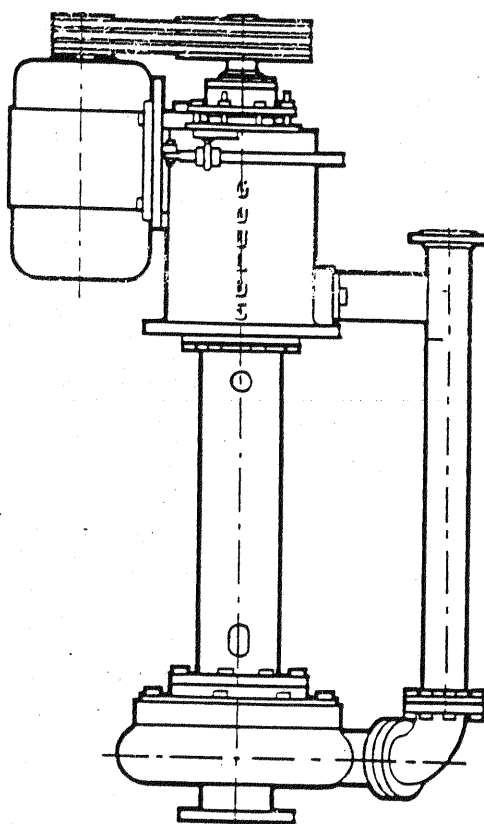




# GOULDS PUMPS

## SLURRY PUMP DIVISION

Installation, Operation and Maintenance Instructions



Model VHS

## IMPORTANT SAFETY NOTICE

*To: Our Valued Customers*

User safety is a major focus in the design of our products. Following the precautions outlined in this manual will minimize your risk of injury.

ITT Goulds pumps will provide safe, trouble-free service when properly installed, maintained, and operated.

Safe installation, operation, and maintenance of ITT Goulds Pumps equipment are an essential end user responsibility. This *Pump Safety Manual* identifies specific safety risks that must be considered at all times during product life. Understanding and adhering to these safety warnings is mandatory to ensure personnel, property, and/or the environment will not be harmed. Adherence to these warnings alone, however, is not sufficient — it is anticipated that the end user will also comply with industry and corporate safety standards. Identifying and eliminating unsafe installation, operating and maintenance practices is the responsibility of all individuals involved in the installation, operation, and maintenance of industrial equipment.

Please take the time to review and understand the safe installation, operation, and maintenance guidelines outlined in this Pump Safety Manual and the Instruction, Operation, and Maintenance (IOM) manual. Current manuals are available at [www.gouldspumps.com/literature\\_ioms.html](http://www.gouldspumps.com/literature_ioms.html) or by contacting your nearest Goulds Pumps sales representative.

**These manuals must be read and understood before installation and start-up.**

For additional information, contact your nearest Goulds Pumps sales representative or visit our Web site at [www.gouldspumps.com](http://www.gouldspumps.com).

# SAFETY WARNINGS

Specific to pumping equipment, significant risks bear reinforcement above and beyond normal safety precautions.

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## **WARNING**

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A pump is a pressure vessel with rotating parts that can be hazardous. Any pressure vessel can explode, rupture, or discharge its contents if sufficiently over pressurized causing death, personal injury, property damage, and/or damage to the environment. All necessary measures must be taken to ensure over pressurization does not occur.

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## **WARNING**

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Operation of any pumping system with a blocked suction and discharge must be avoided in all cases. Operation, even for a brief period under these conditions, can cause superheating of enclosed pumpage and result in a violent explosion. All necessary measures must be taken by the end user to ensure this condition is avoided.

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## **WARNING**

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The pump may handle hazardous and/or toxic fluids. Care must be taken to identify the contents of the pump and eliminate the possibility of exposure, particularly if hazardous and/or toxic. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks.

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## **WARNING**

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Pumping equipment Instruction, Operation, and Maintenance manuals clearly identify accepted methods for disassembling pumping units. These methods must be adhered to. Specifically, applying heat to impellers and/or impeller retaining devices to aid in their removal is strictly forbidden. Trapped liquid can rapidly expand and result in a violent explosion and injury.

ITT Goulds Pumps will not accept responsibility for physical injury, damage, or delays caused by a failure to observe the instructions for installation, operation, and maintenance contained in this Pump Safety Manual or the current IOM available at [www.gouldspumps.com/literature](http://www.gouldspumps.com/literature).

# SAFETY

## DEFINITIONS

Throughout this manual the words **WARNING**, **CAUTION**, **ELECTRICAL**, and **ATEX** are used to indicate where special operator attention is required.

**Observe all Cautions and Warnings highlighted in this Pump Safety Manual and the IOM provided with your equipment.**



### **WARNING**

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

**Example:** Pump shall never be operated without coupling guard installed correctly.

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### **CAUTION**

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

**Example:** Throttling flow from the suction side may cause cavitation and pump damage.

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### **ELECTRICAL HAZARD**


Indicates the possibility of electrical risks if directions are not followed.

**Example:** Lock out driver power to prevent electric shock, accidental start-up, and physical injury.

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When installed in potentially explosive atmospheres, the instructions that follow the Ex symbol must be followed. Personal injury and/or equipment damage may occur if these instructions are not followed. If there is any question regarding these requirements or if the equipment is to be modified, please contact an ITT Goulds Pumps representative before proceeding.







**Example:**  Improper impeller adjustment could cause contact between the rotating and stationary parts, resulting in a spark and heat generation.














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## GENERAL PRECAUTIONS

### WARNING

A pump is a pressure vessel with rotating parts that can be hazardous. Hazardous fluids may be contained by the pump including high temperature, flammable, acidic, caustic, explosive, and other risks. Operators and maintenance personnel must realize this and follow safety measures. Personal injuries will result if procedures outlined in this manual are not followed. ITT Goulds Pumps will not accept responsibility for physical injury, damage or delays caused by a failure to observe the instructions in this manual and the IOM provided with your equipment.

