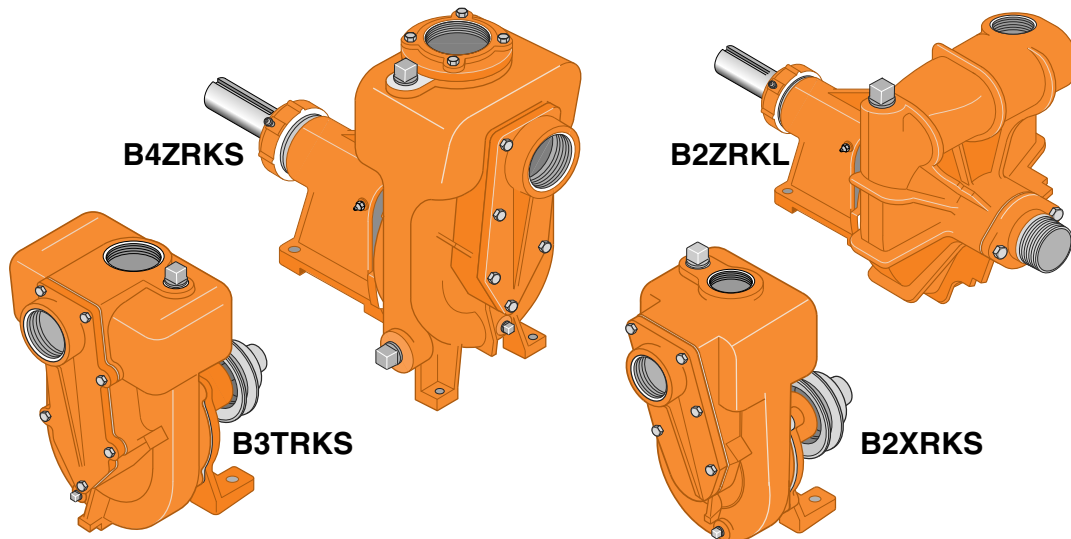




OWNERS MANUAL

INSTALLATION AND OPERATING INSTRUCTIONS
REPAIR PARTS LIST

Self Prime Frame Mounted Centrifugal Pump



Direct Coupling Drive/ Belt Driven/Hydraulic Drive

IMPORTANT

For best possible performance and continuous, satisfactory operation, read these instructions before installing your new pump.

Should service be required, this manual can be a valuable guide.

It should be kept near the installation for ready reference.

Record nameplate data from pump on blank nameplate inside this manual for future reference.

Berkeley Pumps / 293 Wright Street / Delavan, WI 53115

F00633 (Rev. 4/18/05)

Safety First

General Information

Pump Location

General Safety

Do not allow pump, piping, or any other system component containing water to freeze. Freezing may damage system, leading to injury or flooding. Allowing pump or system components to freeze will void warranty.

Pump approved liquids only with this pump.

Periodically inspect pump and system components.

Wear safety glasses at all times when working on pumps.

Keep work area clean, uncluttered and properly lighted; store properly all unused tools and equipment.

Keep visitors at a safe distance from the work areas.

READ AND FOLLOW SAFETY INSTRUCTIONS!

⚠ This is the safety alert symbol. When you see this symbol on your pump or in this manual, look for one of the following signal words and be alert to the potential for personal injury:

⚠ DANGER warns about hazards that **will** cause serious personal injury, death or major property damage if ignored.

⚠ WARNING warns about hazards that **will** or **can** cause serious personal injury, death or major property damage if ignored.

⚠ CAUTION warns about hazards that **will** or **can** cause minor personal injury or property damage if ignored.

The label **NOTICE** indicates special instructions which are important but not related to hazards.

Carefully read and follow all safety instructions in this manual and on pump.

Keep safety labels in good condition. Replace missing or damaged safety labels.

LOCATION:


Locate the pump as near to the water source as practical. Make the suction pipe run short and straight with as few pipe fittings as possible to keep total friction loss to a minimum.

Install pump in a clean, dry and well drained location if possible and protect against moisture and adverse weather conditions. Pump should be located on a level, hard surface to prevent shifting or tipping. Locate to be readily accessible for inspection and maintenance.


Careful attention should be taken to assure that Net Positive Suction Head Available (NPSHA) exceeds Net Positive Suction Head Required (NPSHR) by the pump or reduced performance and severe pump damage may result.

Figure 1, Page 3, illustrates where these terms (NPSHA / NPSHR) originate, and how to determine if the pumping conditions at which you want to operate meet the proper criteria. When in doubt, consult your nearest Berkeley Professional Dealer.

NOTE: If pump site is 1000 feet above sea level, subtract 1.2 feet from the NPSHA equation and an additional 1.2 feet for each additional 1000 feet of elevation.

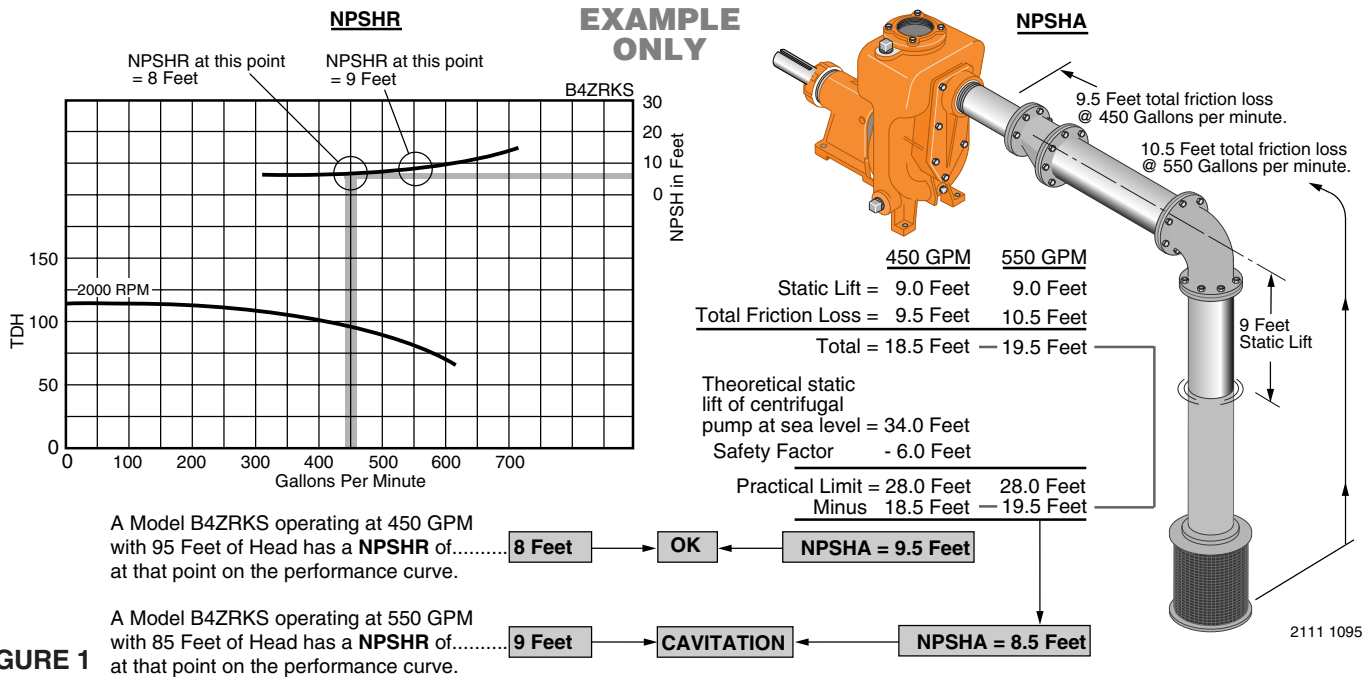
| | |
|--|---|
|  | ⚠ WARNING |
| | <p>Rotating parts. Can catch hands, feet, or clothing.</p> <p>Stay clear of equipment and keep shields in place while pump is running.</p> <p>Stop motor or engine before servicing pump.</p> <p>Read owner's manual before using equipment.</p> |

Electrical Safety

| | |
|---|--|
|  | ⚠ WARNING |
| | <p>⚠ Wire motor for correct voltage. See "Electrical" section of this manual and motor nameplate.</p> |
| | <p>⚠ Ground motor before connecting to power supply.</p> |
| | <p>⚠ Meet National Electrical Code and local codes for all wiring.</p> |
| <p>Hazardous voltage. Can shock, burn, or cause death.</p> <p>Ground pump before connecting to power supply.</p> | |
| | <p>⚠ Follow wiring instructions in this manual when connecting motor to power lines.</p> |

Installation

General Information



FOUNDATION: Refer to illustration on Page 4.

⚠ WARNING Heavy weights; risk of bodily harm due to crushing. Use care and proper lifting equipment when handling pump for installation. Size and weight of some units will require hoists for safe handling.

Pump should be set on a concrete foundation which is sufficiently substantial to absorb vibration and which provides a permanent and rigid support.

When properly positioned, the unit will be level, and the suction and discharge openings of the pump will be aligned with system piping.

PIPING:

System piping should be at least one commercial pipe size larger than pump connections and flow velocity should not exceed eight (8) feet per second. Suction and discharge pipes must be naturally aligned with pump connections.

NOTICE: Misalignment of piping with pump case or excessive pipe strain can cause distortion of pump components resulting in rubbing, breakage and reduced pump life.

Insure that piping is supported in a manner that prevents the exertion of force on pump connections. This can be checked by the following procedure. With the pump shut down, remove pipe flange bolts. If the mating flanges come apart or shift, misalignment is present and causing pressure on the connections. Adjust pipe supports until

flanges mate without any force. This procedure can be done throughout piping system.

SUCTION PIPING:

Refer to illustrations on Page 8 through Page 11 for recommended and not recommended practices in suction connections.

DISCHARGE PIPING:

Refer to illustrations on Pages 12 through 13 for recommended and not recommended practices in discharge connections.

ELECTRICAL CONNECTION:

If electric motor is used.

NOTE: All wiring should be done by a qualified electrician.

⚠ WARNING Hazardous voltage. Can shock, burn, or cause death. Disconnect power to pump before servicing.

