Quality People. Building Solutions.

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Date: 3/13/2024
Return Request: 3/23/2024
Project: Stone Bank HQ - Chenal
Supplier: Fluid Solutions
Manufacturer: Grundfos
Submittal: Pumps
Submittal Number: 23 00 00-04
Drawing # and Installation: Mechanical Drawings

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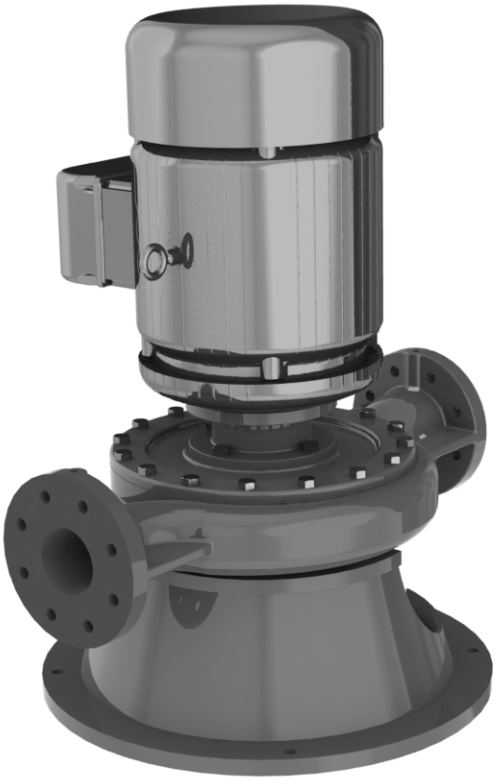
Reviewed for Compliance
EAST HARDING CONSTRUCTION
03/18/2024

VL, VLS

Vertical inline centrifugal pumps

Installation and operating instructions

VL



VLS

be
think
innovate

GRUNDFOS

Original installation and operating instructions.

CONTENTS

1. Symbols used in this document

The following symbols may be used in this document.

Warning

If these safety instructions are not observed, it may result in personal injury.

Warning

If these instructions are not observed, it may lead to electric shock with consequent risk of serious personal injury or death.

Warning

When pumping hazardous liquids, special attention must be paid to the risk of personal injury.

Warning

The surface of the product may be so hot that it may cause burns or personal injury.

Warning

The sound pressure level is so high that hearing protection must be used.

Caution ***If these safety instructions are not observed, it may result in malfunction or damage to the equipment.***

Note ***Notes or instructions that make the job easier and ensure safe operation.***

2. Terms and conditions of sale

2.1 The contract

The Contract shall be comprised of the following terms, together with such terms and conditions as are set forth in Seller's written proposal or quotation (the "Quotation"), including any documents, drawings or specifications incorporated therein by reference, and any additional or different terms proposed in Buyer's purchase order (the "Purchase Order") that are accepted by Seller in writing, which together shall constitute the entire agreement between the parties, provided, however, that preprinted terms on Buyer's purchase order or invoice shall not apply and Seller gives notice of objection to such terms. An offer by Seller in its Quotation that does not stipulate an acceptance date is not binding. This Contract shall be deemed to have been entered into upon written acknowledgment of the Purchase Order by an officer or authorized representative of Seller, which may not be modified, supplemented, or waived except in a writing executed by an authorized representative of the party to be bound.

2.2 Price

The price quoted in the Quotation shall be the Purchase Price unless otherwise agreed in the Purchase Order. The Purchase Price for equipment shall include packing for shipment.
Field Services shall be provided at Seller's standard rates.
All other costs, including packing for storage, freight, insurance, taxes, customs duties and import/export fees, or any other item not specified in the Contract, shall be paid by Buyer unless separately stated in the Quotation and included in the price quoted. Any sales, use, or other taxes and duties imposed on the transaction or the equipment supplied shall be paid or reimbursed by Buyer.

2.3 Payment terms

Payment shall be due within 30 days of the date of Seller's invoice in U.S. funds unless otherwise agreed. If Buyer does not observe the agreed dates of payment, Buyer shall pay interest to Seller on overdue amounts at a rate that is the higher of: 9 % per annum or a rate 5 % in excess of the rate borne from time to time by new issues of six-month United States Treasury bills.
Seller shall be entitled to issue its invoice for the Purchase Price for equipment upon the earlier of shipment, or notice to Buyer that Seller is ready to ship, and for services, upon completion.
If the Purchase Price exceeds $250,000 USD, Buyer shall pay the Purchase Price in Progress payments as follows: Fifteen percent (15 %) upon submittal of general arrangement drawings, thirty five percent (35 %) after receipt of first Bowl Casting, twenty percent (20 %) after first case/bowl hydro test or bowl machining and thirty percent (30 %) after notification of ready to ship.

2.4 Acceptance and inspection

All equipment shall be finally inspected and accepted by Buyer within 14 days after delivery or such other period of time as is agreed in the Purchase Order. Buyer shall make all claims (including claims for shortages), excepting only those provided for under the warranty clause contained herein, in writing within such 14-day period or they are waived. Services shall be accepted upon completion. Buyer shall not revoke its acceptance. Buyer may reject the equipment only for defects that substantially impair its value, and Buyer's remedy for lesser defects shall be in accordance with section 10, Warranty. If tests are made by Buyer to demonstrate the ability of the equipment to operate under the contract conditions and to fulfill the warranties in section 10, Buyer is to make all preparations and incur all expenses incidental to such tests. Seller will have the right of representation at such tests at its expense, and the right to technically direct the operation of the equipment during such tests, including requiring a preliminary run for adjustments.

2.5 Title and risk of loss

Full risk of loss (including transportation delays and losses) shall pass to Buyer upon delivery, regardless of whether title has passed to Buyer, transport is arranged or supervised by Seller, or start-up is carried out under the direction or supervision of Seller. Delivery shall be ex works, INCOTERMS 2000. Loss or destruction of the equipment or injury or damage to the equipment that occurs while the risk of such loss or damage is borne by Buyer does not relieve Buyer of its obligation to pay Seller for the equipment.

2.6 Patent or trademark information

If the equipment sold hereunder is to be prepared or manufactured according to Buyer's specifications, Buyer shall indemnify Seller and hold it harmless from any claims or liability for patent or trademark infringement on account of the sale of such goods.

2.7 Changes

Buyer may request, in writing, changes in the design, drawings, specifications, shipping instructions, and shipment schedules of the equipment. As promptly as practicable after receipt of such request, Seller will advise Buyer what amendments to the Contract, if any, may be necessitated by such requested changes, including but not limited to amendment of the Purchase Price, specifications, shipment schedule, or date of delivery. Any changes agreed upon by the parties shall be evidenced by a Change Order signed by both parties.

2.8 Cancellation or termination

Buyer shall have the right to cancel the Contract upon 15 days' prior written notice to Seller, and Seller shall stop its performance upon the receipt of such notice except as otherwise agreed with Buyer. If Buyer cancels the Contract, it shall pay: (a) the agreed unit price for equipment or components completed and delivered, (b) additional material and labor costs incurred, and for engineering services supplied by Seller with respect to the canceled items, which shall be charged to Buyer at Seller's rates in effect at the time of cancellation, but which shall not exceed the contract price for such items, and (c) such other costs and expenses, including cancellation charges under subcontracts, as Seller may incur in connection with such cancellation or termination.

2.9 Delivery and delays

Seller shall use its best efforts to meet quoted delivery dates, which are estimated based on conditions known at the time of quotation. Seller shall not be liable for any nonperformance, loss, damage, or delay due to war, riots, fire, flood, strikes or other labor difficulty, governmental actions, acts of God, acts of the Buyer or its customer, delays in transportation, inability to obtain necessary labor or materials from usual sources, or other causes beyond the reasonable control of Seller. In the event of delay in performance due to any such cause, the date of delivery or time for completion will be extended to reflect the length of time lost by reason of such delay. Seller shall not be liable for any loss or damage to Buyer resulting from any delay in delivery.

2.10 Warranty

Seller warrants that the equipment or services supplied will be free from defects in material, and workmanship for a period of 12 months from the date of initial operation of the equipment, or 18 months from the date of shipment, whichever shall first occur. In the case of spare or replacement parts manufactured by Seller, the warranty period shall be for a period of six months from shipment. Repairs shall be warranted for 12 months or, if the repair is performed under this warranty, for the remainder of the original warranty period, whichever is less. Buyer shall report any claimed defect in writing to Seller immediately upon discovery and in any event, within the warranty period. Seller shall, at its sole option, repair the equipment or furnish replacement equipment or parts thereof, at the original delivery point.
Seller shall not be liable for costs of removal, reinstallation, or gaining access. If Buyer or others repair, replace, or adjust equipment or parts without Seller's prior written approval, Seller is relieved of any further obligation to Buyer under this section with respect to such equipment or parts. The repair or replacement of the equipment or spare or replacement parts by Seller under this section shall constitute Seller's sole obligation and Buyer's sole and exclusive remedy for all claims of defects. SELLER MAKES NO OTHER WARRANTY OR REPRESENTATION OF ANY KIND WITH RESPECT TO THE EQUIPMENT OR SERVICES OTHER THAN AS SPECIFIED IN THIS SECTION 10. ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED. For purposes of this Section, the equipment warranted shall not include equipment, parts, and work not manufactured or performed by Seller.
With respect to such equipment, parts, or work, Seller's only obligation shall be to assign to Buyer any warranty provided to Seller by the manufacturer or supplier providing such equipment, parts or work. No equipment furnished by Seller shall be deemed to be defective by reason of normal wear and tear, failure to resist erosive or corrosive action of any fluid or gas, Buyer's failure to properly store, install, operate or maintain the equipment in accordance with good industry practices or specific recommendations of Seller, or Buyer's failure to provide complete and accurate information to Seller concerning the operational application of the equipment.

2.11 Technical documents

Technical documents furnished by Seller to Buyer, such as drawings, descriptions, designs and the like, shall be deemed provided to Buyer on a confidential basis, shall remain Seller's exclusive property, shall not be provided in any way to third parties, and shall only be used by Buyer for purposes of installation, operation and maintenance. Technical documents submitted in connection with a Quotation that does not result in a Purchase Order shall be returned to Seller upon request.

2.12 Limitation of liability

Seller shall in no event be liable for any consequential, incidental, indirect, special or punitive damages arising out of the Contract, or out of any breach of any of its obligations hereunder, or out of any defect in, or failure of, or malfunction of the equipment, including but not limited to, claims based upon loss of use, lost profits or revenue, interest, lost goodwill, work stoppage, impairment of other equipment, environmental damage, nuclear incident, loss by reason of shutdown or nonoperation, increased expenses of operation, cost of purchase of replacement power or claims of Buyer or customers of Buyer for service interruption whether or not such loss or damage is based on contract, tort (including negligence and strict liability) or otherwise. Seller's maximum liability under this Contract shall not exceed the Purchase Order amount of the equipment or portion thereof upon which such liability is based. All such liability shall terminate upon the expiration of the warranty period, if not sooner terminated.

2.13 This company is an equal opportunity employer

This agreement incorporates by reference applicable provisions and requirements of Executive Order 11246 and FAR Section 52.222- 26 (covering race, color, religion, sex and national origin); the Vietnam Era Veterans Readjustment Assistance Act of 1974 and FAR Section 52.222-35 (covering special disabled and Vietnam era veterans); and the Rehabilitation Act of 1973 and FAR Section 52.222- 36 (covering handicapped individuals).
By acceptance of this agreement Buyer certifies that it does not and will not maintain any facilities in a segregated manner, or permit its employees to perform their services at any location under its control where segregated facilities are maintained, and further that appropriate physical facilities are maintained for both sexes. Buyer agrees that it will obtain a similar certificate prior to award of any nonexempt lower-tier subcontracts.

2.14 Law and arbitration

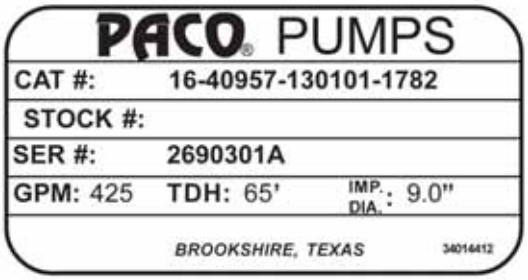
The Contract shall be governed by the law of the State of Texas. Any disputes arising out of this Contract shall be resolved by informal mediation in any manner that the parties may agree within 45 days of written request for mediation by one party to the other. Any dispute that cannot be resolved through mediation shall be resolved by binding arbitration conducted in English in Portland, Oregon under the Commercial Rules of the American Arbitration Association except as otherwise provided in this section. The arbitration shall be conducted by three arbitrators chosen in accordance with said Rules. The arbitrators are not entitled to award damages in excess of compensatory damages. Judgment upon the award may be entered in any court having jurisdiction.

3. Installation - mechanical

Read these instructions thoroughly before installing and operating your PACO Vertical In-line Centrifugal Pump. Successful operation depends on careful attention to the procedures described in the first four sections of this manual. Keep this instruction manual handy for future use.

3.1 Pump identification

All PACO pumps are identified by catalog and serial numbers. These numbers are stamped on the pump nameplate (fig. 1) affixed to each pump volute casing, and should be referred to in all correspondence with the Company.



TM05 4873 2612

Fig. 1 Sample nameplate

The first digits in the Catalog Number (preceding the first hyphen) are known as the Product Code. The Product Code may be 2 or 3 digits in length. This installation and Operation Manual applies to the following Product Codes. NOTE: Hyphens may not appear on the name plate.

Product code	Description
16	Paco type VL, in line Centrifugal pump
17	Paco type VLS, in line Centrifugal pump (split coupled)

3.2 Receiving

Check pumping unit for shortage and damage immediately upon arrival. Pump accessories when required are packaged in a separate container and shipped with the unit. If equipment is damaged in transit, promptly report this to the carrier's agent. Make complete notations on the freight bill to speed satisfactory adjustment by the carrier. Unload and handle the unit with a sling.

Warning

Do not lift pump assembly by motor eye bolts alone. Motor eye bolts are not designed to support weight of entire pump assembly.

3.3 Temporary storage

If pump is not to be installed and operated soon after arrival, store it in a clean, dry area of moderate ambient temperature. Rotate the shaft by hand monthly to coat bearings with lubricant to retard oxidation and corrosion. Follow motor manufacturer's storage recommendations where applicable.

3.4 Location

Locate the pump as close to the suction supply as possible. Use the shortest and most direct suction piping practical. Refer to section *3.10 Suction (inlet) piping*. Locate the pump below system level wherever possible. This will facilitate priming, assure a steady liquid flow, and provide a positive suction head. Make sure sufficient NPSH (Net Positive Suction Head) is provided at the suction end by considering the pump's location in relation to the entire system. Available NPSH must always equal or exceed required NPSH specified on the pump performance curve. Always allow sufficient accessibility for maintenance and inspection. Provide a clear space with ample head room for use of a hoist strong enough to lift the pump/motor assembly. Make sure a suitable power source is available for the pump motor. Electrical characteristics should match those specified on the motor data plate, within the limits covered in sections *4. Installation - electrical* and *5. Operation*. Avoid pump exposure to sub-zero temperatures to prevent pump liquid from freezing. If freezing conditions exist during shutdown periods, see sections *5.7 Short duration shutdown* and *5.8 Extended period shutdown* for specific recommendations.

3.5 Mounting of pump

PACO In-line centrifugal pumps may be mounted on the equipment room floor, or suspended in the piping, depending on the size and configuration of the pump. The following instructions shall apply:

3.6 Floor mounted pumps (VL, VLS)

Pumps mounted on equipment room floors should be permanently installed on a firm, concrete foundation, mounting pad or spring isolation base of sufficient size to dampen any vibration and prevent any deflection. Suitable anchor bolts shall be used to secure the pump assembly to the pad or floor.

3.7 Suspended pumps (VL, VLS)

PACO In-line Centrifugal pumps, when properly supported, may be suspended in system piping. Pipe supports must be used on piping immediately adjacent to the pump. Pipe supports must be adequately sized to support the weight of pump and piping, full of liquid, and shall be designed to eliminate transmission of noise or vibration. PACO In line pumps are designed to be mounted in horizontal pipe runs with motor positioned vertically upward.

3.8 Suspended pumps (VL only)

Pumps with motor frame sizes of 256JM/JP or smaller may be mounted in vertical pipe runs (risers) or in horizontal pipe runs with motors mounted horizontally. Consult PACO Factory for suitability of mounting with larger motors. In no case shall motors be mounted vertically downward (upside down, with motor positioned below the pump).

3.9 Piping - general

Caution

Do not use pump as a support for piping! Use pipe hangers or other supports at proper intervals to provide complete piping support near the pump.

Both suction and discharge piping should be independently supported and properly aligned so that no strain is transmitted to the pump when flange bolts are tightened. Make sure piping is as straight as possible, avoiding unnecessary bends and fittings. Where necessary, use 45 ° or long-sweep 90 ° pipe fittings to decrease friction loss. Where flanged joints are used, make sure that inside diameters properly match and mounting holes are aligned. Do not spring or force piping when making any connections!

3.10 Suction (inlet) piping

The sizing and installation of suction piping is particularly important. It must be selected and installed in a manner that minimizes pressure loss and permits sufficient liquid flow into the pump during starting and operation. Many NPSH problems can be traced directly to improper design of suction piping systems. Observe the following precautions when installing suction piping: Suction piping should be as direct as possible, and ideally the length should be at least ten times the pipe diameter.
Short suction piping can be the same diameter as the suction opening. Longer piping should be one or two sizes larger (depending on length), reducing to the diameter of the pump suction opening. Use an eccentric reducer, with the eccentric side down (fig. 2) when reducing the pipe diameter to the diameter of suction opening.

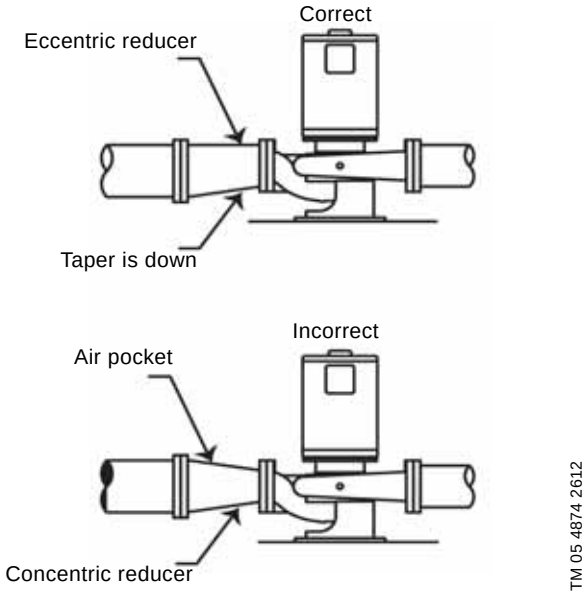


Fig. 2 Eccentric reducer usage

At no point should suction piping be smaller in diameter than the pump suction opening. Avoid any high points, such as pipe loops (fig. 3), that may create air pockets and throttle the system or produce erratic pumping.

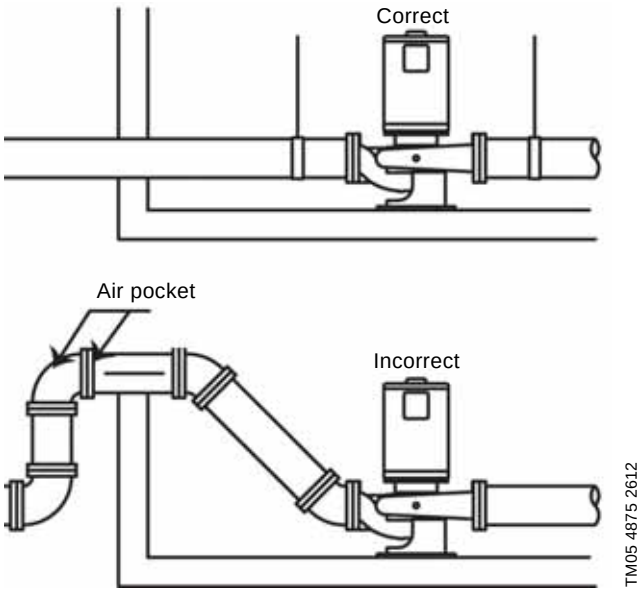


Fig. 3 Eccentric reducer usage

Install a valve in the suction line to isolate the pump during shutdown and maintenance, and facilitate pump removal. Where two or more pumps are connected to the same suction line, install a valve for each pump to isolate pump from the line. Valves should always be installed in positions that avoid air pockets. Globe valves should not be used, particularly when NPSH is critical. During pumping operation, valves on suction line must always be at FULL OPEN. Properly sized pressure gauges can be installed in gauge taps on pump suction and discharge nozzles. Gauges enable the operator to monitor pump performance and determine that the pump conforms to the parameters of the performance curve. If cavitation, vapor binding, or other unstable operation occurs, pressure gauges will indicate wide fluctuation in suction and discharge pressures. Gauge cocks are recommended for use with pressure gauges, to protect gauges from constant wear and vibration when not in use.