General Precautions		
WARNING		NEVER APPLY HEAT TO REMOVE IMPELLER. It may explode due to trapped liquid.
WARNING		NEVER use heat to disassemble pump due to risk of explosion from tapped liquid.
WARNING		NEVER operate pump without coupling guard correctly installed.
WARNING		NEVER run pump below recommended minimum flow when dry, or without prime.
WARNING		ALWAYS lock out power to the driver before performing pump maintenance.
WARNING		NEVER operate pump without safety devices installed.
WARNING		NEVER operate pump with discharge valve closed.
WARNING		NEVER operate pump with suction valve closed.
WARNING		DO NOT change service application without approval of an authorized ITT Goulds Pumps representative.
WARNING		<b>Safety Apparel:</b> <ul style="list-style-type: none"> <li>♦ Insulated work gloves when handling hot bearings or using bearing heater</li> <li>♦ Heavy work gloves when handling parts with sharp edges, especially impellers</li> <li>♦ Safety glasses (with side shields) for eye protection</li> <li>♦ Steel-toed shoes for foot protection when handling parts, heavy tools, etc.</li> <li>♦ Other personal protective equipment to protect against hazardous/toxic fluids</li> </ul>
WARNING		<b>Receiving:</b> Assembled pumping units and their components are heavy. Failure to properly lift and support equipment can result in serious physical injury and/or equipment damage. Lift equipment only at specifically identified lifting points or as instructed in the current IOM. Current manuals are available at <a href="http://www.gouldspumps.com/literature_ioms.html">www.gouldspumps.com/literature_ioms.html</a> or from your local ITT Goulds Pumps sales representative. Note: Lifting devices (eyebolts, slings, spreaders, etc.) must be rated, selected, and used for the entire load being lifted.
WARNING		<b>Alignment:</b> Shaft alignment procedures must be followed to prevent catastrophic failure of drive components or unintended contact of rotating parts. Follow coupling manufacturer's coupling installation and operation procedures.

General Precautions		
<b>WARNING</b>		Before beginning any alignment procedure, make sure driver power is locked out. Failure to lock out driver power will result in serious physical injury.
<b>CAUTION</b>		<b>Piping:</b> Never draw piping into place by forcing at the flanged connections of the pump. This may impose dangerous strains on the unit and cause misalignment between pump and driver. Pipe strain will adversely effect the operation of the pump resulting in physical injury and damage to the equipment.
<b>WARNING</b>		<b>Flanged Connections:</b> Use only fasteners of the proper size and material.
<b>WARNING</b>		Replace all corroded fasteners.
<b>WARNING</b>		Ensure all fasteners are properly tightened and there are no missing fasteners.
<b>WARNING</b>		<b>Startup and Operation:</b> When installing in a potentially explosive environment, please ensure that the motor is properly certified.
<b>WARNING</b>		Operating pump in reverse rotation may result in contact of metal parts, heat generation, and breach of containment.
<b>WARNING</b>		Lock out driver power to prevent accidental start-up and physical injury.
<b>WARNING</b>		The impeller clearance setting procedure must be followed. Improperly setting the clearance or not following any of the proper procedures can result in sparks, unexpected heat generation and equipment damage.
<b>WARNING</b>		If using a cartridge mechanical seal, the centering clips must be installed and set screws loosened prior to setting impeller clearance. Failure to do so could result in sparks, heat generation, and mechanical seal damage.
<b>WARNING</b>		The coupling used in an ATEX classified environment must be properly certified and must be constructed from a non-sparking material.
<b>WARNING</b>		Never operate a pump without coupling guard properly installed. Personal injury will occur if pump is run without coupling guard.
<b>WARNING</b>		Make sure to properly lubricate the bearings. Failure to do so may result in excess heat generation, sparks, and / or premature failure.
<b>CAUTION</b>		The mechanical seal used in an ATEX classified environment must be properly certified. Prior to start up, ensure all points of potential leakage of process fluid to the work environment are closed.
<b>CAUTION</b>		Never operate the pump without liquid supplied to mechanical seal. Running a mechanical seal dry, even for a few seconds, can cause seal damage and must be avoided. Physical injury can occur if mechanical seal fails.
<b>WARNING</b>		Never attempt to replace packing until the driver is properly locked out and the coupling spacer is removed.
<b>WARNING</b>		Dynamic seals are not allowed in an ATEX classified environment.
<b>WARNING</b>		DO NOT operate pump below minimum rated flows or with suction and/or discharge valve closed. These conditions may create an explosive hazard due to vaporization of pumpage and can quickly lead to pump failure and physical injury.

General Precautions		
<b>WARNING</b>		Ensure pump is isolated from system and pressure is relieved before disassembling pump, removing plugs, opening vent or drain valves, or disconnecting piping.
<b>WARNING</b>		<b>Shutdown, Disassembly, and Reassembly:</b> Pump components can be heavy. Proper methods of lifting must be employed to avoid physical injury and/or equipment damage. Steel toed shoes must be worn at all times.
<b>WARNING</b>		The pump may handle hazardous and/or toxic fluids. Observe proper decontamination procedures. Proper personal protective equipment should be worn. Precautions must be taken to prevent physical injury. Pumpage must be handled and disposed of in conformance with applicable environmental regulations.
<b>WARNING</b>		Operator must be aware of pumpage and safety precautions to prevent physical injury.
<b>WARNING</b>		Lock out driver power to prevent accidental startup and physical injury.
<b>CAUTION</b>		Allow all system and pump components to cool before handling them to prevent physical injury.
<b>CAUTION</b>		If pump is a Model NM3171, NM3196, 3198, 3298, V3298, SP3298, 4150, 4550, or 3107, there may be a risk of static electric discharge from plastic parts that are not properly grounded. If pumped fluid is non-conductive, pump should be drained and flushed with a conductive fluid under conditions that will not allow for a spark to be released to the atmosphere.
<b>WARNING</b>		Never apply heat to remove an impeller. The use of heat may cause an explosion due to trapped fluid, resulting in severe physical injury and property damage.
<b>CAUTION</b>		Wear heavy work gloves when handling impellers as sharp edges may cause physical injury.
<b>CAUTION</b>		Wear insulated gloves when using a bearing heater. Bearings will get hot and can cause physical injury.