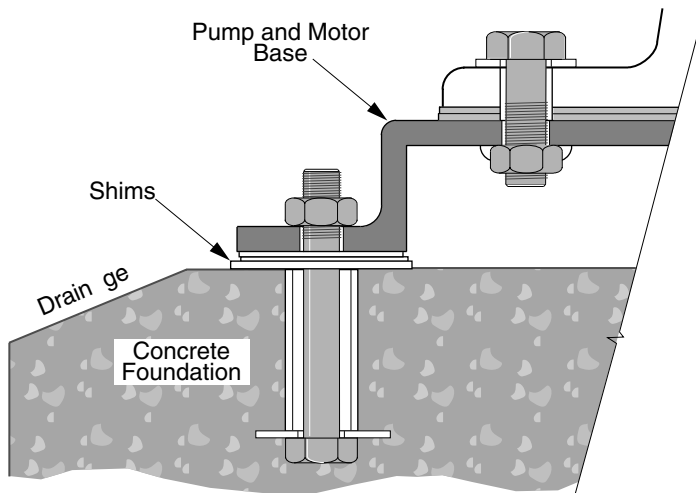
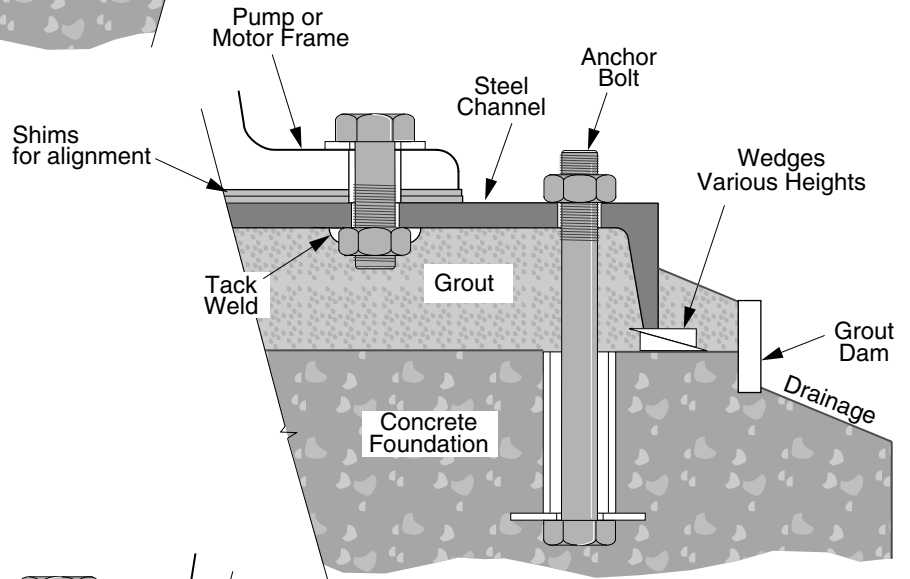
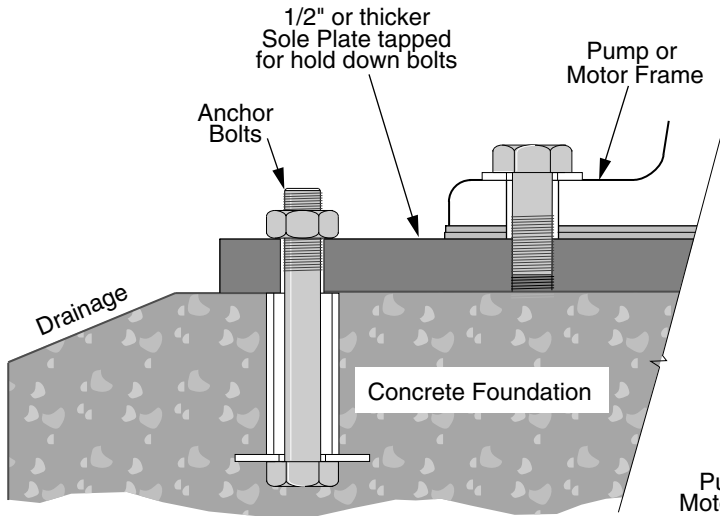
Check voltage and phase stamped on pump motor nameplate before making wiring connections to electrical system. Be sure they agree with your electric current supply. They **MUST** be the same. If in doubt, check with your local power company.

Refer to illustration on Page 7 for minimum recommended pumping panel components that help safeguard your pump during operation.

Installation

Pump Foundation

Typical Installations



1300 1094

- There are several types of permanent pump/foundation installations in use. Those pictured above are typical.
- If grout is used, top of concrete should be left rough to provide a good bonding surface.
- Foundation should slope away from pump to prevent liquid from pooling.

Installation

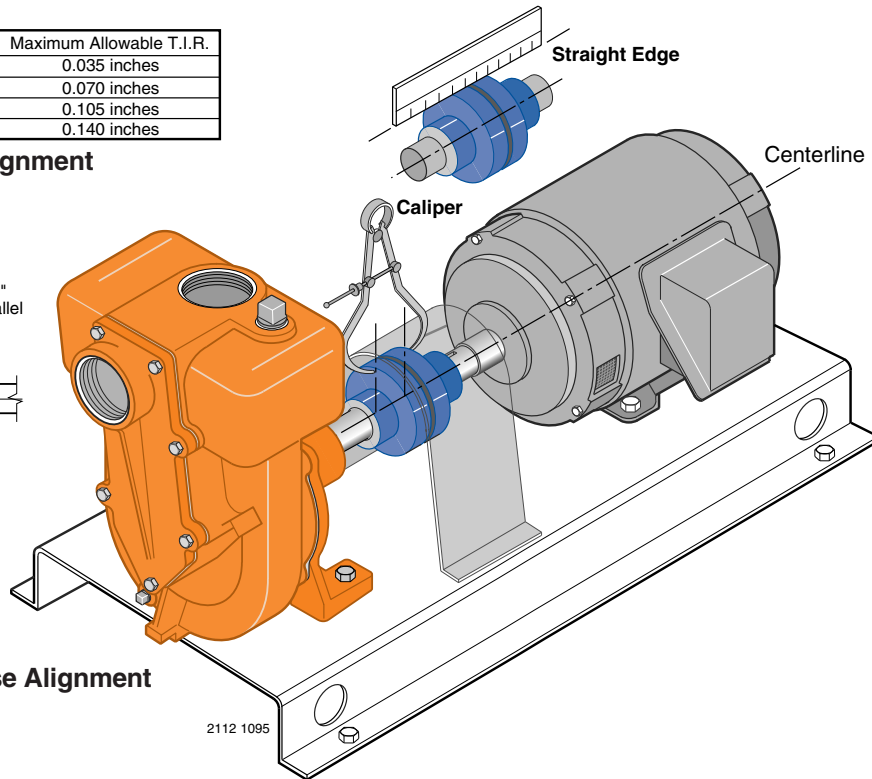
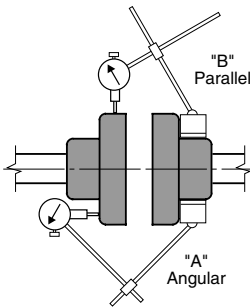
Direct Coupling Drive

Shaft Alignment

Table I

| Distance from Centerline | Maximum Allowable T.I.R. |
|--------------------------|--------------------------|
| 1.00 inch | 0.035 inches |
| 2.00 inches | 0.070 inches |
| 3.00 inches | 0.105 inches |
| 4.00 inches | 0.140 inches |

Fine Alignment



Course Alignment

⚠ WARNING Rotating shaft can catch and trap clothing or body. Coupling guard must ALWAYS be in place when pump is running. Coupling guard shown in phantom for pictorial clarity.

ALIGNMENT OF PUMP AND MOTOR SHAFT

- A flexible coupling (except for double universal joint shaft) will not compensate for misalignment. After the pump unit is fastened on the foundation, it is necessary to see that the shafts of the pump and motor are properly aligned.
- Each motor and pump foot should be shimmed to avoid shifting or *soft foot*.

COURSE ALIGNMENT

- By moving the entire unit, bring suction and discharge openings of the pump into alignment with the system piping. Install piping at this time. Pipes should align naturally with the pump (see Installation Section).
- Bring the pump and motor shaft into approximate alignment by shifting or shimming the motor. Use a straight edge to check alignment of the shafts.
- Use calipers, or a wedge thickness gauge to check the distance between coupling halves. The distance between halves should be equal at 90 degree intervals around the coupling, and the shafts should be concentric when checked with a straight edge.

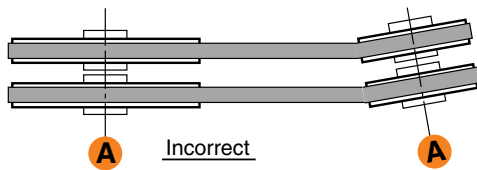
FINE ALIGNMENT

- Angular and parallel misalignment of the coupling may be corrected simultaneously. Maintain a separation between coupling halves, per manufacturer's specifications, to avoid preloading of pump and motor bearings. Clamp dial indicators to the pump and motor shaft as shown above.
- Start with angular alignment and finish check with parallel alignment.
- Rotate both the shaft and coupling together by hand. Note the total indicated runout shown on indicator "A". The maximum allowable angular misalignment is 1 degree. Limits of reading on indicator "A" at various distances from shaft centerline are shown in Table I.
- Continue to rotate both shafts by hand and note the runout shown on indicator "B". The maximum allowable total indicated runout is .005 inches. Should either angular or parallel misalignment exceed the value shown, shift or shim the motor until misalignment is within the allowable limits shown. Do not move pump unless absolutely necessary. When shimming, be sure that all feet on the pump and motor are equally supported to avoid strains on the castings when the hold down bolts are tightened.

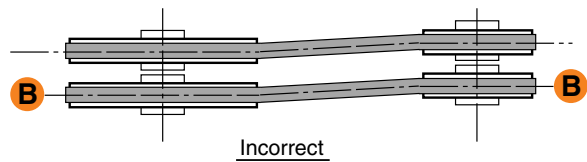
Installation

Belt Drive

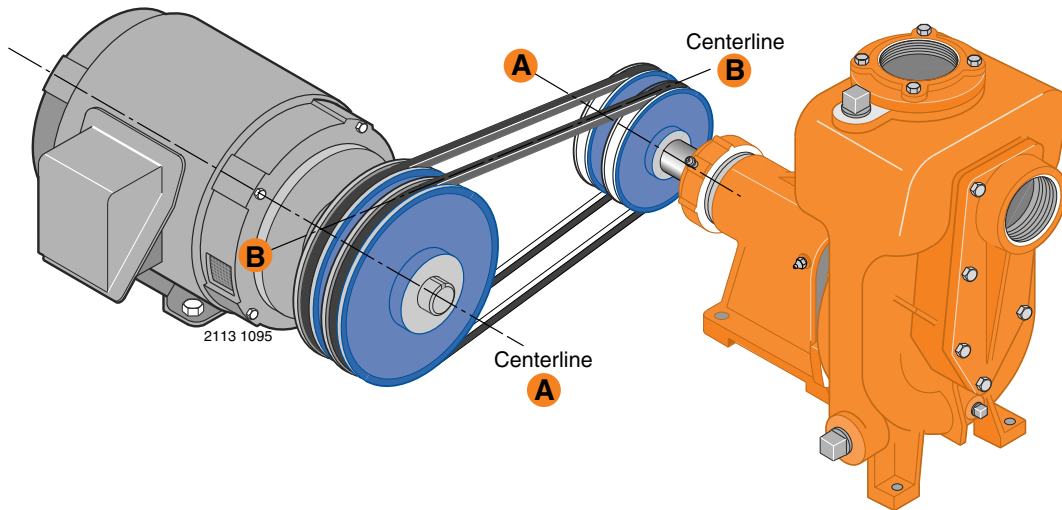
Alignment/Proper Belt Tension



Centerline - A of each shaft and pulley must be parallel for proper alignment.



