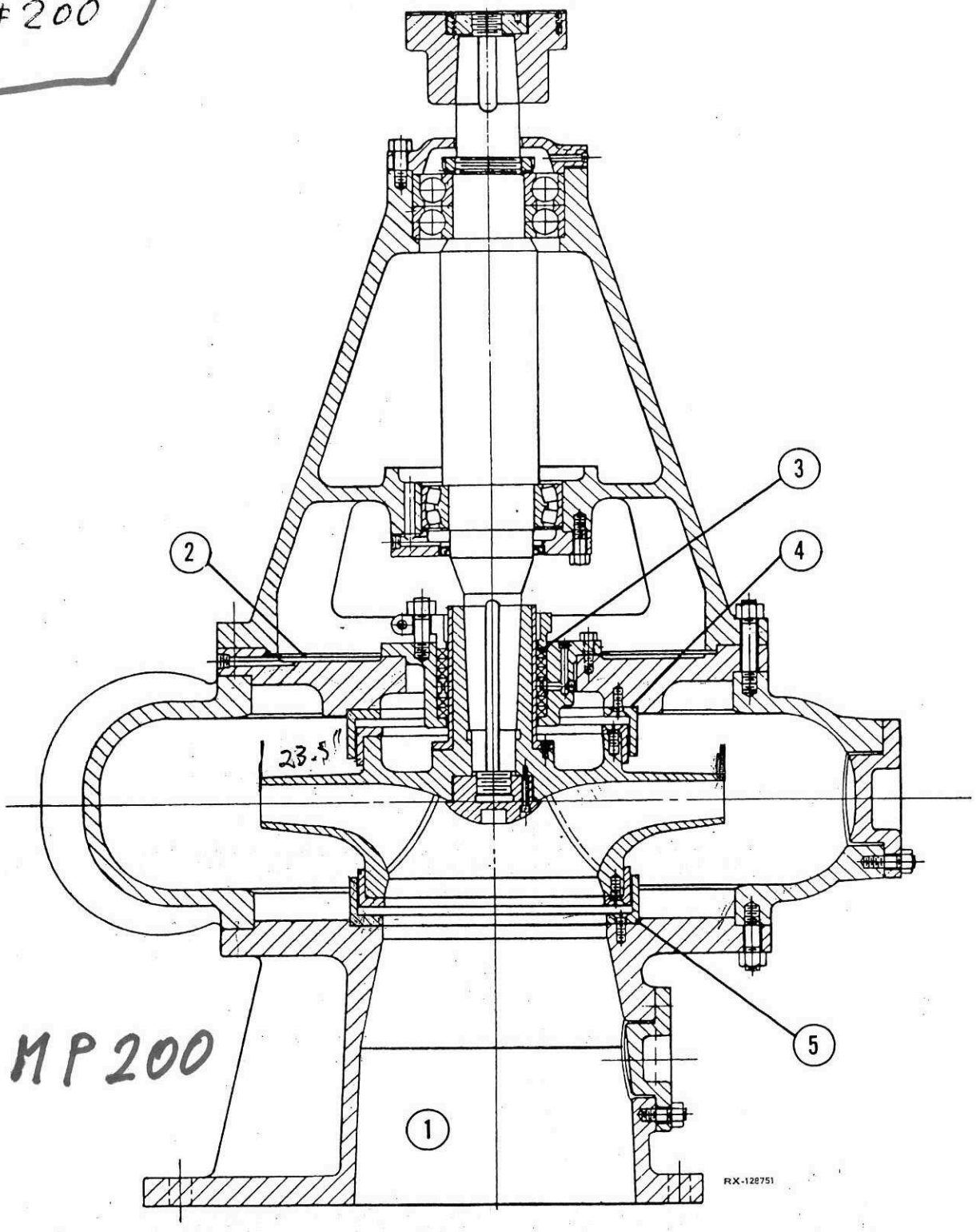
GLAND BOLT TORQUE

Seal Size	Torque Value
1 to 1-3/8"	15 – 20 ft-lbs.
1-1/2 to 2"	25 – 30 ft-lbs.
2-1/8 to 3-1/4"	30 – 35 ft-lbs.



SLEEVE HAS TO BE LONGER

PUMP # 200
PRPS



MP200

TYPES FA-FC Typical Section

Section Elevation showing typical construction of the type FA and FC pump. Refer to Harrison for specific construction of any given pump.

1 Bottom suction with two winged feet rigidly supporting the pump.

2 Stuffing box head permits easy drainage.

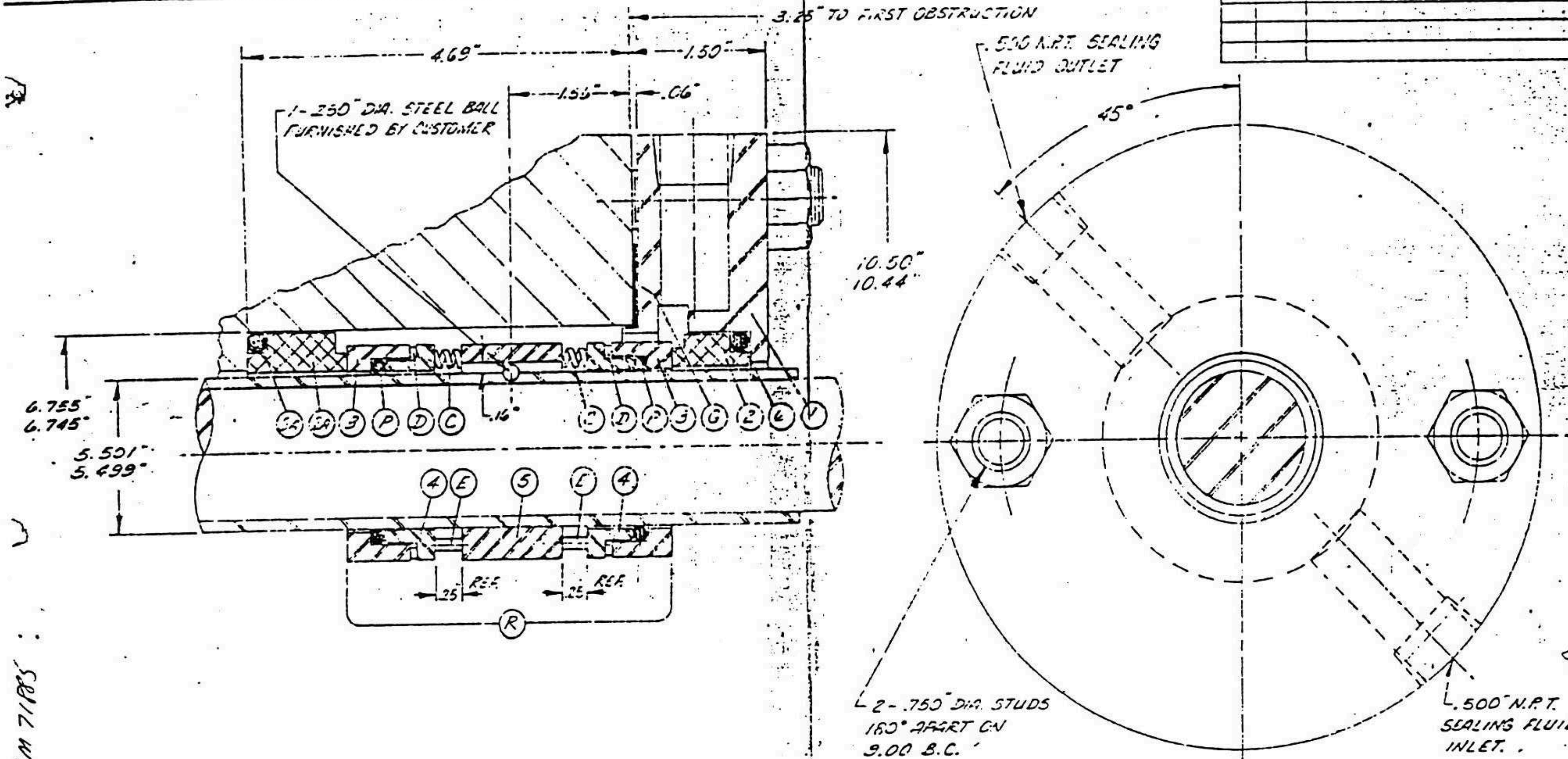
3 Easily accessible stuffing box.

4 Back rings may be furnished to minimize hydraulic thrust.

5 Generous renewable double wearing rings.

NEW PEDESTAL AND VOLUTE WEIGHT IS 2900 lb. (2009)

NO.	DATE	REVISION



BM 71885

R	ROTARY UNIT CONSISTING OF:				
3	SEAL RING	DURAMATE	1	GLAND RING	316 STAIN.
4	COMP. RING	316 STAIN.	2	INSERT (OUTER)	#5 CARBON
5	COLLAR	316 STAIN.	2A	INSERT (INNER)	#5 CARBON
C	SPRINGS	20 STAIN.	6	"O" RING	BUNA "N"
D	DRIVE PINS	20 STAIN	6A	"O" RING	BUNA "N"
E	SPRING PINS	20 STAIN	P	SHAFT PKG.	BUNA "N"
			G	GASKET	DMC 340

RECOMMENDED SPARE PARTS. 2 2A 6 6A 3 P

BUYER – WORTHINGTON (CANADA) LTD., BRANTFORD, ONTARIO

ORDER NO – B-0254021-0000-105

USER: – CITY OF WINNEPEG, WINNEPEG, MANITOBA

PUMP TYPE & SIZE	PUMP ITEM NO.	PUMP SERIAL NO.	REFERENCE DRAWING NO.	FLUID	PRESSURE SUCT.	PRESSURE DISCH.	R.P.M.	TEMP. °F	SP. GR.
WORTHING-TON 16 CFCV-1		807540-211 C		RAW SEWAGE	FLOOD-ED	75 FT	854	AMB.	1.0

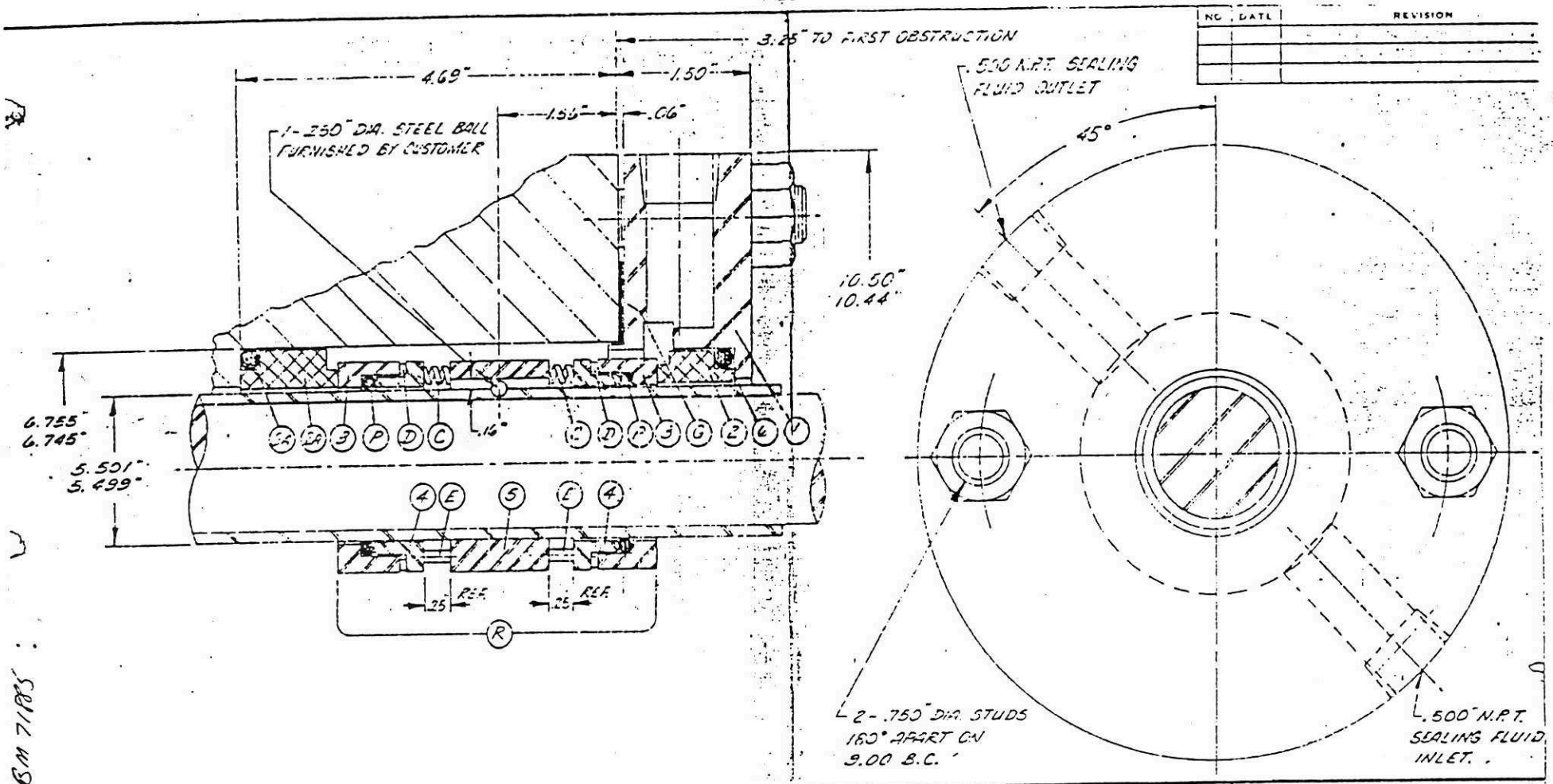
DURA SEAL TYPE: DOUBLE INSIDE "RO"

MAT'L CODE	E	D	5	E	F	O

DURAMETALLIC CORPORATION
KALAMAZOO, MICH.

ORDER PARTS BY B/M NO. 71885
F.O. NO.: C1475-75 SCALE: N.T.S.
DATE 9-3-75
DWN: WLN CHK'D:
FORM:
DWG. NO. 2D-138810

AL-BLUE 100M 5-74 50100



NO.	DATE	REVISION

R	ROTARY UNIT CONSISTING OF:				
3	SEAL RING	DURAMATE	1	GLAND RING	316 STAIN.
4	COMP. RING	316 STAIN.	2	INSERT (OUTER)	#5 CARBON
5	COLLAR	316 STAIN.	2A	INSERT (INNER)	#5 CARBON
C	SPRINGS	20 STAIN.	6	"O" RING	BUNA "N"
D	DRIVE PINS	20 STAIN	6A	"O" RING	BUNA "N"
E	SPRING PINS	20 STAIN	P	SHAFT PKG.	BUNA "N"
			G	GASKET	DMC 340

RECOMMENDED SPARE PARTS. 2 2A 6 6A 3 P

BUYER – NORTHINGTON (CANADA) LTD., BRANTFORD, ONTARIO

ORDER NO – B-0254021-0000-105

USER:– CITY OF WINNIPEG, WINNIPEG, MANITOBA

PUMP TYPE & SIZE	PUMP ITEM NO.	PUMP SERIAL NO.	REFERENCE DRAWING NO.	FLUID	PRESSURE SUCT.	PRESSURE DISCH.	R.P.M.	TEMP. °F	SP. GR.
NORTHINGTON 16 CFCV-1		B07540 -211 C		RAW SEWAGE	FLOOD -ED	75 FT	854	AMB.	1.0

DURA SEAL TYPE: DOUBLE INSIDE "RO"

MAT'L CODE: E D 5 E F 0

DURAMETALLIC CORPORATION
KALAMAZOO, MICH.

ORDER PARTS BY B/M NO. 71885

P.O. NO.: C1475-75

SCALE: N.T.S.

DATE: 9-3-75

DWN: HLN CHK'D: I.