## ATEX CONSIDERATIONS and INTENDED USE

Special care must be taken in potentially explosive environments to ensure that the equipment is properly maintained. This includes but is not limited to:

1. Monitoring the pump frame and liquid end temperature.
2. Maintaining proper bearing lubrication.
3. Ensuring that the pump is operated in the intended hydraulic range.

The ATEX conformance is only applicable when the pump unit is operated within its intended use. Operating, installing or maintaining the pump unit in any way that is not covered in the Instruction, Operation, and Maintenance manual (IOM) can cause serious personal injury or damage to the equipment. This includes any modification to the equipment or use of parts not provided by ITT Goulds Pumps. If there is any question regarding the intended use of the equipment, please contact an ITT Goulds representative before proceeding. Current IOMs are available at [www.gouldspumps.com/literature\\_ioms.html](http://www.gouldspumps.com/literature_ioms.html) or from your local ITT Goulds Pumps Sales representative.

All pumping unit (pump, seal, coupling, motor and pump accessories) certified for use in an ATEX classified environment, are identified by an ATEX tag secured to the pump or the baseplate on which it is mounted. A typical tag would look like this:



The CE and the Ex designate the ATEX compliance. The code directly below these symbols reads as follows:

- II = Group 2
- 2 = Category 2
- G/D = Gas and Dust present
- T4 = Temperature class, can be T1 to T6 (see Table 1)

Table 1		
Code	Max permissible surface temperature °F (°C)	Max permissible liquid temperature °F (°C)
T1	842 (450)	700 (372)
T2	572 (300)	530 (277)
T3	392 (200)	350 (177)
T4	275 (135)	235 (113)
T5	212 (100)	Option not available
T6	185 (85)	Option not available

The code classification marked on the equipment must be in accordance with the specified area where the equipment will be installed. If it is not, do not operate the equipment and contact your ITT Goulds Pumps sales representative before proceeding.



# PARTS



The use of genuine Goulds parts will provide the safest and most reliable operation of your pump. ITT Goulds Pumps ISO certification and quality control procedures ensure the parts are manufactured to the highest quality and safety levels.

Please contact your local Goulds representative for details on genuine Goulds parts.

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## SECTION I - GENERAL

### INTRODUCTION

This instruction manual is intended to assist those involved with the installation, operation 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.

#### I-A. 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 thoroughly Sections I, II, III, IV and carefully follow the instructions for installation and operation. Sections V, VI, VII and VIII are answers to trouble and maintenance questions. 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.

#### I-B. 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 pressures, 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.

#### I-C. 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.

Instruction sheets on various components as well as the Instruction Book for the pump are included in the shipment. DO NOT DISCARD.

#### I-D. PRESERVATION AND STORAGE

Goulds' Slurry Pump Division's normal domestic shipping and storage preparation is suitable for protecting the pump during shipment in covered trucks. 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 unit is recommended every 30 days to prevent damage to bearings.

## SECTION II - INSTALLATION INSTRUCTIONS

### VERTICAL PUMPS

#### II-A. PUMP SUPPORT

The pump support must be sufficiently substantial and level to give rigid support to the pump and to absorb vibration.

The bolts which secure the pump to the foundation should be  $1/8$ " less in diameter than the holes in the pump frame (size is shown on the certified dimensions drawing).

#### CAUTION

Provision must be made to support discharge piping independently from the pump to prevent excessive loads and maintain pump-driver alignment.

#### II-B. DISCHARGE PIPE

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

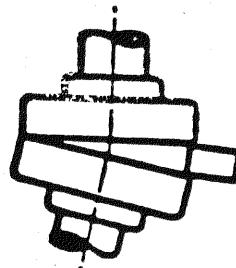
Arrangements should be made to keep the pump from back-spinning severely during shutdown. On a long discharge line, a non-slam check valve should be installed. At no point should the pump be started while the impeller is in reverse rotation.

#### II-C. SUMP

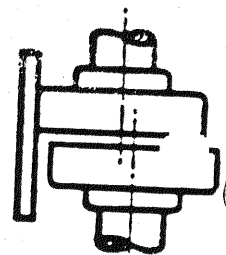
The sump must be screened to prevent any foreign objects from falling into the sump and damaging the pump. The openings in the screening should be the same size or smaller than the openings in the pump strainer.

#### II-D. DIRECT CONNECTION

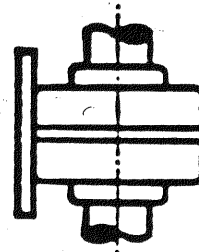
Check parallel alignment by placing a straight edge across the two coupling flanges or using a dial indicator. Check angular alignment with a micrometer or feeler gauge. Measure from the outside of one flange to the outside of the other at intervals around the periphery of the coupling. Alignment of drive and pump should be within  $.003$ ". See Fig. 1.