Centerline - B represents center of belt and pulley. This centerline must be straight for proper alignment.



ALIGNMENT

▲WARNING Drive belt can catch and trap clothing or body. Belt guard must ALWAYS be in place when pump is running. Belt guard is not shown for pictorial clarity.

- Drive and pump shaft centerlines (**A**) must be parallel as shown. Belt centerlines (**B**) must be straight as shown.
- When installing belts, move the driver toward the pump to allow belts to be placed on pulley. Then, move the driver away from pump to obtain proper belt tension as described below.

TENSION

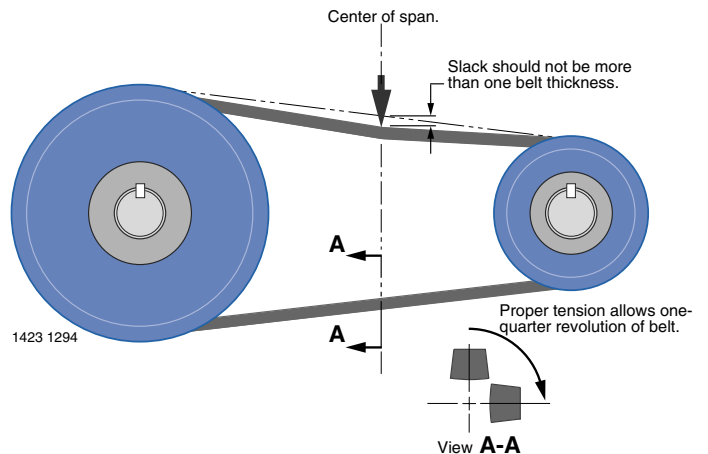
- Multiple belt spans must be equal tension in all belts. Proper belt tension varies with the size of belt being used, however a general rule is:

Belts are properly tensioned when one belt can be depressed one belt thickness at the center of the span when pressing with thumb.

Another method is that a properly tensioned belt can be rotated (twisted) one-quarter revolution at the center of span.

NOTICE: Belts must be tight enough to prevent slipping during operation. Loose belts result in early belt failure and reduced performance. However, **excessive** tightness of belts will result in overheating of the belts and excessive bearing load in the pump and driver.

- Most Vee-belts will stretch slightly after initial installation. After a short period of operation, re-check belt tension and adjust as necessary.

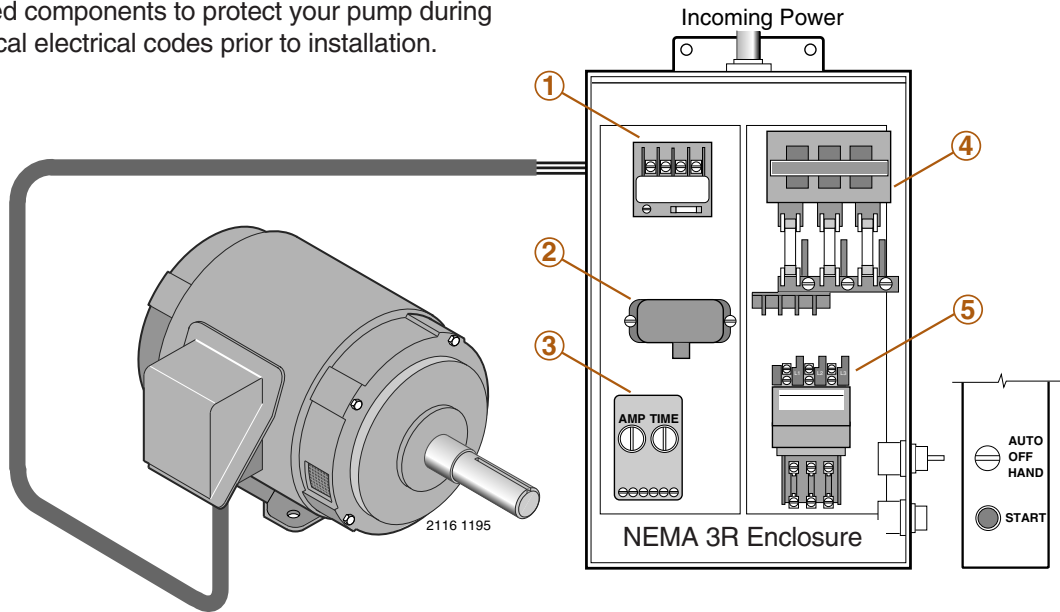


Installation

Electric Motor / Hydraulic Motor

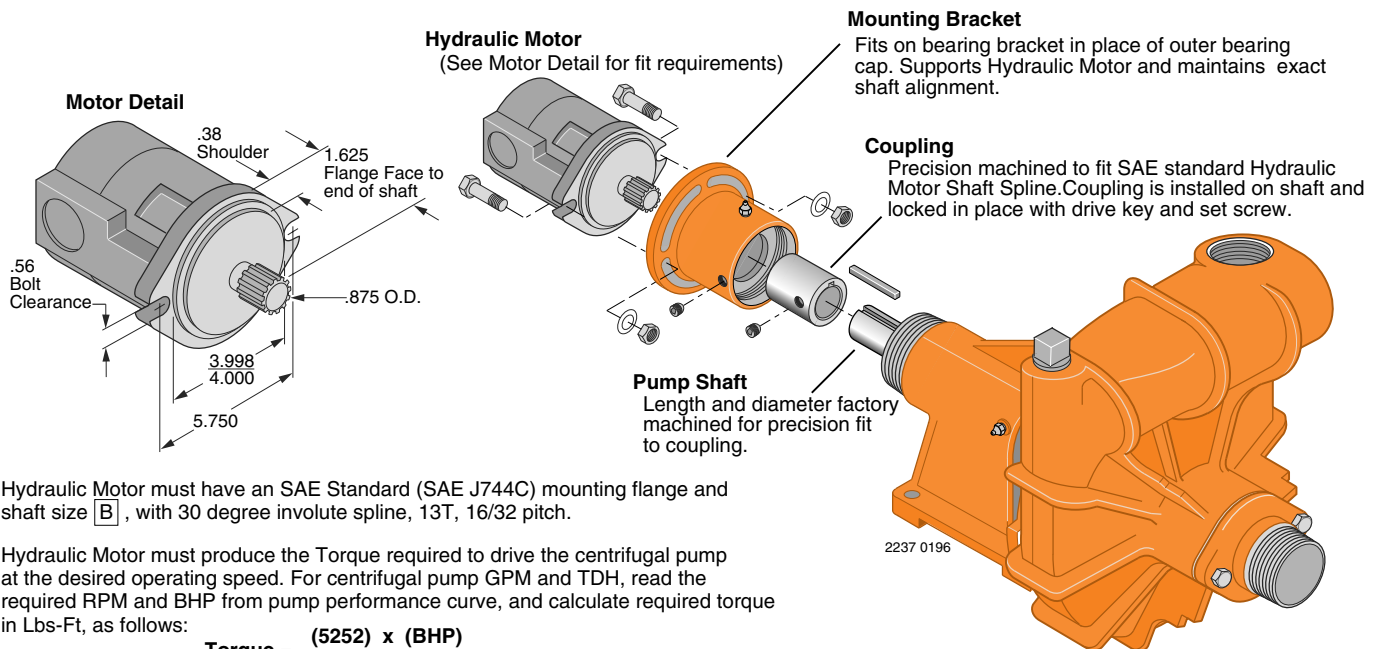
Minimum recommended components to protect your pump during operation. Check all local electrical codes prior to installation.

- ① Contactor
- ② Lightning Arrestor
- ③ Loss of Prime Protection
- ④ Fuseable Disconnect
- ⑤ Starter



Installation

Mounting Hydraulic Motor and Adapter



Hydraulic Motor must have an SAE Standard (SAE J744C) mounting flange and shaft size [B], with 30 degree involute spline, 13T, 16/32 pitch.

Hydraulic Motor must produce the Torque required to drive the centrifugal pump at the desired operating speed. For centrifugal pump GPM and TDH, read the required RPM and BHP from pump performance curve, and calculate required torque in Lbs-Ft, as follows:

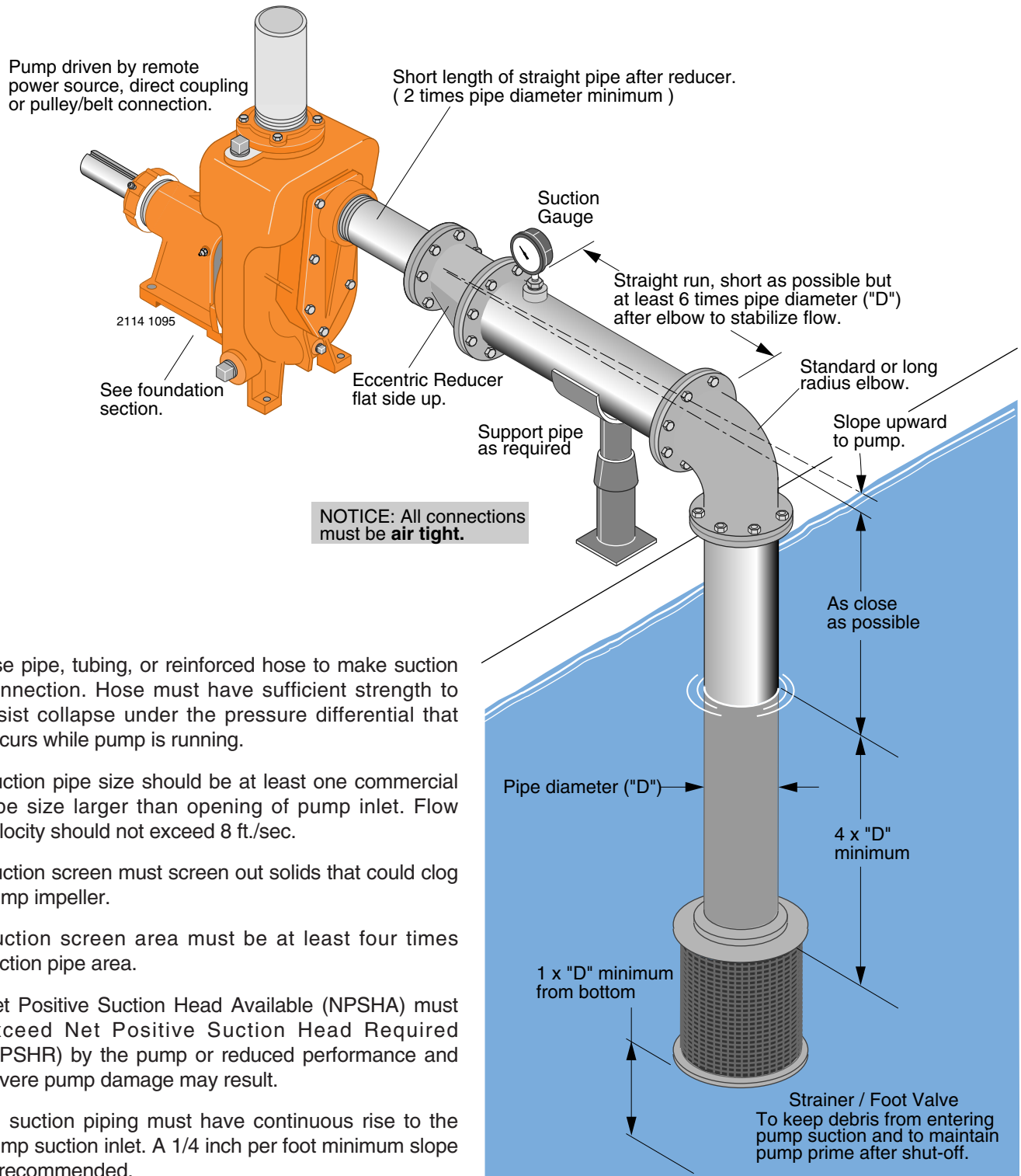
$$\text{Torque} = \frac{(5252) \times (\text{BHP})}{(\text{RPM})}$$

Hydraulic Motor selected must match with the flow and pressure capability of the hydraulic power source system. The operating speed of the centrifugal pump will be controlled by the valves in the hydraulic power source system.