FORM:

DWG. NO. 2D-138810

PERIMETER

2 PUMP MOTOR.

MOD. 5K6318XC295A
SER # A.M.J. 128014 575 V.
H.P. 200 FULL LOAD R.P.M. 880 FULL LOAD AMPS 190
TYPE K. FRAME 6318 P24 SERVICE FACTOR 1.15
TIME RATING CONTINUOUS 60 CYCLE 3 PHASE
INSULATION CLASS B MAX AMBIENT TEMP 40° C
UPPER AND LOWER BEARINGS K5903498 P015

ADJUSTABLE SPEED MAGNETIC DRIVE SER 175210231
INPUT SPEED 880 FULL LOAD 225 H.P. AT 97% SPEED
INSTRUMENT BOOK 291 FRAME MD520

PUMP H.P. 181 T.D.H. -79 G.P.M. 7500
R.P.M. 854 S/N - B07540211 PUMP - 16CFC

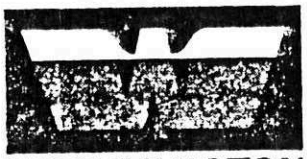
DIESEL MOTOR DRIVE

RIGHT ANGLE
MOD 20 H.P. 300 AT 780 R.P.M.
RATIO 5-2 FIG. 2 R01
SER # P100507 S-S

PUMP FAIRBANKS MORSE
SIZE 14 X 16 INCH FIGURE 5712 STAGE 1
G.P.M. 10774 TOTAL HD. 88 FT. R.P.M. 720
FRAME _____ MOD _____ IMP DIA. 29.50
SER. # K3E1603418

INSTRUCTIONS FOR INSTALLATION, OPERATION AND MAINTENANCE

FC PUMPS



WORTHINGTON CORPORATION

TABLE OF CONTENTS

FC PUMP

TABLE OF CONTENTS (CONT'D.)

SECTION 1

INTRODUCTION AND GENERAL DESCRIPTION

The Worthington FC pump is a volute type centrifugal pump designed for dry pit operation. It is supplied with a bottom suction nozzle. The flow of liquid is both axial and radial.

The pump can be arranged for close-coupled mounting with an attached driver base or for long coupled mounting with an independent driver base and intermediate shafting.

CASING AND REMOVABLE HEADS

The pump casing with its integrally cast discharge nozzle is a volute type. It is machined to provide a rabbet fit for both the stuffing box head and the suction piece.

The removable head is bolted and centered in the casing. The suction piece is provided with a handhole for inspection and cleaning without dismantling the pump.

IMPELLER AND WEARING RINGS

The impeller is the enclosed type. It is capable of passing stringy material, trash and solids of limited size. The impeller hub is keyed to the shaft and held in position by an impeller nut. The nut is locked to the impeller with a set screw.

The pump is provided with renewable casing and impeller wearing rings which are locked in position by set screws.

SHAFT AND SHAFT SLEEVE

The pump shaft is carefully designed and machined to insure rigid support of the impeller. The shaft is protected at the stuffing box with a removable sleeve keyed to the shaft and held in axial position by the shaft shoulder or by a sleeve adjusting nut. The nut, in turn, butts against the shaft shoulder.

STUFFING BOX

The liquid sealed stuffing box seals the pump against leakage along the shaft sleeve at the point where it passes through the casing. It should be packed with rings of braided, graphited asbestos packing and a seal cage. The stuffing box is not packed when the pump is shipped. Independent sealing should be provided from a supply of clean water at a positive pressure slightly higher than the pump discharge pressure.

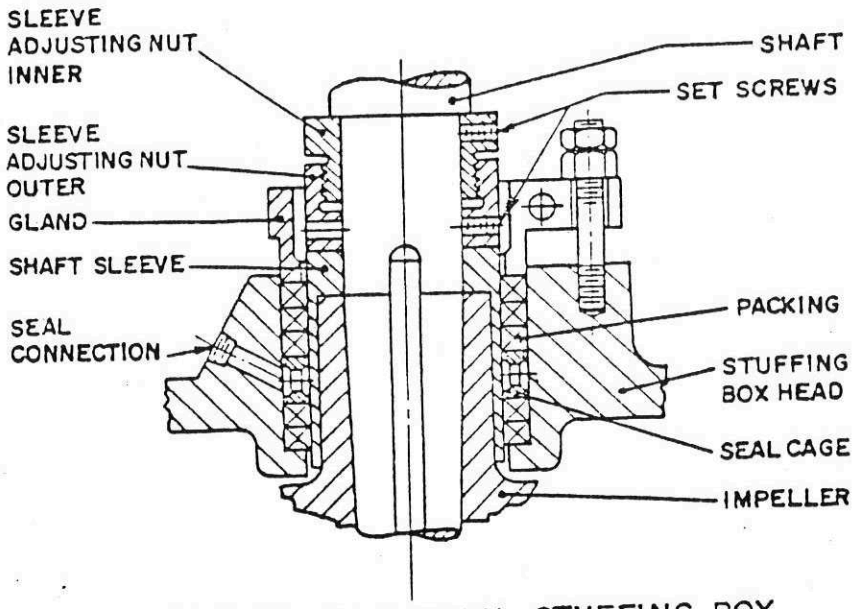


FIG. SECTION OF TYPICAL STUFFING BOX

BEARINGS

The pump is equipped with anti-friction bearings arranged for grease lubrication. The upper or thrust bearing is a double-row angular contact, combined thrust and line bearing mounted back-to-back. It is press fitted on the shaft and secured axially with a nut. The outer races are contained between a shoulder in the bearing housing and a protruding face on the thrust bearing cover to prevent end movement.

The lower or line bearing is a double row self aligning bearing. It is press fitted on the shaft. Clearance in the bearing housing bore allows the outer race to move axially to prevent shaft bending or binding of internal parts as a result of axial shaft expansion.

Both bearings are mounted in the bearing frame which is bolted to the stuffing box head.

For bearing lubrication refer to Section V.

COUPLINGS

Refer to coupling manufacturer's instructions. Where flexible shafting with universal joints is used, refer to "Service Instructions for Flexible Shafting".

SECTION II

PRE-INSTALLATION

INSPECTION OF EQUIPMENT

Immediately on receipt of the equipment, inspect and check it against the shipping manifest. Examine the crate and wrapping before discarding. Parts or accessories are sometimes wrapped individually or fastened to the crate. Report any damage or shortage to the transportation company's local agent.

STORAGE

When it is necessary to store a pump for a short time before it can be installed, place it in a dry location. Protect it thoroughly from moisture. When protecting flanges are bolted to the suction and discharge nozzles at the factory, they should not be removed.

Protect the bearings and the couplings against sand, grit or other foreign matter. To prevent rusting-in or seizing, lubricate the unit (refer to Lubrication, Section V). Turn the rotor over by hand at least once a week.

Check the stuffing box to insure that it contains no packing which could cause rusting of internal parts as a result of condensation.

CLEANING PRIOR TO INSTALLATION

If rust preventative has been used on stored parts they should be thoroughly cleaned. Re-lubricate the bearings. Extreme care must be taken to assure that all traces of the protective coating are removed.

SECTION III

INSTALLATION

LOCATION OF EQUIPMENT

The pump should be placed so that it is easily accessible for inspection during operation while giving due attention to the desirability of simplifying the discharge piping layout. The pump should always be located as near as possible to the suction well or supply to keep suction losses and lift at a minimum. There should be ample head room to allow the use of an overhead crane or lifting device with sufficient capacity to lift the heaviest part of the unit.

FOUNDATION

The foundation may consist of any material that will afford permanent, rigid support to the full area of the pump or driver supporting member and that will absorb expected strains and shocks that may be encountered in service.

Concrete foundations built on solid ground are desirable. Foundation bolts of the specified size should be located according to elevation drawings. Each bolt should be surrounded by a pipe sleeve 2 to 3 times the diameter of the bolt. The sleeves should be held rigidly yet allowing the bolts to be moved to conform with the holes in the bedplate. (Refer to Fig. below).

When the pump unit is mounted directly on structural steel framing, it should be located directly over or as near as possible to the main building members, beams or walls. The pump base should be bolted and doweled to the steel supports to avoid distortion, prevent vibration and retain proper alignment.

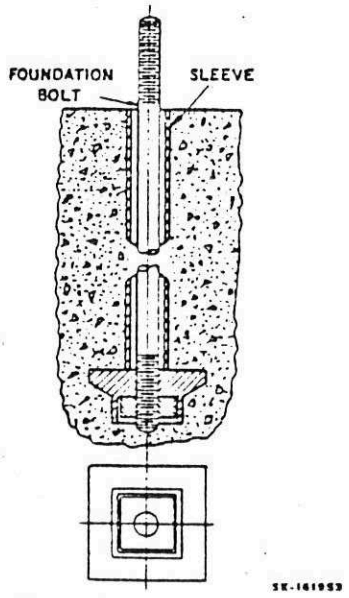


Fig. —Foundation Bolt

ALIGNMENT

Accurate alignment of pump and driver shafts is essential to successful operation regardless of the type of coupling used.

Important - Alignment must be checked after a pump has been completely piped-up. Serious pump misalignment can be caused by drawing up on flange piping bolts if the flange faces are not parallel. Particular care must be taken to properly support the suction and discharge piping so that they cannot exert a strain or pull on the pump. Pipe strains are a common cause of misalignment, hot bearings, worn couplings and vibration.

A flexible coupling is used to compensate for slight changes in alignment which occur during normal operation and is not used to correct for angularity.

Important Note: Couplings must be uncoupled until after a final alignment check has been made prior to starting the unit.

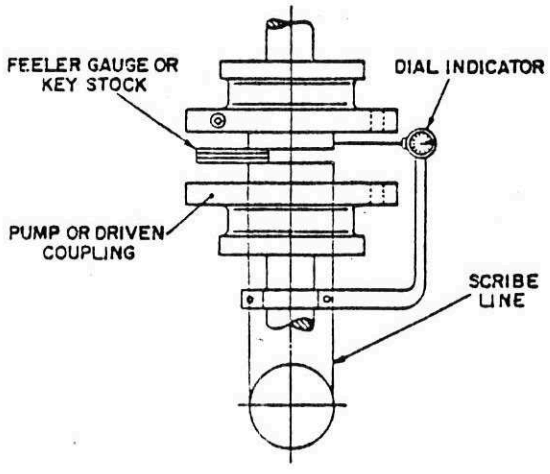
To align the pump and driver, proceed as follows:

CLOSE COUPLED UNITS

1. Disconnect the coupling halves by removing the coupling bolts.
2. Set pump on foundation and shim to correct elevation to insure that the suction and discharge flanges are level and plumb and at the proper elevation.
3. Grout pump base to foundation and tighten anchor bolts.
4. Check the gap between the coupling halves (or coupling hubs where appropriate) against the dimensions shown on the installation drawing.

NOTE: 1/16 in. variation is allowed.

5. Check angular and parallel alignment of coupling halves using a dial indicator and a feeler gauge. The dial indicator should be mounted on the pump-half-coupling with the probe resting on the outer diameter of the driver coupling. Rotate the pump shaft and take readings at every quarter turn to check parallel alignment. For angular alignment rotate both the pump and motor shafts together and take feeler gauge readings at 90 degree intervals around the coupling. Move and shim the driver until the coupling is accurately aligned.
6. Bolt driver to pump securely and recheck alignment as in previous step.
7. Drill, ream, and dowel driver to motor stand (minimum of two dowel pins).



METHOD FOR CHECKING ANGULAR AND PARALLEL ALIGNMENT

LONG COUPLED UNITS

A. INSTALLATION WITH FLEXIBLE SHAFTING (NO GUIDE BEARING) WITH MOTOR BASE RESTING IN PLACE.

1. Set pump on foundation and shim to correct elevation to insure that the discharge flanges are level and plumb and at the proper elevation. During this procedure, align the pump with a plumb bob so that the pump coupling is centered in relation to the motor mounting flange and check the face of the coupling with a precision machinist's level.

2. Place the motor on the motor base and check to determine if the distance between the pump and motor coupling faces agrees with the installation drawing and if the motor coupling face is level. If these conditions are not realized, shim motor base to suit.

3. Tighten motor base foundation bolts.

4. Center motor and pump couplings with a plumb bob by sliding motor on motor base. Scribe motor base for motor hold down bolts. Remove motor and drill and tap holes.

5. Remount and center motor with a plumb bob by sliding motor on motor base. Check coupling faces for parallelism. Adjustment can be made by shimming between motor and motor base.

6. Tighten motor hold-down bolts on motor base and recheck alignment.

7. Install intermediate shafting.

8. Grout pump and motor into place, and dowel motor to motor base.

B. INSTALLATION WITH FLEXIBLE SHAFTING AND ONE OR MORE GUIDE BEARINGS.

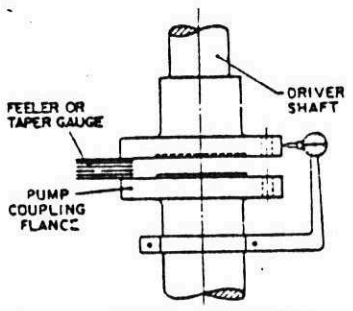
NOTE: Follow first 6 steps of procedure listed under A.

7. Install intermediate shafting with guide bearings in place. Note match marks (if any) on coupling flanges and match numbers at coupling holes and at coupling bolts.

8. Align guide bearing supports to shaft using a plumb line. Shim under guide bearing housing, if necessary, and tighten in place. Recheck guide bearing alignment.

9. Grout pump and motor base into place, and dowel motor to motor base.

NOTE: Due to the many variations and complexity of installations, it is recommended that a Worthington erector be obtained to assist in installation and alignment on long coupled vertical units.



METHOD OF CHECKING ALIGNMENT USING DIAL INDICATOR AND FEELER OR TAPER GAUGE

GROUTING

The purpose of grouting is to prevent lateral shifting of the sole plate, not to take up irregularities in the foundation. We recommend the following procedure:

The typical mixture for grouting-in is composed of one part pure portland cement and two parts building sand, with sufficient water to cause the mixture to flow freely.

The top of the rough concrete foundation should be well saturated with water before grouting. A wooden form should be built around the outside of the sole plate to contain the grout. In some cases this form is placed tightly against the lower edge of the base and in other cases, it is placed a slight distance from the edge of the supporting feet. Grout is added until the entire space under the sole plate is filled. A stiff wire should be used to work the grout and release any air pockets.

After the grout is poured, the exposed surfaces should be covered with wet burlap to effect slow drying in order to prevent cracking. When the grout is set (about 48 hours) remove the forms and smooth the exposed surfaces if desired. The grout should be hard in approximately 72 hours.

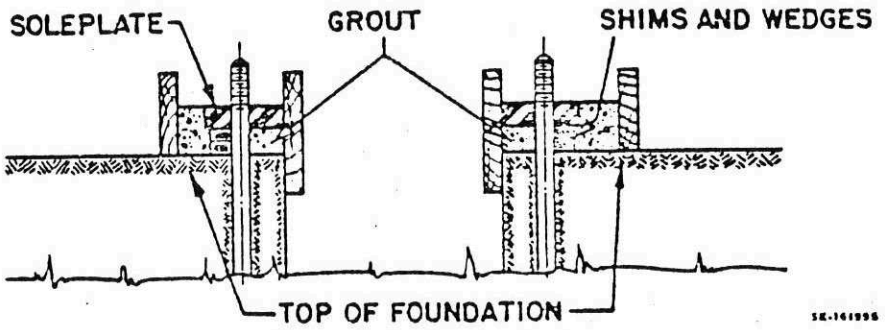


Fig. —Placing Form for Grouting

PIPING

Piping Strains - Satisfactory operation cannot be maintained when piping imposes a force on the pump. Pumps can be sprung and pulled out of position by drawing up on the bolts in the piping flanges. Flanges must be brought squarely together before the bolts are tightened.

Suction and discharge pipes and associated equipment should be supported and anchored near but independent of the pump so that no strain will be transmitted to the pump casing. Pipe strains are a common cause of misalignment, hot bearings, worn couplings and vibration.

Suction Piping - Experience has shown that the major source of trouble in centrifugal pump installations other than misalignment is traceable to a faulty suction line. The utmost attention must be given to this portion of the installation. The suction piping should be as direct as possible and its length held to a minimum. If a long suction line is required, increase the pipe size to

reduce friction losses. The piping should be run without high spots and have continual rise towards the pump. This prevents air pockets which inevitably cause trouble.