3.11 Discharge (outlet) piping

Short discharge piping can be the same diameter as the pump discharge opening. Longer piping should be one or two sizes larger depending on length. An even gradient is best for long horizontal runs of discharge piping. Install a valve near the discharge opening to prime and start the pump. The discharge gate valve is also used to isolate the pump during shutdown, maintenance, and facilitate pump removal. Any high points in discharge piping may entrap air or gas and thus retard pump operation.

3.12 Shaft sealing - general comments

PACO Type VL and VLS pumps are equipped with mechanical shaft seals.

3.13 Mechanical seals

PACO mechanical seals are matched to conditions for which the pump was sold. Unlike packing, mechanical seals require no field adjustments. Observe the following precautions to avoid seal damage and obtain maximum seal life: Do not exceed temperature or pressure limitations for the mechanical seal used.

Caution ***Do not run the pump dry or against a closed valve! Dry operation will cause seal failure within minutes.***

Clean and purge suction piping in new installations before installing and operating pump. Pipe scale, welding slag and other abrasives can cause rapid seal failure.

4. Installation - electrical

Warning

Use only qualified electricians for electrical installation and maintenance.

Refer to manuals provided with electrical accessory components and disconnect power supply as recommended for servicing.

Warning

Never do maintenance work when the unit is connected to power.

4.1 Motor, general

The motor control circuit must have the following components in order to comply with the National Electrical Code Motor Disconnecting Device: A motor disconnecting device must be:

- installed that it is capable of disconnecting both the controller (motor starter) and the motor from their source of power.
- The disconnecting device must be located so that the controller (motor starter) can be seen from the disconnecting means.
- In all cases, the distance from the disconnecting device to the controller must be less than 50'.

In most installations the disconnecting device will be a circuit breaker or fusible disconnect switch. Motor short circuit and ground fault protection: Short circuit and ground fault protection are usually provided by means of a circuit breaker or fusible disconnect switch. The selection of the size of the circuit breaker or fuse must be in accordance with Section 430-52 and Table 430-152 of the National Electrical Code. Motor controller with running over-current protection (magnetic starter) must be installed in accordance with applicable local and state electrical codes in addition to the National Electrical Code. Make sure the motor is properly mounted for easy access to conduit connections, grease fittings and drains. Motor may be rotated upon the bracket of volute casing to achieve a satisfactory position. Starting and overload control devices should match electrical characteristics of motor. For safety and convenience these devices may require installation some distance from the pump. Always follow control manufacturer's instructions for proper installation and connection. Grease lubricated motors are fully lubricated at time of manufacture and do not require further lubrication if prompt installation follows. If motor has been in local storage for six months or longer, refer to section *6.1 Motor lubrication* and lubricate before starting.

4.2 Installation wiring

Motor wiring to be performed by trained, qualified electricians only. Proper electrical lock-out procedures must be used whenever working on equipment.

Mount the control panel or motor starter(s) in close proximity to the pump to provide convenient control and ease of installation. Wire panel or starter(s) to motor(s) and pilot device(s): Wires to each motor must be sized for at least 125 % of the motor nameplate full load amps. AWG #16 Type THW stranded wire is recommended for wiring of pilot devices (float switches). Check incoming power source to ensure that it is the same as the voltage and phase of the motors. Verify that the starters are suitable to operate the pump motors on voltage and phase that is available.

5. Operation

5.1 Priming

The PACO in-line centrifugal pumps are not self priming, and must be completely primed (filled with liquid) before starting. If the pump will operate with a positive suction head, prime by opening the suction valve and allowing liquid to enter pump casing. Open all air vents a the high points of pump and piping to ensure air is forced from pump by liquid. Disconnect the recirculation line at the seal housing and bleed completely of all air. Re-connect the line prior to start-up. Rotate the shaft by hand to free entrapped air from impeller passageways. If pump has a suction lift, priming must be accomplished by other methods. The use of foot valves or ejectors, or manual filling of the pump casing and suction line with liquid are possible methods suggested for this purpose.

Caution ***Never run the pump dry in the hope that it will prime itself! Serious damage to the mechanical seal will result.***

5.2 Pre-start checklist

Make the following inspections before starting your PACO in-line centrifugal pump: Make sure all wiring connections to the motor (and starting device) match the wiring diagram and produce clockwise rotation as viewed from the end of the motor. If the motor has been in storage for an extended length of time, either before or after installation, refer to motor instructions before starting. Check voltage, phase, and line circuit frequency with the motor data plate. Turn rotating element by hand to make sure it rotates freely. Tighten plugs in gauge and drain taps. If pump is fitted with pressure gauges, keep gauge cocks closed when not in use. Check suction and discharge piping for leaks, and make sure all flange bolts are securely tightened.

5.3 Motor rotation

Caution ***Verify driver rotation prior to startup and operation. Failure to do so can result in serious damage to pump and driver if rotation is wrong.***

After the unit has been wired and checked to insure that all components in the system (disconnect device, magnetic starters, pilot devices and motors) are properly connected, check motor rotation as follows: For 3 phase units only-momentarily energize the motors to ensure that the rotation is correct as indicated by the arrow cast into the pump volute. If rotation is incorrect, interchange two wires at the motor starter terminals T1 and T2.

Caution ***The pumps must not be operated while dry. Energize motors only momentarily to determine proper rotation.***

5.4 Starting the pump

1. Install coupling guard on split coupled units.
2. Fully open gate valve (if any) in suction line, and close gate valve in discharge line.
3. Fill suction line with liquid and completely prime pump.
4. Start the motor (pump).
5. Immediately make a visual check of pump and suction piping for pressure leaks.
6. Immediately after pump reaches full operating speed, slowly open the discharge gate valve until complete system flow is achieved.
7. Check discharge piping for pressure leaks.
8. If pump is fitted with pressure gauges, open gauge cocks and record pressure reading for future reference. Verify that the pump is performing in accordance with parameters specified on performance curve.
9. Check and record voltage, amperage per phase, and kilowatts, if a wattmeter is available.

5.5 Voltage regulation

The motor will operate satisfactorily under the following conditions for voltage and frequency variation, but not necessarily in accordance with the standards established for operation under rated conditions: The voltage variation may not exceed 10 % above or below rating specified on the motor data plate.
The frequency variation may not exceed 5 % above or below motor rating. The sum of the voltage and frequency variations may not exceed 10 % above or below motor rating, provided the frequency variation does not exceed 5 %.

5.6 Pump shutdown

The following shutdown procedures will apply in most normal shutdowns for the PACO in-line pump. If pump will be inoperative for an extended length of time, follow storage procedures in Section IC. Always close the discharge gate valve before stopping pump. Close valve slowly to prevent hydraulic shock. Cut power to motor.

5.7 Short duration shutdown

For overnight or temporary shutdown periods under nonfreezing conditions, the pump may remain filled with liquid. Make sure the pump is fully primed before restarting. For short or frequent shutdown periods under freezing conditions, keep fluid moving within pump casing and insulate or heat pump exterior to prevent freezing.

5.8 Extended period shutdown

For long shutdown periods, or to isolate the pump for maintenance, lock-out power to pump and close suction gate valve. If no suction valve is used and the pump has positive suction head, drain all liquid from suction line to terminate liquid flow into pump suction nozzle. Remove plugs in pump drain and vent taps, as required, and drain all liquid from the pump volute casing. If freezing conditions will exist during long shutdown periods, completely drain the pump and blow out all liquid passages and pockets with compressed air. Freezing of pump liquid can also be prevented by filling the pump with antifreeze solution.

6. Maintenance

Warning

Do not attempt any maintenance, inspection, repair or cleaning in the vicinity of rotating equipment. Before attempting any inspection or repair on the pump, the driver controls must be in the "OFF" position, locked and tagged to prevent injury to personnel performing service on the pump. Inspection, maintenance and repair should be performed by trained, qualified personnel only.

6.1 Motor lubrication

To lubricate the motor while running or at rest, remove grease drain plug (if any) and filler plug on grease fitting. Grease with clean lubricant until grease appears at drain hole or along motor shaft. One-half to one cubic inch of grease is sufficient for motors 5 hp and under, with proportionately more grease for greater hp motors.

Recommended lubrication periods

Motor rpm	Motor hp	Operating conditions		
		Standard	**Severe**	**Extreme**
1750 and below	10-40	1 yr	3 mo	6 mo
	50-150	1-3 yrs	6 mo - 1 yr	6 mo - 1 yr
	200 and Up	1 yr	3 mo	6 mo
Above 1750	All hp	1 yr	3 mo	6 mo
		1 yr	3 mo	3 mo

6.1.1 Standard conditions

Eight hours per day operation, normal or light loading, clean air, 100 °F, maximum ambient temperature.

6.1.2 Severe conditions:

Continuous 24-hour operation, shock loading or vibration, poor ventilation, 100-150 °F, ambient temperature.

6.1.3 Extreme conditions

The following are considered Extreme conditions: Continuous operation, heavy shock or vibration, dirt or dust in air, extreme ambient temperature.

To lubricate motor while running or at rest, remove grease drain plug (if any) and filler plug on grease fitting. Grease with clean lubricant until grease appears at drain hole or along motor shaft.

One-half to one cubic inch of grease is sufficient for motors 5 hp and under, with proportionately more grease for greater hp motors. Most fractional and some integral frame motors have "sealed-for-life" bearings, and do not require further lubrication throughout motor life. Always follow motor manufacturer's lubrication instructions, and periodically check grease fittings and drain plugs for leaks. If lubricating instructions do not accompany motor, refer to the following table for recommended lubrication periods.

Recommended bearing Grease for pumps

Manufacturer	Lubricant
Shell	Dolium
Exxon	Polyrex
Chevron	SRI Grease NLGI 22
	Black Pearl NLGI 2
Phillips	Polytrac
Texaco	Polystar RB

This table lists recommended types of grease for both pump and motor lubrication. These types have all been thoroughly tested and should be used whenever possible.

Caution ***Do not lubricate with lithium based grease. Equipment damage will result.***

7. Disassembly

7.1 Preparation for disassembly

Warning

Turn off power, lock-out electrical breaker and provide appropriate "Do Not Operate" or equivalent signage prior to any work on equipment. Verify all power is off at pump using appropriate electrical instrumentation. Work should be performed only by qualified and trained personnel.

Complete disassembly instructions are outlined below. Proceed only as far as required to perform the maintenance work needed. Close valves on suction and discharge side of pumps and drain pump, taking precautions as necessary based on fluid being pumped. Flush, if necessary. Allow adequate working area around pump for maintenance or disassembly.

7.2 Seal replacement (VL)

1. Complete preparations noted in section *7.1 Preparation for disassembly*, above.
2. Unscrew tubing connector from pipe tee of Air Vent assembly (15A) if equipped.
3. Remove Casing Bolts (8B).
4. Back-pull rotating assembly away from Volute (1A). Make sure external wiring will not be torn from motor leads before pulling.
5. Remove Volute Gasket (11A) from outer face of back plate/ bracket, and discard. New sealing gaskets should always be used whenever pump is reassembled.
6. For replacement of Wear Ring (4A), refer to section *7.5 Wear ring replacement* at this time.
7. For replacement of Seal, Sleeve or for general disassembly, continue with the following instructions
8. Impeller removal procedures vary depending on motor type. Follow appropriate instructions as follows:

Impeller removal- fractional horsepower motors

Impeller (3A) is threaded on to fractional horsepower (56J) motor shaft. Loctite is applied to impeller threads during factory assembly. If adhesive shear strength is too great for disassembly with ordinary hand tools parts must be heated by torch and disassembled while hot. Apply torch heat to impeller eye when unscrewing threaded impellers, axially along shaft sleeve exterior to loosen for removal. Holding power of Loctite decreases as temperature rises, and compound completely decomposes at temperatures above 650 °F. Impeller must be unscrewed, while preventing motor shaft rotation by utilizing a large screwdriver securely in slot at back end of motor shaft while unscrewing impeller.

Caution ***Do not insert screwdriver between impeller vanes to prevent rotation. Use strap wrench around the impeller or shaft to prevent rotation.***

Impeller Removal- Integral Horsepower Motors:

Impeller (3A) is keyed onto integral horsepower (JM & JP) motor shaft. Slide impeller axially off of shaft. If impeller can not be removed by hand, additional leverage may be necessary. Using a gear puller or two pry bars, position the tongs in close proximity to impeller vanes and carefully apply smooth, even force to the impeller. Excessive force will distort and damage the impeller.

1. Remove and discard spring and retainer from seal assembly (14A).
2. Remove seal head assembly manually from Shaft Sleeve (5A). Water-soluble lubricant may be applied to shaft to ease removal of Shaft Seal (14A). Pull seal head assembly manually from shaft, using slight twisting motion (as necessary) to loosen bellows from shaft sleeve.
3. Remove and discard seal seat from Bracket (21A). Thoroughly clean the inside cavity of bracket or cap.
4. For replacement of Shaft Sleeve (5A), refer to section *7.4 Sleeve Replacement (VL)* at this time.
5. Interior surface of bellows on new seal head is coated with bonding agent that adheres to motor shaft. When old seal head is removed, bonding agent no longer exists and bellows may crack or split during removal. Installation of new mechanical seal is always recommended if it becomes necessary to remove existing seal from shaft.
6. Clean and lubricate shaft sleeve (shaft on 56J motors) with water-soluble lubricant and make sure no sharp edges exist which could cut bellows of new seal.
7. Press new seal seat firmly into bracket or cap. Avoid direct contact of seal face with metallic or abrasive objects and wipe clean after installation to ensure abrasive-free sealing surface.
8. Slide new seal head assembly onto shaft by applying even pressure to base of assembly. Make sure sealing faces fit snugly.
9. See Reassembly instructions, section *7.6 Reassembly of pumps*.

7.3 Seal replacement (VLS)

1. Complete preparations noted.
2. Remove coupling guard (34F).
3. Remove coupling bolts (8E). Pry apart the coupling halves (23D), remove keys (12B) and set aside.

Note ***Mark or measure the original position of the pump coupling on the motor side.***

4. Unscrew tubing connector from pipe tee of air vent assembly. Pipe dope is applied to threads during factory assembly, and resulting bond may retard but will not prevent manual disassembly.
5. Remove seal cap bolts and slide seal cap (2N) up shaft to remove.
6. Remove seal head assembly manually from shaft (6A). Water-soluble lubricant may be applied to shaft to ease removal of shaft seal (14A). Pull seal head assembly manually from shaft, using slight twisting motion (as necessary) to loosen bellows from shaft.

7. Remove and discard seal spring and retainer.
8. remove and discard seal seat from seal cap (2N) and thoroughly clean the inside cavity of seal cap.
9. Interior surface of bellows on new seal head is coated with bonding agent that adheres to motor shaft. When old seal head is removed, bonding agent no longer exists and bellows may crack or split during removal. Installation of new mechanical seal is always recommended if it becomes necessary to remove existing seal from shaft.
10. Clean and lubricate shaft (6A) with water-soluble lubricant and make sure no sharp edges exist to cut or scratch bellows of new seal.
11. Press new seal seat firmly into seal cap. Avoid direct contact of seal face with metallic or abrasive objects and wipe clean after installation to ensure abrasive free sealing surface.
12. Slide new seal head assembly onto shaft by applying even pressure to base of assembly.
13. Install seal cap (2N) down shaft.
14. See reassembly instructions.

7.4 Sleeve Replacement (VL)

1. Remove impeller key (12A) from shaft (integral horsepower motors only)
2. Sleeves are bonded to shaft using Loctite. Loctite adhesive compound is a liquid resin that produces a tough bond when applied to threaded and close-fitting connections during assembly. It is used by PACO on shaft sleeves to secure sleeve to shaft.
3. Apply light torch heat axially along shaft sleeve exterior to break the Loctite bond and loosen sleeve for removal. Excessive heating is not necessary, and should be avoided to protect bearings. Remove sleeve.
4. Wipe or brush clean all adhesive surfaces before reapplying Loctite. Use LocQuic Primer or equivalent for preparation of surface. LocQuic Primer is a degreasing agent recommended for use in preparing mating surfaces for Loctite application. Do not use gasoline or other petroleum products for cleaning, because an oily surface will remain. Assemble shaft sleeves with twisting motion to ensure an even hold, and always make sure sleeve is firmly in place against shaft shoulder. Allow a few minutes for Loctite to bond prior to completing assembly.

7.5 Wear ring replacement

1. Complete preparations
2. Back-pull rotating assembly,
3. It may be necessary to remove volute (1A) from piping, to facilitate easy access to interior of volute. If necessary, remove flange bolts at piping.
4. To remove worn Case Wear Ring (4A), drill two holes slightly smaller than width of ring into exposed edge of ring. Once holes are drilled, a chisel may be used to completely sever ring at holes and break ring into two halves for easy removal.
5. Clean the ring cavity in the volute prior to installing wear ring to ensure a properly aligned fit.
6. To reassemble, press fit new wear ring squarely into volute casing cavity. Ring may be tapped into place to make sure it is completely impressed into cavity.

Caution ***Do not use metal tooling against wear ring surfaces. Use only rubber, rawhide, wood or other soft material to prevent damage to ring.***

7.6 Reassembly of pumps

1. Clean all parts prior to reassembly, ensuring all contacting surfaces and threads are free of debris. Reassemble pump by following the above instructions in reverse. Inspect and ensure the following:

- All mechanical seal components and shaft sleeve must be in good condition or leakage may result.
- Replacement of complete seal assembly is recommended.
- Appropriate Loctite is used in re-assembly of shaft sleeves.
- Appropriate Loctite is used in re-assembly of threaded impellers.

2. Re-install coupling guards on coupled pumps.

Warning

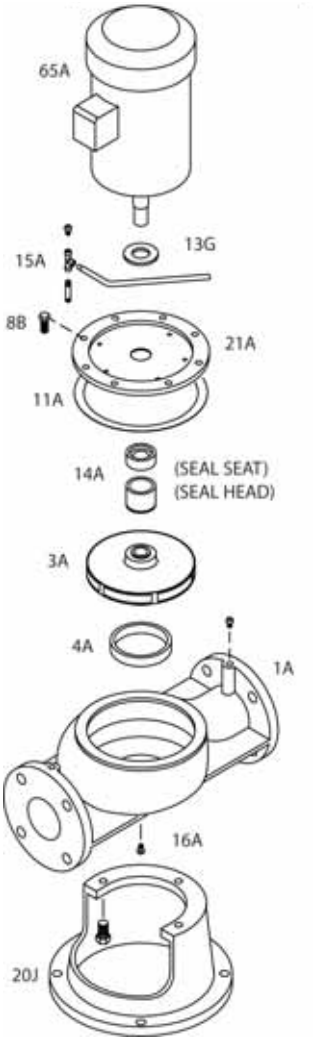
Type VLS pump is a split coupled pump. Coupling guard must be reinstalled and in place prior to operation.

8. Ordering parts

PACO's commitment to state-of-the-art pump design and quality manufacturing assures maximum user benefits with optimum equipment life at lower cost. PACO's commitment to their customers continues through an extensive service organization. Highly trained technicians can assist customers with initial startup, troubleshooting, repair, and system analysis.
PACO maintains an extensive stock of replacement parts and parts kits for our most popular model pumps. Shipment of these parts is normally made within three days after receipt of an order. On larger pumps, where it is impractical for our factory to inventory low usage parts, replacement parts are normally manufactured and shipped within 15 working days of receipt of an order. In order to reduce pump repair time and shorten inconvenient pump service interruptions, it is suggested that the pump user stock spare parts. For suggested spare parts see Replacement Parts Guide A3b.2, and contact your local PACO Sales Representative (see back cover for the number of your nearest PACO sales office). Since spare parts requirements and quantities vary for specific pump constructions, allow your PACO Representative to help in defining your spare part requirements. To ensure that the proper replacement parts are ordered for your particular pump model, when you call: Identify all pertinent data from the pump name plate (see Pump Identification). This should always include the pump Catalog or Model Number, and the pump Serial Number. For replacement impellers, also include from the nameplate the operating conditions (GPM and TDH) and the impeller diameter. Identify all parts by item number and description as indicated by the appropriate assembly drawing in this manual, for your particular pump model.