Installation

Suction Connection

Suction Lift



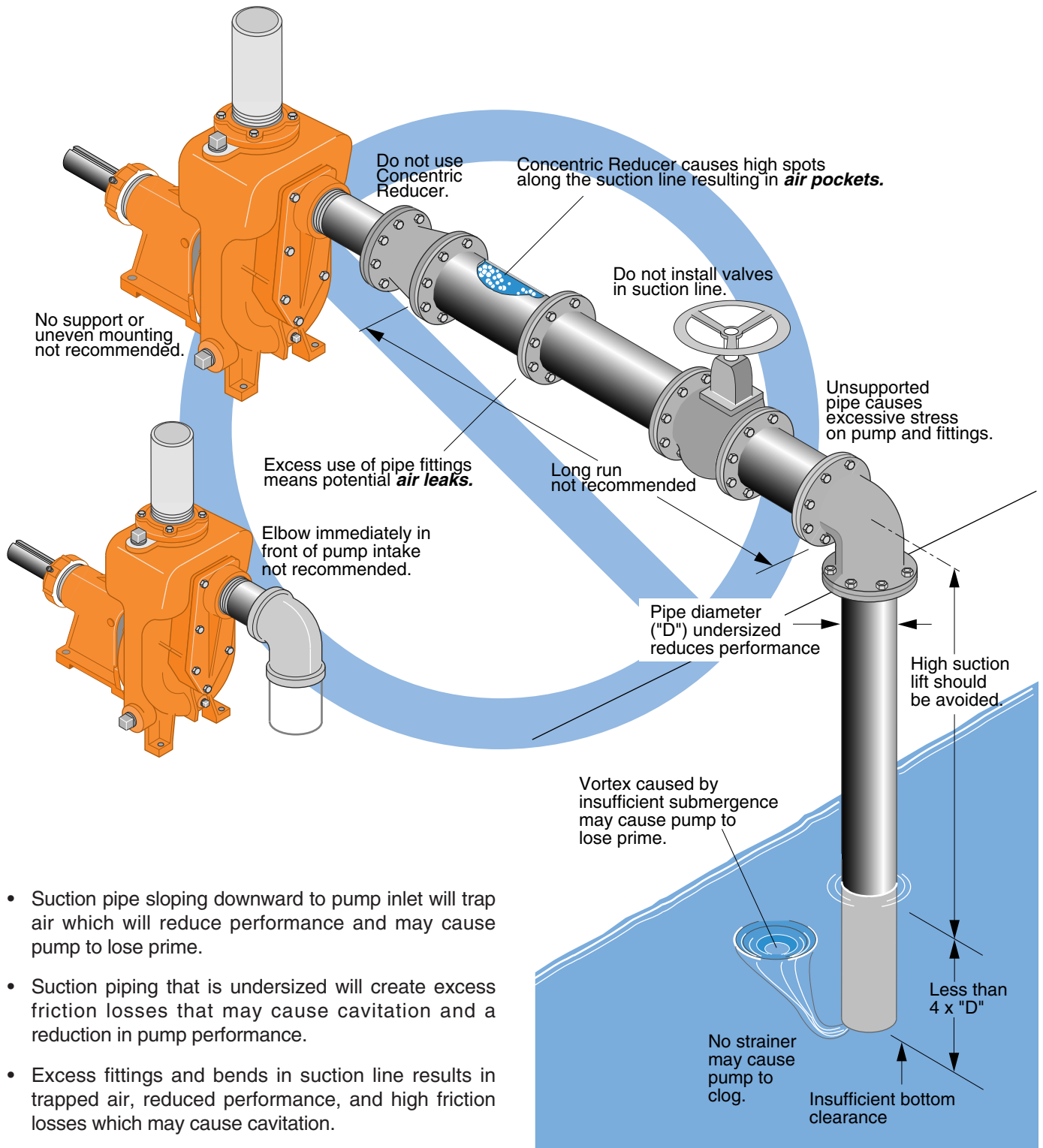
- Use pipe, tubing, or reinforced hose to make suction connection. Hose must have sufficient strength to resist collapse under the pressure differential that occurs while pump is running.
- Suction pipe size should be at least one commercial pipe size larger than opening of pump inlet. Flow velocity should not exceed 8 ft./sec.
- Suction screen must screen out solids that could clog pump impeller.
- Suction screen area must be at least four times suction pipe area.
- Net Positive Suction Head Available (NPSHA) must exceed Net Positive Suction Head Required (NPSHR) by the pump or reduced performance and severe pump damage may result.
- All suction piping must have continuous rise to the pump suction inlet. A 1/4 inch per foot minimum slope is recommended.

Recommended

Installation

Suction Connection

Suction Lift



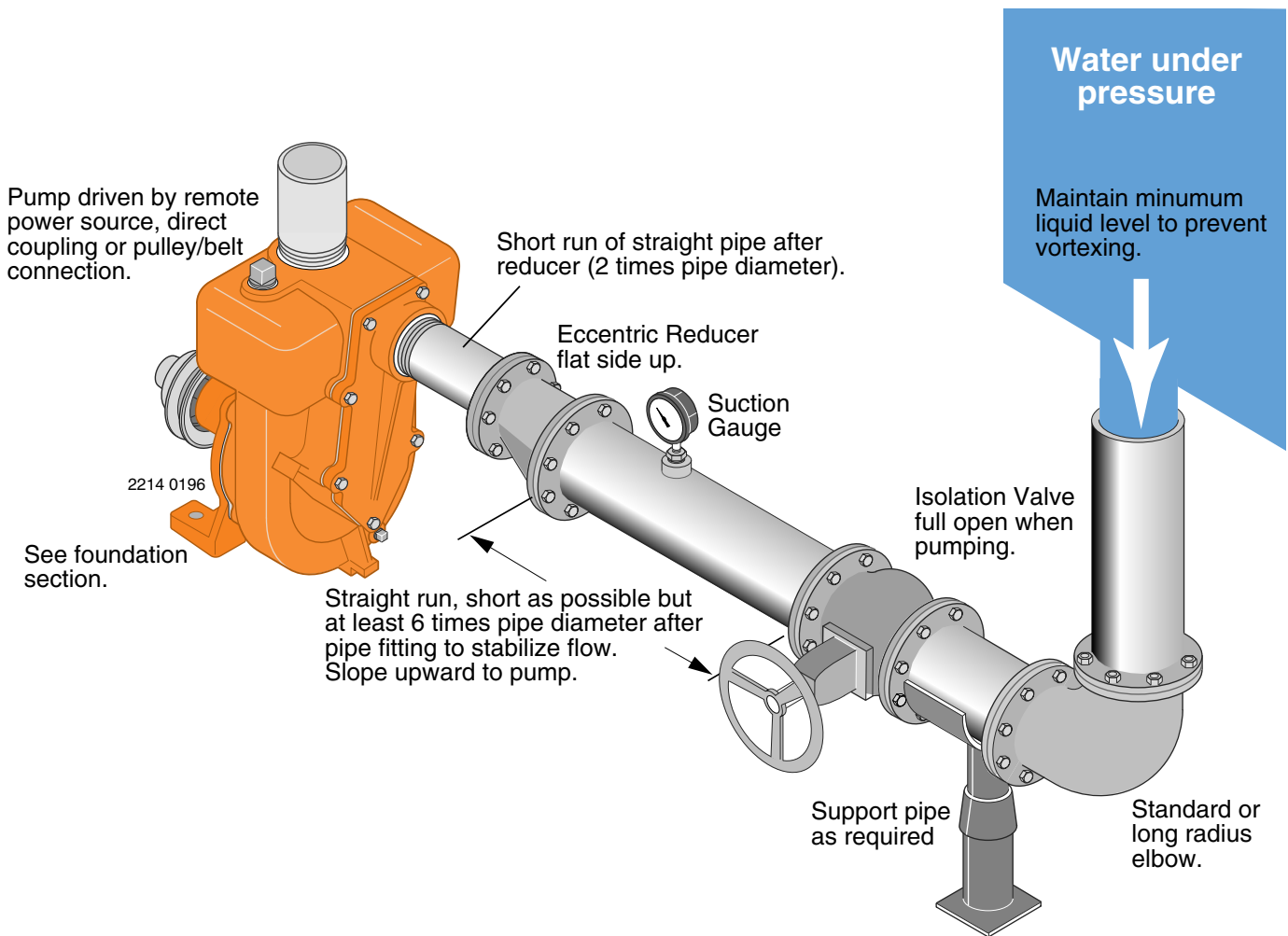
- Suction pipe sloping downward to pump inlet will trap air which will reduce performance and may cause pump to lose prime.
- Suction piping that is undersized will create excess friction losses that may cause cavitation and a reduction in pump performance.
- Excess fittings and bends in suction line results in trapped air, reduced performance, and high friction losses which may cause cavitation.