Angular  
Misalignment



Parallel  
Misalignment



Perfect  
Alignment

## II-E. V-BELT DRIVES

Well designed and properly installed V-belt drives are capable of running for years without maintenance. There are a few points that should be checked periodically.

### 1. Check Belt Fit

Regardless of the belt section used, the belt should never be allowed to bottom in the groove. This will cause the belts to lose their wedging action and slippage can occur. Sheaves or belts that permit such a condition to occur should be changed.

### 2. Keep Belts Clean

Dirt and grease reduce belt life. Belt dressing affects performance only temporarily and is never recommended. Maintaining a clean drive is a better idea.

### 3. Use Belt Guards

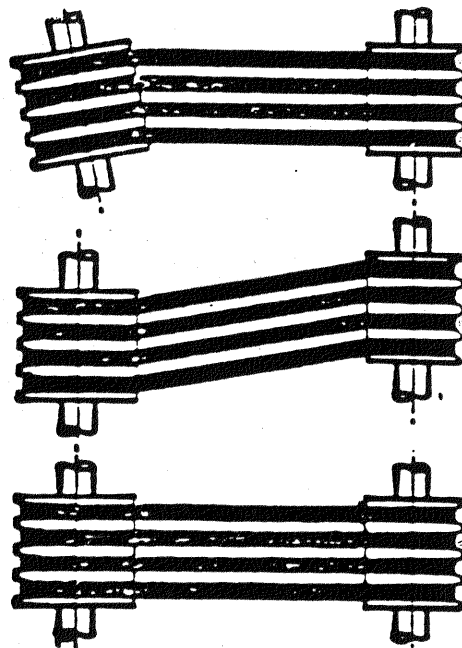
Belt guards protect personnel from danger and the drive from contamination. Inspect periodically to assure that belts do not rub against guard.

### 4. Maintain Proper Belt Tension

Proper tension is the primary reason for long belt life. Improper tension could cause belt fatigue and/or hot bearings.

### 5. Sheave Alignment

Alignment must be maintained for full power transmission, minimum vibration, and long drive life. Make sure sheaves are aligned by placing a straight edge or string along the faces of each sheave. See Fig. II. If any questions arise pertaining to the drive limitations, consult the manufacturer.



Angular Misalignment

Parallel Misalignment

Perfect Alignment

### SECTION III - STARTING A VERTICAL PUMP

Before starting a new pump, check the pump supports and piping to be certain that they conform to the specifications in the "Installation Instructions" section.

The bearing housing is properly filled with grease before shipment. Under normal conditions, grease should be added as required at regular intervals.

Turn the pump shaft by hand. If the pump does not turn freely, it should be checked to determine what is causing the binding.

Check the motor rotation to be certain that it will drive the pump in the correct direction.

The bearing housing seals may generate some heat until broken in. Oil may be applied to them if the heat becomes excessive at the time the pump is started.

The pump must be primed. The pump must not be started unless the liquid level is above the impeller.

Do not operate the pump with a closed discharge line. At the shutoff point, with no water flow, the horsepower delivered to the pump is rapidly converted into heat and presents a great danger.

#### WARNING:

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

## SECTION IV - OPERATING AND MAINTENANCE INSTRUCTIONS

### IV-A. LUBRICATION

#### WARNING

OPERATION OF THE UNIT WITHOUT PROPER LUBRICATION CAN RESULT IN OVERHEATING OF THE BEARINGS, BEARING FAILURES, PUMP SEIZURES AND ACTUAL BREAKUP OF THE EQUIPMENT EXPOSING OPERATING PERSONNEL TO PERSONAL INJURY.

The bearing housing is properly filled before shipment. Under normal conditions, grease should be added at regular intervals and care should be taken not to over-lubricate. Use Shell Alvania No. 2, Mobil 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.

### IV-B. SEALS

The upper bearing housing seals may generate some heat until broken in. Oil may be applied to it if the heat becomes excessive at the time the pump is started. Make sure the seal area is free of dust and dirt prior to start.

### IV-C. MAINTAINED CAPACITY

The amount of liquid being pumped will lessen as impeller wear increases. To maintain full pump capacity, the impeller should be inspected periodically. Each application is different and it is necessary to

### IV-C. MAINTAINED CAPACITY (Cont'd.)

determine the amount of wear for a certain time limit before setting up a schedule for inspection.

#### 1. Impeller Clearance Adjustment

(a) Loosen the thrust bearing housing locking stud nuts (370C) (Fig. IV).

(b) Turn impeller clearance adjusting bolts (3700/ccw) to move the bearing housing up until the impeller (101) touches the stuffing box cover (184). Turn the bolts to lower the bearing housing .03", which gives the recommended operating clearance. Make sure the impeller turns freely through the entire rotation.

(c) Tighten housing locking stud nuts and bolts (370C).

### IV-D. DUPLEX THRUST BEARING REPLACEMENT

Duplex bearings are made up of two single row bearings manufactured with controlled relationship between the axial location of the inner and outer ring faces and are supplied as matched pairs or sets.

When it becomes necessary to replace a duplex bearing, both halves of the new bearing must be marked with the letter "D". Under no circumstances should a duplex bearing be made by using two single row bearings not specifically marked for duplex use.

When replacing a duplex bearing, mount the two mated bearings back-to-back so that the stamped faces (high shoulders) of the outer rings are together.

In case of making replacements for bearings which have been installed and run, it is recommended that both halves be replaced. This avoids the dangers involved in attempting to match two bearings, one of which has unknown internal characteristics.

#### IV-E. O-Rings, Gaskets and Casing Liners

When making inspections or repairs, be sure to replace all gaskets and O-rings. Pumps will operate at reduced capacities if gaskets O-rings are not installed.