9. Exploded views

9.1 Type VL, 56J fractional hp motor (less than 1 hp)

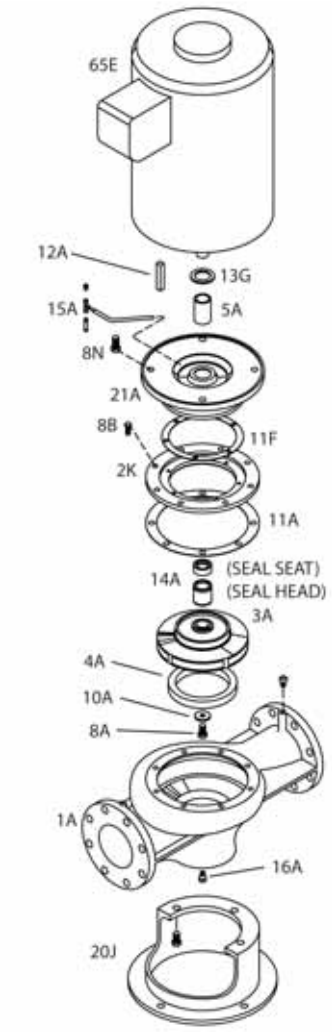


TM05 4877 2612

Pos.	Description
1A	Volute
3A*	Impeller
4A*	Case wear ring
8B	Volute capscrew
11A*	Volute gasket
13G	Slinger
14A*	Seal assembly
15A	Recirc tubing
16A	Pipe plug
20J	Cast iron stand
21A	Motor bracket
65A	Motor, 56J frame

* Recommended spare parts

9.2 Type VL-JM, integral hp motor (1 hp or greater)

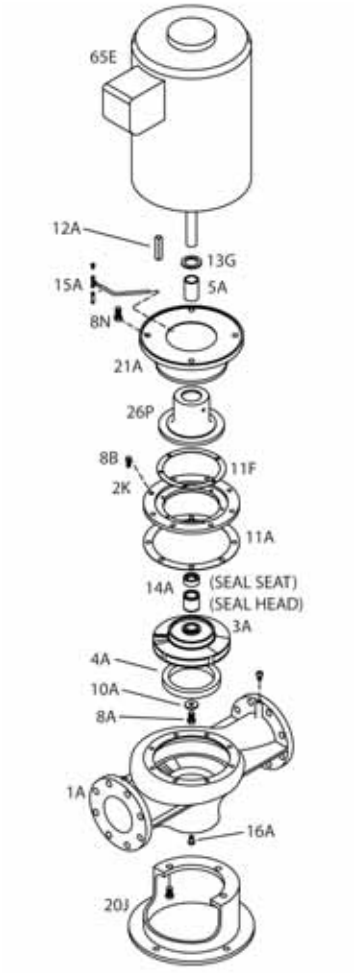


TM05 4878 2612

Pos.	Description
1A	Volute
2K	Back plate
3A*	Impeller
4A*	Case wear ring
5A*	Shaft sleeve
8A*	Impeller screw
8B	Volute screw
8N	Motor screw
10A*	Impeller washer
11A*	Volute gasket
11F*	Bracket gasket
12A*	Impeller key
13G	Slinger
14A*	Seal assembly
15A	Recirc tubing
16A	Pipe plug
20J	Cast iron stand
21A	Motor bracket
65E	Motor, JM frame

* Recommended spare parts

9.3 Type VL-JP, motor (packed pumps)

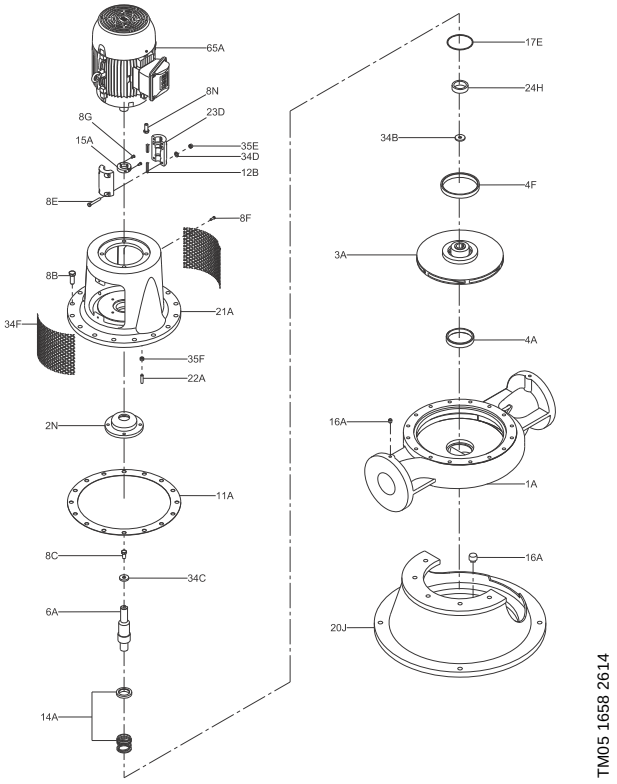


TM05 4879 0213

Pos.	Description
1A	Volute
2K	Back plate
3A*	Impeller
4A*	Case wear ring
5A*	Shaft sleeve
8A*	Impeller screw
8B	Volute screw
8N	Motor screw
10A*	Impeller washer
11A*	Volute gasket
11F*	Bracket gasket
12A*	Impeller key
13G	Slinger
14A*	Seal assembly
15A	Recirc tubing
16A	Pipe plug
20J	Cast iron stand
21A	Motor bracket
26P	Seal cap
65E	Motor, JM frame

* Recommended spare parts

9.4 Type VLS, cross section and parts list



TM05 1658 2614

Pos.	Description
1A	Volute
2N	Seal cap
3A*	Impeller
4A*	Case wear ring
4F	Balance ring
6A	Pump shaft
8B	Volute screw
8C	Pump shaft screw
8E	Coupling screw
8F	Coupling guard screw
8G	Locating ring screw
8N	Motor screw
11A*	Volute gasket
12B	Coupling key
14A*	Seal assembly
15A	Locating ring
16A	Pipe plug
17E	Seal cap o-ring
20J	Cast iron stand
21A	Motor bracket
22A	Seal cap studs
23D	Coupling halves
24H	Bushing
34B*	Impeller washer
34C	Pump shaft washer
34D	Coupling Washer
34F	Coupling guard
35E	Coupling Nut
35F	Seal cap nut
65A	Motor

* Recommended spare parts

10. Troubleshooting

10.1 Cause codes

Symptoms	Cause code
Pump does not deliver any liquid at start-up	1*2*3*4*5*6*7*8*9*10*11*14*16*17*22*23*24*34
Pump stops delivering liquid after start-up	2*3*4*5*6*7*8*9*10*11*12*13*22*23*24*34
Pump overheats and/or ceases to deliver liquid	1*3*9*10*11*21*22*27*29*30*31*33*34*40*41
Insufficient flow rate	2*3*4*5*6*7*8*9*10*11*14*16*17*20*21*22*23*24*25*26*34
Excessive flow rate	15*18*20*34
Discharge pressure is too high	4*14*16*18*20*22*23*24*25*26*34
Shaft seal leaks appreciably, or the packing leaks excessively	27*28*29*30*33*34*35*36*39
Shaft seal or packing fails prematurely	12*13*27*28*29*30*33*34*35*36*37*38*39
Pump uses too much power	15*16*18*19*20*23*25*27*28*31*33*34*35*37*38
Pump runs rough and noisily	2*3*4*5*6*7*8*9*10*11*15*17*18*21*23*24*27*28*29*30*31*32*33*34*40

10.2 Possible causes

1. The pump has not been properly bled of air.
2. The pump suction line has not been completely primed.
3. The suction head (NPSHR) required by the pump is too high, or the net positive suction head available (NPSHA) at your facility is too low.
4. The fluid pumped contains too much entrained air or gas.
5. There are air pockets in the suction line.
6. An entry of air has suddenly occurred in the suction line.
7. An entry of air past the shaft seal into the pump has occurred.
8. The inlet of the suction line is insufficiently submerged.
9. The suction valve is closed or only partially open.
10. The suction strainer is clogged with dirt or debris.
11. The foot valve is clogged or undersized.
12. Little or no cooling fluid supplied to the shaft seals.
13. The lantern ring is not positioned opposite the flushing inlet thereby restricting fluid flow.
14. Pump drive rotational speed too low.
15. Pump drive rotational speed too high.
16. Pump rotation wrong or impeller installed backwards.
17. Total head of installation (back pressure) higher than rated total head of the pump.
18. Total head of installation (back pressure) lower than rated total head of the pump.
19. Density of fluid pumped differs from that specified when the pump was purchased.
20. Viscosity of fluid pumped differs from that specified when the pump was purchased.
21. The pump is operating at too low a rate of flow. The discharge valve may be throttled too much.
22. If pumps are operating in parallel, the pump characteristics may not be suitable for parallel operation.
23. The impeller may be clogged with debris.
24. The impeller may be damaged.
25. The casing and impeller wear rings may be excessively worn.
26. There may be internal leakage from the discharge to the suction compartments as the result of internal gasket failure.
27. There may be a misalignment of the pump shaft.
28. The shaft may chatter because it is bent.
29. The pump may run rough due to improper balancing of the impeller.
30. The shaft may not be running due to worn bearings.
31. The impeller may be rubbing against the inside of the case.
32. The concrete pad might not be of sufficient size to provide pump stability.
33. The pump may have become misaligned during installation.
34. The operating conditions of the installation do not agree with the data specified when the pump was purchased.
35. The shaft seal may be incorrectly installed, or the stuffing box has not been packed correctly.
36. The shaft sleeve may be scored or pitted in the region of the packing due to dirt or abrasive matter in the flushing fluid.
37. Excessive tightening of the packing gland may block the flushing port thereby diminishing the sealing fluid flow.
38. Packing material may have become wedged or extruded between the shaft and the bottom of the stuffing housing due to excessive clearance on the packing backup washer.
39. The mechanical seal may have been damaged by running dry.
40. There may be excessive axial thrust (side loading) due to improper impeller central alignment.

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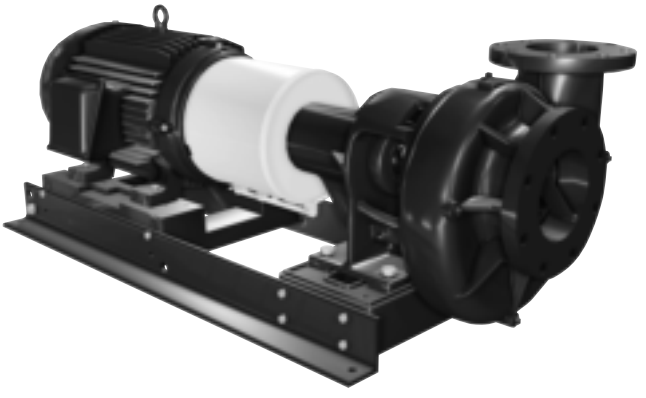
98434722 0714
ECM: 1139103

LC, LCV, LF, LCS

End-suction centrifugal pumps

Installation and operating instructions



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Original installation and operating instructions

These installation and operating instructions describe LC, LCV, LF, and LCS pumps.

Sections 1-6 give the information necessary to be able to unpack, install and start up the product in a safe way.

Sections 7-12 give important information about the product, as well as information on service, fault finding and disposal of the product.

CONTENTS

Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.

The use of this product requires experience with and knowledge of the product. Persons with reduced physical, sensory or mental capabilities must not use this product, unless they are under supervision or have been instructed in the use of the product by a person responsible for their safety. Children must not use or play with this product.

CAUTION

Successful operation depends on careful attention to the procedures described in this manual. Keep this manual for future use.

1. Limited warranty

New equipment manufactured by seller or service supplied by seller is warranted to be free from defects in material and workmanship under normal use and service for a minimum of twelve (12) months from date of installation, eighteen (18) months from date of shipment, unless otherwise stated in product warranty guide (available upon request). In the case of spare or replacement parts manufactured by seller, the warranty period shall be for a period of twelve months from shipment. Seller's obligation under this warranty is limited to repairing or replacing, at its option, any part found to its satisfaction to be so defective, provided that such part is, upon request, returned to seller's factory from which it was shipped, transportation prepaid. Parts replaced under warranty shall be warranted for twelve months from the date of the repair, not to exceed the original warranty period. This warranty does not cover parts damaged by decomposition from chemical action or wear caused by abrasive materials, nor does it cover damage resulting from misuse, accident, neglect, or from improper operation, maintenance, installation, modification or adjustment. This warranty does not cover parts repaired outside seller's factory without prior written approval. Seller makes no warranty as to starting equipment, electrical apparatus or other material not of its manufacture. If purchaser or others repair, replace, or adjust equipment or parts without seller's prior written approval, seller is relieved of any further obligation to purchaser under this paragraph with respect to such equipment or parts, unless such repair, replacement, or adjustment was made after seller failed to satisfy within a reasonable time seller's obligations under this paragraph. Seller's liability for breach of these warranties (or for breach of any other warranties found by a court of competent jurisdiction to have been given by seller) shall be limited to: (a) accepting return of such equipment exw plant of manufacture, and (b) refunding any amount paid thereon by purchaser (less depreciation at the rate of 15 % per year if purchaser has used equipment for more than thirty [30] days), and canceling any balance still owing on the equipment, or (c) in the case of service, at seller's option, redoing the service, or refunding the purchase order amount of the service or portion thereof upon which such liability is based. These warranties are expressly in lieu of any other warranties, express or implied, and seller specifically disclaims any implied warranty of merchantability or fitness for a particular purpose, and in lieu of any other obligation or liability on the part of the seller whether a claim is based upon negligence, breach of warranty, or any other theory or cause of action. In no event shall seller be liable for any consequential, incidental, indirect, special or punitive damages of any kind. For purposes of this paragraph, the equipment warranted shall not include equipment, parts, and work not manufactured or performed by seller. With respect to such equipment, parts, or work, seller's only obligation shall be to assign to purchaser the warranties provided to seller by the manufacturer or supplier providing such equipment, parts or work. No equipment furnished by seller shall be deemed to be defective by reason of normal wear and tear, failure to resist erosive or corrosive action of any fluid or gas, purchaser's failure to properly store, install, operate, or maintain the equipment in accordance with good industry practices or specific recommendations of seller, including, but not limited to seller's installation and operation manuals, or purchaser's failure to provide complete and accurate information to seller concerning the operational application of the equipment.

2. General information

2.1 Symbols used in this document

DANGER

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

WARNING

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

CAUTION

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

The text accompanying the three hazard symbols DANGER, WARNING and CAUTION will be structured in the following way:

SIGNAL WORD

Description of hazard

Consequence of ignoring the warning.

- Action to avoid the hazard.

Example

DANGER

Electric shock

Death or serious personal injury.

- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

2.2 Other important notes

A blue or grey circle with a white graphical symbol indicates that an action must be taken to avoid a hazard.

A red or grey circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.

If these instructions are not observed, it may result in malfunction or damage to the equipment.

Notes or instructions that make the work easier and ensure safe operation.

3. Receiving the product

3.1 Unpacking the product

WARNING

Overhead load

Death or serious personal injury.

- Do not lift the product by the eye bolts on the motor.
  Unload and handle the product with a sling.

3.2 Inspecting the product

- Check that the product received is in accordance with the order.
- Check that the voltage, phase and frequency of the product match the voltage, phase and frequency of the installation site. See section *7.3 Pump identification*.
- Check the product for defects and damage immediately after receiving it. Any accessories ordered will be packed in a separate container and shipped with the product.
- If any equipment is damaged in transit, promptly report this to the carrier's agent. Make complete notations on the freight bill.

3.3 Temporary storage after delivery

- If the product is not to be installed and operated immediately after receiving it, store it in a clean, dry area at a moderate ambient temperature.
- Rotate the shaft by hand periodically, at least weekly, to coat the bearing with lubricant to retard oxidation and corrosion.
- Follow the motor manufacturer's storage recommendations where applicable.

4. Installing the product

4.1 Location

- Locate the pump as close as possible to the liquid supply. Use the shortest and most direct inlet pipe practical. Refer to *4.4.2 Inlet pipe*.
- Locate the pump below system level wherever possible. This will facilitate priming, assure a steady liquid flow, and provide a positive inlet pressure.
- The net positive suction head (NPSH) available must always be equal to or exceed the required NPSH specified on the pump performance curve. Make sure the required NPSH is provided at the inlet.
- Always allow sufficient accessibility space for maintenance and inspection. Provide a clearance of 24 in. (610 mm) with ample head room for use of a hoist strong enough to lift the product.
- Electrical characteristics must match those specified on the motor nameplate, within the limits covered in section *5. Starting up the product*.
- Do not expose the product to sub-zero temperatures to prevent the pumped liquid from freezing. If there is frost during shutdown periods, see sections *5. Starting up the product* and *9.2 Short-time shutdown*.

4.2 Pump foundation

- LF pumps must be grouted in order to ensure a stable pump and motor shaft alignment.
- LCS pumps do not require grouting to maintain shaft alignment, but grouting will increase pump stability within the pipe system.
- LC and LCV pumps do not need to be grouted.

Install the pump permanently on a firm, raised concrete foundation of sufficient size to dampen any vibration and prevent any deflection or shaft misalignment. The foundation may float on springs or be a raised part of the floor.

Proceed like this:

1. Pour the foundation without interruption to 0.75 - 1.5 in. (20-35 mm) below the final pump level. Leave the top of the foundation rough. Then clean and wet it down.
2. Scour and groove the top surface of the foundation before the concrete sets to provide a suitable bonding surface for the grout.
3. Place anchor bolts in pipe sleeves for positioning allowance. See fig. 1.
4. Allow enough bolt length for grout, base flange, nuts, and washers.
5. Allow the foundation to cure several days before proceeding to install the pump.

4.3 Securing the base plate

When the raised concrete foundation has been poured and allowed to set, proceed as follows:

1. Lower the base plate over the anchor bolts and rest it on loose adjustment wedges or shims placed near each anchor bolt and at intervals not exceeding 24 in. (610 mm) along each side.
2. Place the shims or wedges so that they raise the bottom of the base plate 0.75 - 1.25 in. (20-32 mm) above the foundation, allowing clearance for grout.
3. Level the pump shaft, flanges, and base plate using a spirit level, adjusting the wedges or shims, as required.

LCS pumps do not require alignment or grouting.

4. Make sure that the pipes can be aligned to the pump flanges without placing any strain on either flange.
5. After pump alignment has been established, put nuts on the anchor bolts and tighten them just enough to keep the base plate from moving.
6. Construct formwork around the concrete foundation and pour grout inside the base plate, as shown in fig. 1. The grout will compensate for uneven foundation, distribute the weight of the pump, and prevent shifting.

Use an approved, non-shrinking grout.

7. Allow at least 24 hours for the grout to set before proceeding with the pipe connections.

- After the grout has thoroughly hardened, check the foundation bolts and tighten them if necessary. Recheck the pump alignment after tightening the foundation bolts.

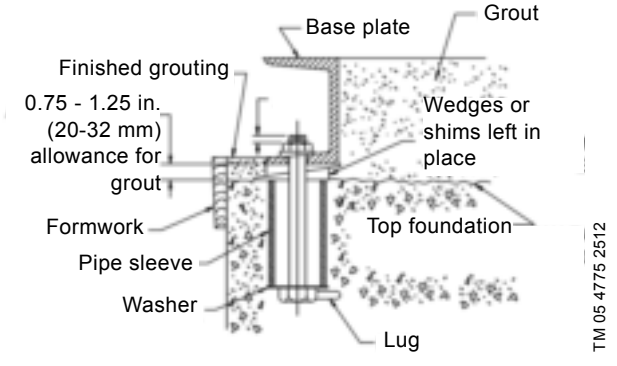


Fig. 1 Anchor bolt installation

4.4 Mechanical installation

4.4.1 Piping

Do not let the pump support the pipes. Use pipe hangers or other supports at proper intervals to provide pipe support near the pump.

- Make sure that both the inlet and outlet pipes are independently supported and properly aligned so that no strain is transmitted to the pump when flange bolts are tightened.
- Make sure the pipes are as straight as possible, so as to avoid unnecessary bends and fittings. Where necessary, use 45 ° or long-sweep 90 ° pipe bends to decrease friction loss.
- Where flanged joints are used, make sure that inside diameters match properly and that mounting holes are aligned.
- Do not apply force to pipes when making any connections!

4.4.2 Inlet pipe

The inlet pipe must be installed in a manner that minimizes pressure loss and permits sufficient liquid flow into the pump during starting and operation.