The suction piping should be checked before initial start-up to insure that there are no leaks.

A gate valve is required on the suction line if a positive head exists above the invert of the suction piping.

SECTION IV

OPERATION

The following procedures are presented to outline the most important steps involved in pump operation. Any modifications of these procedures due to particular installation peculiarities should conform to good engineering practices.

SUCTION LIFT

Sometimes the suction conditions imposed upon a centrifugal pump are extremely unfavorable and lead to a complete breakdown of the operation of the pump. The suction lift must be kept within the suction limitations for which the pump was sold. If the original operating conditions must be changed for any reason, consult your nearest Worthington District Office.

Care should also be exercised to keep the suction piping air tight and sealed against leakage.

PRIMING

CAUTION - PRIME YOUR PUMP BEFORE STARTING

Priming a centrifugal pump means removing the air, gas or vapor from the suction piping and pump casing. Internal pump parts depending on water for lubrication may seize if the casing is not completely filled with liquid prior to starting.

With a positive suction head on the pump, priming is accomplished in the following manner:

1. Open all suction valves to allow liquid to enter the suction piping and pump casing.

2. Open vent valve located on highest point on the pump casing in order to release all entrapped air.

3. When liquid appears as a steady stream (no air bubbles) the pump is primed and may be started.

STARTING AND OPERATING PUMPS

Preliminary Instructions - Test the driver for rotation with the coupling bolts removed. The arrow on the pump casing will show the correct rotation. Replace the coupling bolts.

Refer to the lubrication section, and be sure that the bearings have been properly lubricated.

The valves on the liquid supply line to the stuffing boxes should now be opened.

The pump should now be primed according to instructions given under "Priming". Do not operate the pump unless it is primed as there is danger of damaging

internal parts which depend on the pumped liquid for lubrication. Turn the rotor over by hand; if it is bound, do not operate the pump until the cause of the trouble is found.

Starting Pumps - Turn the rotor several times by hand to lubricate the bearings.

Start the driver according to the driver manufacturer's instructions.

Open the discharge valve slowly as soon as the pump attains full speed.

During the routine operation of the pump, the bearings should be occasionally checked for proper lubrication.

The amount of valve opening on the liquid seal supply lines to the stuffing boxes must be controlled. The stuffing box glands should be adjusted to permit a slight seepage of liquid out of the stuffing box at all times during operation to prevent excessive wear of the shaft sleeves due to lack of lubrication.

STOPPING PUMPS

Normally, there should be a check valve and a gate valve in the discharge line. The check valve should be located between the pump and the gate valve. In such cases the pump can be shut down by stopping the driver according to the driver manufacturer's instructions. The remaining valves should then be closed in the following order: discharge, suction, and sealing liquid supply.

SECTION V

LUBRICATION

GREASE LUBRICATED ANTI-FRICTION BEARINGS

Grease lubricated anti-friction bearings are packed with grease at the factory and ordinarily will require no attention before the pump is started providing the pump has been stored for only a short period in a clean dry location (refer to Pre-Installation Section II). The bearings should be checked for the first hour or so after the pump has been started to insure that they are functioning properly. Proper grease lubrication is very important. The characteristics of the installation and the severity of the service will determine the frequency of lubrication. Do not use graphite. A good No. 2 grease is satisfactory for operation at ordinary room temperatures, a lighter grease (No. 1) for operation at high speeds or low room temperatures. For specific recommendations consult a reputable grease manufacturer. An anti-friction bearing should never have its housing fully packed with grease. It is recommended that the void spaces in the bearings and the housings be 1/3 to 1/2 filled with grease. A fully packed housing will cause the bearing to overheat and will result in reduced bearing life.

The maximum desirable operating temperatures for anti-friction bearings varies from unit to unit. Rising temperatures or an abrupt temperature rise are indicative of trouble. These symptoms require immediate stopping of the pump. Before the unit is returned to service, the trouble must be located and correct

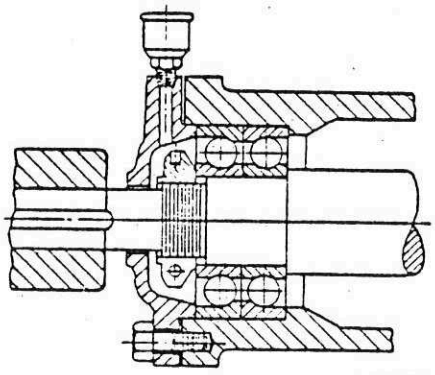


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Fig. —Typical Grease Lubricated Anti-Friction Bearing Arrangement

REGULAR GREASE CHANGE

It is recommended that the grease be changed completely every six months to one year depending on the total running hours of the pump. If the pump is a stand-by unit or if it is run only a few hours each month, the grease should be changed every six months. If the pump runs fifty per cent or more of the time, the grease need not be changed more than once a year.

REGULAR LUBRICATION

Normally, two or three turns of the grease cup caps should add sufficient grease to the bearings, when additional lubrication is required.

COMPLETE CLEANING DURING A MAJOR OVERHAUL

When an overhaul period offers the opportunity, the bearings and the housing should be completely cleaned out in the following manner:

Remove the rotor from the bearing housing. Use a brush and wash out the housing with hot kerosene (200F to 240F) or other nontoxic solvent. Flush out the housing with a light mineral oil to prevent rust and to remove all traces of solvent. Do not use waste to clean the housing.

To clean the bearings wipe off as much grease as possible with clean non-linting cloth. Using a brush dipped in hot kerosene at 180F to 200F, remove the remaining grease and solid particles, gently spinning the bearing. Spin each ball to insure that each one is clean.

If any badly oxidized grease is present and refuses to come off with the above procedure, the rotor should be supported so the bearing can be immersed in the hot kerosene and allowed to soak. Brush and spin the bearing until the oxidized grease is removed. Difficult spots can sometimes be removed with a mixture of alcohol and light mineral solvent.

Reflush the bearings with clean, light oil to remove any contaminated oil.

Fresh grease should now be forced through the bearing to purge any remaining contaminated grease or oil.

REPACKING BEARINGS AND HOUSINGS

Fill all the void spaces between the balls or rollers with clean grease. Fill the bearing housing cover cavities and the bearing housing cavities 1/3 to 1/2 full of grease and assemble the rotor in the bearing housing. Observe the bearing temperatures closely for the first few hours of operation.

SECTION VI

MAINTENANCE

INSPECTIONS

Daily observations should be made of pump operations to avert trouble. Whether or not you consider a log of these inspections necessary, the operator must be alert for irregularities in the operation of the pumps. He should immediately report any trouble symptoms which he detects. Stuffing box operation and bearing temperatures should be checked periodically. An abrupt change in bearing temperatures is much more indicative of trouble than a constant high temperature. A change in the sound of a running pump is also a warning of possible trouble (refer to Locating Troubles).

SEMI-ANNUAL AND ANNUAL INSPECTIONS

Check for free movement of the stuffing box gland, clean and oil the gland bolts and nuts. Closely observe the stuffing box for excessive leakage which cannot be reduced by gland adjustment and replace packing if necessary. Check the pump running records for hourly usage to determine if bearings should be cleaned and regreased. (See Lubrication, Section V).

Check the pump for capacity and discharge pressure to determine if new casing rings or impeller rings are required.

COMPLETE OVERHAULS

Frequency of a complete overhaul depends upon the hours of operation of the pump, the severity of the conditions of service, the materials used in the pump construction, and the care the pump receives in operation. Do not open your pump for inspection unless there is definite evidence that the capacity has fallen off excessively or unless there is indication of trouble inside the pump or in the bearings.

DISMANTLING PROCEDURE

Care must be exercised in the dismantling operation to prevent damage to internal parts of the pump. For convenience at reassembly, lay out all parts in the order in which they are removed. Protect all machined faces against metal-to-metal contact and corrosion. Do not remove bearings unless absolutely necessary.

Close the suction and discharge valves and shut off the sealing water. Drain all water from the casing.

Proceed as follows for complete dismantling: (Not always required)

1. Close Coupled Units. Disconnect coupling halves, unbolt the motor stand and remove the motor and stand from the pump casing.

1A. Long Coupled Units. Remove the intermediate shaft nearest the pump.

2. Unbolt the stuffing [illegible]

3. Draw out the rotor assembly complete with the stuffing box head, bearing housing, etc. Care must be exercised in slinging and handling the unit.

4. Remove the impeller nut, using the special wrench which is supplied with the pump.

5. Remove the impeller and impeller key.

6. Remove the gland, the packing, the seal cage and the stuffing box head.

7. Remove the shaft sleeve.

8. Remove the pump coupling half.

9. Unbolt and remove the bearing housing covers.

10. Withdraw the shaft and the bearings from the bearing frame toward the coupling end.

11. Remove the bearing locknut, bearings and retainers only if replacement is required.

As the pump and rotor is dismantled, all individual parts, all important joints and all wearing surfaces should be carefully examined.

As a general rule, regardless of the performance of the unit, parts appreciably worn should be renewed if it is not intended to examine the pump until the next overhaul period. It should be remembered that when parts (in new or good condition) with metal seats are assembled in contact with dirty or worn parts, the new parts are very likely to wear out rapidly.

ASSEMBLY PROCEDURE

To assemble the pump, reverse the dismantling procedure previously described except for the packing and seal cage instructions. Install the rotor in the casing and check to see that the rotor turns freely by hand. Wearing surfaces at the impeller must not touch. Align the pump carefully. Install packing and seal cage. (See "Packing".)

MAINTENANCE OF CASING

The casing waterways must be kept clean and clear of rust. Whenever a unit has been dismantled, clean and paint the waterways of the casing with a suitable paint which will adhere firmly to the metal. To give best results an enamel-like finish is desirable. Based on experience, a routine program of cleaning and re-painting the casing should be followed. In this manner,

the protective coat will never be fully eroded before replacement.

Two casing gaskets may be damaged when the pump is opened. One is the gasket between the stuffing box head and the casing, and the other is between the suction head and the casing. A new casing gasket must be of the same thickness and material as the original one so it will compress to the same extent. When installing a new gasket trim the edges squarely and neatly. Coat gasket with suitable agent when installing.

MAINTENANCE OF WEARING RINGS

Impeller and casing wearing rings are pressed into place and held by screws. To remove these rings for replacement it is necessary to remove the recessed screws and pry off the rings using wedges or some other suitable device. Care must be exercised to make sure the impeller or the casing is not damaged during this operation.

Due to the press fit of the impeller rings, there is always a danger that some runout may develop at assembly. It is advisable to check the shaft and impeller assembly after mounting the ring on the impeller to determine if the new ring surfaces are true.

NOTE: Generally, it is recommended that the rings should be renewed or overhauled when the original clearance has doubled. This will be dependent upon the required pump performance.

Excessive wear at the running joint can be remedied by reboring the stationary ring to a slightly larger diameter and replacing the impeller ring with an oversize ring. The next repair should be made by turning down the impeller ring and then boring an undersize stationary ring (spare) to suit. Clearance at the running joint should be the same as that provided on the original ring. By alternately renewing or remachining the two rings, each ring can be used two or more times. (Refer to Section VII Service Parts).

MAINTENANCE OF SHAFT AND SHAFT SLEEVE

When the pump is dismantled, examine the shaft carefully. Its condition should be checked at the impeller hub fit, under the shaft sleeves and at the bearings. The shaft may become damaged by rusting or pitting due to leakage along the shaft at the impeller or shaft sleeve. Anti-friction bearings improperly fitted to the pump shaft will result in the inner race rotating on the shaft thus causing undue damage. Check the shaft keyway for distortion. Excessive thermal stresses or corrosion may loosen the impeller on the shaft and subject the keyway to excessive shock. Replace a shaft that is bent or distorted. After a shaft has been repaired, check it for possible runout (maximum .002).

When the sleeve has become worn appreciably, it becomes impossible to adjust the packing to prevent leakage and it should be replaced. Excessively grooved and scored sleeves will tear and score new packing as soon as it is inserted into the stuffing box.

MAINTENANCE OF BEARINGS

Anti-friction bearings are usually pressed or shrunk on the shaft and a pulling device must be used to remove them. The pulling jaws or fingers must be located behind the shoulder of the inner race. When other parts on a shaft do not interfere, the bearing may be supported by a split ring and the shaft pressed out using an arbor press.

NOTE: Unless extreme care is used when removing an anti-friction bearing, the bearing may be damaged to the extent that it is no longer useable. Always check the bearing immediately after removal for any imperfections or any play between the races. It is recommended that new bearings be used for replacement of removed bearings since very often bearing damage due to removal cannot be detected until the pump is put into operation.

When mounting anti-friction bearings on the pump shaft, remember that the satisfactory operation of anti-friction bearings require that the inner race be firmly held on the shaft so that it cannot turn on the shaft. It is also important that the fit of the outer race prevent its free rotation in the housing.

There are two methods in general use for mounting a bearing on a pump shaft:

1. Heating the bearing to expand the inner race and shrinking it on the shaft.

2. Forcing the bearing onto the shaft.

The first method is preferred. Heat the bearing in an oil bath or electric oven to a uniform temperature of 200-250°F. When heated, quickly mount it on the shaft.

If the alternate method is used, apply the force by means of an arbor press or hammer blows (see Fig. below). If an arbor press is available, use a tubular sleeve, a ring, or small blocks of equal thickness to apply the force to the inner race. With proper care it is possible to drive a bearing onto a shaft by hammering alternately on opposite sides of a tubular sleeve held against the inner race.

In forcing a bearing onto a shaft care must be exercised to see that the race is never cocked at any time. Check the position of the bearing on the shaft with a feeler gage to make sure it is pressing firmly against the shaft shoulder.

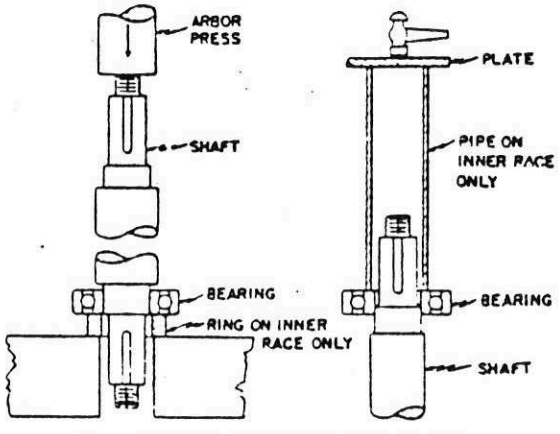


Fig. —Two Methods of Mounting a Ball Bearing on a Shaft

PACKING

For packing the stuffing box use a good grade of graphited braided asbestos packing. Do not under any circumstances use flax packing in the pump since it tends to swell and can cause the rotor to lock should the pump remain idle for short periods of time. Flax packing will also cause rapid wear of the sleeves.

The following procedure should be followed in repacking a stuffing box:

1. Loosen the stuffing box gland.

2. Remove the old packing with a packing puller and clean the stuffing box.

3. Make sure the packing to be used is of correct type and size. Measure the stuffing box to determine the proper length of the packing. Packing should be cut long enough (approximately 1/16" longer than measured) to insure that the O.D. of the packing ring hugs the stuffing box wall rather than the sleeve.

4. Insert each ring of packing separately, pushing it as far as possible into the stuffing box and seating it firmly. Stagger the rings so that the joints are 90 degrees or 180 degrees apart.

5. After inserting the required number of rings of packing, the seal cage can be inserted. Make sure the seal cage is located directly under the sealing connection and that the insertion of successive rings will not displace it.

6. Continue adding the required number of packing rings. Install the gland and tighten the gland nuts by hand; then back off the nuts until the gland is loose. In tightening the gland the nuts should be brought up uniformly so that the gland will not be cocked and so that the packing is subjected to uniform pressure.

7. New packing has to be run in. It is good practice to start the pump with the stuffing box gland quite loose. After the pump has been running for approximately 10 to 15 minutes, gradually tighten the stuffing box gland until leakage is reduced to a constant drip. Packing that is too tight in the box will cause undue friction, creating heat which will glaze the packing and possibly score the shaft sleeves. Packing must remain soft and pliable.