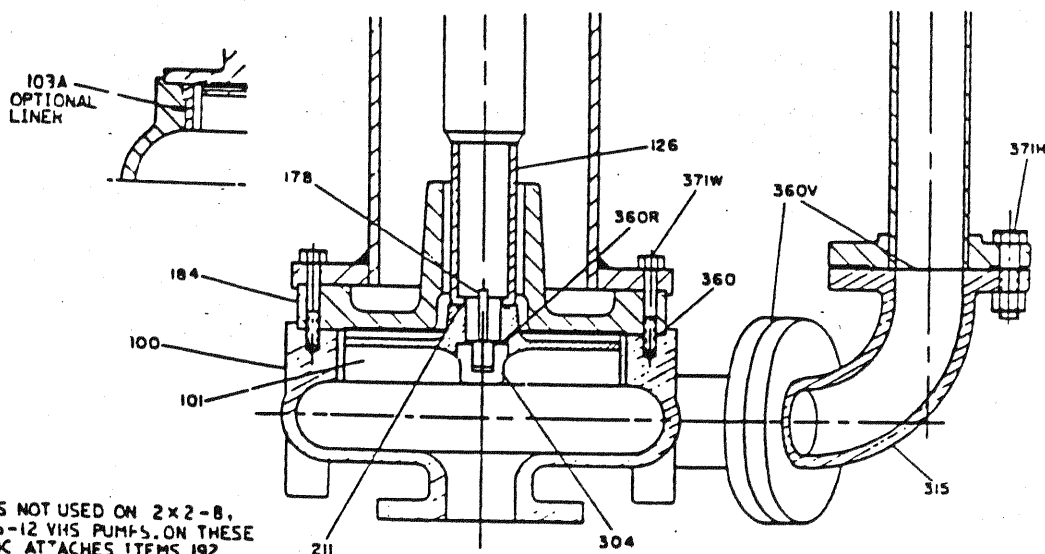
The optional casing liner has a loose fit in the casing for ease of installation and removal by hand. The liner is clamped in place by the stuffing box cover. The gasket #360 seals the joints.



## SECTION V - DISASSEMBLY AND REASSEMBLY

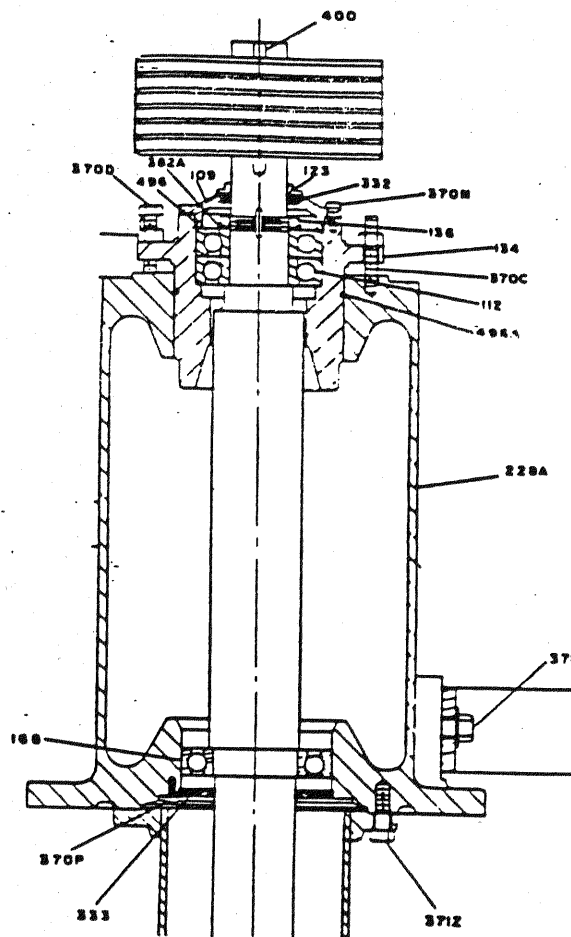
### V-A. DISASSEMBLY OF BOTTOM SUCTION PUMP - VHS

1. Lock out power supply to motor.
2. Shut off valves controlling flow from the pump. Remove all auxiliary piping and tubing.
3. Remove pump from sump.
4. Loosen V-belts or disconnect coupling. Remove either from shaft.
5. Remove motor and motor mount if a direct connected pump.
6. Unbolt discharge elbow and remove.
7. Remove bolts 371 W and withdraw casing (100).
8. Remove impeller nut (304) by turning ccw and slide impeller from shaft.
9. Tape end of shaft and slide stuffing box cover (184) over shaft.
10. Slide shaft sleeve (126) from shaft (122).
11. Disassemble column pipe (192) and discharge pipe (195).
12. Remove nuts from housing locking studs (370C).
13. Draw bearing housing and shaft assembly from the frame (228A).



V-B. DISASSEMBLY OF BEARING HOUSING AND SHAFT ASSEMBLY

1. Press inboard bearing (168) off shaft.
2. Remove deflector (123) and outboard end cover (109).
3. Remove bearing housing (134) from bearing and slide off bottom of shaft.
4. Remove outboard bearing locknut (136) and lockwasher (382A) and press outboard bearings (112) off shaft.



V-C. INSPECTION AND PARTS REPLACEMENT GUIDELINES

1. Impeller - Replace if impeller shows excessive erosion, corrosion, extreme wear or vane breakage. Impeller hub must be in good condition. Reduction in hydraulic performance may be caused by excessive impeller wear.
2. Shaft Sleeve - Sleeve surface and throttle area must be smooth. If badly grooved or cut, replace sleeve.
3. Casing - Replace if worn.
4. Shaft - Check for runout (.006" max.) to see that shaft has not been bent. Bearing seats and oil seal area must be smooth and free of scratches or grooves. Shaft threads must be in good condition. Replace if necessary.
5. Bearings - Replace if worn, loose or rough and noisy when rotated.
6. Oil Seals - Replace if worn or otherwise damaged.
7. General - All parts should be clean before assembly. All burrs should be removed.