Observe the following precautions when installing the inlet pipe:

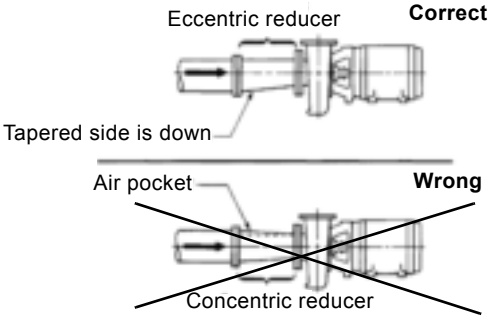


Fig. 2 Inlet pipe

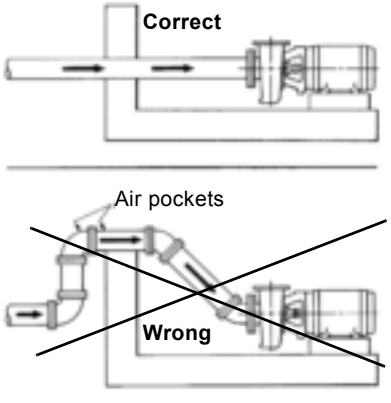
- Run the inlet pipe as direct as possible, and ideally, make sure the length is at least ten times the pipe diameter. A short inlet pipe can be the same diameter as the inlet port. A long inlet pipe must be one or two sizes larger than the inlet port, depending on the length, and with a reducer between the pipe and the inlet port.
- Use an eccentric reducer, with the tapered side down. See fig. 2.

At no point must the diameter of the inlet pipe be smaller than that of the pump inlet port.

- If possible, run a horizontal inlet line along an even gradient. We recommend a gradual upward slope to the pump under suction lift conditions, and a gradual downward slope under positive inlet pressure conditions.
- Avoid any high points, such as pipe loops (see fig. 3), as this may create air pockets and throttle the system or cause erratic pumping.
- Install a gate valve in the inlet line to be able to isolate the pump during shutdown and maintenance, and to facilitate pump removal. Where two or more pumps are connected to the same inlet line, install two gate valves to be able to isolate each pump from the line.
- Always install gate or butterfly valves in positions that prevent air pockets.

Do not use globe valves, particularly when NPSH is critical.

- During pumping operation, the valves on the inlet line must always be fully open.
- Install properly sized pressure gauges in the tapped holes on the pump inlet and outlet flanges.
  Pressure gauges will enable the operator to monitor the pump performance and determine whether the pump conforms to the parameters of the performance curve. If cavitation, vapor binding, or other unstable operating situations occur, the pressure gauges will indicate wide fluctuation in the inlet and outlet pressures.



TM05 4792 2613

Fig. 3 Air pocket prevention

4.4.3 Outlet pipe

- A short outlet pipe can be the same diameter as the pump outlet port. A long outlet pipe must be one or two sizes larger than the outlet port, depending on the length.
- It is best to use long horizontal outlet pipes.
- Install a gate valve near the outlet port to be able to isolate the pump during shutdown and maintenance, and to facilitate pump removal.
- Any high points in the outlet pipe may entrap air or gas and thus retard pump operation.
- If water hammer occurs, i.e. if check valves are used, close the outlet gate valve before pump shutdown.

4.4.4 Shaft seals

The pumps are available with both stuffing boxes with packing rings and mechanical shaft seals.

Stuffing boxes

The stuffing boxes are normally packed before shipment.

If the pump is installed within 60 days after shipment, the packing material will be in good condition for operation with a sufficient supply of lubricating liquid.

If the pump is stored for more than 60 days, it may be necessary to repack the stuffing boxes.

The stuffing box must be supplied at all times with a source of clean, clear liquid to flush and lubricate the packing rings.

Packing gland adjustment

With the pump running, adjust the packing gland to permit a leakage of 40 to 60 drops per minute for shaft lubrication. After initial startup, additional packing and adjustment may be required.

Mechanical shaft seals

Mechanical shaft seals require no maintenance or adjustment.

End suction pumps equipped with mechanical shaft seals are matched to the operating conditions for which the pump was sold. Observe the following precautions to avoid shaft seal damage and to obtain maximum shaft seal life:

Do not run the pump dry or against a closed valve. Dry running will cause shaft seal failure within minutes.

Do not exceed the temperature or pressure limitations for the mechanical shaft seal used.

Clean and purge the inlet pipe in new installations before installing and operating pump. Pipe scale, welding slag and other abrasives can cause rapid shaft seal failure.

4.4.5 Coupling alignment of LF pumps

The pump and motor were accurately aligned from factory, but handling during shipment usually alters this pre-alignment.

1. If the pump and motor were shipped mounted on a common base frame as an assembly, remove the coupling guard.
2. **Checking parallel alignment**
   Place a straight edge across both coupling rims at the top, the bottom and both sides. See fig. 4. After each adjustment, recheck all features of alignment. Parallel alignment is correct when the measurements show that all points of the coupling faces are within ± 0.005 in. (0.127 mm) of each other.
   If misalignment is detected, loosen the motor and shift or shim as necessary to re-align. Then re-tighten the anchor bolts. Always align the motor to the pump as pipe strain will occur if the pump is shifted. Never reposition the pump on the base frame.

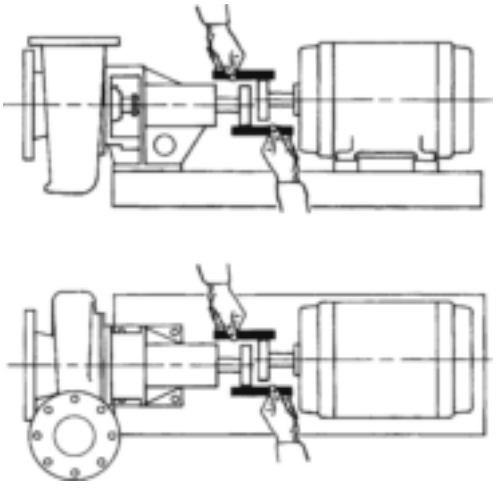


Fig. 4 Checking parallel alignment

3. **Checking angular alignment**
   Insert a pair of inside callipers or a taper gauge at four points at 90 ° intervals around the coupling. See fig. 5. Angular alignment is correct when the measurements show that all points of the coupling faces are within ± 0.005 in. (0.127 mm) of each other.
   – If misalignment is detected, loosen the motor and shift or shim as necessary to re-align. Then re-tighten the anchor bolts. Always align the motor to the pump as pipe strain will occur if the pump is shifted. Never reposition the pump on the base frame.

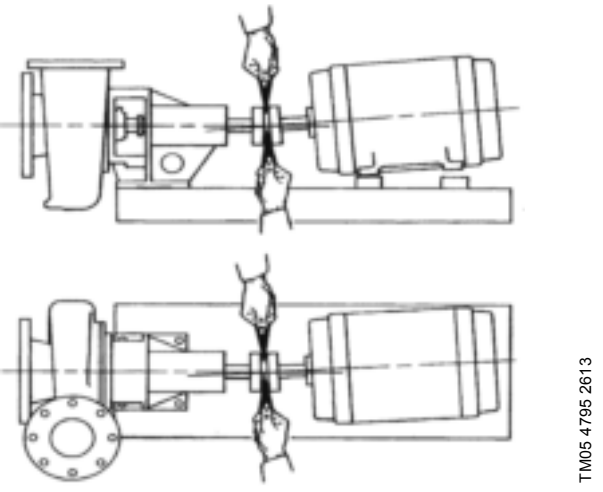


Fig. 5 Checking angular alignment

   – Check shaft alignment once again after final pipe connections to the pump have been made, motor wiring verified, correct direction of rotation has been established, and pipes have been filled with liquid.
4. Leave the coupling guards off until the pump priming procedure has been completed.
5. Install the coupling guards after installation has been completed to protect personnel from rotating machinery.

Coupling alignment of LCS pumps

Alignment of the pump and motor is not required.

4.5 Electrical connection

DANGER

Electric shock

Death or serious personal injury

- The electrical installation must be carried out by a qualified electrician in accordance with local regulations and the manuals provided with the electrical accessories.

DANGER

Electric shock

Death or serious personal injury

- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

4.5.1 Motors

The motor control circuit must include the following components in order to comply with the National Electrical Code:

Motor disconnecting device

- Install a motor disconnecting device that is capable of disconnecting both the controller (motor starter) and the motor from their source of power.
- Locate the disconnecting device in such a way that the controller (motor starter) can be seen from the disconnecting device. In all cases, the distance from the disconnecting device to the controller must be less than 50 ft (15.24 m).

In most installations, the disconnecting device will be a circuit breaker or fusible disconnect switch.

Motor short circuit and ground fault circuit interrupter

A short circuit and ground fault circuit interrupter is usually a circuit breaker or fusible disconnect switch.

- Select the circuit breaker or fuse in accordance with section 430-52 and table 430-152 of the National Electrical Code.

Motor controller with overcurrent protection (magnetic starter)

- Install these components in accordance with applicable local and state electrical codes in addition to the National Electrical Code.

DANGER

Explosive environment

Death or serious personal injury

- Observe the rules and regulations generally or specifically imposed by the relevant responsible authorities or trade organizations in relation to running powered equipment in an explosive environment.

4.5.2 Wiring

- Mount the control panel or the motor starter(s) close to the pump to provide convenient control and easy installation.
- Wire panel or starter(s) to motor(s) and pilot device(s). Wires to the motor(s) must be sized for at least 125 % of the motor nameplate full load amps. We recommend AWG #16 Type THW stranded wire for wiring of pilot devices, such as float switches.
- Check that the voltage, phase and frequency of the incoming power source correspond to the voltage, phase and frequency of the motor(s).
- Make sure that the starters are suitable for operating the pump motors on the voltage, phase and frequency available.

5. Starting up the product

5.1 Priming

End suction pumps are non-self-priming and must be completely primed, i.e. filled with liquid, before starting.

- If the pump will be operating with a positive inlet pressure, prime it by opening the inlet valve and allowing liquid to enter the pump housing. Open the air vents and make sure all air is forced out of the pump by the liquid before closing the air vents.
- Rotate the shaft by hand to free entrapped air from the impeller passageways.
- If the pump will be operating with a suction lift, priming must be accomplished by other methods. Use foot valves or ejectors, or fill the pump housing and the inlet line manually with liquid.

Never run the pump dry in the hope that it will prime itself. The result will be serious damage to the shaft seals, pump wear rings and shaft sleeves.

5.2 Pre-start checklist

Do not operate the product above the nameplate conditions. This may damage the product.

Make the following inspections before starting your L pump:

1. Make sure the inlet and outlet pipes have been cleaned and flushed to remove dirt and debris.
2. Double check the direction of rotation which must be clockwise. Operating in reverse will destroy the impeller and shaft.
3. Make sure all wiring connections to the motor and starting device are in accordance with the wiring diagram.
4. If the motor has been in storage for a long time, either before or after installation, refer to the motor instructions before starting.
5. Check the voltage, phase and frequency with the motor nameplate. Turn the impeller by hand to make sure it rotates freely.
6. Tighten the plugs in the gauge and drain holes. If the pump is fitted with pressure gauges, keep the gauge cocks closed when they are not in use.
7. Check the inlet and outlet pipes for leaks, and make sure all flange bolts are securely tightened.

5.3 Motor direction of rotation

Never check the motor direction of rotation unless the pump and motor couplings have been disconnected and physically separated. Failure to follow this instruction can result in serious damage to the pump and the motor if the direction of rotation is wrong.

After the product has been wired and checked to ensure that all components in the system, such as disconnect devices, magnetic starters, pilot devices and motors, are properly connected, check the motor direction of rotation as follows:

- For three-phase products only, momentarily energize the motor to ensure that the direction of rotation is correct as indicated by the arrow cast into the pump housing.
  If direction of rotation is incorrect, interchange two wires at the motor starter terminals T1 and T2.

The pumps must not be operated while dry.

Use extreme caution that motors are energized only momentarily to determine proper direction of rotation.

5.4 Starting the pump

DANGER

Moving machine parts

Death or serious personal injury.

- Mount an approved coupling guard before operating the product.

1. Install a coupling guard on coupled products.
2. Fully open the gate valve (if any) in the inlet line, and close the gate valve in the outlet line.
3. Fill the inlet line with liquid and completely prime the pump.
4. Start the pump.
5. Immediately make a visual check of the pump and inlet pipe for pressure leaks.
6. Immediately after the pump has reached full operating speed, slowly open the outlet gate valve until complete system flow is achieved.
7. Check the outlet pipe for pressure leaks.
8. If the pump is fitted with pressure gauges, open gauge cocks and record pressure readings for future reference. Verify that the pump is performing in accordance with the parameters specified in the performance curves.
9. Check and record voltage, amperage per phase, and kilowatts, if a wattmeter is available.

5.5 Voltage and frequency variation

The motor will operate satisfactorily under the following voltage and frequency variations, but not necessarily in accordance with the standards established for operation under rated conditions:

- The voltage variation must not exceed 10 % above or below the rating specified on the motor nameplate.
- The frequency variation must not exceed 5 % above or below the motor rating.
- The sum of the voltage and frequency variations must not exceed 10 % above or below the motor rating, provided the frequency variation does not exceed 5 %.

6. Storing and handling the product

See sections *3.3 Temporary storage after delivery*, *9.2 Short-time shutdown* and *9.3 Long-term shutdown*.

7. Product introduction

7.1 Applications

We recommend the L pumps for these applications:

- commercial and industrial cooling systems
  – pumping both primary and secondary cooling water
- condenser water systems
- district cooling systems
- water distribution systems
- irrigation systems.

7.2 Pumped liquids

Clean, thin, non-aggressive liquids, not containing solid particles or fibers. Do not pump liquids that will attack the pump materials chemically.

7.3 Pump identification

All pumps are identified by catalog and serial numbers. These numbers are stamped on the pump nameplate, as shown in fig. 6, affixed to the pump housing. Refer to these numbers in all correspondence with Grundfos.

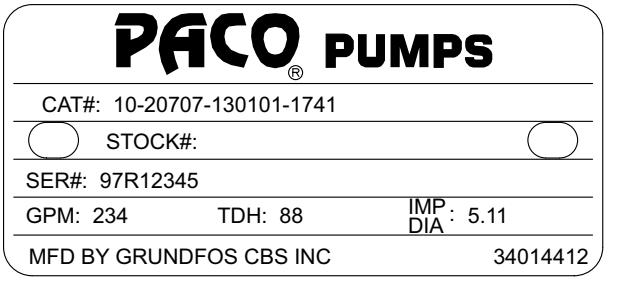


Fig. 6 Nameplate

8. Servicing the product

8.1 Maintaining the product

DANGER

Moving machine parts

Death or serious personal injury.

- Before any inspection, maintenance, service or repair of the product, make sure the motor controls are in the "OFF" position, locked and tagged.

8.2 Lubricating the product

8.2.1 Lubricating the motor

Always follow the motor manufacturer's lubricating instructions, if they are available, and periodically check grease fittings and drain plugs for leaks. If the lubricating instructions are not available, refer to the table below for recommended lubricating intervals.

- The motor can be lubricated both when it is running or when it is at rest.
  Remove the grease drain plug, if any, and filler plug on the grease fitting. Grease with clean lubricant until grease appears at the drain hole or along the motor shaft.

Recommended lubricating intervals

Motor rpm	Motor hp	Operating conditions		
		Standard	Severe	Extreme
1750 and below	0.33 - 7.50	3 years	1 year	6 months
	10-40	1-3 years	6 months - 1 year	3 months
	50-150	1 year	6 months	3 months
	200 and up	1 year	6 months	3 months
above 1750	all hp	6 months	3 months	3 months

Standard conditions:

Operating 8 hours per day, normal or light load, clean air, 100 °F (37 °C) maximum ambient temperature.

Severe conditions:

Operating continuously 24-hours, shock loads or vibrations, poor ventilation, 100-150 °F (37-65 °C) ambient temperature.

Extreme conditions:

Operating continuously, heavy shocks or vibrations, dirt or dust in the air, extremely high ambient temperature.

One-half to one cubic inch (0.5^3 - 1^3 in.) of grease is sufficient for motors of 5 hp and lower, with proportionately more grease for bigger hp motors.

Most fractional and some integral frame motors have "sealed-for-life" bearings, and do not require further lubrication throughout motor life.

If lubricating instructions are not available, refer to the table *Recommended lubricating intervals* on page 11 for recommended lubrication periods.

The table *Approved grease lubricants* in section *8.2.2 Lubricating the pump* lists the recommended types of grease for both pump and motor lubrication. These grease types have all been thoroughly tested and must be used whenever possible.

8.2.2 Lubricating the pump

Grease lubrication

In the standard configuration, LF pumps on horizontal base frames have sealed-for-life bearings. For customized pumps with regreasable bearings, use an approved grease and proceed as described below.

Approved grease lubricants

Manufacturer	Lubricant
Shell	Dolium® R
Exxon	Polyrex®
Chevron	SRI Grease NLGI 2
	Black Pearl - NLGI 2
Philips	Polytac™
Texaco	Polystar RB

- Remove the drain plug, if any, and the filler plug. Add clean lubricant until grease appears at the drain hole or along the pump shaft. On pumps with drain hole, all old grease can be purged. In such cases, the drain hole must be left unplugged for several minutes during pump operation to allow excess grease to be forced out.
- Lubricate the pump bearings at 1-3 month intervals, depending on the severity of the environment. Pumps in a clean, dry, moderate-temperature (100 °F (65 °C) maximum) environment must be regreased at 3-month intervals.

Do not over-grease! Too much grease can cause overheating and premature bearing failure.

Oil lubrication

LF pumps with oil lubricated bearings are fitted with a transparent reservoir, a constant-level oiler, that maintains the oil level about the centerline of the bearing. See fig. 7.

- Follow a regular oil maintenance program. When necessary, renew the oil supply in the reservoir of the constant-level oiler.
- Change the oil after the first 200 hours of operation. To change the oil, remove the drain plug at the bottom of the bearing cover and the filler plug, that also acts as a vent plug, at the top of the bearing frame. After draining the oil, replace the drain plug and refill the reservoir with an oil from the table *List of acceptable oil lubricants* on page 12. After the first oil change, the oil must be changed again at 2000 hours and then at intervals of 8000 hours or once a year, thereafter.

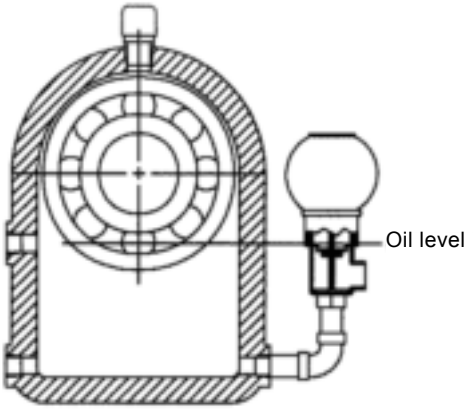


Fig. 7 Oil lubrication

List of acceptable oil lubricants	
Lubricant manufacturer	**Bearing oil brand name**
Aral Refining Co.	Aral Oil CMU
	Aral Oil TU 518
British Petroleum Co.	BP Energol
	TH 100-HB
Calypsol Oil Co.	Calypsol Bison Oil
	SR 25 or SR 36
Standard Oil Co.	Chevron
	Hydraulic Oil 11
	Circulating Oil 45
Esso Corp	Esso-Mar 25
	Teresso 47
	Esstic 50
Fina Oil Co.	Fina Hydran 34
	Fina Cirkan 32
Gulf Refining Co.	Gulf Harmony 47
	Gulf Paramount 45
Socony Mobil Oil Co.	Vac hlp 25
	Mobulix D.T.E. 25
Shell Oil Co.	Shell Tellus Oil 29
Sundco Oil Co.	Sunvis 821
The Texas Co.	Texaco Ursa Oil P 20
	Dea Viscobil Sera 4

8.3 Disassembling the pump

8.3.1 Preparations before disassembling the pump

DANGER

Electric shock

Death or serious personal injury.

- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

CAUTION

Toxic material

Minor or moderate personal injury.

- Wash down the pump before doing any work on it.

DANGER

Hot, caustic, flammable or toxic materials, including vapors

Death or serious personal injury.

- Be extremely cautious when venting and/or draining hazardous liquids.
  Wear protective clothing when there are caustic, corrosive, volatile, flammable, or hot liquids.
  Do not breathe toxic vapors.
  Do not allow sparks, open fire, or hot surfaces near the equipment.

Complete disassembly instructions are outlined below. Proceed only as far as required to perform the maintenance work needed.

1. Switch off the power supply.
2. Drain the system.
3. Flush the system, if necessary.
4. For close-coupled pumps: Remove the motor fixation bolts.