Precaution: It may be impossible to add the last ring of packing in the stuffing box and still insert the gland. When this occasion arises, omit the last ring of packing and tighten the gland. Continue to tighten the gland daily, allowing for proper leakage, until the packing has seated itself well enough to allow the final ring to be inserted.

LOCATING TROUBLES

The troubles which may occur with your pump and their causes are listed below. The operator can often avoid unnecessary expense by careful consideration of the points outlined.

Failure to Deliver Liquid
(a) Pump not primed.
(b) Insufficient speed.
(c) Discharge head too high (greater than that for which the pump is rated).
(d) Suction lift too high.
(e) Impeller passages partially clogged.
(f) Wrong direction of rotation.

Insufficient Capacity
(a) Air leaks in suction piping.
(b) Speed too low.
(c) Total head higher than that for which pump is rated.
(d) Suction lift too high.
(e) Impeller passages partially clogged.
(f) Mechanical defects:
Impeller damaged.
Wearing rings worn.

Insufficient Discharge Pressure
(a) Speed too low.
(b) Air in liquid.
(c) Mechanical defects:
Impeller damaged.
Wearing rings worn.

Pump Loses Prime After Starting
(a) Leaky suction line.
(b) Suction lift too high.
(c) Air or gases in the liquid.

Pump Overloads Driver
(a) Speed too high.
(b) Liquid pumped of different specific gravity and viscosity than that for which pump is rated.
(c) Mechanical defects.
(d) Packing gland too tight causing excessive friction loss in the stuffing box.

Pump Vibrates
(a) Misalignment.
(b) Foundation not rigid.
(c) Impeller partially clogged, causing unbalance.
(d) Mechanical defects:
Bent shaft.
Rotating element binds.
Worn bearings.

SECTION VII

SERVICE PARTS AND PARTS LIST

SERVICE PARTS

The severity of the conditions of service, the extent to which repairs can be carried out in the field and the number of units installed will determine to a great extent the minimum number of service parts which should be carried in stock at the site of the installation.

The minimum service parts for one pump should include the following:

1. A set of bearings.
2. A shaft sleeve.
3. *A set of wearing rings.
4. A set of grease seals.
5. Sufficient stock of spare stuffing box packing and material for the casing gaskets.

*NOTE: If rings are ordered as service parts after the pump has been put into service, undersized stationary rings or oversized impeller rings will not be furnished unless specifically requested by the customer. If undersize or oversize rings are desired, the amount of undersize or oversize of the rings will be 1/8" on the I.D. or the O.D.

It is recommended as insurance against delays that spare parts be purchased at the time the order for the complete unit is placed or as soon after receiving the pump as possible.

HOW TO ORDER SERVICE PARTS

When ordering service parts the pump serial number, size, and type of pump must be given.

Refer to the nameplate. This information is essential in order that Worthington may identify the pump and furnish the correct parts. Give the name and number of the part as listed in the parts list of the sectional elevation applicable to the pump, the quantity required and where possible the complete symbols stamped on the old part. Orders for service parts should be sent to the nearest Worthington Sales Office.

RETURNING PARTS

All materials returned to the factory must have a shipping label attached. Consult the nearest Sales Office or Worthington Service Corporation (W.S.C.) office for shipping instructions. Unnecessary delays are avoided when parts or equipment are returned to the proper factory using the correct procedure. Contact your nearest Sales Office or W.S.C. Office, listing the material to be returned and the reasons for returning it.

GEH-3296C

INSTRUCTIONS

TRI/CLAD® VERTICAL INDUCTION MOTORS

NORMAL THRUST, SOLID SHAFT, "P" BASE

FRAMES 213-445, B254-B445, 6284-6289, 6314-6339

OPEN ENCLOSURES

Lubrication Page 4

INTRODUCTION

General Electric vertical motors covered by these instructions are carefully constructed of high-quality materials and are designed to give long periods of trouble-free service when properly installed and maintained.

The ventilating openings and the bearing lubrication system have been arranged for the ultimate in vertical motor operation. Therefore, these normal-thrust motors (see Fig. 1) are suitable for operation in the shaft-down position only unless otherwise recommended by the General Electric Company.

General mechanical construction for wound-rotor motors is the same as for other types with the addition of rings, brushes, rotor windings, etc. (see Fig. 4).

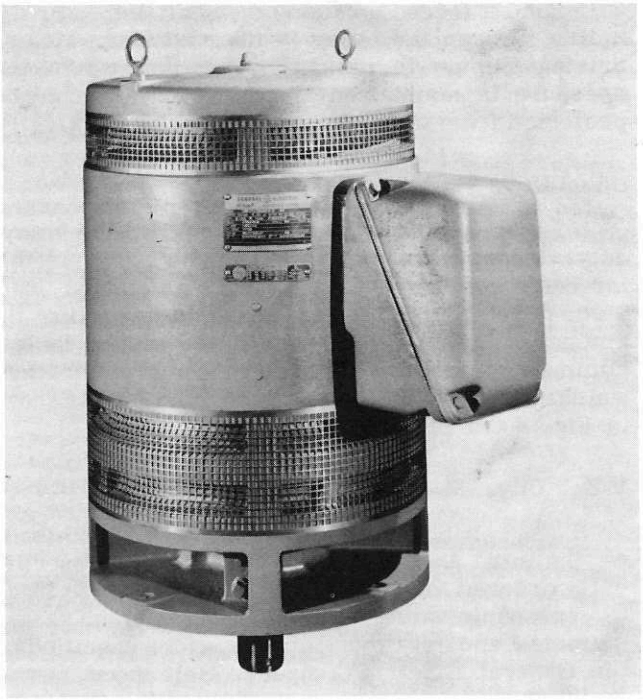


Fig. 1. Typical vertical motor

RECEIVING, HANDLING AND STORAGE

Each motor should be carefully examined upon arrival, and any damage reported promptly to the carrier and to the nearest office of the General Electric Company.

WARNING: *MOTORS SHOULD BE LIFTED BY THE EYEBOLTS OR LUGS PROVIDED. THESE LUGS OR EYEBOLTS ARE INTENDED FOR LIFTING THE MOTOR ONLY AND MUST NOT BE USED TO LIFT ANY ADDITIONAL WEIGHT. CHECK EYEBOLTS BEFORE LIFTING TO BE SURE THAT THEY ARE SCREWED IN ALL THE WAY. BE CAREFUL NOT TO TOUCH OVERHEAD POWER LINES WITH LIFTING EQUIPMENT. FAILURE TO OBSERVE THIS WARNING MAY RESULT IN PERSONAL INJURY OR DEATH.*

If the motor is not to be installed immediately, it should be stored in a clean, dry location. Precautions should be taken to prevent the entrance of moisture, dust, or dirt during storage and installation.

During storage, windings should be protected from excessive moisture absorption by some safe and reliable method of heating. Space heaters, if supplied, may be used for this purpose. The temperature of the windings should always be maintained a few degrees above the temperature of the surrounding air. It is recommended that motors in storage be inspected, the windings meggered, and a log of pertinent data kept. Any significant decrease in insulation resistance should be investigated.

See RELUBRICATION for details of lubrication of motors in storage.

If the motor is to be in storage for over one year, it is recommended that competent technical inspection service be contracted for, such as General Electric Installation and Service Engineering Department, to ensure that the storage has been adequate and that the motor is suitable for service.

CUSTOMER: CANADIAN GENERAL ELECTRIC CO.

DATE: AUGUST 27, 1975

REQN. 9203-9261-00-06324-000

C.O.# 80754021

MODEL 5K6318XC295A
ITEM 1

REED CRITICAL FREQUENCY DATA

TO AVOID EXCESSIVE VIBRATION IT IS NECESSARY THAT THE REED CRITICAL FREQUENCY (CPM) OF THE MOTOR-PUMP SYSTEM BE NUMERICALLY AT LEAST 25% ABOVE OR BELOW MOTOR OPERATING SPEED (RPM). DESIGN OF COMPLETE SYSTEM (MOTOR, PUMP, FOUNDATIONS AND PIPING) MUST PROVIDE FOR THIS.

MOTOR DATA FOR SYSTEM CRITICAL CALCULATION ARE BELOW. REED CRITICAL FREQUENCY AND DEFLECTION OF MOTOR AT CENTER OF GRAVITY (C.G.) ARE SHOWN FOR MOTOR BOLTED TO A RIGID MASS AND CONSIDERED AS A HORIZONTAL CANTILEVER BEAM. DEFLECTION OF MOTOR AT C.G. IS THAT CAUSED BY WEIGHT OF MOTOR ONLY, AT STANDSTILL.

MOTOR WEIGHT	2450 LBS.
DIST. FROM MOTOR BASE TO C.G.	25 INCHES
MOTOR REED CRITICAL FREQUENCY	2420 CPM
DEFLECTION ON MOTOR AT C.G.	.0060 INCHES

MINIMUM ALLOWABLE CONTINOUS DOWNTHRUST TO PREVENT DAMAGE TO GUIDE BEARING -0-.

MOMENTARY PERIODS OF UPTHRUST OR LIGHTER DOWNTHRUST ARE PERMISSIBLE.

GENERAL ELECTRIC COMPANY
SAN JOSE, CALIFORNIA

RCF-1

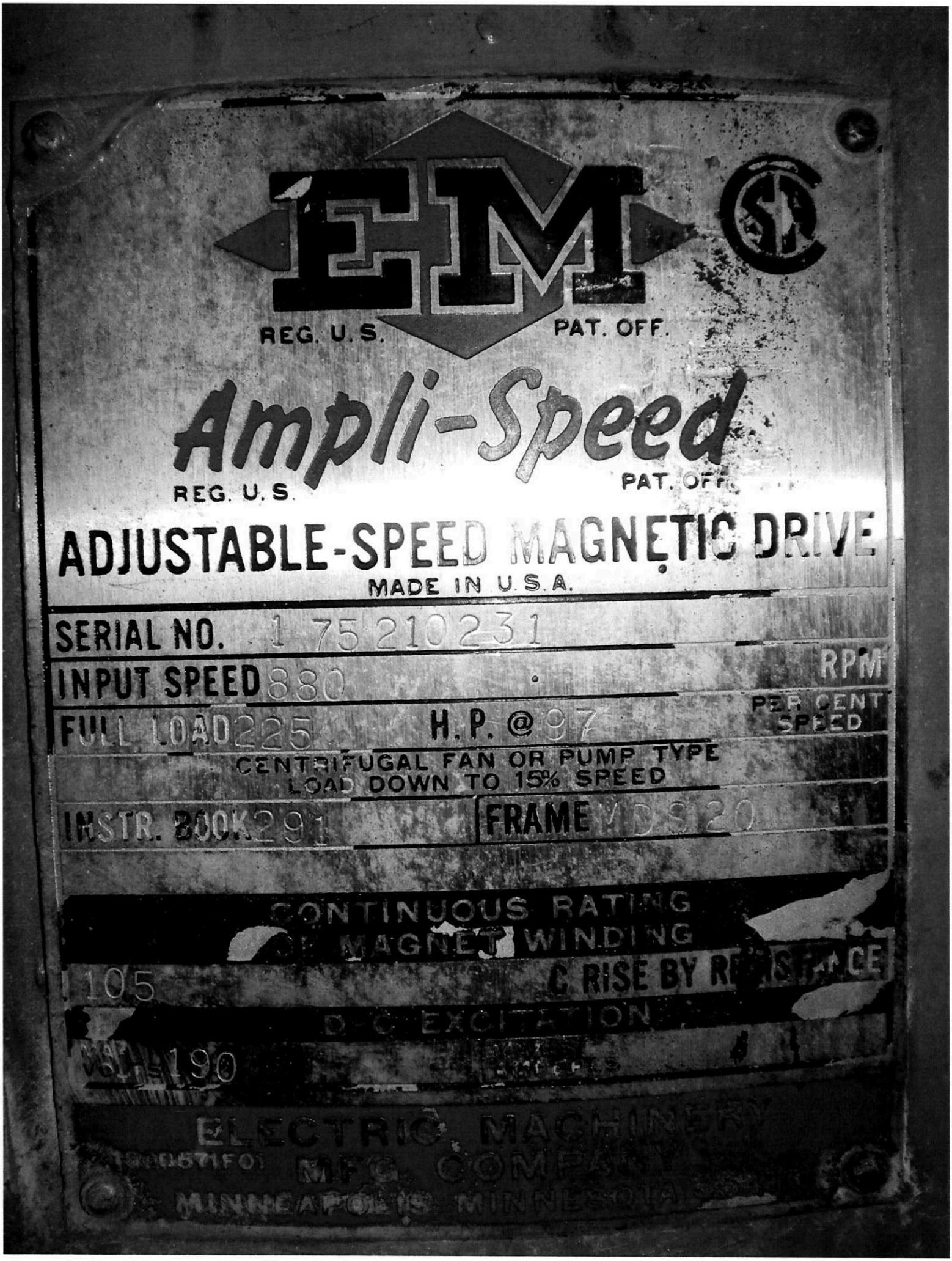
HOW TO ORDER SERVICE PARTS

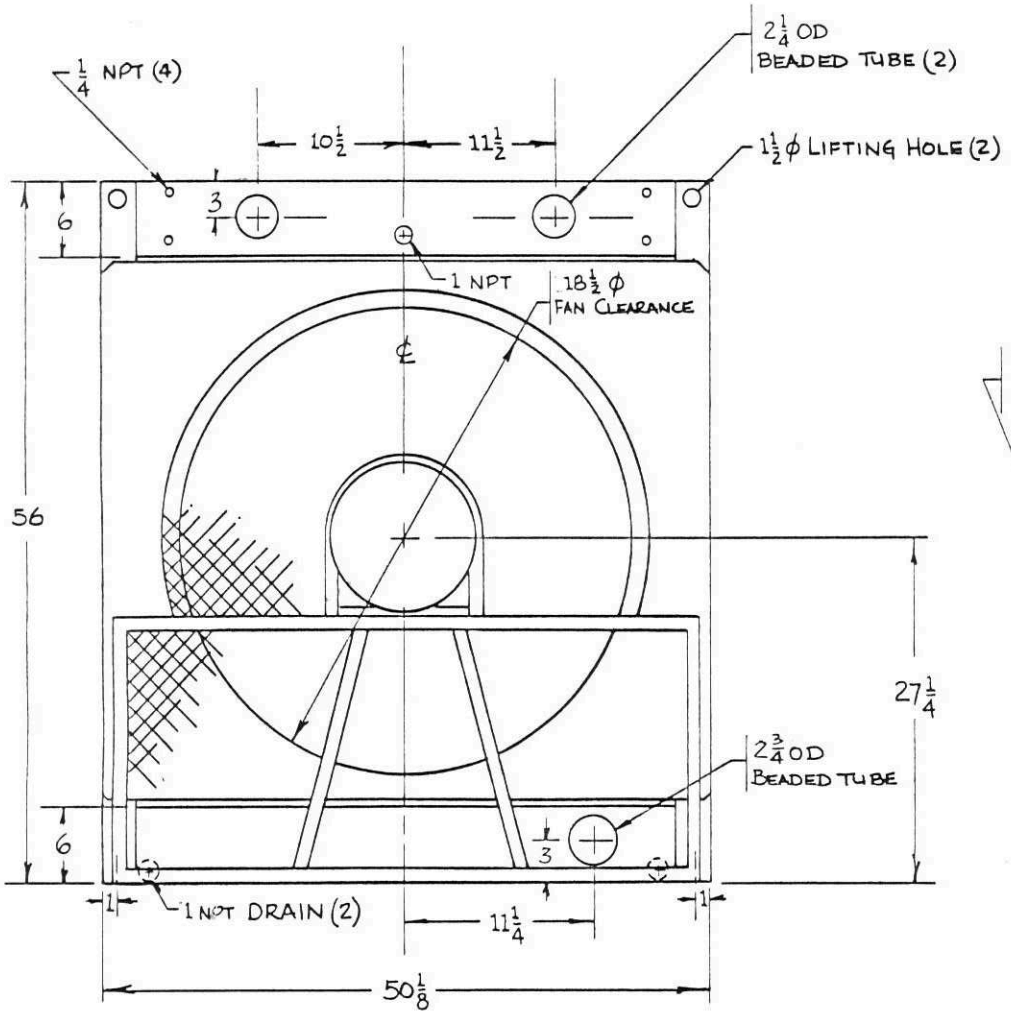
When ordering service parts the pump serial number, size, and type of pump must be given.