⊘
Not Recommended
⊘

Installation

Suction Connection

When Flooded Suction Exists



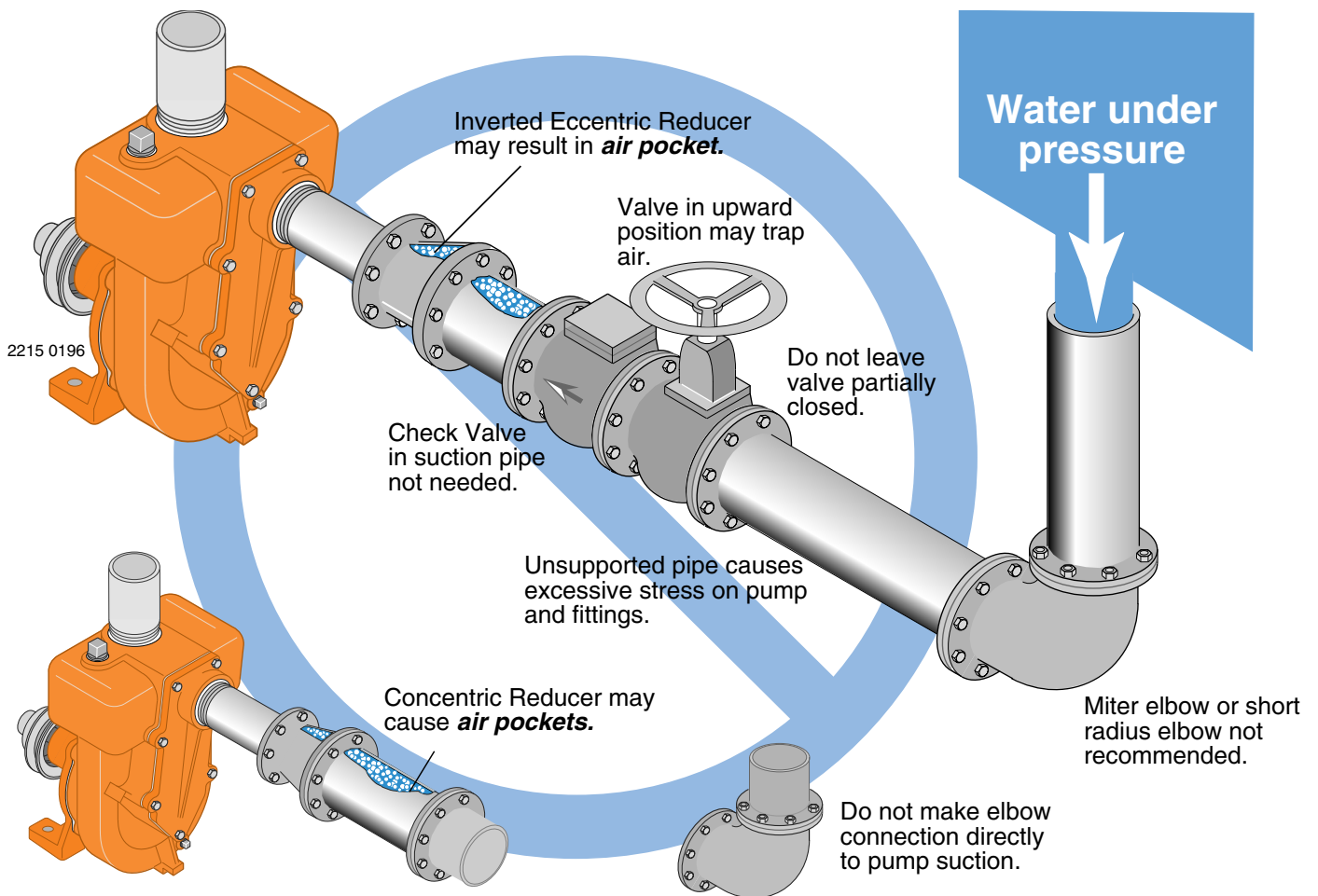
- Use pipe, tubing, or reinforced hose to make suction connection. Hose must have sufficient strength to resist collapse under the atmospheric pressure differential that may occur while pump is running.
- It is important, even with a flooded suction condition, that proper pipe fittings are used so water is delivered to impeller eye with a smooth flow and consistent velocity.
- Suction pipe size should be at least one commercial pipe size larger than opening of pipe inlet. Flow velocity should not exceed 8 ft./sec.
- An isolation valve is used in a pressurized suction pipe to permit servicing pump.
- Piping run and connection fittings should be properly aligned and independently supported to reduce strain on pump case.
- If solids are present, a strainer should be used to protect the pump.

Recommended

Installation

Suction Connection

When Flooded Suction Exists



- Suction piping that is undersized will create excess friction losses that may cause cavitation and a reduction in pump performance.
- Excess fittings and bends in suction line results in trapped air, reduced performance, and high friction losses which may cause cavitation.
- If check valve is required for back flow prevention, locate on the discharge side of pump.