8.3.2 Disassembling the pump

1. Remove the pump housing screws (8B).
2. Remove the back pull-out bearing frame (20Y) from the pump housing (1A).
3. Remove the impeller screw (8A).
   If necessary, use a strap wrench around the impeller or shaft to prevent rotation.

WARNING

Moving machine parts

Death or serious personal injury.

- Do not insert a screwdriver between the impeller vanes to prevent rotation.

4. Use an appropriately sized puller aligned behind the impeller vanes to remove the impeller (3A) from the shaft (6A).
5. Remove the impeller key (12A).
6. Remove the back plate screws (8D). Remove the back plate (2K) and the seal housing (26P).
7. Place the seal housing on a flat surface and press out the shaft seal (14A).
8. If the shaft sleeve (5A) requires replacement, heat it evenly to approximately 350 °F (176 °C) to loosen the thread-locking fluid. Twist the sleeve off the shaft (6A).

8.3.3 Disassembling the bearing frame (LF)

1. Remove the slinger (13G).
2. Remove the lip seal(s) (14S), if any.
3. Remove the bearing housing locking ring (61K).
4. Press or tap on the pump end of the bearing-shaft assembly until one bearing is out.
5. When one bearing is out, remove the second locking ring (61F), then remove the complete bearing-shaft assembly from bearing housing.
6. Remove the shaft locking ring (61C) and press off the bearings.
7. Press new bearings on to the shaft; remember to press only on the inner race of the bearings while pressing them on.
8. Assemble the bearing frame in the reverse procedure used for disassembling.
9. Observe the following when reassembling the bearing frame:
   – Replace the lip seals (14S) if they are worn or damaged.
   – Replace the bearings (18A) and (18B) if they are loose, rough or noisy when rotated.
   – Check the shaft (6A) for shaft runout at the shaft sleeve (5A) area. Maximum permissible runout is 0.002 in. (0.05 mm) total indicator runout.

8.4 Replacing the shaft seal (LCS pumps)

1. Complete the preparations listed in section *8.3 Disassembling the pump*.
2. Remove the coupling guard screws (8E).
3. Remove the coupling guard (34F).
4. Remove the nut (35E) and the bolt (8E) that hold the coupling halves together.
5. Pry apart the coupling halves (23D), remove the coupling key (12B).

Mark or measure the original position of the pump coupling on the motor side.

6. Unscrew the tubing connector from the pipe tee of the air vent assembly. Thread sealing compound was applied to the threads during factory assembly, and the resulting bond may retard but will not prevent manual disassembling.
7. Remove the seal housing cap screws and slide the seal housing (2N) up the shaft to remove it.
8. Remove the shaft seal manually from the shaft (6A). Apply water-soluble lubricant to the shaft, if necessary, to ease the removal of the shaft seal (14A). Pull the shaft seal manually from the shaft, using a slight twisting motion (as necessary) to loosen the bellows from the shaft.
9. Remove and discard the shaft seal spring and the shaft seal retainer.
10. Remove and discard the shaft seal seat from the seal housing (2N) and thoroughly clean the inside cavity of the seal housing.
11. The interior surface of the bellows on a new shaft seal is coated with a bonding agent that adheres to the motor shaft. When the old shaft seal is removed, the bonding agent no longer exists and the bellows may crack or split during removal. We always recommend that you install a new mechanical shaft seal if it becomes necessary to remove the existing shaft seal from the shaft.
12. Clean and lubricate the shaft (6A) with a water-soluble lubricant and make sure no sharp edges can cut or scratch the bellows of the new shaft seal.
13. Press the new shaft seal seat firmly into the seal housing. Avoid direct contact between the seal face and metallic or abrasive objects, and wipe the seal face clean after installation to ensure an abrasive-free sealing surface.
14. Slide the new shaft seal onto the shaft by applying even pressure to the shaft seal.
15. Install the shaft seal housing (2N) on the shaft.
16. See the reassembly instructions in section *8.6 Reassembling the pump*.

8.5 Replacing the wear ring

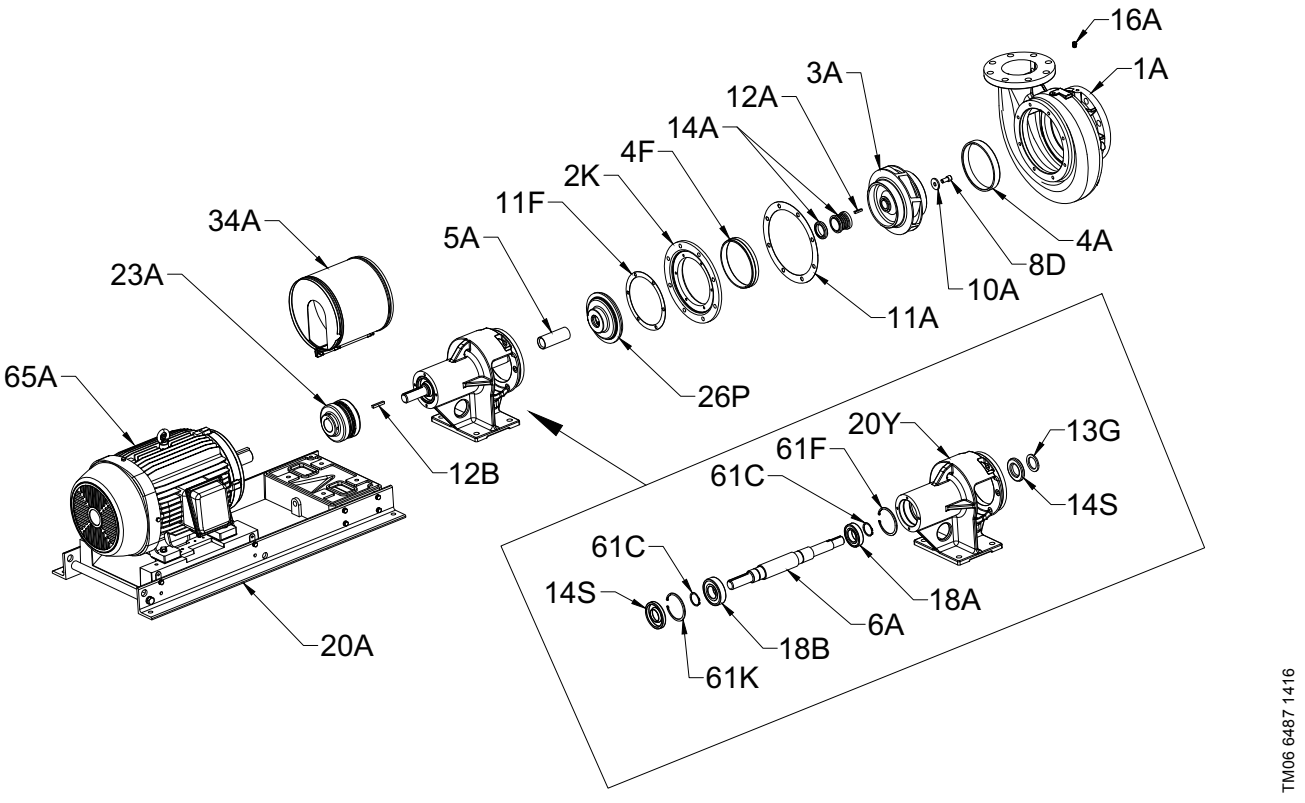
1. Complete the preparations in sections *8.3.1 Preparations before disassembling the pump* and *8.3.2 Disassembling the pump*.
2. Remove the rotating assembly.
3. Remove the pump housing (1A) from the pipes, if necessary, to facilitate easy access to the interior of the pump housing. If necessary, remove the flange bolts at the pipes.
4. Remove a worn wear ring (4A) by drilling two holes slightly smaller than the width of the wear ring into the exposed edge of the wear ring. Insert a chisel into the holes to completely sever the wear ring at the holes and break the wear ring into two halves for easy removal.
5. Clean the wear ring cavity in the pump housing prior to installing a new wear ring to ensure a properly aligned fit.
6. To reassemble, press fit the new wear ring squarely into the pump housing cavity. Tap the wear ring into place to make sure it is pressed home into the cavity.

Do not use metal tools on the wear ring surfaces. Use only rubber, rawhide, wood or other soft material to prevent damage to the wear ring.

8.6 Reassembling the pump

1. Clean all parts before reassembly.
2. Refer to the parts list to identify required replacement items. Specify the pump serial or catalog number when ordering parts.
3. Reassemble the pump in the reverse procedure used for disassembling.
4. Observe the following when reassembling the pump:
   – All mechanical seal components must be in good condition or leakage may result. We recommend that you replace the complete shaft seal.
   – Install new shaft sleeves by bonding them to the shaft with a thread-locking fluid.
5. Re-install the coupling guards on coupled pumps.

8.7 LF, exploded view and parts list



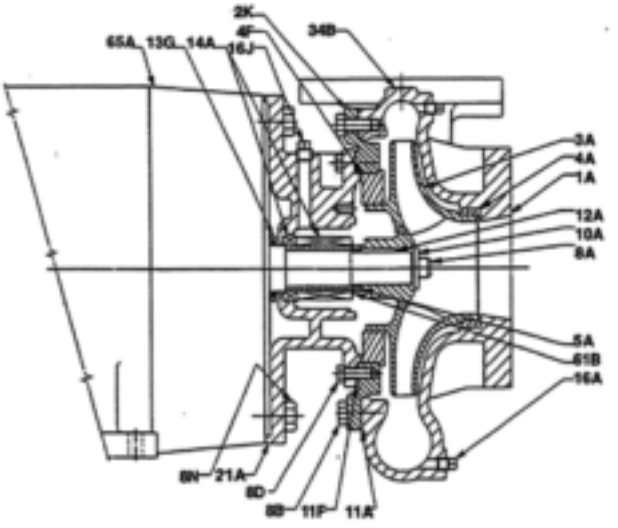
Pos.	Description
1A	Pump housing
2K	Back plate
3A	Impeller
4A	Wear ring
4F*	Balance wear ring
5A	Shaft sleeve
6A	Shaft
8D	Cap screw
10A	Washer
11A	Gasket
11F	Gasket
12A	Key
12B	Key
13G	Slinger

Pos.	Description
14A	Shaft seal
14S	Lip seal
16A	Drain plug
18A	Bearing, inboard
18B	Bearing, outboard
20A	Baseplate
20Y	Bearing frame
23A	Coupling hub
26P	Seal housing
34A	Coupling guard
61C	Locking ring
61F	Locking ring
61K	Locking ring
65A	Motor

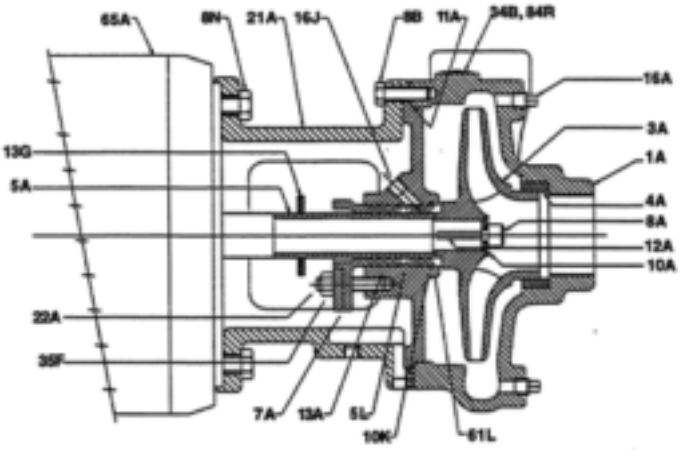
* If applicable

8.8 LC, cross section and parts list

Pump with shaft seal



Pump with stuffing box



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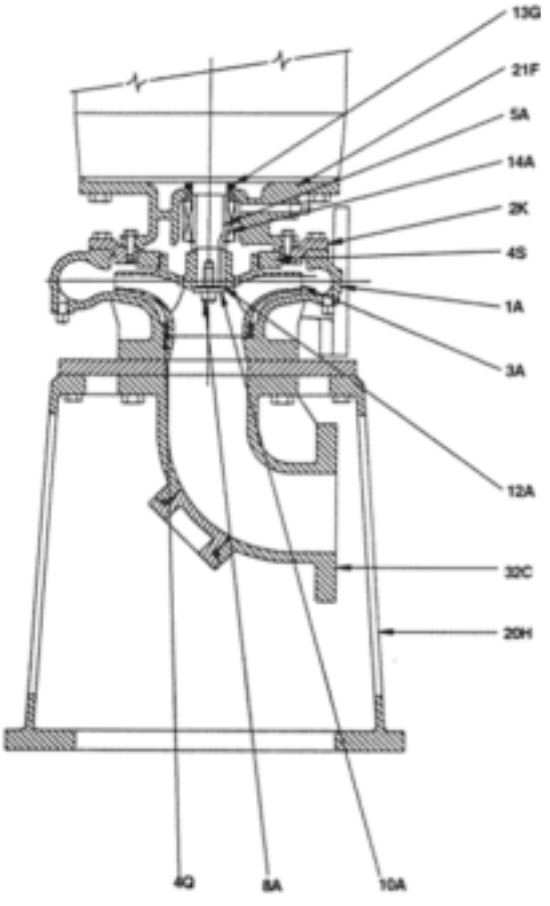
Pos.	Description
1A*	Pump housing
2K**	Back plate
3A	Impeller
4A	Wear ring
4F	Wear ring
5A	Shaft sleeve
5L*	Distribution ring
7A*	Stuffing box gland
8A	Cap screw
8B	Cap screw
8D	Cap screw
8N	Cap screw
10A	Washer
10K*	Washer
11A	Gasket

Pos.	Description
11F**	Gasket
12A	Key
13A*	Stuffing box
13G	Slinger
14A**	Mechanical shaft seal
16A	Drain plug
16J*	Plug
21A	Motor stool
22A*	Stud
34B	Nameplate
35F*	Nut
61B	Locking ring
61L*	Locking ring
65A	Motor
84R	Screws

* Pumps with stuffing box only

** Pumps with shaft seal only

8.9 LCV, cross section and parts list



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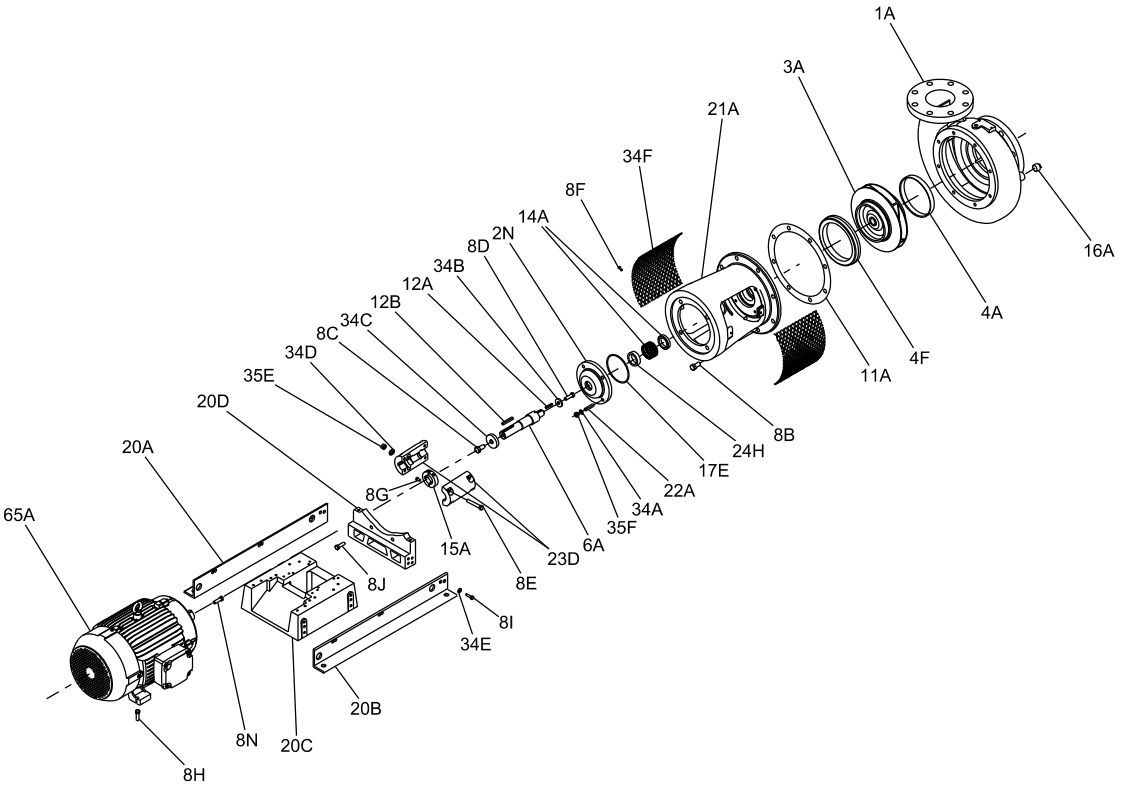
Pos.	Description
1A	Pump housing
2H	Hand hole cover (not shown)
2K	Back plate
3A	Impeller
4Q	Wear ring
4S	Wear ring
5A	Shaft sleeve
8A	Cap screw

Pos.	Description
10A	Washer
12A	Key
13G	Slinger
14A	Single mechanical shaft seal
20H	Stand
21F	Motor stool
32C	Elbow with cleanout port

8.10 LCS, exploded view and parts list



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Pos.	Description
1A	Pump housing
2N	Shaft seal housing
3A	Impeller
4A	Wear ring
4F	Balance wear ring
6A	Pump shaft
8B	Cap screw
8C	Screw
8D	Screw
8E	Bolt
8F	Screw
8G	Screw
8H	Cap screw
8I	Cap screw
8J	Cap screw
8N	Screw
11A	Gasket
12A	Key
12B	Key
14A	Shaft seal

Pos.	Description
15A	Locating ring
16A	Drain plug
17E	O-ring
20 A + 20B	Base plate profile
20C	Base plate
20D	Pump support
21A	Motor stool
22A	Stud
23D	Coupling halves
24H	Bushing
34A	Washer
34B	Washer
34C	Washer
34D	Washer
34E	Washer
34F	Coupling guard
35E	Nut
35F	Nut
65A	Motor

9. Taking the product out of operation

The following shutdown procedures will apply for the L pumps in most normal shutdown situations. If the pump will be inoperative for a long time, follow the storage procedures in section *9.3 Long-term shutdown*.

9.1 General procedure

- Always close the outlet gate valve before stopping the pump. Close the valve slowly to prevent hydraulic shock.
- Switch off and lock off the power supply to the motor.

9.2 Short-time shutdown

- For overnight or temporary shutdown periods under non-freezing conditions, the pump may remain filled with liquid. Make sure the pump is fully primed before restarting.
- For short or frequent shutdown periods under freezing conditions, keep the liquid moving within the pump housing and insulate or heat the pump exterior to prevent freezing.

9.3 Long-term shutdown

- For long shutdown periods, or to isolate the pump for maintenance, close the inlet gate valve. If no inlet valve is used and the pump has positive inlet pressure, drain all liquid from the inlet line to stop the liquid flow into the pump inlet. Remove the plugs in the pump drain and vent holes, as required, and drain all liquid from the pump housing.
- If there will be freezing conditions during long shutdown periods, completely drain the pump and blow out all liquid passages and pockets with compressed air. Freezing of the pumped liquid can also be prevented by filling the pump with antifreeze solution.

10. Fault finding

DANGER

Electric shock

Death or serious personal injury.

- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

CAUTION

Toxic material

Minor or moderate personal injury.

- Wash down the pump before doing any work on it.

DANGER

Hot, caustic, flammable or toxic materials, including vapors

Death or serious personal injury.

- Be extremely cautious when venting and/or draining hazardous liquids.
  Wear protective clothing when there are caustic, corrosive, volatile, flammable, or hot liquids.
  Do not breathe toxic vapors.
  Do not allow sparks, open fire, or hot surfaces near the equipment.