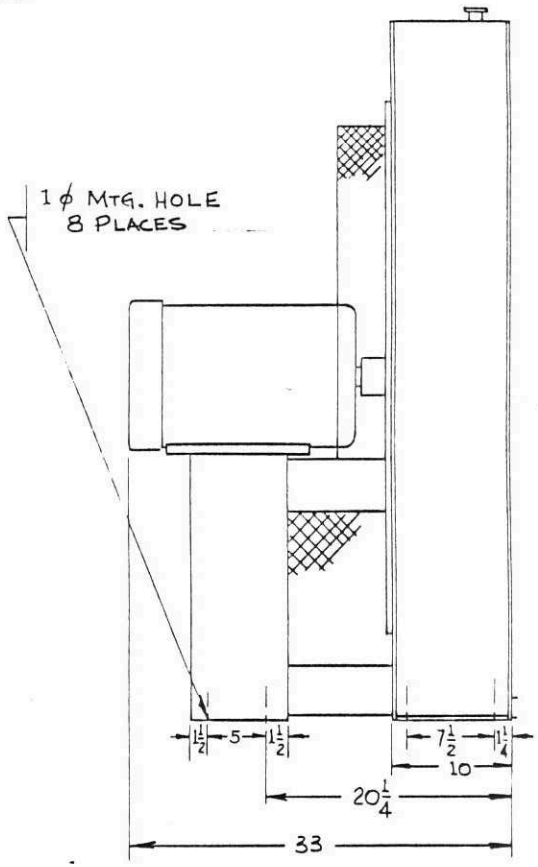
Refer to the nameplate. This information is essential in order that Worthington may identify the pump and furnish the correct parts. Give the name and number of the part as listed in the parts list of the sectional elevation applicable to the pump, the quantity required and where possible the complete symbols stamped on the old part. Orders for service parts should be sent to the nearest Worthington Sales Office.

RETURNING PARTS

All materials returned to the factory must have a shipping label attached. Consult the nearest Sales Office or Worthington Service Corporation (W.S.C.) office for shipping instructions. Unnecessary delays are avoided when parts or equipment are returned to the proper factory using the correct procedure. Contact your nearest Sales Office or W.S.C. Office, listing the material to be returned and the reasons for returning it.


EM
REG. U. S.
PAT. OFF.
Ampli-Speed
REG. U. S.
PAT. OFF.
ADJUSTABLE-SPEED MAGNETIC DRIVE
MADE IN U.S.A.
SERIAL NO. 1 75 210 231
INPUT SPEED 880
RPM
FULL LOAD 225
H.P. @ 97
PER CENT SPEED
CENTRIFUGAL FAN OR PUMP TYPE
LOAD DOWN TO 15% SPEED
INSTR. BOOK 291
FRAME VDS20
CONTINUOUS RATING
MAGNET WINDING
105
RISE BY RESISTANCE
D C EXCITATION
VOLTS 190
ELECTRIC MACHINERY
MFG. COMPANY
MINNEAPOLIS MINNESOTA





NOTES:

1. ALL DIMENSIONS IN INCHES
2. MOTOR: 575/3/60, TEFC, 1200 RPM, 254-T, 7.5 HP.
3. FAN: 36ϕ, AXIAL, 8 BLADE.
4. COOLANT: 60/40 GLYCOL.
5. ENGINE POWER: 396 BHP @ 1800 RPM
6. ENGINE MODEL: 8V71-T

TOLERANCES	FANRAD CORP. MISSISSAUGA ONTARIO		
DECIMAL .	CLIENT HARPER DETROIT DIESEL	SCALE NTS	DRAWN BY JY
FRACTIONAL .	TITLE RADIATOR GENERAL ARRANGEMENT		
ANGULAR .	DATE 6 OCT. '80	DRAWING NUMBER MODEL FDR-3411	

INSTALLATION
AND
OPERATION
INSTRUCTIONS

FAIRBANKS MORSE
NO. 5700
HORIZONTAL, VERTICAL
VERTICAL BILTOGETHER
DRY PIT
ANGLEFLOW PUMPS

Colt Industries
Fairbanks Morse
Pump Division
KANSAS CITY, KANSAS 66110

STANDARD WARRANTY

Fairbanks Morse Inc Pump Division warrants products of its own manufacture against defects in materials and workmanship under normal use and service for the following periods:

Pumps One (1) year from date of installation or start-up, but not more than eighteen (18) months after date of shipment from the Fairbanks Morse Inc Pump Division factory.

This warranty is subject to the following terms and conditions:

Accessories and components not manufactured by Fairbanks Morse Inc Pump Division are warranted only to the extent of the original manufacturer's warranty.

THIS WARRANTY IS THE SOLE WARRANTY OF SELLER AND ANY OTHER WARRANTIES, EXPRESS, IMPLIED IN LAW OR IMPLIED IN FACT, INCLUDING ANY WARRANTIES OF MERCHANTABILITY AND FITNESS FOR USE ARE HEREBY SPECIFICALLY EXCLUDED.

The manufacturer's sole obligation under this warranty shall be, at its option, to repair or replace or refund the purchase price of, any product or part thereof which proves to be other than as warranted. Written permission must be obtained before returning any product or part(s) for replacement; no allowances will be made for repairs or alterations effected without written authorization from Fairbanks Morse Inc Pump Division.

Notice of the alleged defect must be given to the manufacturer within thirty days of the discovery of same during the warranty period and must state the serial number, type of equipment and date of purchase. If requested by the manufacturer, such product or part thereof must be promptly and prior to any attempted repair returned to the manufacturer or to an authorized service station designated by the manufacturer with shipping charges prepaid by customer. Manufacturer accepts no responsibility for loss or damage in transit of the goods nor will any claim be considered unless the returned goods are received intact and undamaged as the result of shipment. Replaced material returned to customer will be shipped F.O.B. the manufacturer's factory.

Under the terms of this warranty, the manufacturer shall not be responsible nor liable for:

a Consequential, collateral or special losses or damages;

b Defects caused by fair wear and tear, abnormal conditions of use, accident, neglect or misuse of equipment;

c Labor charges, loss or damage resulting from the supplying of defective part(s) or improper repairs by unauthorized persons;

d Damage caused by sand or abrasive materials, scale or chemical deposits, corrosion, lightning, improper voltage or mishandling.

If any servicing or repair is done by the manufacturer which is not covered by this warranty, a charge will be made in accordance with the manufacturer's current service contract prices.

The manufacturer reserves the right to substitute new and/or improved part(s) on any equipment adjudged defective and shall not be responsible for delays in shipment from the factory.

CREDIT WILL NOT BE ALLOWED ON ANY PART(S) OR EQUIPMENT RETURNED UNLESS PRIOR APPROVAL IN WRITING HAS BEEN OBTAINED.

This warranty is void unless the purchaser stores, installs and maintains the equipment in accordance with published instructions.

No employee of the manufacturer and no agent, dealer or distributor has any authority to change or enlarge the terms of this warranty or make any other or different warranty, and the manufacturer's obligation is limited strictly to the terms of this written warranty.

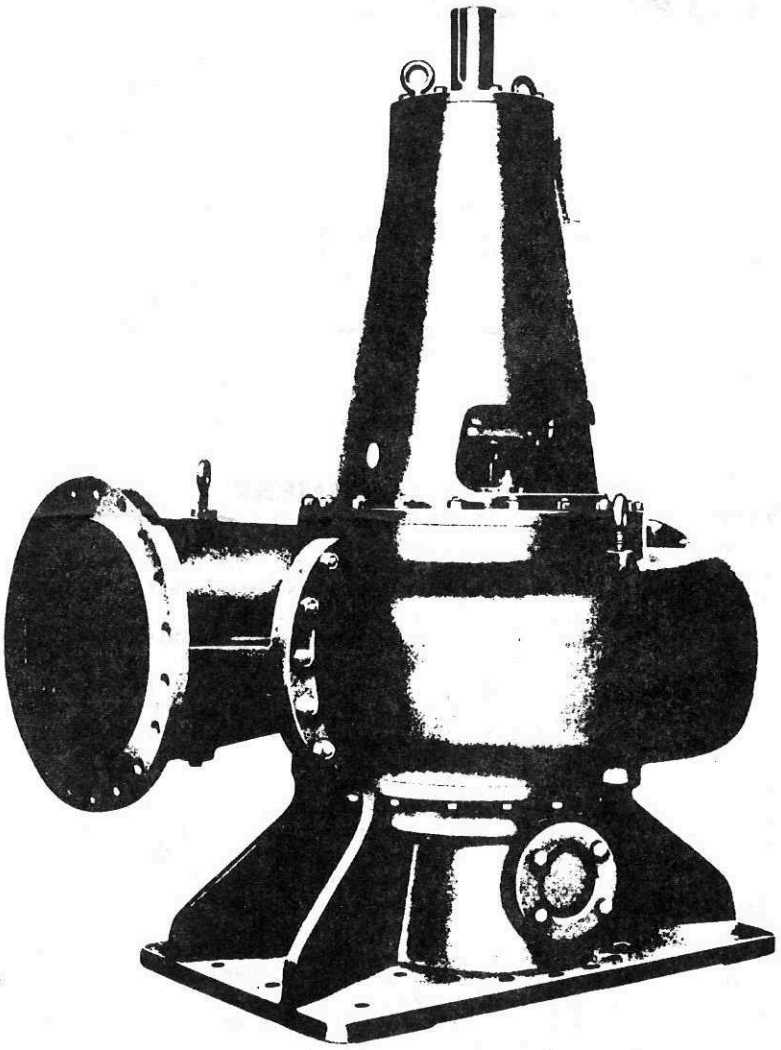
Claims under this warranty should be made to:

Colt Industries

Fairbanks Morse Pump Division
3601 Kansas Avenue
Kansas City, Kansas 66110

A division of the Colt Industries Operating Corp

INSTRUCTIONS NO. 5700



Horizontal
Vertical
Vertical Builtogethe
Dry Pit
Angleflow Pump

- **INSTALLATION**
- **OPERATION**
- **MAINTENANCE**
- **SERVICE & REPAIR**

FAIRBANKS MORSE
A MAJOR INDUSTRIAL COMPONENT OF
FAIRBANKS WHITNEY

PUMP AND HYDRAULIC DIVISION – KANSAS CITY, KANSAS

INSTRUCTIONS NO. 5700

for Installing and Operating

FAIRBANKS-MORSE

FIGURES 5710 5720 5730 & 5750

VERTICAL HORIZONTAL DRY PIT VERTICAL BUILTOGETHER CENTRIFUGAL

ANGLEFLOW PUMPS

Location -

The angle flow pumps should be located as close to the liquid supply as possible and preferably with a very low suction lift or a positive suction head. For the best operation it is advisable, whenever possible, to locate the pump so that the liquid flows to the suction opening by gravity. This is especially desirable where there is any possibility of the suction line becoming clogged by suspended solids. The total suction lift, including pipe friction, should not exceed 15 feet.

Foundations -

Massive foundations are unnecessary, but they should be constructed sufficiently heavy to support the pump so that it will be free from vibration. If the pump is to be belt driven, the foundation must be constructed to withstand the belt strain. It must be located so as to make the pump accessible at all times, and a suitable support for the piping must be provided. The top of the foundation should be finished off reasonably smooth and level; and the height be left a little less than desired. This allows for grouting after the pump has been set on the foundation.

ERECTING THE PUMP

Placing the Pump on the Foundation -

Place the pump on the foundation with foundation bolts in place, but not tightened. Support the base at several points, preferably near the foundation bolts, with steel wedges. These wedges should be of the proper thickness to bring the pump to the required level.

Single Base Mountings -

Upon installing a direct connected unit mounted on a single base, care should be taken to support the base at several points where the weight comes on the foundation, as it is liable to spring in handling and thus throw the shaft out of alignment. A good way to do this is to set the pump over the foundation bolts on as many steel or iron wedges as there are foundation bolts, placing the wedges as close to the foundation bolts as possible. These wedges should be of the proper thickness to bring the pump unit to its predetermined level. In case of larger sub-bases, other wedges may be placed at convenient points. After the unit has been leveled and the weight evenly distributed on all the wedges, attention should be given to the alignment of the coupling.

Support of Intermediate Shaft -

The installation of a vertical Angle Flow pump must be made in such a manner that the weight of the intermediate shaft (when required) is not borne by the pump bearings. For average installations, the weight of the shaft, including compression coupling, can be safety carried by the motor bearings. If the weight of the shaft cannot be borne by the motor bearings, a special thrust bearing must be installed immediately below the motor for the purpose of carrying the weight in which case a flexible coupling must be introduced between the motor shaft and the intermediate shaft so that the entire load will be carried by the special thrust bearing.

Connection of Pump and Intermediate Shaft -

A flexible coupling is introduced between the pump and the intermediate shaft and either a rigid or compression type coupling between the intermediate and motor shafts. It is good practice to install a piece of shafting immediately above the pump, that will permit removing the pump rotor without disturbing the intermediate shaft bearings or dismantling pipe connections; this should be connected by a compression coupling to the adjacent piece of intermediate shafting.

ALIGNMENT

Check Pump and Driving Machine Alignment -

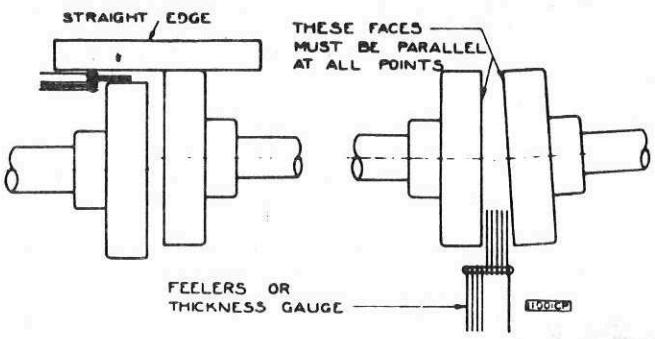
The following instructions cover foreign makes of couplings as well as Fairbanks-Morse. With couplings that are properly machined, accurate alignment is secured when the coupling faces are absolutely parallel as measured by feelers, and a straight edge placed squarely across the rings of the coupling halves. See Illustration. This alignment adjustment is accomplished by the use of wedges and shims under the pump feet.

When installing a coupling, it is well to check it carefully. Should there be any indication of misalignment, the adjustment is made by driving the wedges in or out until no variation is registered by the feelers or the straight edge.

Should the outside diameter of the coupling flanges vary slightly, this must be allowed for in checking the alignment. Any difference in height of one flange over the other should be checked with a straight edge and feelers at all points.

Chalk four marks 90° apart on the circumference of both coupling halves. Hold the pump half coupling stationary and rotate the driver half coupling 90° at a time and check the alignment each time. Particular care must be taken to keep all end play on the revolving coupling in one direction. The driver half coupling should now be held stationary, the pump half coupling revolved and the four points on the pump coupling checked with one point on the driver coupling. If any variation appears, it is advisable to check the coupling by placing it on an arbor.

The clearance between the faces of the coupling halves should be set so that they cannot strike, rub, or exert a pull on either machine. After the pump has been aligned and leveled, the foundation bolts can be tightened.



Suggested method of aligning couplings

Do not put the coupling bolts in until the engine has been tried out for proper rotation. After the unit has been leveled and connected, the alignment should be tested again, and if necessary, realigned by use of shims; when rechecking the alignment, make sure that the coupling bolts have been removed.

PIPING

Support Piping System Independently -

Always support all suction and discharge piping independently from the pump, otherwise the combined weight of the piping and the contained water would tend to spring the base and draw the pump out of alignment. It is a good plan when installing the piping to leave the suction and discharge connections to the pump until the last, being sure at the time these joints are made up that all flanges match without undue forcing. This eliminates the possibility of the pump being drawn out of alignment by the piping.