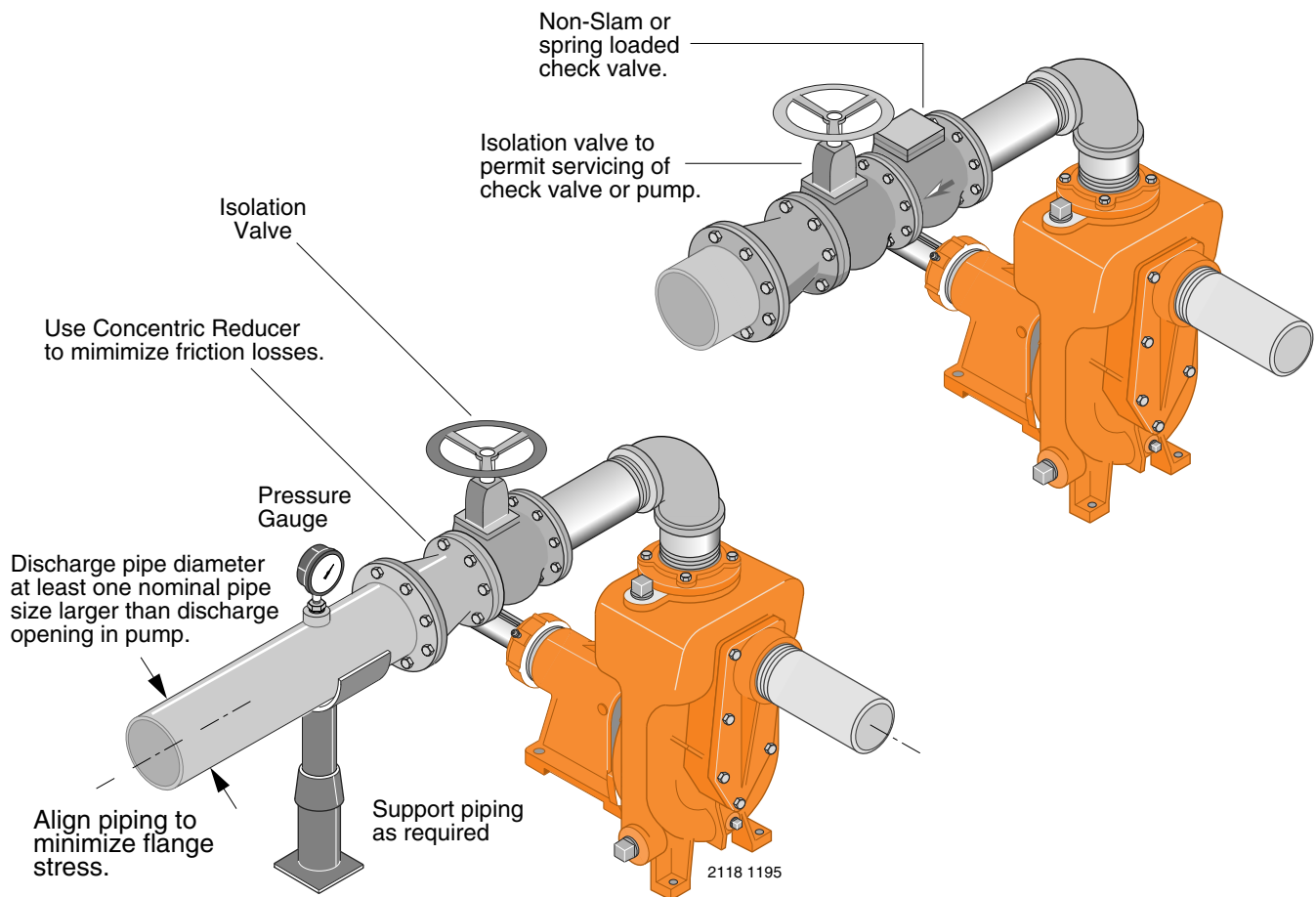


Not Recommended



Installation

Discharge Connection

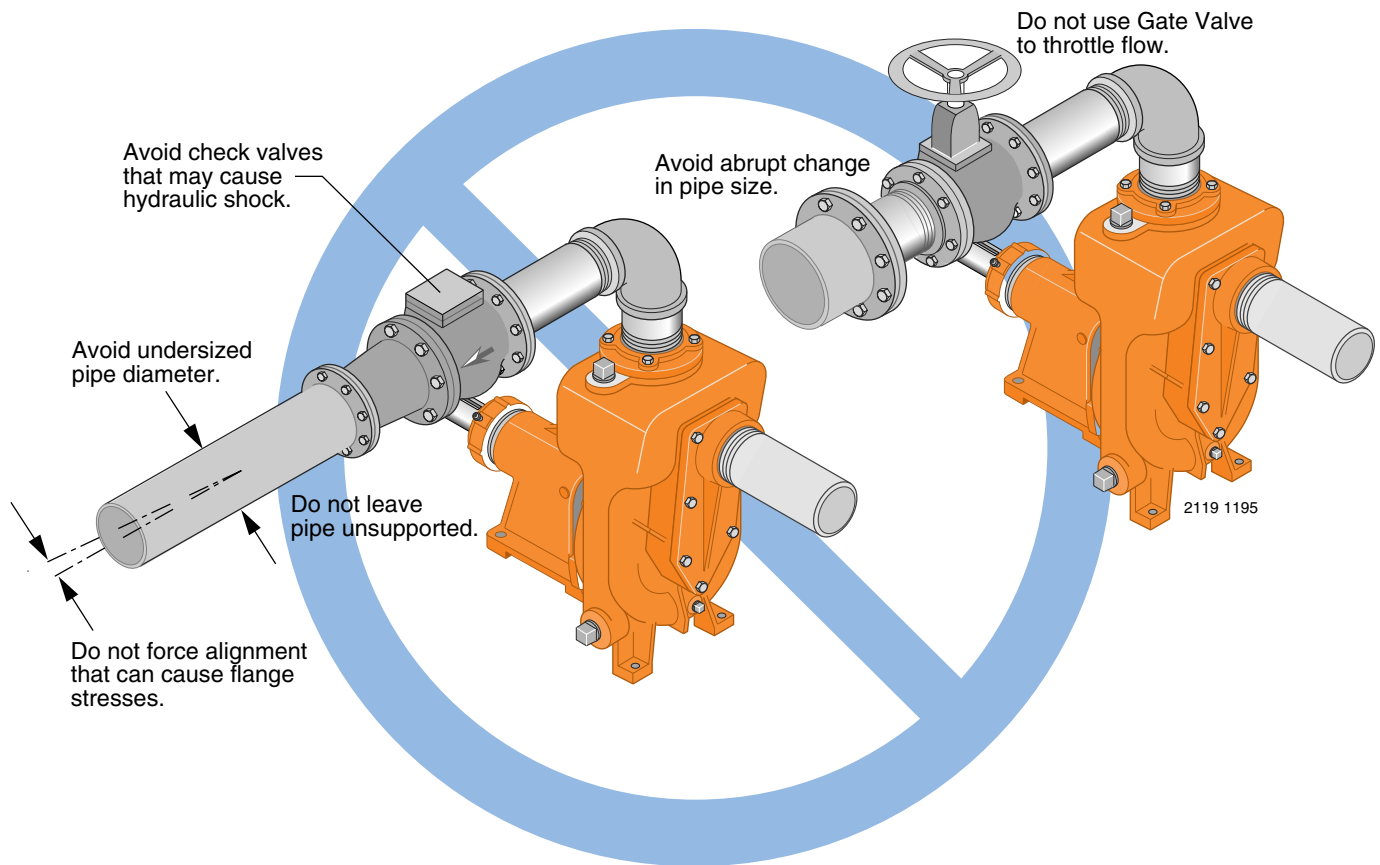


- Use pipe, tubing or reinforced hose to make discharge connection. Material selected must have sufficient strength for operating pressures.
- Discharge pipe should be sized so that flow velocity is below 8 feet per second.
- Use **ONLY** non-slamming check valves to prevent hydraulic shock (water hammer).
- Use gate, ball, or butterfly valve for isolation. Valve should be full open during operation.
- Maintain proper pipe size throughout discharge system, using as few elbows and tees as possible to keep friction loss to a minimum.
- Install pressure gauge after reducer as shown to check operating pressure or shut-off head.

Recommended

Installation

Discharge Connection



- Avoid excess friction loss caused by numerous fittings, insufficient pipe diameter, and sharp turns in pipe run.
- Swing type check valves can permit build-up of reverse velocity before closing causing hydraulic shock or “water hammer.”



Not Recommended



Start-up

General Information

CHECK ROTATION:

Before pump is put into operation, rotational direction must be checked to assure proper performance of pump. Refer to illustration below to verify proper rotational direction for each model covered in this manual.

⚠ WARNING Hazardous voltage. Can shock, burn, or cause death. Disconnect power to pump before servicing.

Do not attempt any wiring changes without first disconnecting power to pump.

PRIMING:

Pump priming is the displacement of air with water in the pump and suction piping. Pump **MUST BE** completely filled with water when operating.

A self-priming pump only needs to be manually primed at the first start-up. Once primed, under normal conditions pump will reprime automatically at each subsequent start-up.

To prime, remove plug from top of pump case and fill case with water. Replace plug and start pump. Unit is equipped with a flapper type check valve which will

open at start-up and allow pump to evacuate air from the suction line. After several minutes of operation, pump will be fully primed and pumping water. Priming time will vary, depending on length and diameter of suction line.

STARTING (Electric Motor):

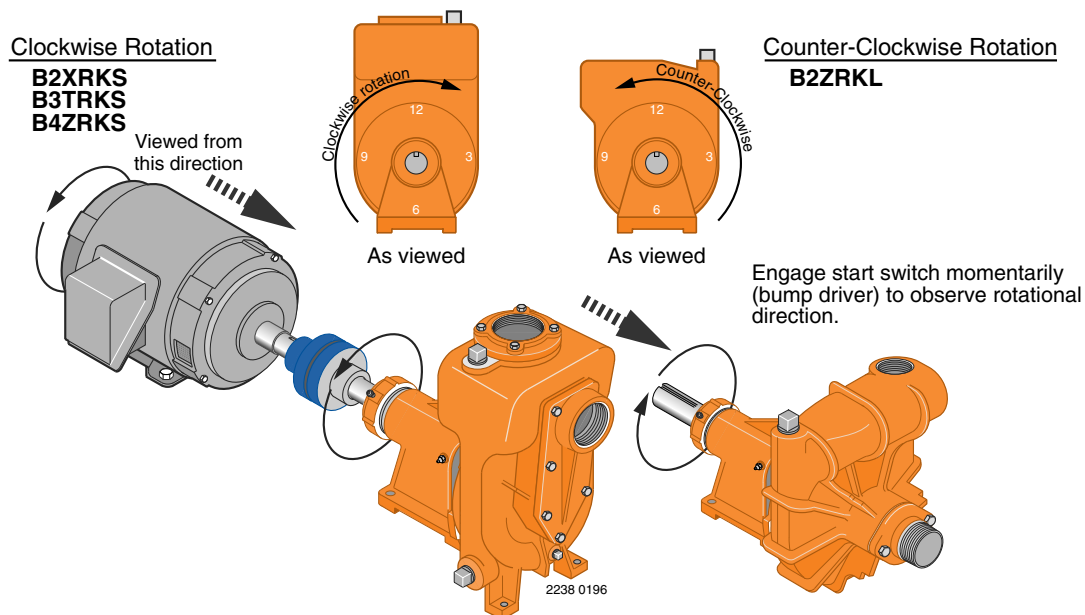
NOTICE: Never run pump dry. Running pump without water will overheat pump and damage internal parts. Always make sure pump is primed prior to start-up.

NOTICE: Refer to maintenance section if pump has packing for adjustment prior to start-up.

Prime pump by the above method. Turn on power to pump. Slowly open discharge valve until desired flow rate is achieved. Place the “Hand-Off-Auto” selector switch in the “Auto” position. The pump will start automatically when the pilot device signals the motor starter.

STOPPING (Electric Motor):

Pump will stop automatically when the pilot device de-energizes the motor starter. Turn the “Hand-Off-Auto” selector switch to “Off” position if you want to stop the pump while it is running.



ELECTRIC MOTORS:

Single Phase: Refer to wiring information on the motor plate to obtain proper rotation.

Three Phase: If pump runs backwards, reverse any two leads coming of incoming power (L1, L2, L3) until proper rotation is obtained. Reverse L1 and L2, L2 and L3, or L1 and L3.

Pump running backwards - Centrifugal pumps will still

pump liquids, however, GPM and head will be a fraction of the published performance.

ENGINE DRIVEN:

If engine is used for pump driver, check with engine instruction and operation manual or engine manufacturer to determine how rotation is defined, then use above illustration for proper connection.

Maintenance

General Information

LUBRICATION:

LIQUID END of pump requires **no** lubrication. Wear rings, packing rings, and models using a mechanical shaft seal, are lubricated by the liquid being pumped. Do not run dry!

BEARING FRAME - add approximately 2 ounces of a lithium-based NGLI No. 2 extra pressure ball bearing grease to each bearing during quarterly inspection.

NOTE: Excess grease will cause bearings to run hot.

The following are factory approved brands of grease for use with Berkeley Pumps: Alvania EP2, Shell Oil; Mobilith AW2, Mobil Oil, Ronex MP, Exxon, Litholine EP2, Atlantic Richfield; and Amolith EP2, Amoco.

ELECTRIC MOTOR: Refer to motor manufacturer's operating manual for complete instruction.

GAS/DIESEL ENGINE: Refer to engine manufacturer's operating manual for complete instruction.

PERFORMANCE CHECK:

Periodically check the output of the pump. If performance is noticeably reduced, refer to Troubleshooting Chart.

OBSERVATIONAL MAINTENANCE:

When the pump and system operation have been stabilized, verify that pump unit is operating properly. Observe the following:

VIBRATION: All rotating machines can be expected to produce some vibration, however, excessive vibration can reduce the life of the unit. If the vibration seems excessive, discontinue operation, determine cause of the excessive vibration, and correct.

NOISE: When the unit is operating under load, listen closely for unusual sounds that might indicate that the unit is in distress. Determine the cause and correct.

OPERATING TEMPERATURE: During operation, heat is dissipated from the pump and the driver. After a short period of time, the surface of the pump bracket will be quite warm (as high as 150°F), which is normal. If the surface temperature of the pump bracket or driver is excessive, discontinue operation, determine cause of the excessive temperature rise, and correct.

Bearings will run hotter for a brief run-in period after packing which is normal. However, worn bearings will cause excessive temperatures and need to be replaced. The pump unit is cooled by the water flowing through it, and will normally be at the temperature of the water being pumped.

STUFFING BOX: After a short period of operation, verify that the stuffing box area and gland are not hot. If heating is detected, loosen the gland nuts evenly until water is just running out of stuffing box in a *DROPLET* form (approximately 40-60 drops per minute). Water must not be streaming or spraying out. Verify cool operation periodically. Adjust gland nuts *EVENLY* as necessary for lubrication and cooling of the packing. If packing has been tightened to the limit of the packing gland travel, additional packing is necessary.

PUMPS WITH PACKING: *Starting new pump.*

Before starting pump for the first time, loosen gland nuts and retighten finger tight. Proceed with pump start-up procedure. Allow packing to leak liberally for a few moments. Then tighten gland nuts one complete turn each until leakage is reduced to 40 to 60 drops per minute.

REPACKING:

Refer to illustration on Page 16.

PUMPS WITH MECHANICAL SEAL:

Adjustment or maintenance is normally not required. The seal is enclosed within the pump and is self adjusting. Seal is cooled and lubricated by the liquid being pumped. Consult factory for proper replacement procedure.

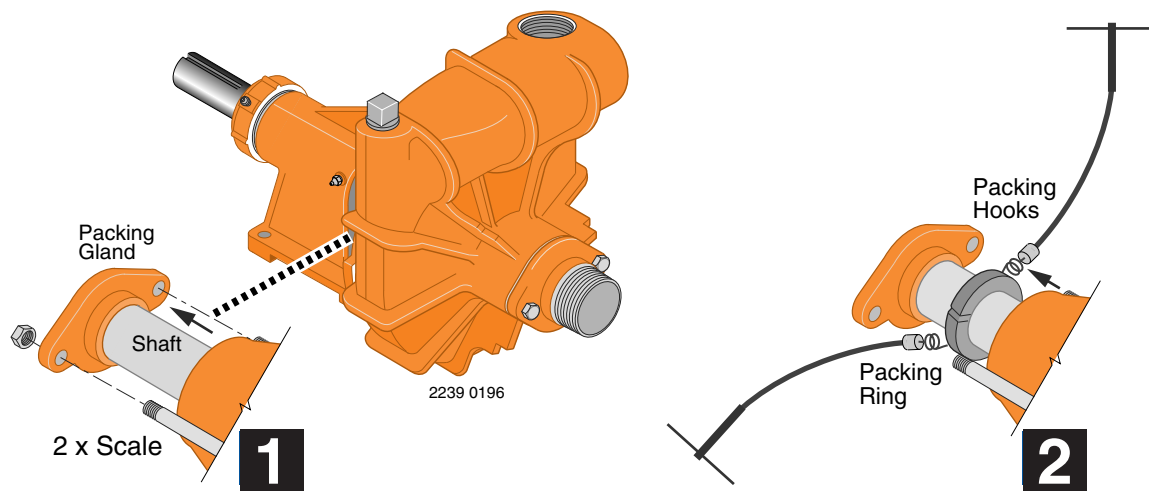
SHAFT:

Bearing frame shaft assemblies should be periodically torn down for inspection of worn parts, cleaning and re-greasing. Most importantly, to check shaft sleeve and bearings for pitting. Replace worn components as necessary.