NOTE: STANDARD BEARING MANUFACTURER FITS AND TOLERANCE DIMENSIONS ARE USED IN THE MANUFACTURE OF SPD VERTICAL PUMPS.

V-D. REASSEMBLY OF BEARING HOUSING AND SHAFT ASSEMBLY

1. Clean shaft (122) thoroughly, checking for nicks or worn areas.
2. Press outboard seal (332) into outboard end cover (109), positioning the seal so that the lip points upward when installed with the pump. Press inboard seal (333) into frame (228A) with the lip pointing downward and secure with capscrews (370P).
3. Position outboard bearing locknut (136) and lockwasher (382A) against the bearing shoulder and tighten firmly. Bend "tang" of lockwasher into slot in locknut.
4. Hand pack outboard bearing with recommended grease (See Section IV). Mound a small amount of grease above bearing to insure sufficient lubrication.
5. Insert bearing housing (134) over the impeller end of shaft and pull over outboard bearing. Attach end cover (109) with O-Ring (496). Tighten bolts evenly so outboard bearing seats properly. A gap of approximately .06" should exist between the end cover flange and the bearing housing. This gap assures the bearing is tight into the bearing housing.
6. Press inboard bearing (168) onto shaft until inner race seats onto shaft shoulder.
7. Hand pack radial bearing with recommended grease. (See Section IV). Mound a small amount of grease above bearing to insure sufficient lubrication.

V-E. PUMP REASSEMBLY - VERTICAL BOTTOM SUCTION - VHS

1. Install O-Ring (496A) onto bearing housing (134). (Not on C1 frame).
2. Remove impeller nut (304) and key (178) from shaft and tape shaft threads for protection.
3. Insert bearing housing and shaft assembly into frame (228A).
4. Reassemble column pipe (192), frame (228A), and stuffing box cover (184).
5. Position bearing housing shaft assembly so that the shaft is as far into the water end as possible. This will assure proper placement of the impeller (101) on the shaft.
6. Install nuts on bearing housing locking studs (370C). On C1 frame, install outboard end cover (109) with O-Ring (496) and screws (370N). Tighten bolts evenly. A gap of approximately .06" should exist between the end cover flange and the frame (228A). Place deflector (123) above outboard end cover (109).
7. Slide shaft sleeve (126) on shaft after coating shaft with an anti-seizing compound such as "Never Seez" or equal.
8. Remove protective tape from shaft threads. Place gasket (211) against end of impeller (101). Position impeller key (178) in shaft.
9. Dress shaft and impeller bore fit.
10. Slide impeller (101) onto shaft (122) engaging impeller key. Make sure impeller contacts sleeve (126).
11. Place gasket (360R) on impeller nut (304). Apply a light coating of grease on the gasket to eliminate tearing during tightening.
12. Screw impeller nut on threaded portion of shaft. The threads are righthand. Tighten impeller nut (304).
13. Reassemble casing (100), discharge elbow (315), and discharge pipe (195).
14. Rotate shaft to assure that all parts are free.
15. Turn impeller clearance adjusting bolts to move the bearing housing up until the impeller (101) touches the stuffing box cover (184). Turn in the opposite direction to lower the bearing housing .03" which is the recommended operating clearance. Make sure the impeller turns freely through the entire rotation. Lock adjusting bolts in place. (Adjustment is not provided on the C1 frame.)

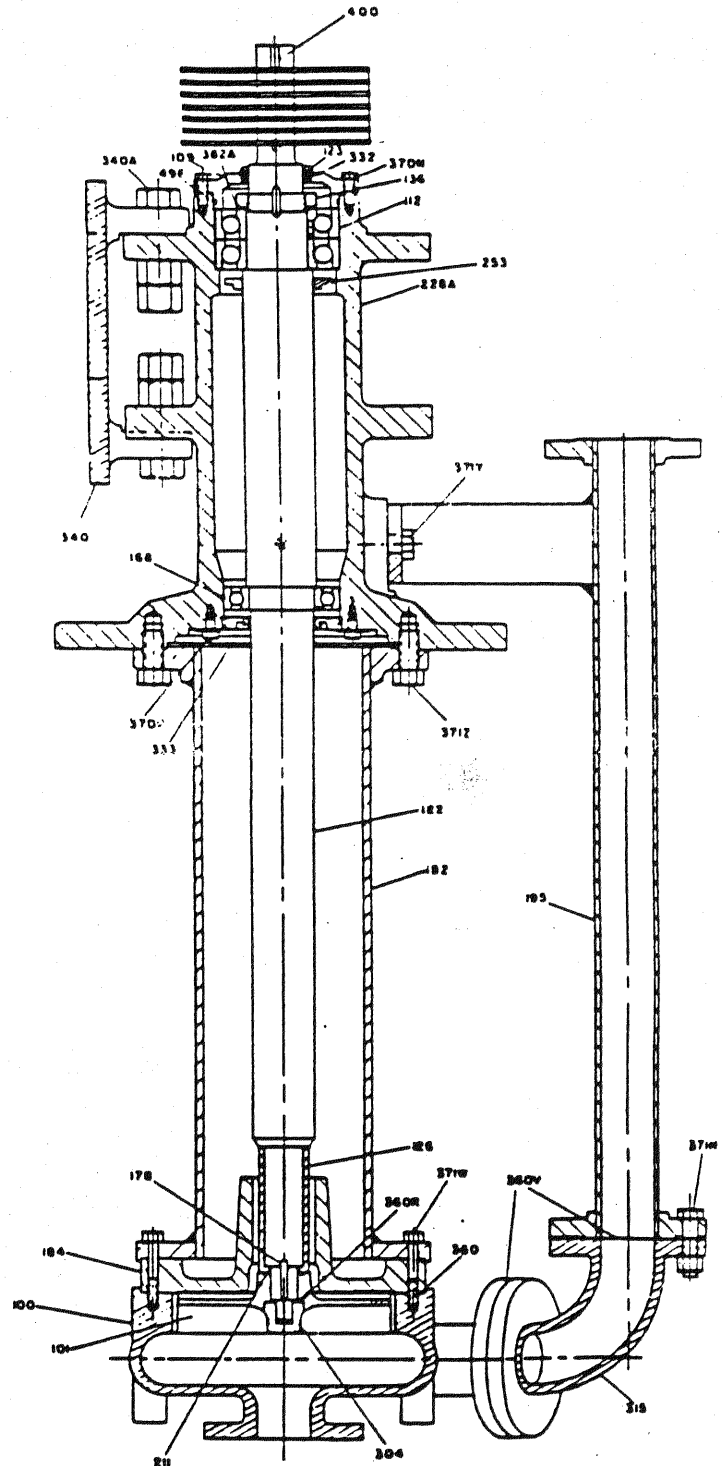
16. Tighten housing locking studs (370C). (Not on C1 frame.)
17. Attach motor mount if a direct connected pump.
18. Connect V-belt drive or coupling.
19. Follow procedures for installation of vertical pumps.