Remove Burrs and Sharp Edges -

When making up joints in the piping system, always remove the burrs and sharp edges from the pipe ends, and when flanged joints are used, be careful to have the inner diameters match. Burrs, sharp edges, unmatched joints, etc., all cause extra pipe friction and will reduce the capacity of the pump.

Install Make-Up Pieces -

In installations where the piping is cemented firmly, into the walls or foundation, it is a good plan to install short liners or "make-up" pieces next to the pump which can be removed easily and altered at any time to suit new fittings or additions to the pumping equipment.

Installations of Suction Pipe -

In making up the suction piping, too much care cannot be taken to have all joints absolutely air tight. If air is admitted, the capacity of the pump will be reduced. All horizontal sections of the suction pipe should be inclined gradually upward toward the pump in order to avoid all danger of air pockets.

Where possible, avoid connecting a pump to a series of wells, if this is necessary however, make sure that all piping and connections are air tight.

When necessary to connect two or more angle flow pumps to the same suction line, gate valves should be provided so that any pump may be taken out of operation and isolated from the line. Installations of this character require great care at all times to keep all gate valve stems and pump stuffing boxes well packed and air tight. If possible, install gate valves with the stems in a horizontal position, to avoid possible air pockets.

Suction Pipe Size

If the suction pipe is short, it may be of the same size as the suction opening in the pump. If, however, the pump is placed at a considerable distance from the water supply, the size should be increased one or two sizes depending on the distance.

Discharge Pipe Size -

If the discharge pipe is short, it may be of the same size as the discharge opening in the pump, but where it is of considerable length, it should be one or two sizes larger. If the pump is to discharge into a closed system or an elevated tank, it is always good practice to place a gate valve or a check valve in the discharge line close to the pump, so that the pump may be opened for inspection without flooding the immediate vicinity.

Avoid Elbows -

Make the suction and discharge piping as straight as possible, avoiding unnecessary elbows. Where elbows are required, it is preferable to use 45 degree fittings or long sweep 90 degree fittings instead of the regular 90 degree type.

Check Valves -

For pumps operating against high discharge heads, an effective check valve as well as a gate valve should be placed in the discharge line. The check valve should be installed between the gate valve and the pump. When shutting down the pump in installations where a foot valve is provided or there are other possibilities of water hammer, it is advisable that the discharge valve be closed before shutting off the power. A check valve is not furnished as regular equipment with the pump.

Foot Valve -

Where the pump operates against a low head or is installed for automatic operation, a foot valve should be provided to avoid the necessity of priming each time it is started. The valve should be of the flap type rather than the multiple spring type and should be of ample size to introduce no undue friction in the suction line. A foot valve is not furnished as regular equipment with the pump.

Expansion Allowance -

When pumps are driven by steam turbines, an allowance must be made for the fact that the turbine will expand as it is heated and the distance between the feet and the shaft center will increase. To allow for this expansion when lining up cold, the turbine should be set approximately .0005" low for every inch of height from the bottom of the feet to the centerline of the shaft. In any event when the turbine is lined up cold, the alignment should be checked when hot. Further checking should be made after the unit has been in service several hours. No heat allowance is made for electric motors. If possible, the motor should be operated alone before aligning up the pump so as to determine the magnetic center of the rotor. If this is not possible the rotor of the motor should be pulled over and pushed back to determine the collar clearance and then the rotor placed in mid-position for aligning.

LUBRICATION

Lubrication

Fairbanks-Morse recommends that all ball and roller bearings be lubricated with FMC05 "Oil Film Grease", unless otherwise specified by the Engineering Department. A definite procedure must be followed to insure proper and adequate lubrication. It is very important that the correct amount and the proper grade of grease be used in each bearing assembly. FMCO "Oil Film" grease prevents overheating even in cases where bearings are over greased. It is recommended that the

bearing housings be filled not more than 3/4 full.

When it is impossible to obtain FMCO "Oil Film Grease"; pure high grade vasoline can be used as a substitute.

Inspect the bearings at regular intervals to insure proper and adequate lubrication.

Packing -

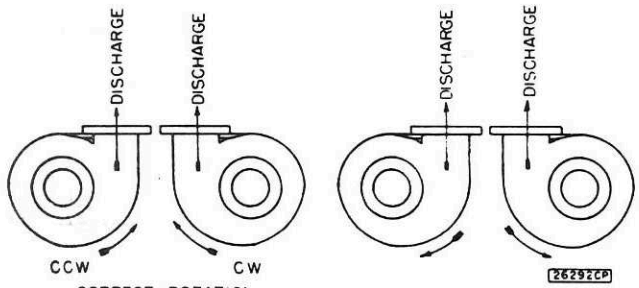
Before starting the pump, make sure that the packing gland nuts are drawn up evenly and the glands fit squarely in the stuffing boxes. Do not draw up the gland too tightly, as this will cause heating and in high speed pumps especially, the packing will be burned and glazed where it bears on the shaft thus rendering it useless and causing undue wear and grooving of the shaft sleeves. It is best to draw up the glands with a wrench sufficiently to set the packing and then release the nuts until they can be turned with the fingers. Always use a good grade of soft packing for renewal, as hard, inferior grades allow excessive water leakage and quickly wear grooves in the shaft sleeves.

Water Seal -

The stuffing boxes are fitted with water seal rings. This sealing chamber should be connected to a source of clear fresh water whenever possible. A grease seal may be used if clear fresh water is not available. This water seal insures cool running and at the same time prevents any air from being drawn through the stuffing box into the suction chamber of the pump. To insure that the water seal space is always supplied, be sure that the proper number of rings of packing are first placed in the stuffing box to bring the water seal ring directly in line with the supply pipe. When the pump is in operation, a small amount of water should be allowed to drip from the glands at all times, both to insure cool running and as an indication that the packing is not drawn up excessively tight.

Rotation -

If for any reason the pump is dismantled or a new impeller installed, make sure that the proper relations exist upon reassembly. The impeller must always rotate towards the discharge flange.



CORRECT ROTATION
ALWAYS VIEWED FROM THE DRIVEN END OF THE PUMP, PUMPS ROTATING TOWARD THE DISCHARGE OUTLET

WRONG ROTATION
PUMPS ROTATING AWAY FROM THE DISCHARGE OUTLET

BEFORE STARTING THE PUMP

Before starting the pump for the first time, attention to the following points should be given:

Water Seal -

Be sure that the water seal piping is connected properly.

Lubrication -

Make sure that the bearings are properly lubricated and that no dirt or grit has entered the bearing housings.

Packing -

It will be necessary to install the packing before starting the pump. Examine the packing glands and see that they fit in the stuffing boxes squarely and evenly. Also make sure that the gland nuts are not drawn up too tightly.

Rotation -

Be sure that the driving machine rotates the pump in the proper direction after it is started.

Rotate the pump a few revolutions by hand to be sure there is no binding due to mis-alignment, tight packing, etc.

Foreign Matter -

Take an inventory of tools used during installation. The suction and discharge nozzles of the pump make excellent places to lay tools which are apt to be forgotten and may be drawn into the pump when first started, causing damage to the impeller and casing. If any doubt exists as to the freedom of the suction line and casing from tools, bolts, nuts, etc., much time and expense may be saved by checking over this point before starting.

STARTING THE PUMP

Priming -

All centrifugal pumps, unless the water supply flows to them with sufficient head to fill the pump casing, must be primed before they will deliver water. This may be done by any one of the following methods, as best suit the local conditions.

Priming by Ejector -

Where steam or compressed air is available, this is a very convenient method of priming. Attach an ejector at the pipe tap on the top of the pump casing and make the necessary air or steam connections. A valve should be provided between the ejector and the pump which may be closed after the pump is primed and started. The discharge line from the pump must also be provided with a tight fitting gate valve, located so as to allow all the air to be exhausted from the pump casing and suction line. The length of time required for priming will be shortened and operation of the pump facilitated if this valve is placed as close to the pump as possible.

Priming by Vacuum Pump -

When steam or compressed air is not available, a hand or power operated air pump may be substituted for the ejector, the same statements applying as in the preceding paragraph on priming by ejector. If the pumping installation contains a power or steam driven pump of the reciprocating type, priming may be readily accomplished by connecting the top of the pump casing to the suction line of the reciprocating pump through suitable valves and piping. If the reciprocating pump is small, it may be necessary to provide a valve in the suction line of the reciprocating pump, so that the full suction force may be available at the centrifugal pump priming connection.

Priming by Water Supply -

When it is feasible to place a foot valve at the end of the suction pipe and a supply of water is available, this is a very convenient method of priming. A valve should be provided near the pump in the discharge line which should be closed during the priming operation. The water supply may be piped to the pump casing at any convenient point, and priming is accomplished by allowing the suction pipe and casing to fill. An air vent at the top of the pump casing must be provided, either by removing the pipe plug or by substituting an air cock for the plug.

Close Discharge Valve -

When starting the pump, close the gate valve in the discharge line.

Start at Reduced Speed -

After the pump is primed, start the driving machine, at reduced speed if possible, until satisfied that everything is operating satisfactorily. After this, bring up to full speed.

Do Not Run Empty -

If the pump fails to prime, do not run empty, as the wearing rings, which have very small clearances, are apt to heat, bind and cut. Locate and correct the condition preventing the proper priming of the unit before attempting to start again. It will do no good to run it empty and may cause damage.

Open Discharge Valve -

After the pump is properly primed and running at full speed, open the discharge line gate valve. This should be done slowly in order to bring the load on the driver gradually, and prevent water hammer in the distribution system. This is especially important on the larger units.

Air in Water Supply -

In some localities, the water supply contains an excessive amount of air or gas which tends to separate from the water and remain in the passages of the pump, thus causing the pump to become "Air Bound" and reducing the capacity. To prevent this condition, the pipe plug at the top of the casing should be loosened occasionally, enough to allow any entrapped air or gas to escape.

Drain Pump Casing -

Whenever there is a possibility of freezing, the pump should be drained during the shut down periods, to prevent breakage of the pump casing. Also drain all piping which may freeze during cold weather when the pump is not in operation.

Balance -

The unbalanced hydraulic end thrust due to the suction opening in one side of the impeller, is taken by a generously proportioned thrust bearing. This bearing is so designed that it carries radial load as well as axial load. The other bearing is mounted so that it carries radial load only. In addition, all impellers, pulleys, and couplings are given a careful static balance before leaving the factory, thus insuring freedom from vibration while in operation.

Guarantee -

All guarantees of performance of pumps made by Fairbanks, Morse & Co. are based on the understanding that the pump is to handle clear, fresh water, having a temperature not to exceed 85 degrees F., unless otherwise expressly stated.

Inspect Frequently -

If after the pump is installed, there is reason to suspect that the water has a deteriorating effect on the metals of which the pump is constructed, it is advisable to inspect them frequently so that any renewals can be made in sufficient time. Particular attention should be given to pumps handling sea water or acidulous water.

Special Metals -

Fairbanks, Morse & Co. does not guarantee the metals to withstand any corrosive action of the liquid; it does, however, advise the use of special metals, where such corrosive action is anticipated. When specially ordered, acid resisting metals are furnished as experience has proved to be best adapted for the service.

TROUBLE CHART

No Water Delivered -

1. Pump not primed.
2. Speed too low.
3. Discharge head too high.
4. Suction lift too high, check with gauges.
5. Impeller completely plugged.
6. Wrong direction of rotation.

Not Enough Water Delivered -

1. Air leaks in suction or stuffing boxes.
2. Speed too low.
3. Discharge head higher than anticipated.
4. Suction lift too high, check with gauges.
5. Impeller partially plugged.
6. Not enough suction head for hot water.
7. Mechanical defects:
   - Wearing rings worn.
   - Impeller damaged.
   - Casing packing defective.
8. Foot Valve too small.
9. Foot Valve not submerged to proper depth.

Not Enough Pressure -

1. Speed too low.
2. Air in water.
3. Mechanical defects.
   - Wearing rings worn.
   - Impeller damaged.
   - Casing packing defective.
4. Impeller too small in diameter.

Water Delivery Irregular -

1. Leaky suction line.
2. Water seal plugged.
3. Suction lift too high.
4. Air or gases in liquid.

Pump Takes Too Much Power -

1. Speed too high.
2. Head lower than calculated, pump too much water.
3. Liquid heavier than water.
   - Viscosity greater than water.
4. Mechanical defects:
   - Misalignment.
   - Shaft bent.
   - Rotating element binds.
   - Stuffing boxes too tight.
   - Wearing rings worn.
   - Casing packing defective.

Low Speed -

When pumps are direct connected to electric motors, check whether motor is across the line and receives full voltage. If the voltage of the supply circuit falls, motors will lose speed and power in most cases depending on the type. If the voltage fails completely, the motors will stop.

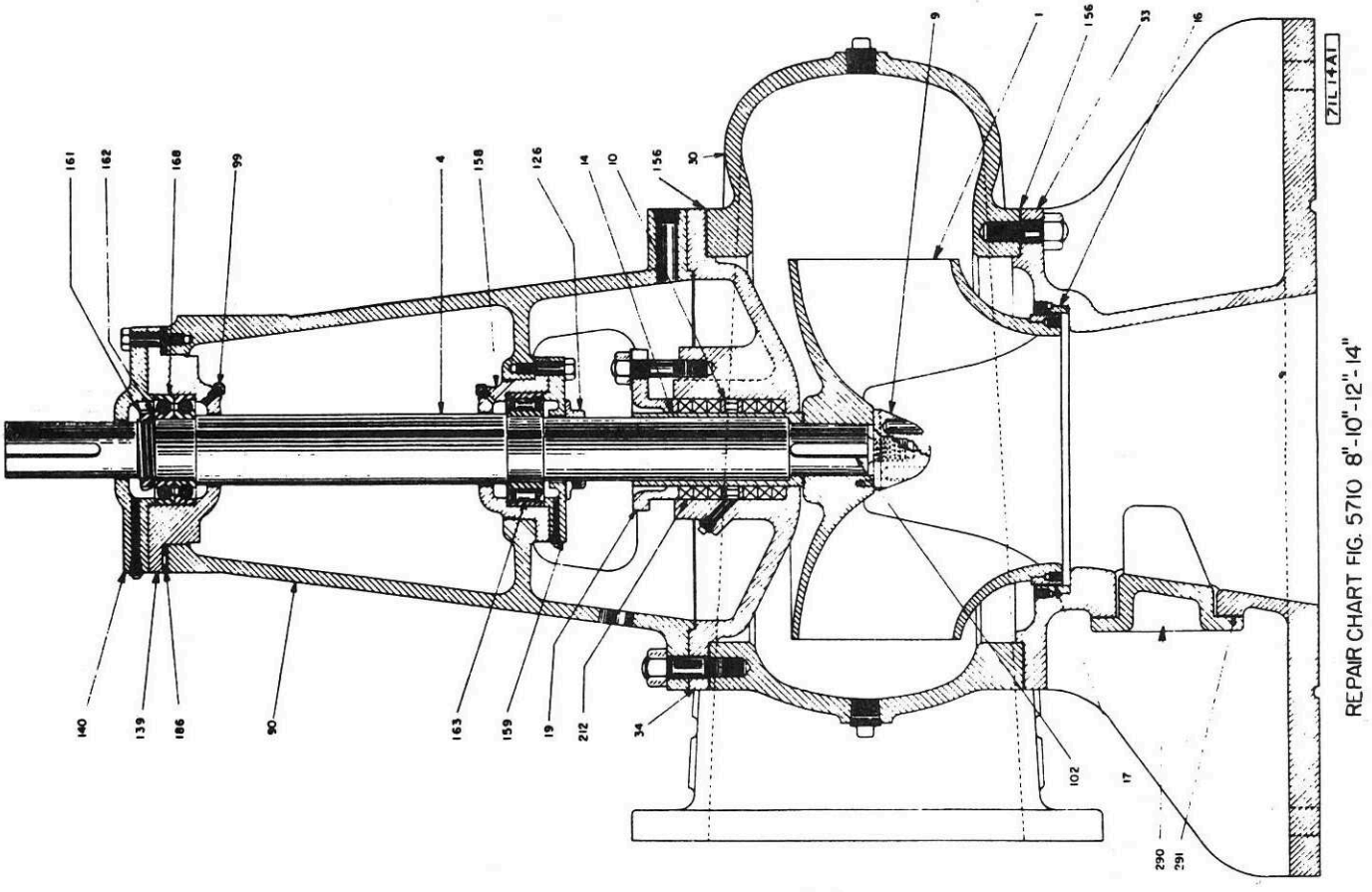
When pumps are direct connected to steam turbines, make sure that the turbine receives the full steam pressure.