Maintenance

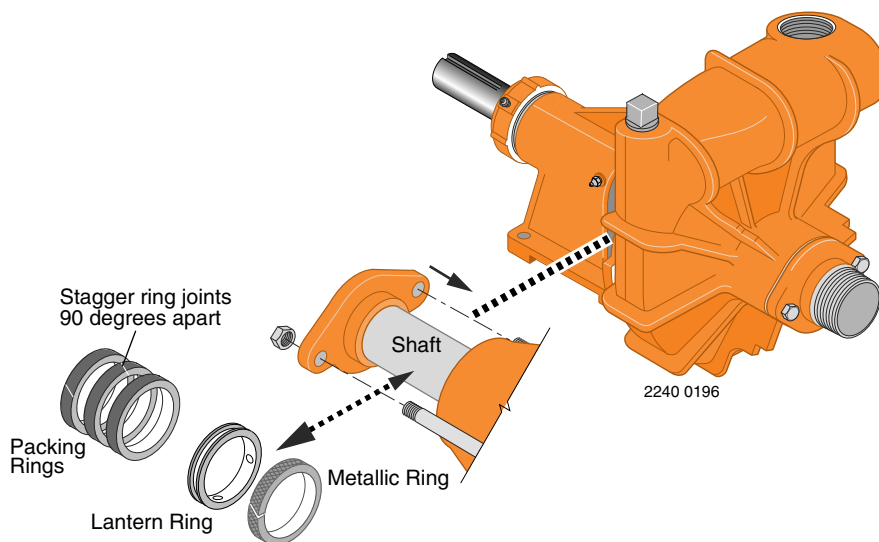
Packing Ring Replacement

Removal



- Unfasten hardware holding Packing Gland in place and slide back on shaft to expose packing rings.
- Remove packing rings from Stuffing box using two commercially available Packing Hooks as shown.
- Slide Lantern Ring (if used) back to expose any remaining rings, including metallic. Remove them in the same manner.

Installing New Rings



- Clean shaft sleeve and Packing Gland.
- Inspect shaft sleeve for wear, replace if needed.
- Install new packing rings in stuffing box by placing over shaft sleeve and pushing them in as far as they will go.
- Rotate ring joint 90 degrees when installing each ring as shown.
- Slide packing gland into position, then gently and evenly tighten nuts to force rings into place and seat (do not overtighten). Loosen nuts again to hand tight.
- Start primed pump and allow packing to leak liberally.
- Tighten gland nuts one complete turn each until leakage is reduced to 40 to 60 drops per minute.

Maintenance

General Pump Care

ROUTINE MAINTENANCE

A well maintained pumping system will extend the life of the unit and will require fewer repairs. This means less down time which can be very critical when a constant delivery of water is required.

A routine maintenance and inspection schedule should be set up on a weekly, quarterly, and annual basis with records kept of these actions. For weekly checks see observational maintenance on Page 15. For quarterly and annual maintenance, refer to check list on Page 22. Copy page as necessary for continual usage.

RECOMMENDED SPARE PARTS

It is recommended that the following spare parts be kept on-site as a minimum back-up to service your pump and reduce down-time. Check your model/style against parts breakdown drawing on Pages 18 and 19 when selecting spares.

- Mechanical Shaft Seal
- Packing Set and Packing Hooks
- Shaft Sleeve(s)
- All Gaskets and O-Rings Required for One Pump
- Oil Seal(s)
- Bearings

If having a pump non-operational has severe consequences, a back-up pump should be considered. Otherwise, a back-up impeller, volute case, bearings and shaft, would be prudent.

PUMP PROTECTION-COLD WEATHER/ WET WEATHER INSTALLATIONS:

SYSTEM DRAINS: Provide drain valves to empty system, including pump case, to prevent freezing damage.

SHELTER: If possible, provide shelter for unit to protect from weather. Allow adequate space around pump unit for service. When effectively sheltered, a small amount of heat will keep temperature above freezing. Provide adequate ventilation for unit when running. For severe weather problems, where other shelter is not practical, a totally enclosed fan-cooled enclosure can be considered for electric motors.

CONDENSATION: When the temperature of metal parts is below dew point and the surrounding air is moist, water will condense on the metal surfaces and can cause corrosion damage. In severe situations, a space heater can be considered to warm the unit.

WINTERIZING

If pump is to be out of service for an extended period of time, such as the winter months, the following storage procedures should be followed.

- Remove exterior dirt and grime or any substance that may trap moisture. Exposed metal is subject to oxidation, prime and repaint if necessary. If this is not possible, coat with grease or heavy oil.
- Flush suction and discharge lines. Check for leaks at this time and replace any worn gaskets.
- Remove lowest plug in pump and drain pump casing and suction and discharge lines.
- Lubricate bearings.
- If possible, keep unit clean and dry during storage period to guard against corrosion.
- Seal all open ports to keep out foreign objects such as insects, rodents, dust and dirt.
- Rotate driver shaft periodically to prevent freeze-up of internal components.
- Shelter unit from elements if possible.
- Work oil into impeller wear ring by dripping oil into the gap while rotating by hand.

SPRING START-UP

- Inject sufficient grease into the bearings to displace old grease.
- Visual inspection.
- Rotate by hand, if any binding occurs, disassemble and inspect.

Pump Nomenclature

General Information

ORDERING REPLACEMENT PARTS:

Locate the Berkeley nameplate on the pump, plate is normally on the bearing bracket. Information found on this plate is shown below. To be sure of receiving correct parts, provide all nameplate data when ordering. The **BM (Bill of Material)** number is most important. Write your nameplate information on the blank nameplate below for future reference as nameplates can become worn or lost.

SAMPLE ONLY

| BERKELEY PUMPS | |
|-------------------------------|--------------------------------|
| MODEL B2ZRKL | S.N. OR DATE G021196 |
| IMPELLER DIA. 9.00" | B.M. B52346 |

BERKELEY

788 0394

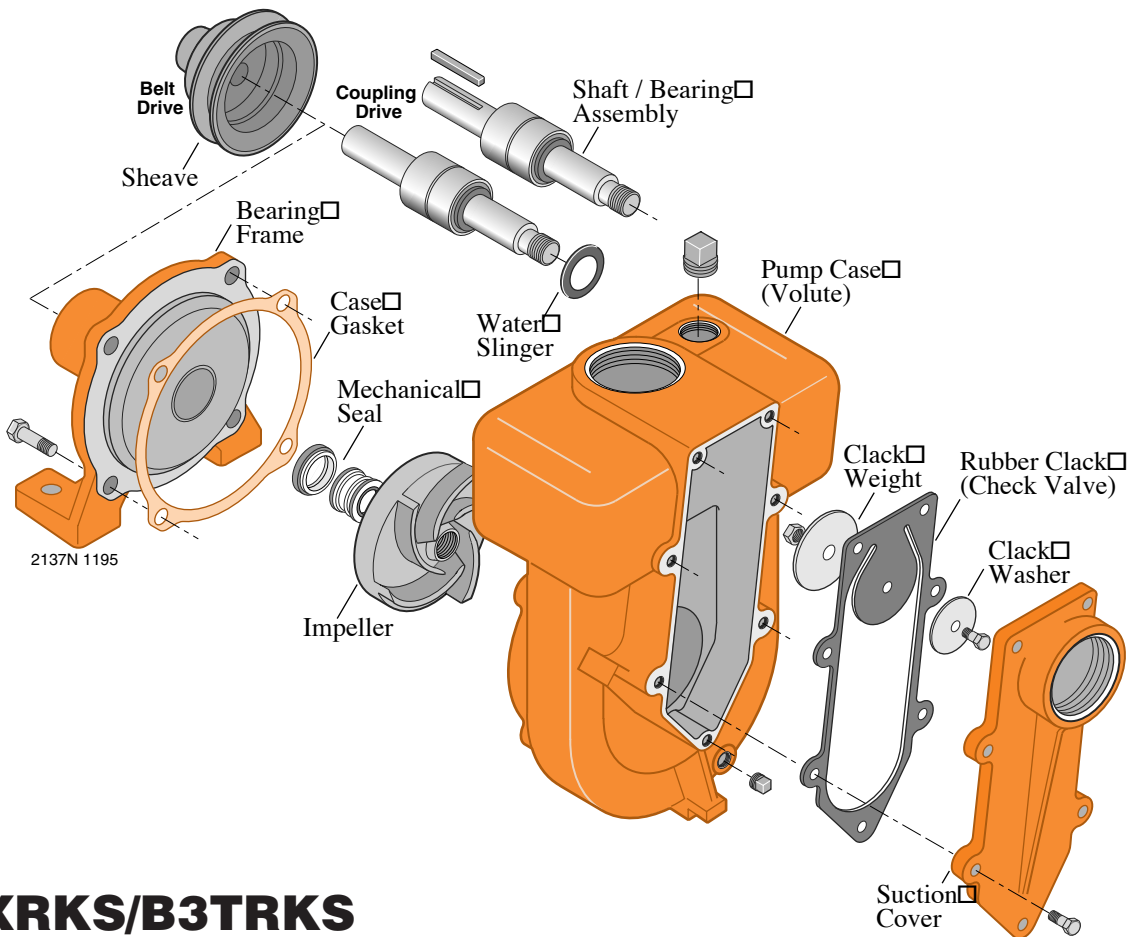
| BERKELEY PUMPS | |
|----------------|--------------|
| MODEL | S.N. OR DATE |
| IMPELLER DIA. | B.M. |

BERKELEY

344 1093

Record your nameplate data here.

The following illustrations show typical components used in the assembly of self priming bearing frame mounted centrifugal pumps. Refer to these drawing when ordering any replacement parts.