# SECTIONAL VI - VHS SECTIONAL DRAWING

WITH C1 BEARING ASSEMBLY

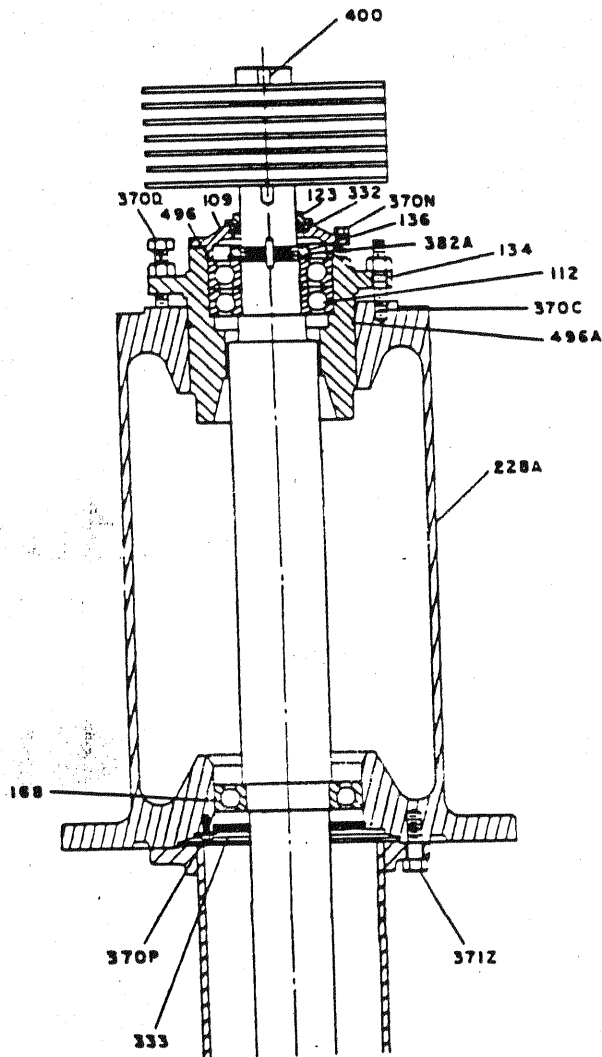
ITEM	QTY PER PUMP	PART NAME	MATERIAL
100	1	CASING	
101	1	IMPELLER	
109	1	OUTBOARD END COVER	CAST IRON
112	1	OUTBOARD BEARING (DUPLX)	STEEL
122	1	SHAFT	
123	1	DEFLECTOR	
126	1	SHAFT SLEEVE	
136	1	OUTBOARD BEARING LOCKNUT	STEEL
168	1	INBOARD BEARING	STEEL
178	1	IMPELLER KEY	
181	1	SUCTION PIPE (NOT SHOWN)-OPT	
181A	1	SUCTION BELL (NOT SHOWN)-OPT	
184	1	STUFFING BOX COVER	
192	1	COLUMN PIPE	
193	1	DISCHARGE PIPE	
211	1	O-RING (101 TO 126)	BUNA-RBR
228A	1	FRAME	DUCT IRON
253	1	GREASE RETAINER OUTBOARD	CAST IRON
304	1	IMPELLER NUT	
315	1	DISCHARGE ELBOW	
337	1	OUTBOARD SEAL	BUNA-RBR
333	1	INBOARD SEAL	BUNA-RBR
340	1	MOYOT MOUNT	DUCT IRON
340A	2	MOYOT MOUNT BOLT	STEEL
340B	1	MTR MT ADJUST BOLT (NOT SHOWN)	STEEL
360	1	GASKET (101 TO 184)	RUBBER
360R	1	GASKET (101 TO 304)	FIBER
360V	2	GASKET (100 TO 315 TO 193)	RUBBER
370M	1	W HD BOLT (100 TO 181 OR 181A) NS	
370N	4	W CAP SCREW (109 TO 228A)	STEEL
370P	4	W CAP SCREW W/ WASH (333 TO 228A)	
371H	1	W HD BOLT (315 TO 193 & 100)	
371W	1	W HD BOLT #82 TO #84 TO 100)	
371Y	2	W CAP SCREW (193 TO 228A)	
371L	1	W HD BOLT (228A TO 192)	
382A	1	OUTBOARD BISHING LOCKWASH	STEEL
400	1	DRIVE KEY	STEEL
498	1	O-RING (109)	BUNA-RBR

Refer to specific pump bill of material for detailed part description.