Fault	Cause	Remedy
1. Outlet pressure is too low.	a) The speed of rotation is too low.	Reestablish correct speed and direction of rotation.
	b) The system pressure is lower than anticipated.	Check the system curve.
	c) There is air or gas in the pumped liquid.	Remove the air from the pumped liquid.
	d) The wear rings are worn.	Replace the wear rings.
	e) The impeller is damaged.	Repair or replace the impeller.
	f) The impeller diameter is too small.	Replace the impeller with one of the correct diameter.
	g) Wrong direction of rotation.	Interchange two wires in the power supply.
	h) The pump has lost its prime.	Re-prime the pump.
	i) There is insufficient NPSH.	Restore required NPSH.
	j) Passages are restricted.	Clean the impeller and pump housing passages.
	k) Joints or the stuffing box are leaking.	• Tighten the joints or the stuffing box gland. • Replace the shaft sleeve. • Replace the gaskets.
2. Insufficient inlet pressure.	a) The inlet line is drawing air.	Tighten the connections.
	b) The suction lift is too high or there is insufficient NPSH.	Reduce the suction lift or restore required NPSH.
	c) Air or gas is trapped in the pumped liquid.	Remove the trapped air or gas from liquid.
	d) The strainer is clogged.	Clean the strainer.
3. Noise level has increased.	a) Poor alignment of the pump. Inlet and outlet pipe clamps are loose.	• Reestablish proper alignment of the pump and the motor. • Support the inlet and outlet pipes. • Make sure the vibration dampers, flexible pipes and conduit connectors are installed correctly.
	b) Cracked foundation.	Repair the foundation.
	c) Worn ball bearings.	• Replace the worn bearings. • Renew the lubrication.
	d) The motor is unbalanced.	• Disconnect the motor and operate it alone. • Remove large pieces of debris, such as wood or rags from the pump. • Clean out the pump, if necessary.
	e) Hydraulic resonance.	• Alter the resonant pipes. • Change the pump speed. • Insert a pulsation damper on the pump or the pipes. • Insert a flow straightener.

Fault	Cause	Remedy
4. Insufficient flow.	a) The pump is not primed.	Prime the pump.
	b) The system pressure exceeds the shut off pressure.	• Increase the liquid level on the inlet side. • Open the isolating valve in the inlet pipe.
	c) The speed of rotation is too low.	Reestablish the correct speed of rotation.
	d) The suction lift is too high or there is insufficient NPSH.	Reduce the suction lift or restore required NPSH.
	e) The strainer or the impeller is clogged.	Clean the strainer and the impeller passages.
	f) Wrong direction of rotation.	Reestablish the correct direction of rotation.
	g) Leaking joints.	Tighten the joints.
	h) Broken shaft or coupling	Repair or replace damaged parts.
	i) Closed inlet valve.	If the inlet valve is closed, open it slowly.
	j) There is not enough inlet pressure for hot or volatile liquids.	Reestablish required inlet pressure.
	k) Foot valve is too small.	Replace the foot valve.
	l) Worn or damaged hydraulic parts.	Repair or replace the worn parts.
	m) Excessive clearance between the wear surfaces.	See section *8.5 Replacing the wear ring*.
5. The pump loses its prime after starting.	a) Joints or the stuffing box are leaking.	• Tighten the joints or the stuffing box gland. • Replace the shaft sleeve. • Replace the gaskets.
	b) The suction lift is too high or there is insufficient NPSH.	Reduce the suction lift or restore required NPSH.
6. Excessive power required.	a) The speed of rotation is too high.	Reduce the speed of rotation.
	b) The pump is operating beyond its recommended performance range.	Set the duty point in accordance with the recommended performance range.
	c) The specific gravity or viscosity of the pumped liquid is too high.	If less flow is sufficient, reduce the flow on the outlet side, or fit the pump with a more powerful motor.
	d) The shaft is bent.	Replace the shaft.
	e) The stuffing-box is too tight.	Retighten the stuffing box if possible. Alternatively, repair or replace the stuffing box.
	f) The impeller clearance is too small causing rubbing or worn wear surfaces.	Adjust the impeller clearance, if possible, or replace the wear ring.
	g) There is an electrical or mechanical defect in the motor.	Contact your local service center for diagnostics.
	h) The pump is restricted in its rotation.	Remove any obstacles or replace any worn parts.
	i) Incorrect lubrication of the motor.	Reestablish correct lubrication of the motor.

11. Technical data

11.1 Operating conditions

11.1.1 Flow rate

Minimum flow rate

The pump must not run against closed outlet valve as this will cause an increase in temperature or formation of steam in the pump.

This may cause shaft damage, impeller erosion, short life of bearings, damage to stuffing boxes or mechanical shaft seals due to stress or vibrations.

The minimum continuous flow rate is shown when selecting the pump in Grundfos Express online selection tool.

Maximum flow rate

The maximum flow rate must not exceed the value stated on the nameplate. If the maximum flow rate is exceeded, cavitation and overload may occur.

11.1.2 Ambient temperature and altitude

The ambient temperature and the installation altitude are important factors for the motor life, as they affect the life of the bearings and the insulation system.

Too high ambient temperature or low density and consequently low cooling effect of the air may result in overheating.

In such cases, it may be necessary to use a motor with a higher output.

11.1.3 Liquid temperature

The maximum liquid temperature depends on the material of the mechanical shaft seal, O-rings and gaskets used:

- Temperature range for BUNA:
  32-212 °F (0-100 °C).
- Temperature range for FKM:
  59-275 °F (15-135 °C).
- Temperature range for EPDM:
  59-275 °F (15-135 °C).

11.1.4 Outlet pressure

Maximum outlet pressure

The maximum outlet pressure is the pressure (total dynamic head or TDH) stated on the pump nameplate.

11.1.5 Inlet pressure

Minimum inlet pressure

The minimum inlet pressure must correspond to the NPSH curve for the pump + a safety margin of minimum 1.6 ft (0.5 m) head.

Pay attention to the minimum inlet pressure to avoid cavitation. The risk of cavitation is higher in the following situations:

- The liquid temperature is high.
- The flow rate is considerably higher than the pump's rated flow rate.
- The pump is operating in an open system with suction lift.
- The inlet conditions are poor.
- The operating pressure is low.

Maximum inlet pressure

Inlet pressure + pump pressure must be lower than maximum pressure (total dynamic head or TDH) of the pump.

12. Disposing of the product

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

Subject to alterations.

Grundfos CBS Inc.
902 Koomey Road
Brookshire, TX 77423 USA
Phone: 281-994-2700
Toll Free: 1-800-955-5847
Fax: 1-800-945-4777

www.grundfos.us

GRUNDFOS Canada
2941 Brighton Road
Oakville, Ontario L6H 6C9 Canada
Phone: +1-905 829 9533
Telefax: +1-905 829 9512

www.grundfos.ca

GRUNDFOS México
Boulevard TLC No. 15
Parque Industrial Stiva Aeropuerto
C.P. 66600 Apodaca, N.L. México
Phone: 011-52-81-8144 4000
Fax: 011-52-81-8144 4010

www.grundfos.mx

99327137 0817
ECM: 1214834

INSTALLATION OPERATION & MAINTENANCE
PACO SUCTION DIFFUSER
TYPE PSD, 125# & 250# FLANGED

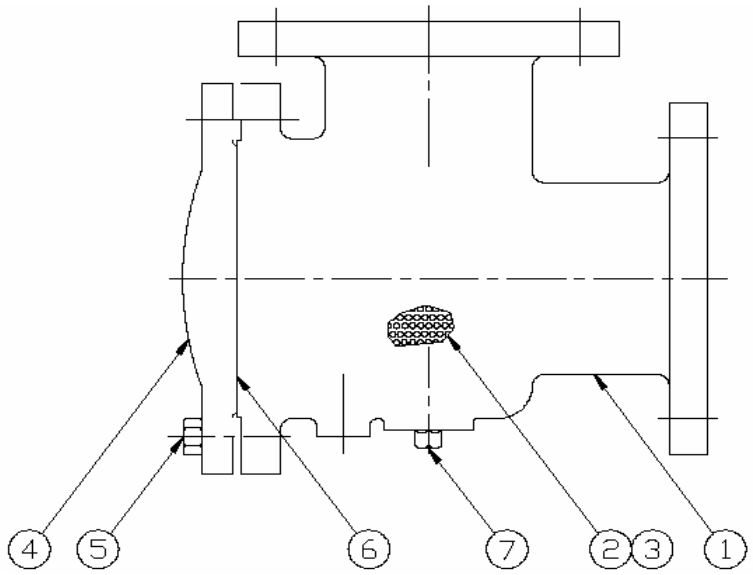
PACO PUMPS

Installation:

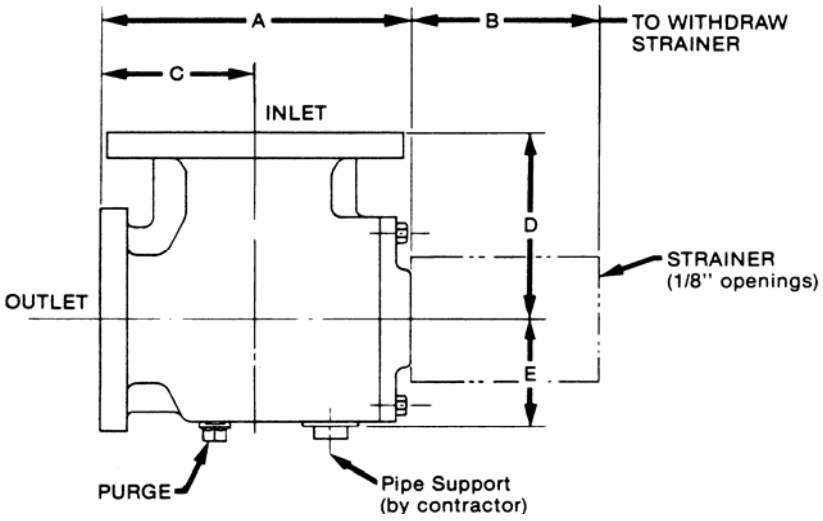
1. Install Suction Diffuser in piping with proper flow direction as indicated on diffuser.
2. Provide appropriate clearance in back of diffuser for removal of strainer. (Refer to dimension "C" on other side.)
3. Install a support leg and foot using standard pipe (see dimension "G" on other side) on underside of strainer.
4. Flush system piping and operate pumps for initial circulation of system.
5. After initial system circulation is complete, remove and discard the temporary fine mesh strainer. Do not discard the permanent strainer.

Operation & Maintenance:

1. Periodically (dependent on system conditions) open the suction diffuser and clean debris from strainer basket. Inspect strainer for holes. Replace if damaged.
2. Inspect stabilizing vanes for wear, scale or contaminants. Clean with wire brush as necessary.
3. Inspect magnet (if so equipped) for metal particulates. Clean or replace as necessary.



Key No.	Description	Material
1	Body	Cast Iron
2	Strainer	304SS
3	Mesh Grid	304SS
4	Cover	Cast Iron
5	Cap Screw	Steel
6	O Ring	NBR
7	Plug	Malleable Iron



PRODUCT DESCRIPTION

For use on suction of centrifugal pump to save space, simplify piping and provide a uniform flow condition at the pump suction.

- Flanges are 125# ASA (flat face).
- Maximum working temperature is 300º F.
- Maximum working pressure is 175 PSI.

Model Number	125# ANSI		Strainer Open Area Sq. In.	Wgt. (lbs)	Dimensions							
	Inlet (pipe)	Outlet (pump)			A	B	C*	D	E	J	Purge	G
PSD2015-125	2	1 1/2	35	20	10.25	4.50	4.50	4.50	2.25	6.00	3/4"	1¼"
PSD2020-125	2	2	38	25	10.25	4.50	4.50	4.50	2.25	6.00	3/4"	1¼"
PSD2520-125	2 1/2	2	38	30	10.75	5.00	5.00	5.00	2.50	6.50	3/4"	1¼"
PSD2525-125	2 1/2	2 1/2	40	35	10.75	5.00	5.00	5.00	2.50	6.50	3/4"	1¼"
PSD3020-125	3	2	38	35	10.25	5.50	4.50	5.50	2.25	6.00	3/4"	1¼"
PSD3025-125	3	2 1/2	40	45	11.25	5.50	5.25	5.50	3.00	7.00	3/4"	1¼"
PSD3030-125	3	3	50	50	11.25	5.50	5.25	5.50	3.00	7.00	3/4"	1¼"
PSD4030-125	4	3	50	60	13.00	6.50	6.50	6.50	3.75	8.75	1"	1¼"
PSD4040-125	4	4	78	75	12.75	6.50	6.25	6.50	3.75	8.25	1"	1¼"
PSD5040-125	5	4	78	90	15.75	7.50	8.50	7.50	4.50	10.00	1"	1¼"
PSD5050-125	5	5	102	110	16.25	7.50	6.50	7.50	5.50	10.00	1"	1¼"
PSD6040-125	6	4	78	105	13.00	8.00	8.50	8.00	3.75	8.75	1"	1¼"
PSD6050-125	6	5	102	125	17.00	8.00	9.50	8.00	5.50	10.75	1"	1¼"
PSD6060-125	6	6	154	150	17.00	8.00	9.50	8.00	5.50	10.75	1"	1¼"
PSD8060-125	8	6	154	195	17.00	8.00	9.50	9.00	5.50	10.75	1"	1¼"
PSD8080-125	8	8	280	255	20.75	9.00	13.50	9.00	7.00	11.50	1¼"	2"
PSD1080-125	10	8	280	310	20.75	9.00	13.50	11.00	7.00	11.50	1¼"	2"
PSD1010-125	10	10	430	400	26.25	11.00	17.75	11.00	9.75	14.25	1¼"	2"
PSD1280-125	12	8	280	400	25.25	11.00	17.00	11.00	8.25	15.00	1¼"	2"
PSD1210-125	12	10	430	475	26.25	11.00	17.75	12.00	9.75	14.25	1¼"	2"
PSD1212-125	12	12	560	575	26.25	12.00	17.75	12.00	9.75	15.25	1¼"	2"

*Dimension "C" is space needed to withdraw the strainer from the housing.

LETTER OF TRANSMITTAL

TO: East Harding Construction

DATE: April 1, 2024

RE: Stone Bank

JOB NO.: 23-057

ATTN: Jake Honeycutt, Jack Whitley, Kim Brass

COPIES	DATE	NO.	DESCRIPTION
1 Emailed	03/18/24	23 00 00-100	*Pumps (CP-1, 2 & 3)*

THESE ARE TRANSMITTED:

[ ]For Approval [ ]As Requested [XX] Reviewed for General Compliance [ ]Resubmit___copies for approval

[ ]For Your Use [ ]For Review and Comment [] Reviewed and Noted [ ]Submit ___copies for distribution

[ ]For Your Information [] Revise and Resubmit Comments [ ]Return___corrected prints

REMARKS:

COPY TO: Job File

BY: JoAnn White

JoAnn White, CIT
Contract Administrator

SHOP DRAWING SUBMITTAL REVIEW COMMENTS

Batson Inc.
ENGINEERING SOLUTIONS
1300 Brookwood Drive
Little Rock, AR 72202
501.664.3311

www.batson.com

CLIENT	**WDD Architects**
PROJECT	**Stone Bank**
ENG JOB #	**5978**
SUBMITTAL #	**Mechanical #1**
PAGE	**1 of 2**
DATE	**3/26/2024**
REVIEWER	**Cooper Longley**

SEE SHOP DRAWINGS & APPROVAL STAMP ON SHOP DRAWING DOCUMENTS FOR ADDITIONAL INFORMATION AND NOTATIONS

NO.	DESCRIPTION	APPROVED	APPROVED AS CORRECTED	REVISE & RESUBMIT	NOT APPROVED	SUBSTITUTIONS	REMARKS
1	COOLING TOWER (CT-1)	X					
2	EXHAUST FANS (EF-4 THRU 12 & EF-23 THRU 25)		X			X	EF-24 NOT SPECIFIED AS GN-168 IN SUBMITTAL, BUT FAN QUANTITY IS CORRECT
3	HEATING BOILER (HWB-1)	X				X	208/1 PH POWER ACCEPTABLE
4	PUMPS (CP-1,2,&3)	X					
5	23 05 29 HANGERS & SUPPORTS	X					
6	23 05 53 MECHANICAL IDENTIFICATION	X					
7	23 07 00 MECHANICAL INSULATION	X					
8	23 09 00 CONTROLS	X					
9	23 11 23 NATURAL GAS PIPING	X					
10	23 21 13 HYDRONIC PIPING	X					

The Contractor is reminded that per the specifications:

1) The Contractor is responsible for submitting all items required.
2) When substitutions to the specifications and drawings are approved, the Contractor is responsible for all costs related to other systems affected by the incorporation of substitutions into the work.

SHOP DRAWING SUBMITTAL REVIEW COMMENTS

Batson Inc.
ENGINEERING SOLUTIONS
1300 Brookwood Drive
Little Rock, AR 72202
501.664.3311

www.batson.com

APPROVED	APPROVED AS CORRECTED	REVISE & RESUBMIT	NOT APPROVED	SUBSTITUTIONS

SEE SHOP DRAWINGS & APPROVAL STAMP ON SHOP DRAWING DOCUMENTS FOR ADDITIONAL INFORMATION AND NOTATIONS

CLIENT	**WDD Architects**
PROJECT	**Stone Bank**
ENG JOB #	**5978**
SUBMITTAL #	**Mechanical #1**
PAGE	**2 of 2**
DATE	**3/26/2024**
REVIEWER	**Cooper Longley**

NO.	DESCRIPTION	APPROVED	APPROVED AS CORRECTED	REVISE & RESUBMIT	NOT APPROVED	SUBSTITUTIONS	REMARKS
11	23 31 13 METAL DUCTS	X					
12	23 33 00 AIR DUCT ACCESSORIES		X				PROVIDE SIGHT BAFFLE FOR LSR2 THRU9

The Contractor is reminded that per the specifications:

1) The Contractor is responsible for submitting all items required.
2) When substitutions to the specifications and drawings are approved, the Contractor is responsible for all costs related to other systems affected by the incorporation of substitutions into the work.

EAST HARDING
CONSTRUCTION

2230 Cottondale Lane, Suite 3
Little Rock, AR 72202
501.661.1646 – 501.661.9546 (fax)
www.eastharding.com

Submittal
#48

Distribution Summary

Distributed on by

To:

Message:

Additional Attachments:

NAME	RESPONSE	ATTACHMENTS	COMMENT

23.038 230000 100 Pumps

SPEC SECTION:		**CREATED BY:**	
STATUS:	Open	**DATE CREATED:**	03/18/2024
ISSUE DATE:	03/18/2024	**REVISION:**	0
RESPONSIBLE CONTRACTOR:	Comfort Systems USA (Arkansas), Inc.	**RECEIVED FROM:**	Matthew Aldridge
RECEIVED DATE:	//	**SUBMIT BY:**	//
FINAL DUE DATE:	04/06/2024	**LOCATION:**	
TYPE:	Product Information	**COST CODE:**	
APPROVERS:	Jake Honeycutt **(East-Harding, Inc.)**, Jack Whitley **(East-Harding, Inc.)**, JoAnn White **(Wittenberg, Delony & Davidson, Inc.)**		
Project: 23.038:			
Architect's Project: 23-057:			

BALL IN COURT:
Matthew Aldridge **(Comfort Systems USA (Arkansas), Inc.)**

DISTRIBUTION:
Kim Brass **(East-Harding, Inc.)** , Jon Isham **(East-Harding, Inc.)** , Jake Honeycutt **(East-Harding, Inc.)** , Jack Whitley **(East-Harding, Inc.)**

DESCRIPTION:

ATTACHMENTS:

SUBMITTAL WORKFLOW

#	NAME	SUBMITTER/ APPROVER	SENT DATE	DUE DATE	RETURNED DATE	RESPONSE	ATTACHMENTS	COMMENTS
1	Matthew Aldridge	Submitter		3/19/2024		Pending		
2	Jake Honeycutt	Approver		3/21/2024		Pending		
3	Jack Whitley	Approver		3/23/2024		Pending		
4	JoAnn White	Approver		4/6/2024		Pending		

BY **DATE** **COPIES TO**

SUBMITTAL DATA

Date:	March 5, 2024
Project:	Stone Bank
Contractor:	Comfort Systems USA
Engineer:	Batson Inc.

PUMPS, ACCESSORIES

Tags: CP-1 thru 3 (AS SPECIFED)
Grundfos pumps complete with bronze impellers, wear rings, coupling, coupling guard, mechanical seals, and premium efficient motors.