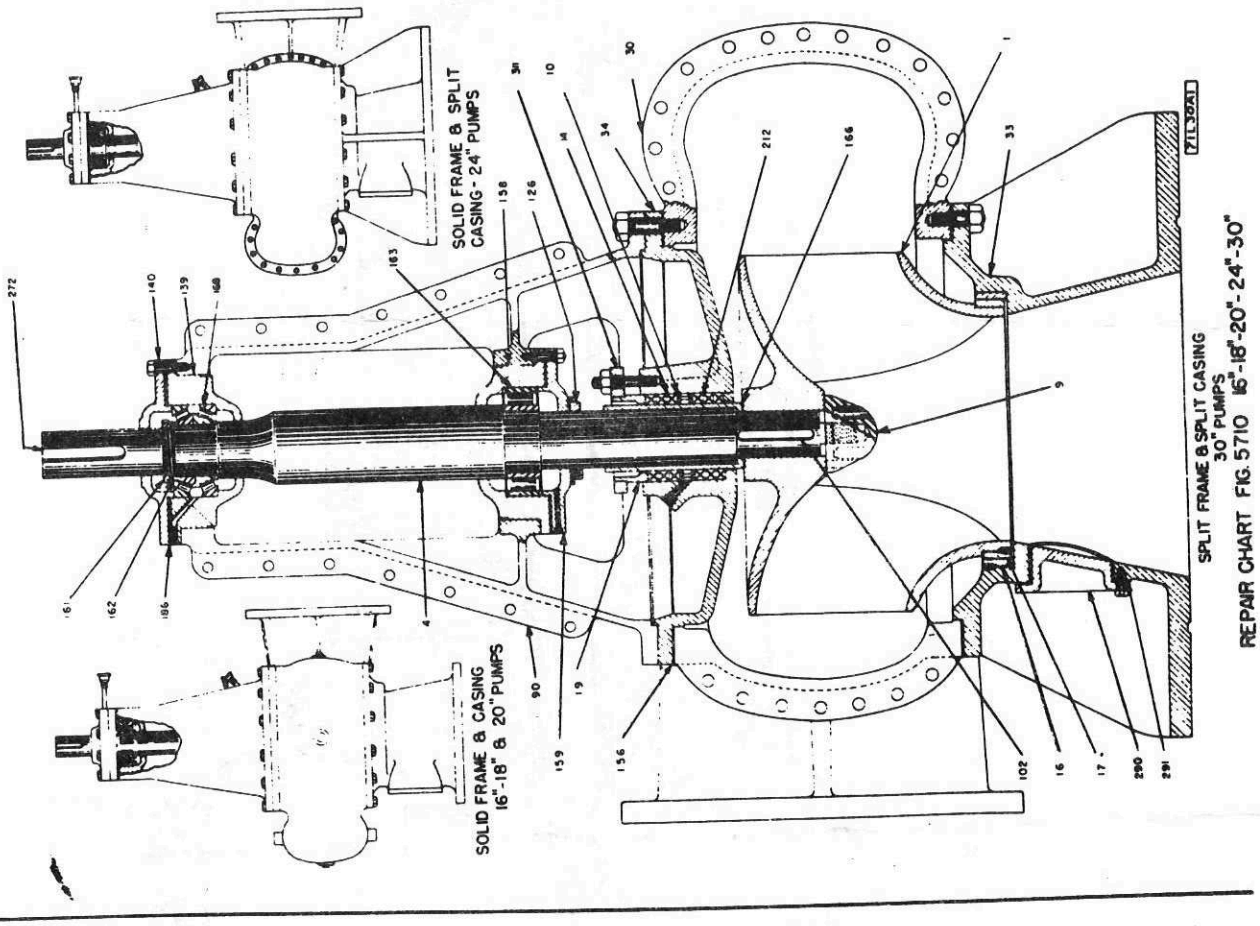
ORDERING REPAIR PARTS

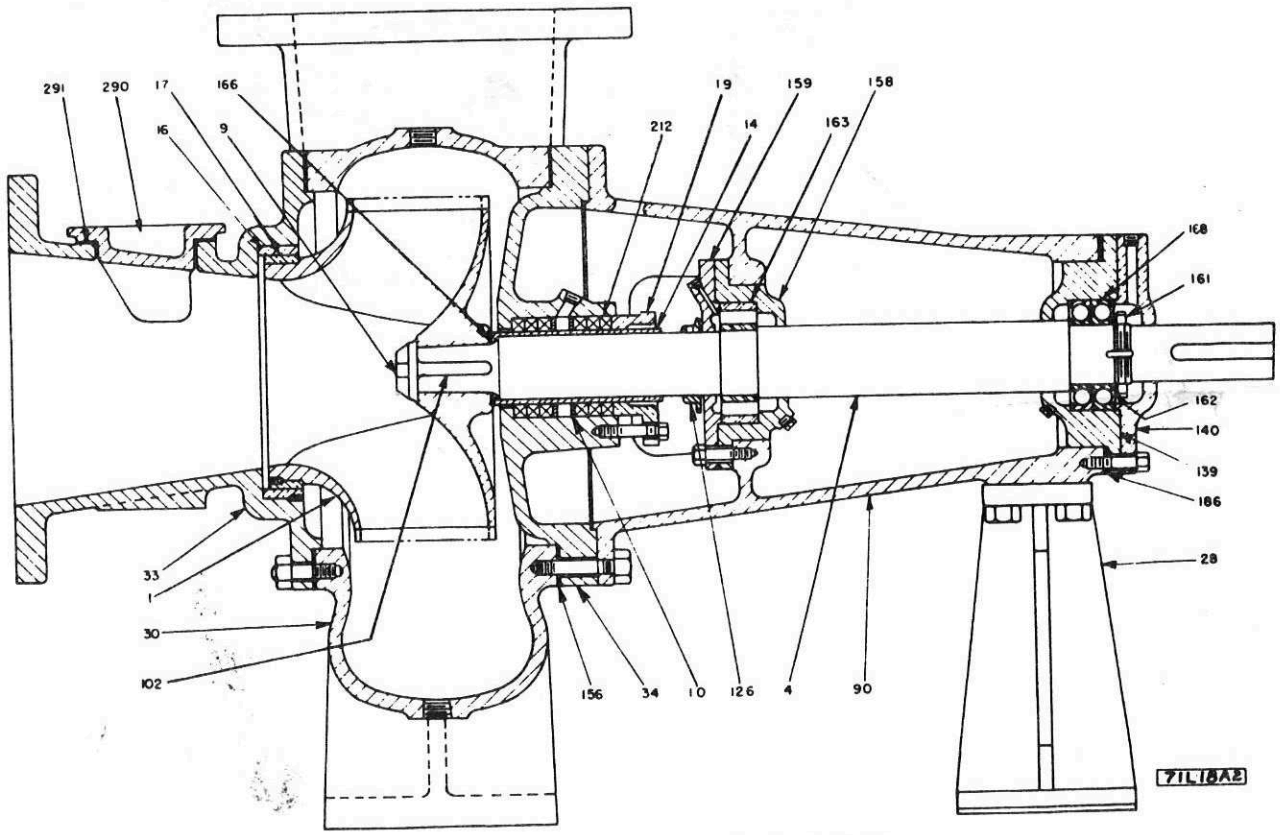
When ordering repairs, always give the size, type, and shop number of the pump (Serial Number). The number is very important. It is stamped on the name plate and the discharge nozzle of the volute. Also, give the description as given in the list by the repair number and name of part wanted. In ordering an impeller, give the diameter across the blade tips and also the symbol that is stamped on the flange where the water enters. With a coupling, state the number of pins or bushings it contains. Too much care cannot be taken in giving these particulars.

REPAIR PARTS LIST

1 - Impeller
4 - Impeller Shaft
9 - Impeller Nut
10 - Water Seal Ring
14 - Shaft Sleeve
16 - Front Head Wearing Ring
17 - Impeller Wearing Ring
19 - Gland Half
28 - Pedestal
30 - Casing
33 - Front Head
34 - Back Head
90 - Frame
95 - Stuffing Box Bushing
99 - Grease Relief Fitting
102 - Impeller Key
126 - Liquid Deflector
136 - Nameplate
139 - Thrust Bearing Housing
140 - Thrust Bearing Housing Cover
156 - Casing Gasket
158 - Inner Bearing Housing
159 - Inner Bearing Housing Cover
161 - Bearing Locknut
162 - Bearing Lockwasher
163 - Guide Bearing
166 - Shaft Sleeve Gasket
168 - Thrust Bearing
186 - Shims
198 - Impeller Screw Key
202 - Casing Handhole Cover
203 - Casing Handhole Cover Gasket
212 - Packing
219 - Gland Clip
272 - Coupling Key
290 - Front Head Hand Hole Cover
291 - Front Head Hand Hole Cover Gasket







REPAIR CHART FIG. 5720 8"-10"-12"-14"-16"-18"

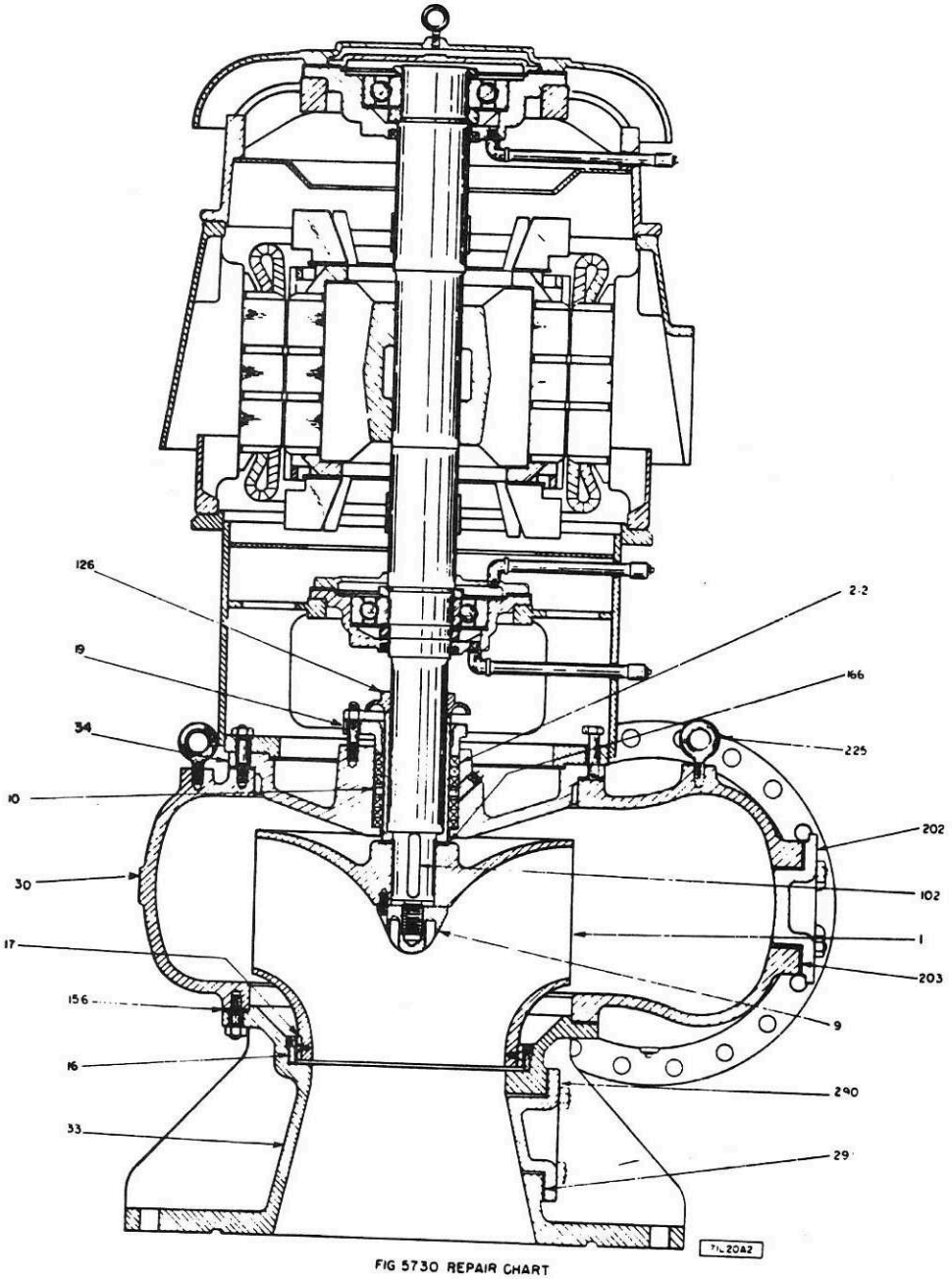


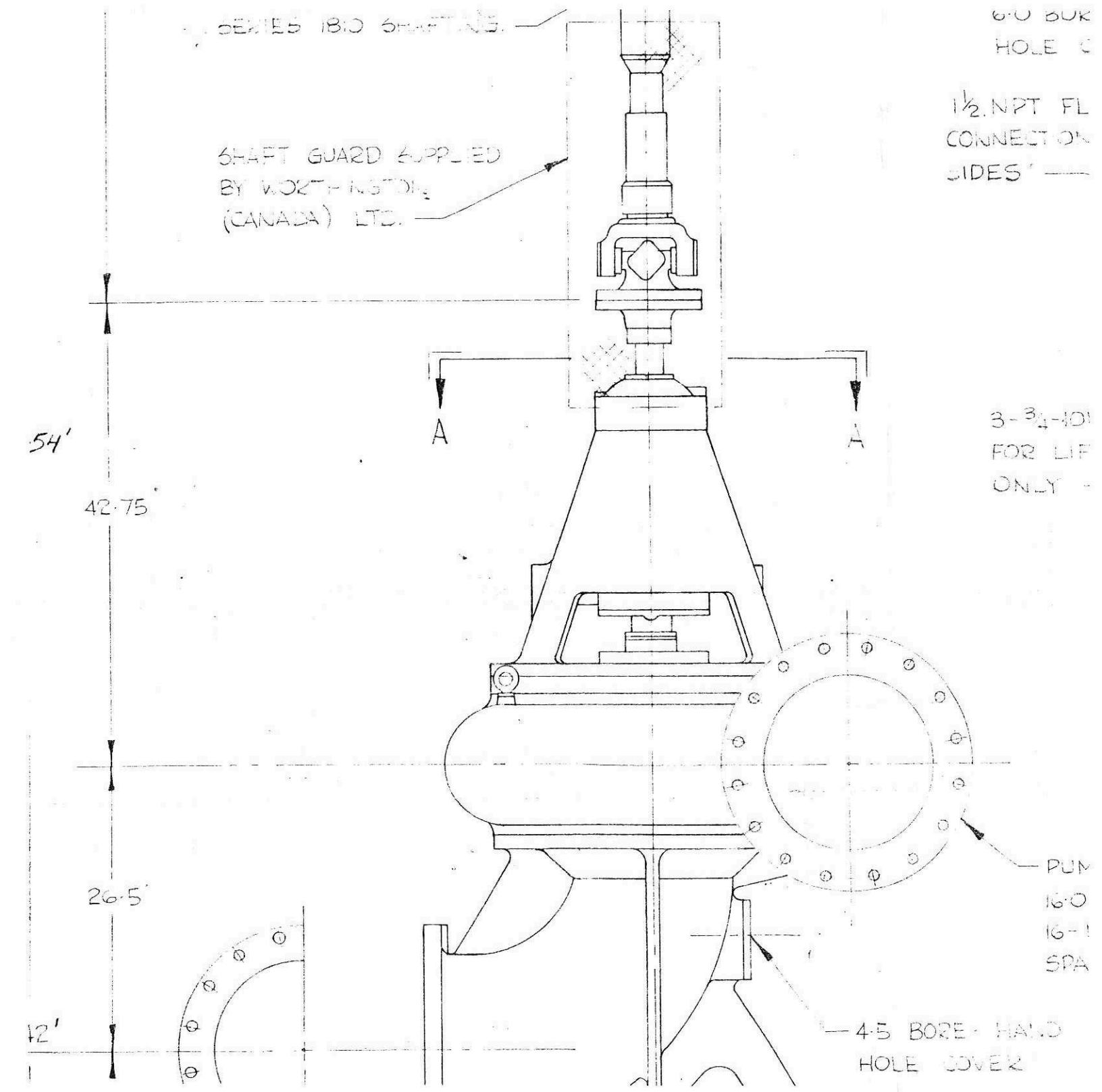
FIG 5730 REPAIR CHART

Colt Industries

Fairbanks Morse
Pump Division

KANSAS CITY, KANSAS 66110

40038355
JK3M1166


SERIES 1810 SHAFTING.
SHAFT GUARD SUPPLIED BY WORTHINGTON (CANADA) LTD.
A
A
54'
42·75'
26·5'
12'
4·5 BORE · HAND HOLE COVER

DRAWING NOTES

02" X 45° MAX
URRS
IOJECTION UNLESS STATED

RE INDICATED BY / UNLESS
ERWISE
CES FOR FINISHED SURFACES
TED OTHERWISE.