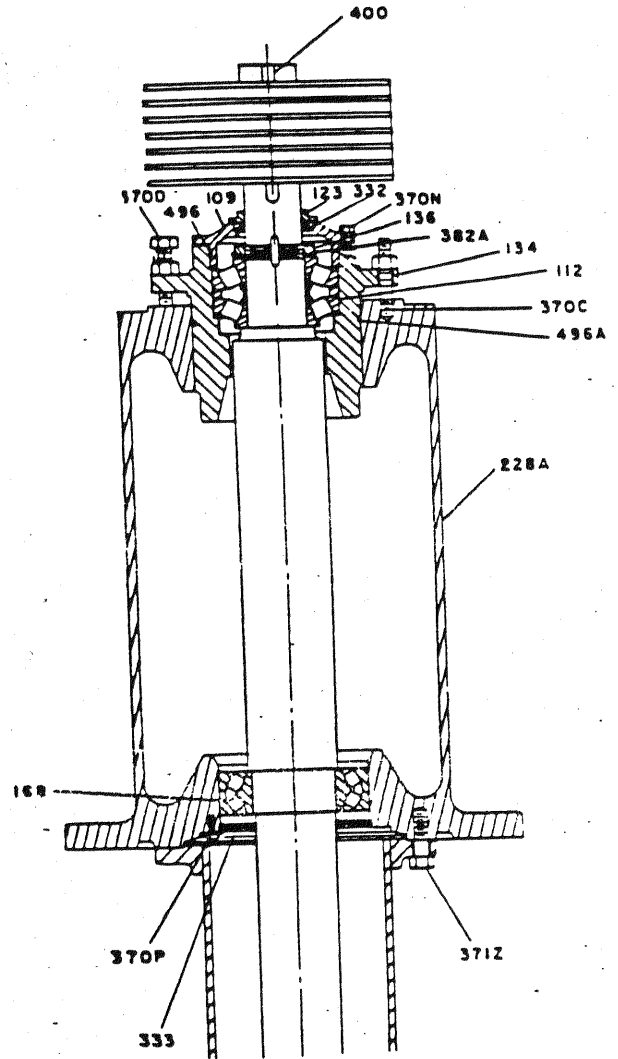
# SECTION VI-B - SECTIONAL DRAWING

C-2, C-3, C-4  
Bearing Assembly



Pumps manufactured with C1-C4 bearing assemblies are supplied with ball bearings.

C-5, C-6  
Bearing Assembly



Pumps manufactured with C5 and C6 bearing assemblies use spherical rocker bearings (Item 168) and tapered roller bearings (Item 112)

## NOTE

Consult Page 1 of specific pump bill of material for bearing assembly used in your pump.



## SECTION VII - CHECK LIST FOR LOCATING TROUBLE

### VII-A. INSUFFICIENT CAPACITY

1. Pump not primed, insure sump level above casing.
2. Speed too low.
3. Total head higher than pump rating.
4. Suction lift too great or insufficient NPSH of system.
5. Impeller passages partially blocked.
6. Suction line partially blocked.
7. Wrong direction of rotation.
8. Mechanical defects: Impeller worn or damaged; defective gasket causing leakage.

### VII-B. INSUFFICIENT PRESSURE

1. Speed too low.
2. Air in slurry.
3. Wrong direction of rotation.
4. Mechanical defects: Impeller worn or damaged; defective gasket causing leakage.

### VII-C. MOTOR OVERLOAD

1. Speed too high.
2. Total head lower than pump rating (pump will attempt to pump too much water).
3. Slurry being pumped has higher specific gravity than that for which pump is rated.
4. Mechanical defects: Shaft bent; worn bearings; worn impeller or other water end parts.

### VII-D. PUMP VIBRATION

1. Foundation not sufficiently rigid.
2. Impeller partially blocked causing unbalance.
3. Misalignment.
4. Mechanical defects: Shaft bent, worn bearings; impeller worn.

## SECTION VIII - ORDERING SPARE PARTS

### VIII-A.

To insure against possible long and costly downtime periods, especially on critical services, it is advisable to have spare parts on hand.

Repair orders will be handled with a minimum of delay if the following directions are followed:

1. Give model number, size of pump, and serial number. These can be obtained from the nameplate on the pump.
2. Write plainly the name and part number of each part required. These names and numbers should agree with those on the bill of material.
3. Give the number of parts required.
4. Give complete shipping instructions.

### VIII-B. RECOMMENDED SPARES

The following are pump application categories and their recommended spare parts.

Light Duty - Random mildly abrasive particles.

Recommended spare parts:

- 1 Shaft Sleeve
- 1 Gasket Set

Medium Duty - Light slurries up to 1.2 S.G. w/moderately abrasive materials:

- 1 Impeller
- 1 Shaft Sleeve
- 1 Gasket Set
- 1 Set Bearings

Heavy Duty - Slurries over 1.2 S.G. w/highly abrasive materials.

- 1 Casing
- 1 Impeller
- 1 Bearing Assembly
- 2 Shaft Sleeves
- 3 Gasket Sets

Severe Duty - Key process equipment on heavy slurries over 1.2 S.G. w/high heads and highly abrasive particles:

- 1 Casing
- 2 Impellers
- 2 Shaft Sleeves
- 3 Gasket Sets
- 1 Spare Pump



**GOULDS PUMPS INC.**  
SLURRY PUMP DIVISION  
EAST CENTRE STREET  
ASHLAND, PENNSYLVANIA, 17921