3 – Suction Diffusers
6 – Flexible Pump Connectors

6815 Dewaffelbaker Dr., Maumelle, AR 72113
Phone (501) 663-8886 • Fax (501) 663-8738
www.fluidsolutionsinc.com

Pump Performance Datasheet

Customer	:	Quote Number / ID	: 030524A
Customer ref. / PO	:	Model	: 40957 LF
Tag Number	: CP-1 & 2	Stages	: 1
Service	: Pump Room	Based on curve number	: RC1995-SS Rev 0
Quantity	: 2	Basic model number	: -
		Date last saved	: 03/05/2024 2:46 PM

Operating Conditions

Flow, rated	: 570.0 USgpm
Differential head / pressure, rated (requested)	: 55.00 ft
Differential head / pressure, rated (actual)	: 55.01 ft
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available, rated	: Ample
Site Supply Frequency	: 60 Hz

Performance

Speed, rated	: 1760 rpm
Impeller diameter, rated	: 8.32 in
Impeller diameter, maximum	: 9.60 in
Impeller diameter, minimum	: 7.50 in
Efficiency	: 81.24 %
NPSH required / margin required	: 8.31 / 0.00 ft
nq (imp. eye flow) / S (imp. eye flow)	: 35 / 175 Metric units
MCSF	: 153.9 USgpm
Head, maximum, rated diameter	: 68.96 ft
Head rise to shutoff	: 24.14 %
Flow, best eff. point	: 583.9 USgpm
Flow ratio, rated / BEP	: 97.63 %
Diameter ratio (rated / max)	: 86.67 %
Head ratio (rated dia / max dia)	: 65.87 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Energy Indexes

PEI (CL)	: 0.98
ER (CL)	: 2

Liquid

Liquid type	: Cold Water
Additional liquid description	:
Solids diameter, max	: 0.00 in
Solids concentration, by volume	: 0.00 %
Temperature, max	: 68.00 deg F
Fluid density, rated / max	: 1.000 / 1.000 SG
Viscosity, rated	: 1.00 cP
Vapor pressure, rated	: 0.34 psi.a

Material

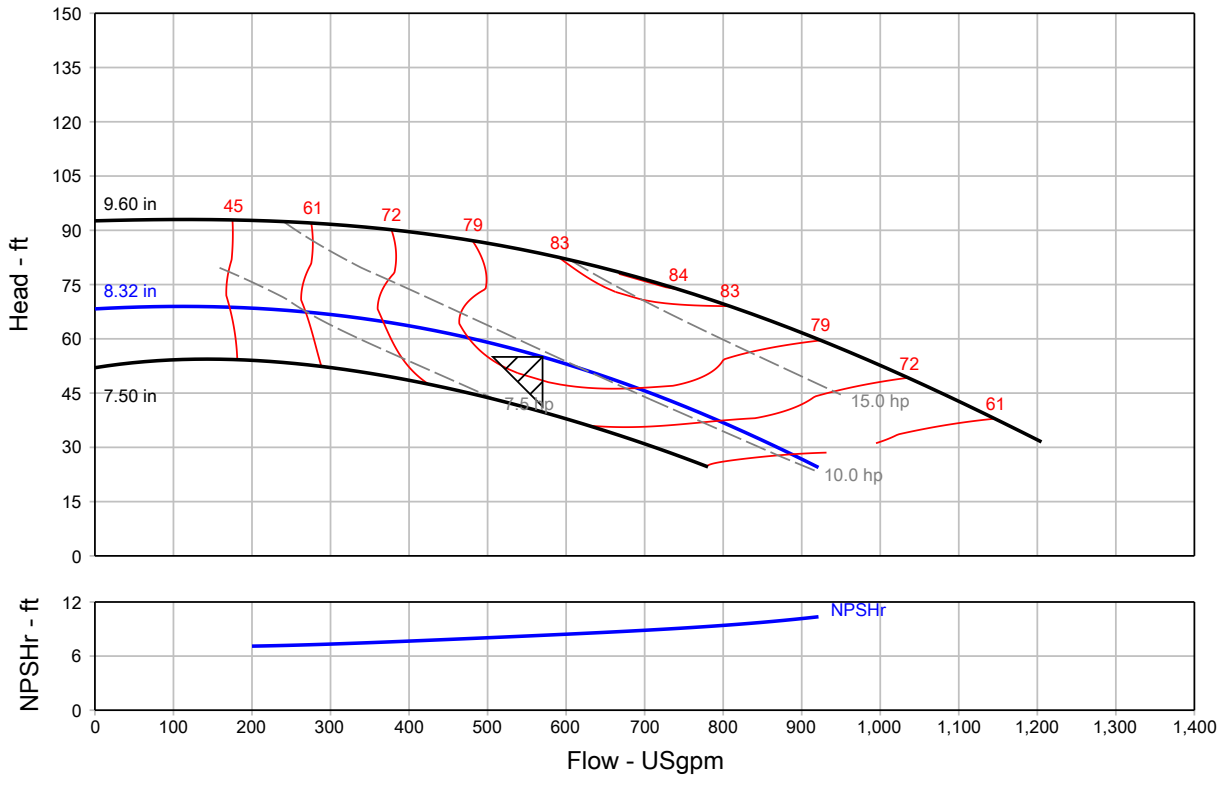
Material selected	: Cast iron

Pressure Data

Maximum working pressure	: 29.84 psi.g
Maximum allowable working pressure	: 175.0 psi.g
Maximum allowable suction pressure	: 175.0 psi.g
Hydrostatic test pressure	: 263.0 psi.g

Driver & Power Data (@Max density)

Motor sizing specification	: Max power (non-overloading)
Margin over specification	: 0.00 %
Service factor	: 1.00
Power, hydraulic	: 7.91 hp
Rated power (based on duty point)	: 9.74 hp
Max power (non-overloading)	: 10.40 hp
Nameplate motor rating	: 15.00 hp / 11.19 kW



Construction Datasheet

Project name	: Stone Bank	Tag Number	: CP-1 & 2
Consulting engineer	:	Service	: Pump Room
Customer	: FLUID SOLUTIONS INC	Model	: 40957 LF
Customer ref. / PO	:	Quantity	: 2
Quote Number / ID	: 030524A	Quoted By (Sales Office)	: FLUID SOLUTIONS INC
Date last saved	: 03/05/2024 2:46 PM	Quoted By (Sales Engineer)	: James Dayer

Construction

Nozzle	Size (in.)	Nozzle Configuration	Pos'n
Suction	5	125# ANSI	End
Discharge	4	125# ANSI	Top

Orientation / Configuration	: Horizontal
Rotation	: Clockwise
Wear Ring Configuration	: Single - Case
Discharge Elbow Size	: -
Subplate	: -
Sump Depth (feet)	: -
Bearing Frame	: 3P
Bearing Frame Foot	: -
Bearing Type (Radial/Thrust)	: Ball/Ball
Bearing Lubrication	: Greased for life
Thrust Bearing	: -
Intermediate Bearing	: -
Lower Bearing	: -
Bearing Housing Accessories	: -
PACO Construction Code	: 11-40957-133P08-1822P

Baseplate, Coupling and Guard

Baseplate	: Welded Steel Fabrication
Drip Pan	: Drip Pan
Coupling	: Woods Sureflex Type S (elastomeric) 6S
Guard	: OSHA Approved

Seal & Packing Construction

Sealing Method	: Single Seal, Type 21S
Seal Material	: Buna Carbon Ceramic SS-Spring and Hardware
Packing Gland	: -
Lantern Ring	: -
Recirculation Lines	: None

Weights (Approx.)

Pump	: 138.0 lb
Baseplate	: 0.00 lb
Driver	: 217.0 lb
Estimated Shipping gross weight	: 355.0 lb

Motor Information

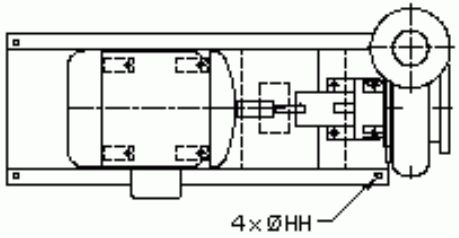
Manufacturer	: Baldor
Frame Size	: 254T
Power	: 15.00 hp
RPM	: 1800 rpm
Enclosure	: ODP
Operating Power Supply	: 230/460/3/60
Efficiency	: Premium
Service factor	: 1.15
Motor Application	: General Purpose
Motor Options/Accessories	: -
Cord Length (feet)	: -

Materials

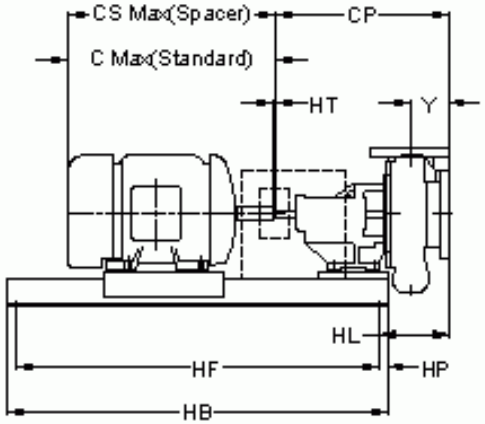
Case	: Cast Iron, ASTM A48 - Class 30
Motor Bracket	: -
Impeller	: Stainless Steel, AISI-304 (H304)
Impeller Cap Screw and Washer	: Stainless Steel, AISI-303
Impeller Key	: Stainless Steel, AISI 316
Case wear ring	: Tin Bronze, ASTM B584-90500 (B18)
Impeller wear ring	: Not Applicable
Pump Shaft	: Stressproof Steel, AISI 1144
Sleeve	: Bronze, III932, C89835
Line Shaft	: -
Column	: -
Discharge Pipe	: -
Discharge Elbow	: -
Suction Elbow	: -
Subplate	: -
Hardware	: Steel, Grade 5
O Rings	: Buna N
Pump Coatings	: Standard Manufacturer's Paint

General Arrangement

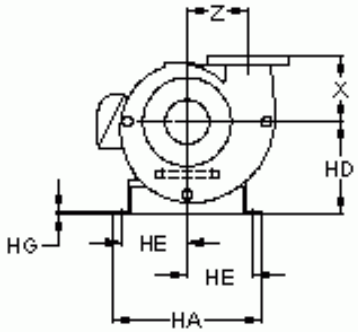
Project name	: Stone Bank	Tag Number	: CP-1 & 2
Consulting engineer	:	Service	: Pump Room
Customer	:	Model	: 40957 LF
Customer ref. / PO	:	Quantity of pumps	: 2
Quote Number / ID	: 030524A	Quoted By (Sales Office)	: FLUID SOLUTIONS INC
Date last saved	: 03/05/2024 2:46 PM	Quoted By (Sales Engineer)	: James Dayer



PLAN VIEW



SIDE VIEW



END VIEW

NOT FOR CONSTRUCTION, UNLESS CERTIFIED AND REFERENCED ON ORDER

Units	Frame	Ped	Suct(in)	Disch(in)	C	CP	HA	HB	HD	HE	HF	HG	HH	HL	HP	HT	MU	N	Q	U	X	Y	Z	Weight ea
inches	**254T**	**3P**	**5**	**4**	**27.00**	**19.60**	**17.00**	**38.13**	**10.38**	**7.50**	**36.13**	**0.25**	**0.63**	**8.03**	**1.00**	**0.69**	**1.63**	**2.25**	**3.88**	**0.88**	**7.50**	**4.28**	**6.88**	**355.0**

Conditions of Service		Motor Data			
Flow: 570.0 USgpm	Fluid: Cold Water	HP: 15	Encl: ODP	Phase: 3	Efficiency: Premium
TDH: 55.00 ft	Temp.: 68.00 deg F	RPM: 1760 rpm	Hz: 60	Voltage: 230/460	S.F.: 1.15

Pump Performance Datasheet

Customer	:	Quote Number / ID	: 030524A
Customer ref. / PO	:	Model	: 25709 VL
Tag Number	: CP-3	Stages	: 1
Service	: Mech Yard	Based on curve number	: VL_25709_4P Rev May22
Quantity	: 1	Basic model number	: -
		Date last saved	: 03/05/2024 2:48 PM

Operating Conditions

Flow, rated	: 125.0 USgpm
Differential head / pressure, rated (requested)	: 30.00 ft
Differential head / pressure, rated (actual)	: 30.04 ft
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available, rated	: Ample
Site Supply Frequency	: 60 Hz

Performance

Speed, rated	: 1760 rpm
Impeller diameter, rated	: 6.01 in
Impeller diameter, maximum	: 7.10 in
Impeller diameter, minimum	: 5.00 in
Efficiency	: 68.95 %
NPSH required / margin required	: 2.80 / 0.00 ft
nq (imp. eye flow) / S (imp. eye flow)	: 26 / 128 Metric units
MCSF	: 39.09 USgpm
Head, maximum, rated diameter	: 36.35 ft
Head rise to shutoff	: 20.72 %
Flow, best eff. point	: 129.2 USgpm
Flow ratio, rated / BEP	: 96.76 %
Diameter ratio (rated / max)	: 84.65 %
Head ratio (rated dia / max dia)	: 61.21 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Energy Indexes

PEI (CL)	: 0.95
ER (CL)	: 5

Liquid

Liquid type	: Cold Water
Additional liquid description	:
Solids diameter, max	: 0.00 in
Solids concentration, by volume	: 0.00 %
Temperature, max	: 68.00 deg F
Fluid density, rated / max	: 1.000 / 1.000 SG
Viscosity, rated	: 1.00 cP
Vapor pressure, rated	: 0.34 psi.a

Material

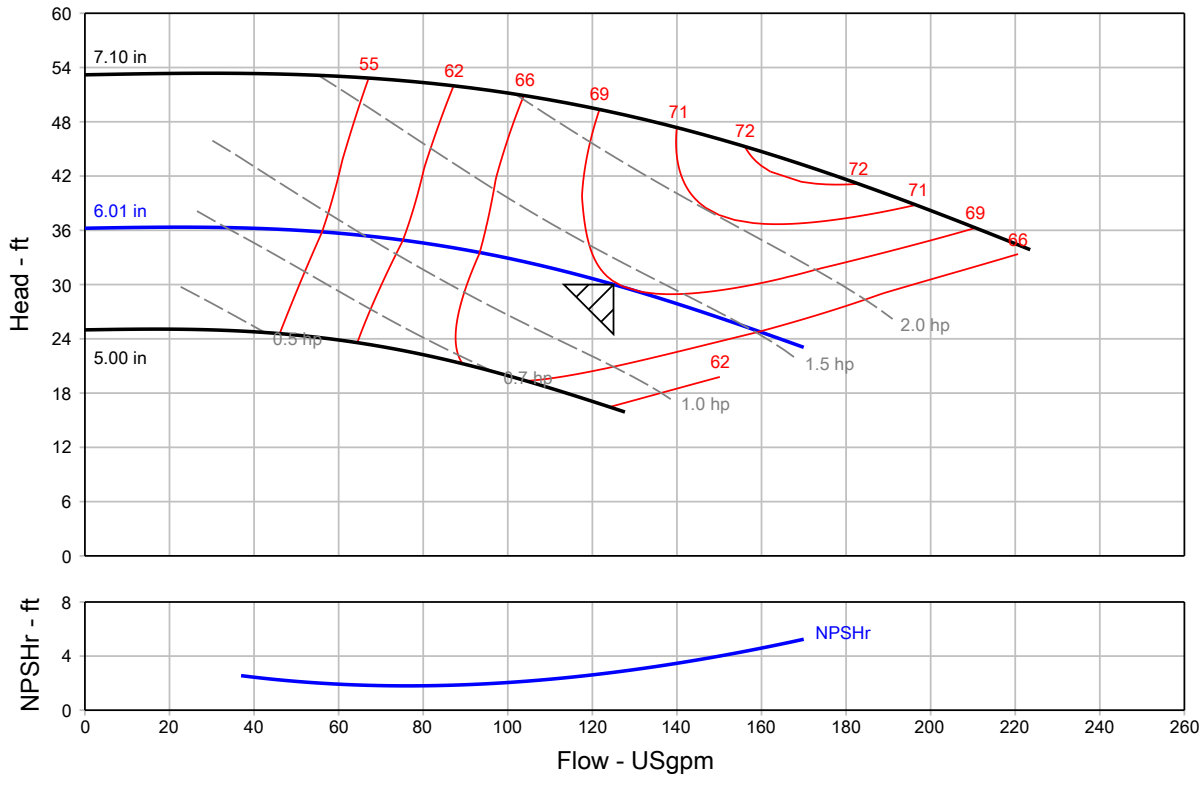
Material selected	: Cast iron - 125#

Pressure Data

Maximum working pressure	: 15.73 psi.g
Maximum allowable working pressure	: 175.0 psi.g
Maximum allowable suction pressure	: 175.0 psi.g
Hydrostatic test pressure	: 263.0 psi.g

Driver & Power Data (@Max density)

Motor sizing specification	: Max power (non-overloading)
Margin over specification	: 0.00 %
Service factor	: 1.00
Power, hydraulic	: 0.95 hp
Rated power (based on duty point)	: 1.37 hp
Max power (non-overloading)	: 1.57 hp
Nameplate motor rating	: 2.00 hp / 1.49 kW



Construction Datasheet

Project name	: Stone Bank	Tag Number	: CP-3
Consulting engineer	:	Service	: Mech Yard
Customer	: FLUID SOLUTIONS INC	Model	: 25709 VL
Customer ref. / PO	:	Quantity	: 1
Quote Number / ID	: 030524A	Quoted By (Sales Office)	: FLUID SOLUTIONS INC
Date last saved	: 03/05/2024 2:48 PM	Quoted By (Sales Engineer)	: James Dayer

Construction

Nozzle	Size (in.)	Nozzle Configuration	Pos'n
Suction	2.5	125# ANSI	Side
Discharge	2.5	125# ANSI	Side

Orientation / Configuration	: Vertical
Rotation	: Clockwise
Wear Ring Configuration	: Single - Case
Discharge Elbow Size	: -
Subplate	: -
Sump Depth (feet)	: -
Bearing Frame	: -
Bearing Frame Foot	: -
Bearing Type (Radial/Thrust)	: In motor
Bearing Lubrication	: Regreasable
Thrust Bearing	: -
Intermediate Bearing	: -
Lower Bearing	: -
Bearing Housing Accessories	: -
PACO Construction code	: 16-25709-130108-2562P

Baseplate, Coupling and Guard

Baseplate	: Not Applicable
Drip Pan	: -
Coupling	: -
Guard	: OSHA Approved

Seal & Packing Construction

Sealing Method	: Single Seal, Type 21S
Seal Material	: Buna Carbon Ceramic SS-Spring and Hardware
Packing Gland	: -
Lantern Ring	: -
Recirculation Lines	: Nylon Tubing with Brass Fittings

Weights (Approx.)

Pump	: 91.00 lb
Baseplate	: -
Driver	: 53.00 lb
Estimated Shipping gross weight	: 144.0 lb

Motor Information

Manufacturer	: Baldor
Frame Size	: 145JM
Power	: 2.00 hp
RPM	: 1800 rpm
Enclosure	: TEFC
Operating Power Supply	: 230/460/3/60
Efficiency	: Premium
Service factor	: 1.15
Motor Application	: General Purpose
Motor Options/Accessories	: -
Cord Length (feet)	: -

Materials

Case	: Cast Iron, ASTM A48 - Class 30
Motor Bracket	: Cast Iron, ASTM-A48, CL 30
Impeller	: Stainless Steel, AISI-304 (H304)
Impeller Cap Screw and Washer	: Stainless Steel, AISI-303
Impeller Key	: Stainless Steel, AISI 316
Case wear ring	: Tin Bronze, ASTM B584-90500 (B18)
Impeller wear ring	: -
Pump Shaft	: Steel, AISI-1040
Sleeve	: Bronze, III932, C89835
Line Shaft	: -
Column	: -
Discharge Pipe	: -
Discharge Elbow	: -
Suction Elbow	: -
Subplate	: -
Hardware	: Steel, Grade 5
O Rings	: Buna N
Pump Coatings	: Standard Manufacturers Paint

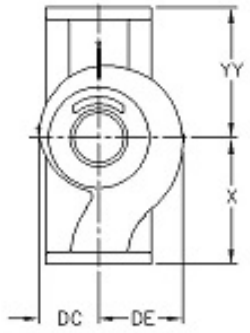
General Arrangement

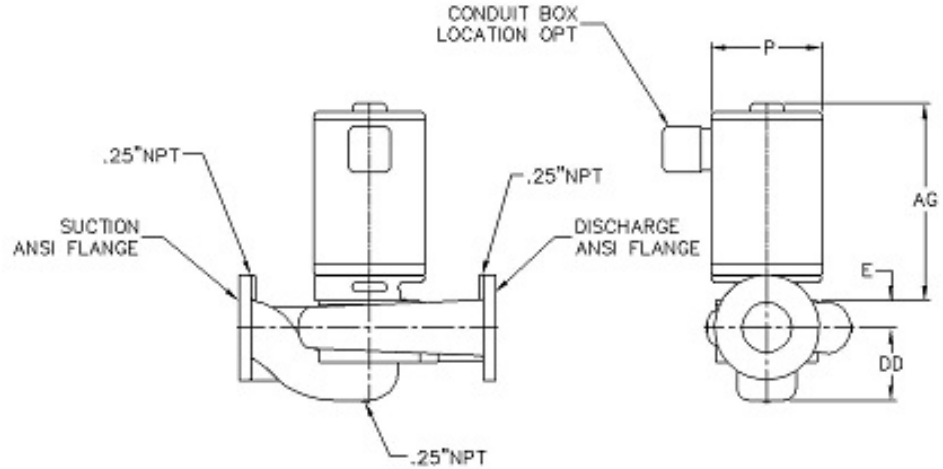
Project name	: Stone Bank	Tag Number	: CP-3
Consulting engineer	:	Service	: Mech Yard
Customer	:	Model	: 25709 VL
Customer ref. / PO	:	Quantity of pumps	: 1
Quote Number / ID	: 030524A	Quoted By (Sales Office)	: FLUID SOLUTIONS INC
Date last saved	: 03/05/2024 2:48 PM	Quoted By (Sales Engineer)	: James Dayer

Do not install pump larger than 215JM in vertical piping.