3 PLACE DECIMAL | 2 PLACE DECIMAL

SHAFT GUARD SUPPLIED
BY WORTHINGTON
(CANADA) LTD.

17·54'

42·75

26·5'

ELEV. 44·42'

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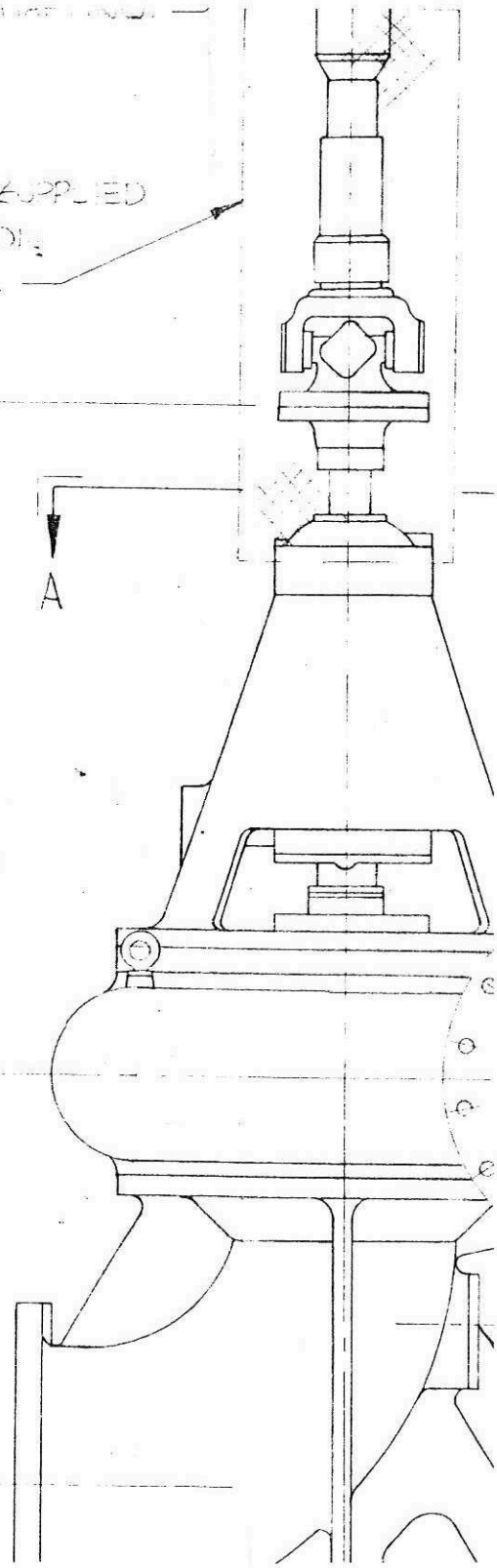

IMP # 200

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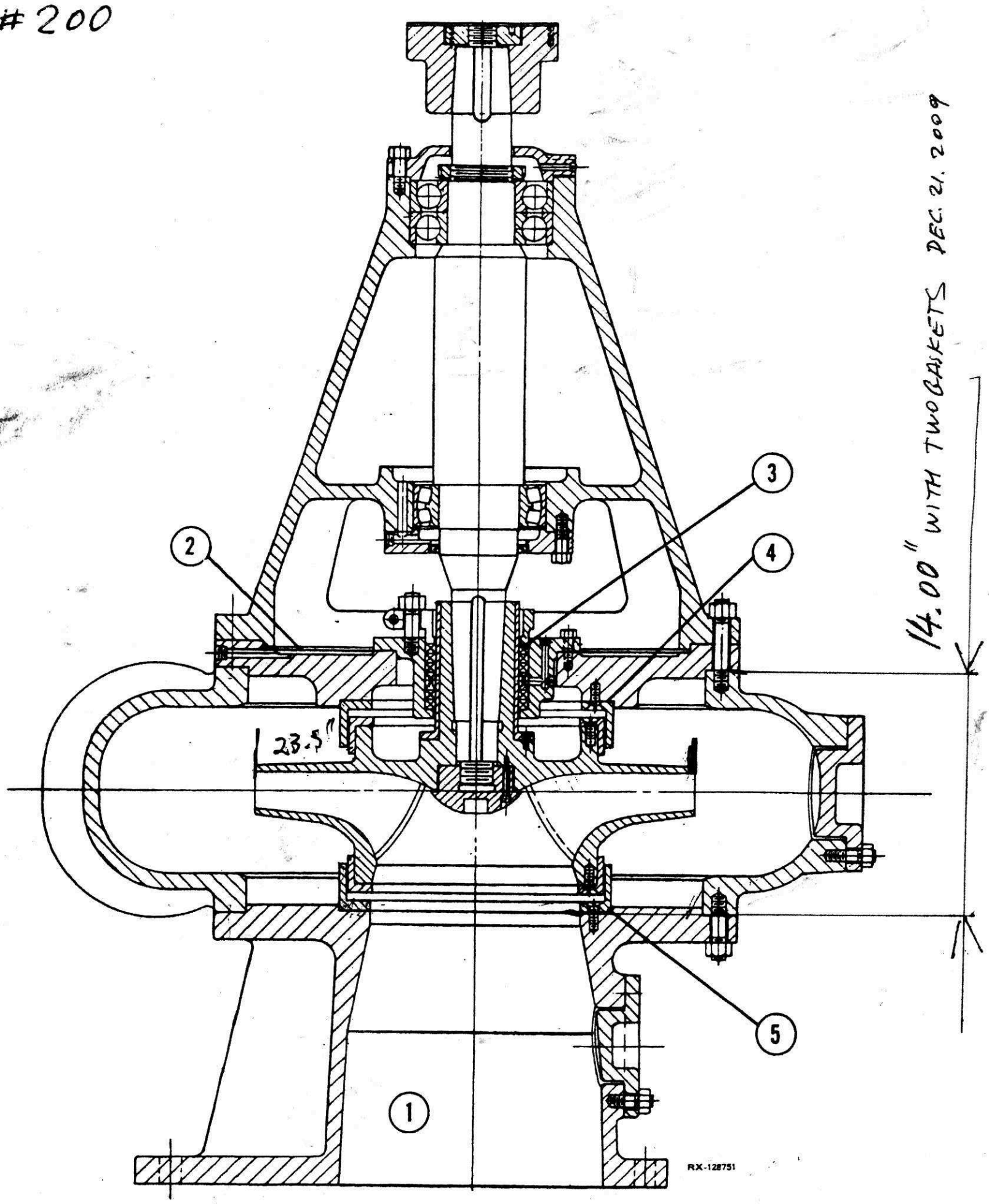


TYPES FA-FC Typical Section

Section Elevation showing typical construction of the type FA and FC pump. Refer to Harrison for specific construction of any given pump.

1 Bottom suction with two winged feet rigidly supporting the pump.

2 Stuffing box head permits easy drainage.

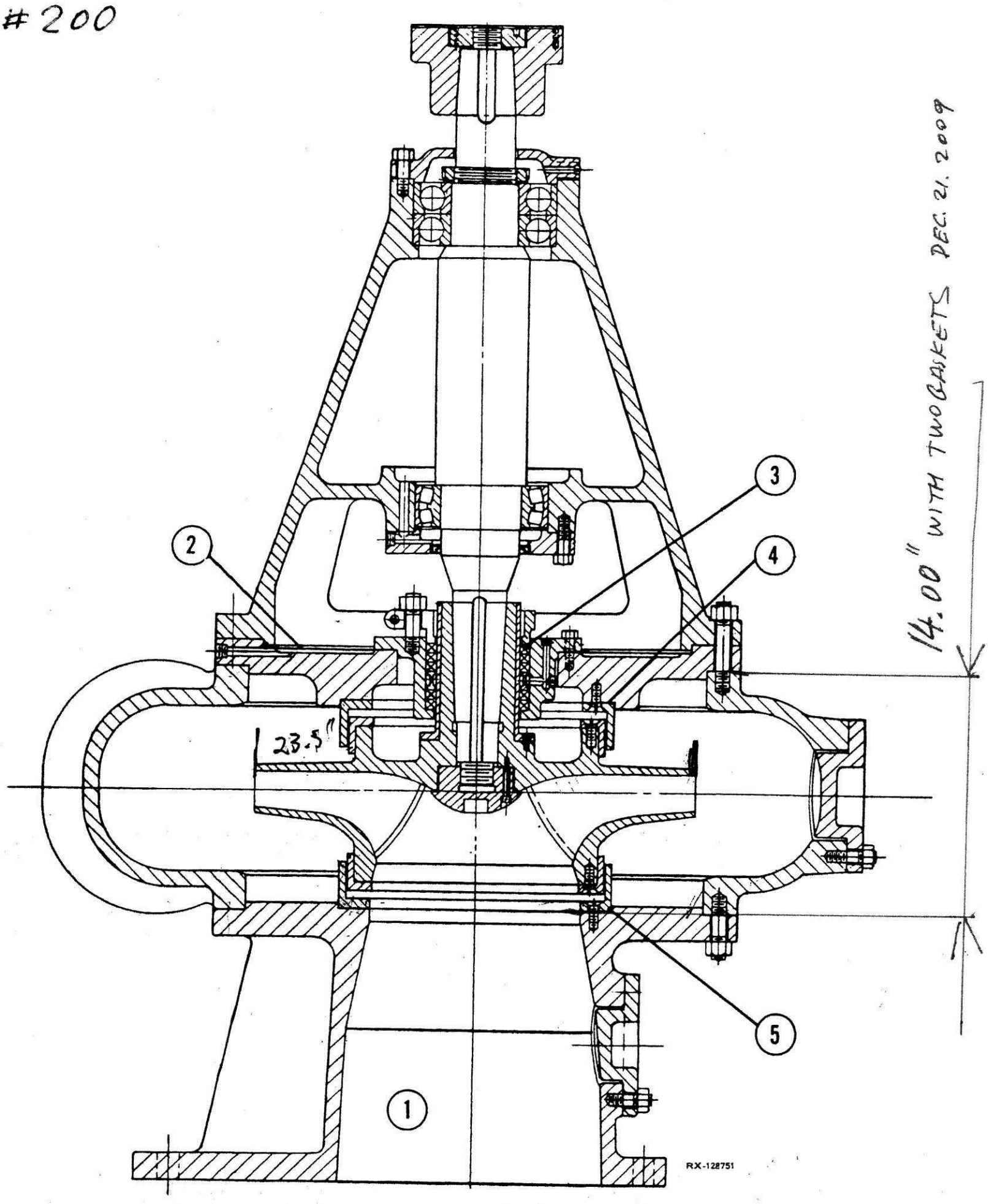
3 Easily accessible stuffing box.

4 Back rings may be furnished to minimize hydraulic thrust.

5 Generous renewable double wearing rings.

14.00" WITH TWO GASKETS DEC. 21, 2009

PUMP # 200
PRPS



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2013 NEW SEAL
PUMP 17200 PMPS

POWERPUMPER
DOUBLE/TANDEM CARTRIDGE SEAL
INSTALLATION INSTRUCTIONS

PREPARE PUMP

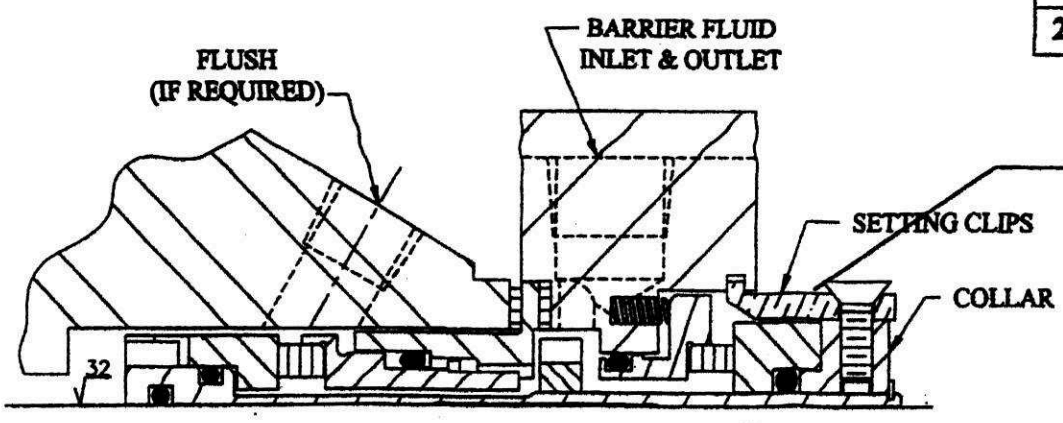
1. Clean and inspect pump parts.
2. Replace shaft or shaft sleeve if worn in secondary sealing areas under o-rings.
3. Check for good starting bevel and remove all burrs that would cut secondary seal o-rings or cause misalignment.
4. Check shaft run out (to be within .001" TIR per inch of shaft dia.), shaft end play (not to exceed .005"), stuffing box face alignment (must be square to shaft within .003" TIR and have good sealing surface, 125 RMS min.), and condition of the pump bearings: Replace if necessary.

INSTALLING SEAL

1. Lubricate shaft or sleeve.
2. Insert seal into stuffing box with barrier fluid ports facing desired location.
3. Loosely thread gland bolts into back plate. **IMPORTANT:** Do not tighten gland bolts at this time. Also, do not remove any setting clips at this time. **NOTE:** For larger pumps with heavy back plates, install the seal on the shaft or sleeve, then slip on the back plate and loosely thread the gland bolts.
4. Install and bolt back plate to pump frame.
5. Install and tighten impeller.
6. Make all necessary impeller adjustments as required. The impeller can be reset at any time, as long as the setting clips are in place and the seal set screws are loosened while the shaft is being moved.
7. Tighten gland bolts evenly.
8. Tighten set screws in collar.
9. Remove setting clips and flat head screws. **NOTE:** Apply pressure to clip at the gland face, as shown, with a screwdriver or flat edge then lift rear of clip to remove. (The setting clips must be removed entirely)
10. Turn shaft by hand to make sure there is no rubbing between rotating and stationary parts.
11. Make all necessary pump connections and alignments.
12. Clean out barrier fluid lines and seal pot.
13. Connect and open barrier fluid lines to seal.
14. If a seal pot is used, fill seal pot with barrier fluid and bleed out air in lines. For API Plan 53 pressurize to 20-30 PSI above stuffing box pressure.
15. Run pump according to normal start up and operating procedures.

GLAND BOLT TORQUE

Seal Size	Torque Value
1 to 1-3/8"	15 – 20 ft-lbs.
1-1/2 to 2"	25 – 30 ft-lbs.
2-1/8 to 3-1/4"	30 – 35 ft-lbs.



SLEEVE HAS TO BE LONGER