Pressure and drain tap locations are approximate.

Suction and discharge flanges, are cast per 250# ANSI thickness and diameter. All flanges are flat face. Some holes may be threaded because of nut clearances.





NOT FOR CONSTRUCTION, UNLESS CERTIFIED AND REFERENCED ON ORDER

Units	Frame	S x D (in.)	AG (Max)	DC	DD	DE	E	P (Max)	X	YY	Weight ea
inches	**145JM**	**2.5 X 2.5**	**18.00**	**4.75**	**5.84**	**5.50**	**1.75**	**8.00**	**8.50**	**8.50**	**144.0**

Conditions of Service		Motor Data			
Flow: 125.0 USgpm	Fluid: Cold Water	HP: 2	Encl: TEFC	Phase: 3	Efficiency: Premium
TDH: 30.00 ft	Temp.: 68.00 deg F	RPM: 1760 rpm	Hz: 60	Voltage: 230/460	S.F.: 1.15

Project name	: Stone Bank	Tag Number	: CP-1 & 2
Consulting engineer	:	Service	:
Customer	: FLUID SOLUTIONS INC	Model	: SD6050-125
Customer ref. / PO	:	Quantity	: 2
Quote Number / ID	: 030524A	Quoted By (Sales Office)	: FLUID SOLUTIONS INC
Date last saved	: 03/05/2024 2:57 PM	Quoted By (Sales Engineer)	: James Dayer

Construction

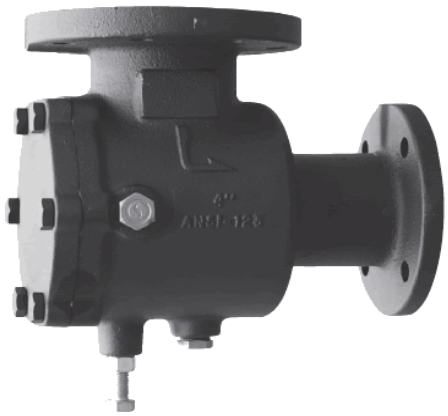
Nozzle	Size (in.)	Nozzle Configuration	Pos'n
Inlet	6	-	Top
Outlet	5	-	Side

Difuser Body	: Cast Iron, ASTM-A126, CL B
Hardware	: Steel, ASTM A-283C
Internal Magnet	: -
Strainer	: SS 304, ASTM-A240, 3.5MM Holes
Mesh Grid (Startup strainer)	: SS 304, ASTM-A240, (#20 Mesh)
Strainer Cover	: Cast Iron, ASTM-A126, CL B
O Rings	: EPDM
Coating	: Standard Manufacturers Paint
Construction Code/Part Number	: 99329704

Weights (Approx.)

Estimated Shipping gross weight	: 122.0 lb

Grundfos Suction Diffusers



Description

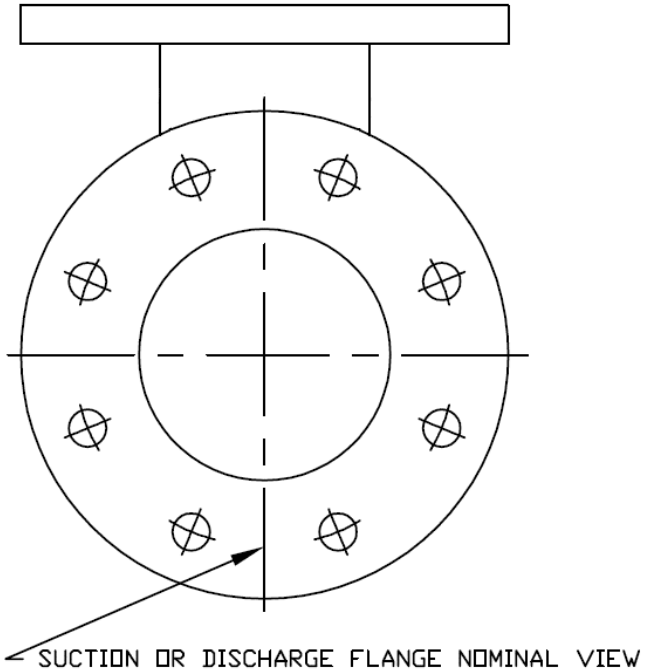
Grundfos Series SD, Suction diffuser provides and ensures a uniform flow pattern to the suction side of the pump ensuring a stable NPSH. Suction diffuser makes it possible to install the pump in a very narrow spacing as no long bends are necessary.

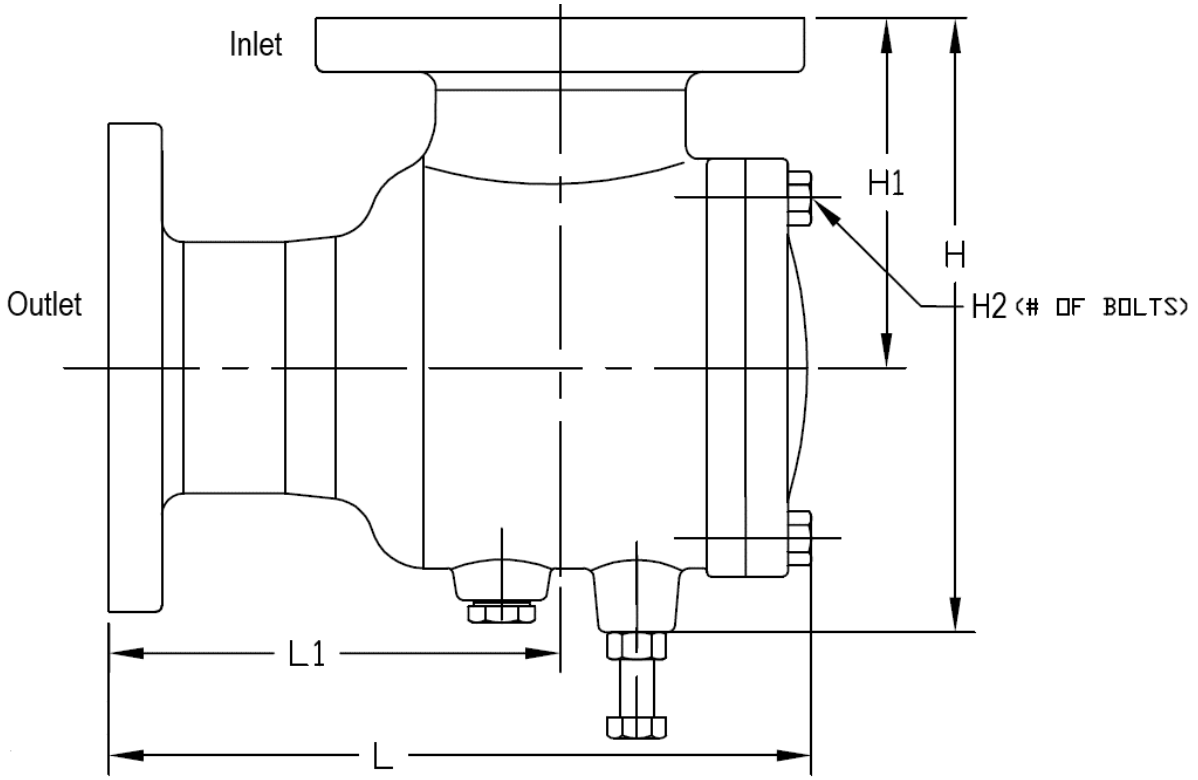
The suction diffuser incorporates a cylindrical strainer preventing impurities from entering the pump. Additional feature includes an adjustable support for mounting.

-

General Arrangement

Project name	: Stone Bank	Tag Number	: CP-1 & 2
Consulting engineer	:	Service	:
Customer	:	Model	: SD6050-125
Customer ref. / PO	:	Quantity of pumps	: 2
Quote Number / ID	: 030524A	Quoted By (Sales Office)	: FLUID SOLUTIONS INC
Date last saved	: 03/05/2024 2:57 PM	Quoted By (Sales Engineer)	: James Dayer





NOT FOR CONSTRUCTION, UNLESS CERTIFIED AND REFERENCED ON ORDER

Units	Inlet (in)	Outlet (in)	Strainer Area (sq in)	L (in)	L1 (in)	H1 (in)	H (in)	H2 (qty)	Weight (lbs)
inches	**6**	**5**	**102**	**15.60**	**10.30**	**8.00**	**13.90**	**6.00**	**122**

Project name	: Stone Bank	Tag Number	: CP-3
Consulting engineer	:	Service	:
Customer	: FLUID SOLUTIONS INC	Model	: SD3025-125
Customer ref. / PO	:	Quantity	: 1
Quote Number / ID	: 030524A	Quoted By (Sales Office)	: FLUID SOLUTIONS INC
Date last saved	: 03/05/2024 2:58 PM	Quoted By (Sales Engineer)	: James Dayer

Construction

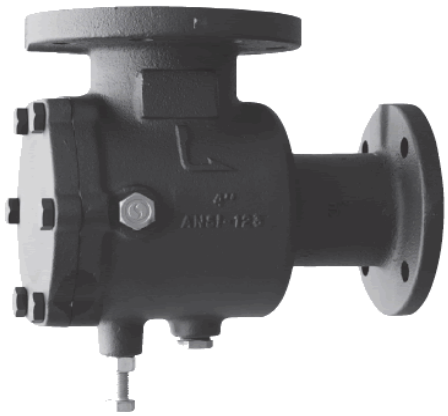
Nozzle	Size (in.)	Nozzle Configuration	Pos'n
Inlet	3	-	Top
Outlet	2.5	-	Side

Difuser Body	: Cast Iron, ASTM-A126, CL B
Hardware	: Steel, ASTM A-283C
Internal Magnet	: -
Strainer	: SS 304, ASTM-A240, 3.5MM Holes
Mesh Grid (Startup strainer)	: SS 304, ASTM-A240, (#20 Mesh)
Strainer Cover	: Cast Iron, ASTM-A126, CL B
O Rings	: EPDM
Coating	: Standard Manufacturers Paint
Construction Code/Part Number	: 97523150

Weights (Approx.)

Estimated Shipping gross weight : 39.00 lb

Grundfos Suction Diffusers



Description

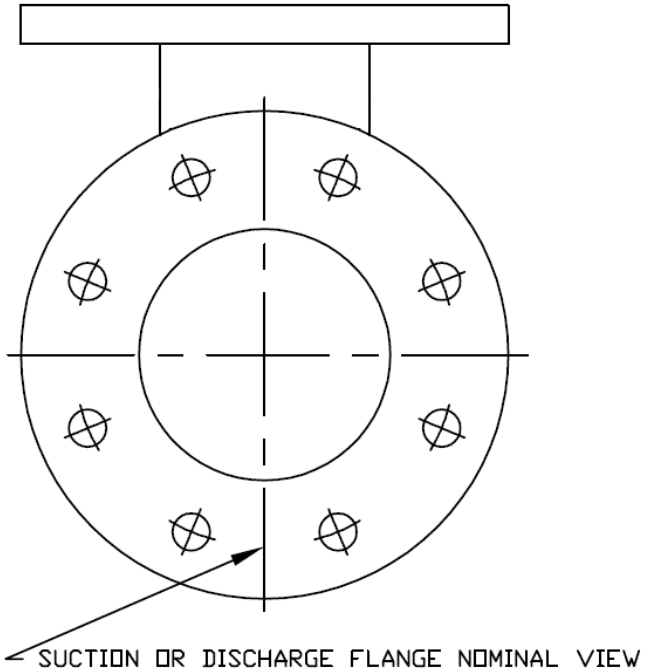
Grundfos Series SD, Suction diffuser provides and ensures a uniform flow pattern to the suction side of the pump ensuring a stable NPSH. Suction diffuser makes it possible to install the pump in a very narrow spacing as no long bends are necessary.

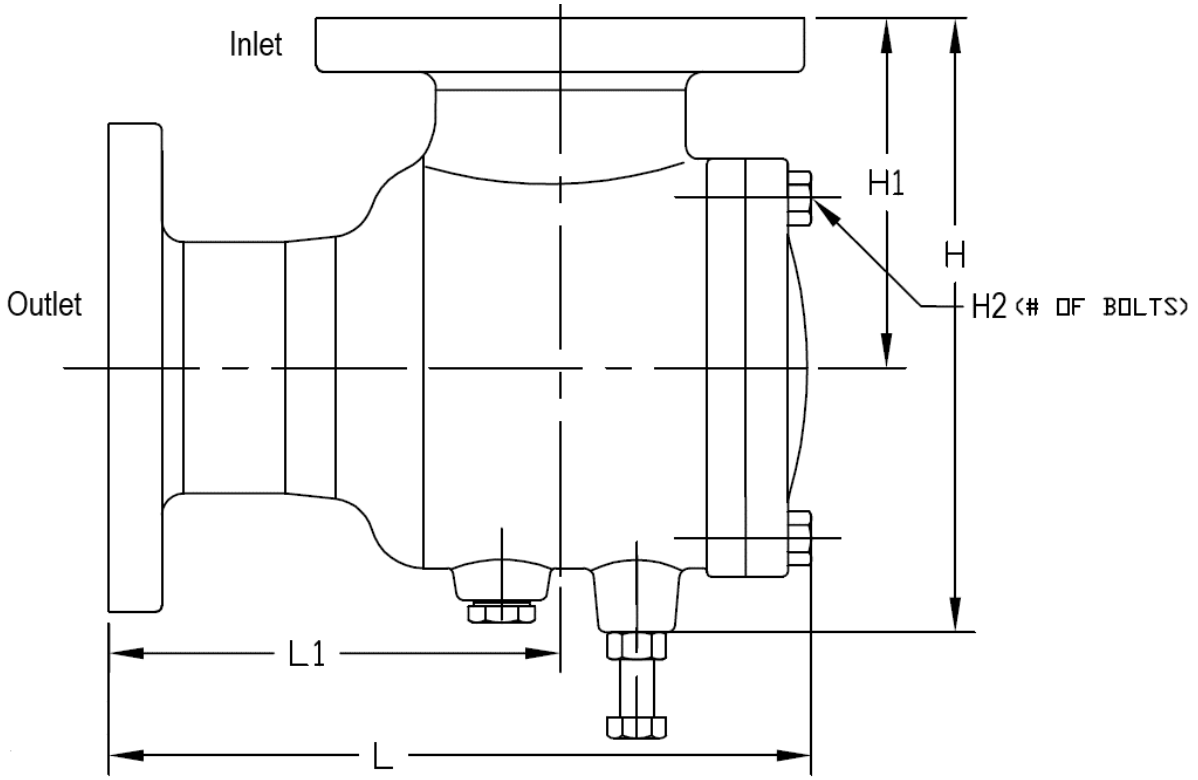
The suction diffuser incorporates a cylindrical strainer preventing impurities from entering the pump. Additional feature includes an adjustable support for mounting.

-

General Arrangement

Project name	: Stone Bank	Tag Number	: CP-3
Consulting engineer	:	Service	:
Customer	:	Model	: SD3025-125
Customer ref. / PO	:	Quantity of pumps	: 1
Quote Number / ID	: 030524A	Quoted By (Sales Office)	: FLUID SOLUTIONS INC
Date last saved	: 03/05/2024 2:58 PM	Quoted By (Sales Engineer)	: James Dayer





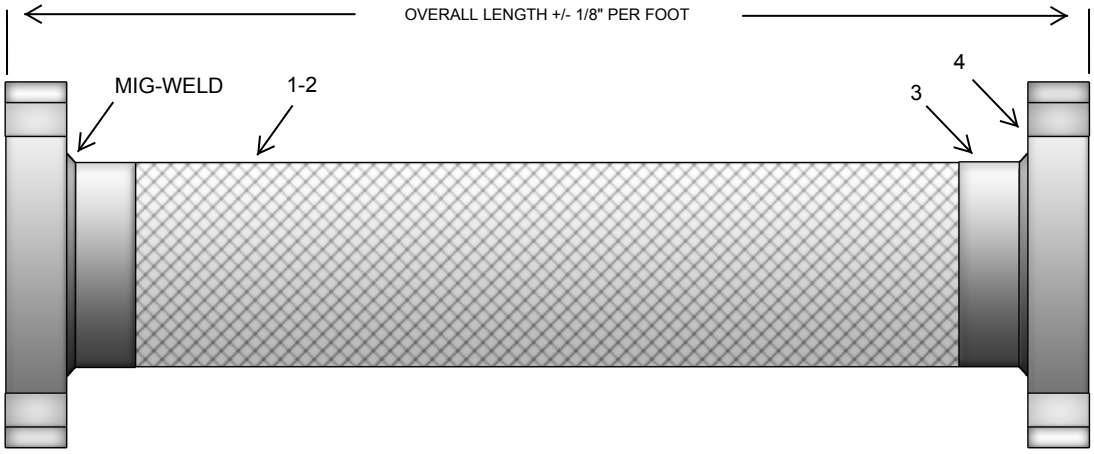
NOT FOR CONSTRUCTION, UNLESS CERTIFIED AND REFERENCED ON ORDER

Units	Inlet (in)	Outlet (in)	Strainer Area (sq in)	L (in)	L1 (in)	H1 (in)	H (in)	H2 (qty)	Weight (lbs)
inches	**3**	**2.5**	**40**	**11.10**	**7.10**	**5.60**	**9.60**	**4.00**	**39**

CP-1, 2, 3 Pump Connectors

TCHS - FLG

TWIN CITY HOSE, LLC.



MATERIALS

#1-2 HOSE: T-321 STAINLESS STEEL HOSE 1-LAYER T-304 BRAID

#3 BRAID BAND: T-304 STAINLESS STEEL

#4 END FITTING: CARBON STEEL PLATE FLANGES 150# DRILL

QTY	MODEL NUMBER	SIZE	OAL	MAX O.D.	WRK. PSIG	MAX TEST	@ TEMP.	LATERAL OFFSET	WT. LBS.
	TCHS-150-FLG	1 ½"	9"	1.91"	370	555	70° F	1/16"	7
	TCHS-200-FLG	2"	9"	2.46"	370	555	70° F	1/16"	9
	TCHS-250-FLG	2 ½"	9"	3.45"	400	600	70° F	1/16"	12
2	TCHS-300-FLG	3"	9"	4.01"	288	431	70° F	1/16"	13
	TCHS-400-FLG	4"	9"	5.03"	250	375	70° F	1/16"	18
4	TCHS-500-FLG	5"	11"	6.10"	200	300	70° F	1/16"	25
	TCHS-600-FLG	6"	11"	7.15"	220	330	70° F	1/16"	28
	TCHS-800-FLG	8"	12"	9.44"	215	323	70° F	1/16"	52
	TCHS-1000-FLG	10"	13"	11.49"	200	350	70° F	1/16"	65
	TCHS-1200-FLG	12"	14"	13.51"	160	240	70° F	1/16"	105
	TCHS-1400-FLG	14"	14"	15.67"	150	225	70° F	1/16"	115
	TCHS-1600-FLG	16"	14"	17.31"	110	165	70° F	1/16"	235

TEMPERATURE DERATING FACTORS: MULTIPLY X WRK. PSIG									
200° F	250° F	300° F	350° F	400° F	500° F	600° F	700° F		
0.94	0.92	0.88	0.86	0.83	0.78	0.74	0.7		

DRAWN BY: _____ **DRAWING NUMBER:** _____ **REV:** _____

SIGNATURE: _____ **DATE:** _____

PO NUMBER: _____ **PROJECT:** _____

CUSTOMER: _____ **NOTES:**

20615 Commerce Blvd., Rogers, MN 55374 P 1-800-670-9475 F 763-428-5111 E sales@twincityhose.com W www.twincityhose.com