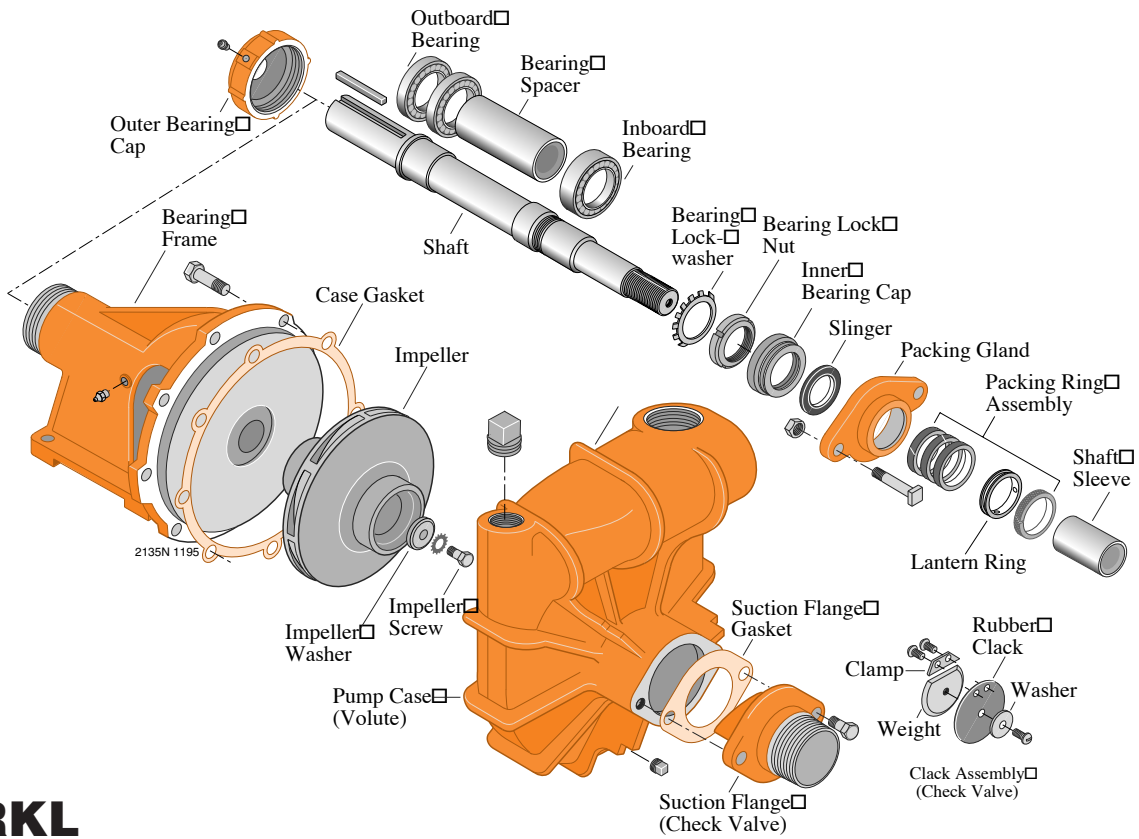


B2XRKS/B3TRKS

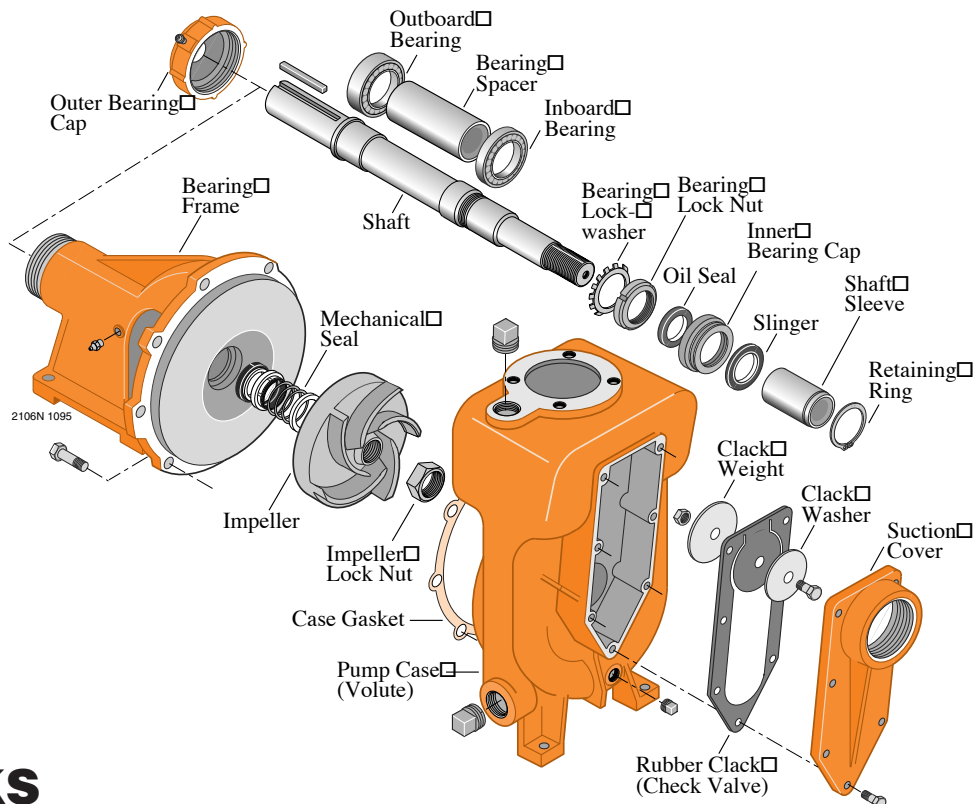
Pump Nomenclature

Self Prime Bearing Frame

Parts Breakdown



B2ZRKL



B4ZRKS

Maintenance

Troubleshooting

Electrical Drive Pumps

| SYMPTOM | PROBABLE CAUSE | | | | | | | | | | | | | | | | | |
|-----------------------------------|-----------------------|---|---|---|---|---|---|---|---|------------------------|---|---|---|---|---------------------|---|---|---|
| | GROUP I ELECTRICAL | | | | | | | | | GROUP II MECHANICAL | | | | | GROUP III SYSTEM | | | |
| | A | B | C | D | E | F | G | H | I | A | B | C | D | E | F | A | B | C |
| Pump runs, but no water delivered | | | | | | | | | | X | | X | | | | X | X | |
| Not enough water delivered | | | X | X | | | | X | | X | X | | X | | | X | X | |
| Not enough pressure | | | X | X | | | | X | | X | X | | X | | | X | X | |
| Excessive vibration | | | | | | | | X | | X | X | | | X | | | X | X |
| Abnormal noise | | | | | | | | | | X | X | X | | X | X | | X | X |
| Pump stops | X | X | X | X | X | X | X | X | | | | | | | | | | |
| Overheating | | X | X | X | | | | X | | | X | | X | X | X | | | X |

| CAUSE | CORRECTIVE ACTION |
|--|--|
| I. ELECTRICAL | |
| A. No voltage in power system | Check phase-to-phase on line side of starter contactor. Check circuit breaker or fuses. |
| B. No voltage on one phase (Three Phase Units) | Check phase voltage on line side of starter contactor. Isolate open circuit (circuit breaker, fuse, broken connections, etc.) |
| C. Low voltage at motor | Running voltage across each leg of motor must be $\pm 10\%$ of nominal voltage shown on nameplate. |
| D. Motor leads improperly grouped for voltage | Refer to lead grouping diagram on motor nameplate. |
| E. Control failure | Check control device, starter contactor, H-O-A selector switch, etc., for malfunction. |
| F. Thermal overload switch open | Check phase-to-phase on line side of starter contactor. |
| G. Installation failure | Check motor or windings to ground with megohmmeter. |
| H. Open windings | Check leg-to-leg with ohmmeter. |
| I. Frequency variation | Check frequency of power system. Must be less than 5% variation from motor nameplate rating. |
| II. MECHANICAL | |
| A. Flow through pump completely or partially obstructed | Locate and remove obstruction. Refer to Repair Instructions for disassembly. |
| B. Wrong direction of rotation | Reverse rotation of three phase motor by interchanging any two leads. See manufacturer's Instructions for reversing single phase motor. |
| C. Pump not primed | Reprime. Inspect suction system for air leaks. |
| D. Internal leakage | Check impeller for wear of controlled clearances (See Repair Instructions). |
| E. Loose parts | Inspect. Repair. |
| F. Stuffing box not properly adjusted | Adjust gland. |
| III. SYSTEM | |
| A. Pressure required by system at design flow rate exceeds pressure rating of pump | Compare pump pressure and flow rate against pump characteristic curve. Check for closed or partially closed valve in discharge piping system. Reduce system pressure requirement. Increase pressure capability of pump. |
| B. Obstruction in suction piping | Locate and remove obstruction. |
| C. Pressure rating of pump exceeds pressure requirement of system at design flow rate | Compare pump pressure and flow rate against pump characteristic curve. Inspect discharge piping system for breaks, leaks, open by-pass valves, etc. If necessary, reduce flow rate by partially closing discharge valve. |

Maintenance

Troubleshooting

Engine Drive Pumps

| SYMPTOM | PROBABLE CAUSE | | | | | | | | | | | | | | |
|-----------------------------------|-------------------|---|---|---|---|---|------------------------|---|---|---|---|---|---------------------|---|---|
| | GROUP I ENGINE | | | | | | GROUP II MECHANICAL | | | | | | GROUP III SYSTEM | | |
| | A | B | C | D | E | F | A | B | C | D | E | F | A | B | C |
| Pump runs, but no water delivered | X | | | | | | X | | X | | | | X | X | |
| Not enough water delivered | X | | | | X | | X | X | | X | | | X | X | |
| Not enough pressure | X | | | | X | | X | X | | X | | | X | X | |
| Excessive vibration | | | X | X | X | | X | X | | | X | | | X | X |
| Abnormal noise | | | X | X | X | | X | X | X | | X | X | | X | X |
| Pump stops | | X | | X | X | X | | | | | | | | | |
| Overheating | | X | X | X | X | | | X | | X | X | X | | | X |

| CAUSE | CORRECTIVE ACTION |
|---|--|
| I. ENGINE | |
| A. Speed too low | Refer to engine manufacturer's manual. |
| B. Rotating and/or reciprocating parts drag | Refer to engine manufacturer's manual. |
| C. Speed too high | Refer to pump and engine power curves. Adjust. |
| D. Loose or broken parts | Refer to engine manufacturer's manual. |
| E. Improper adjustment | Check fuel and ignition systems. Adjust per engine manufacturer's manual. |
| F. Fuel supply | Check fuel supply, fuel pump, filters, etc. |
| II. MECHANICAL | |
| A. Flow through pump completely or partially obstructed | Locate and remove obstruction. Refer to Repair Instructions for disassembly. |
| B. Wrong direction of rotation | Reverse rotation of three phase motor by interchanging any two leads. See manufacturer's Instructions for reversing single phase motor. |
| C. Pump not primed | Reprime. Inspect suction system for air leaks. |
| D. Internal leakage | Check impeller for wear of controlled clearances (See Repair Instructions). |
| E. Loose parts | Inspect. Repair. |
| F. Stuffing box not properly adjusted | Adjust gland. |
| III. SYSTEM | |
| A. Pressure required by system at design flow rate exceeds pressure rating of pump | Compare pump pressure and flow rate against pump characteristic curve. Check for closed or partially closed valve in discharge piping system. Reduce system pressure requirement. Increase pressure capability of pump. |
| B. Obstruction in suction piping | Locate and remove obstruction. |
| C. Pressure rating of pump exceeds pressure requirement of system at design flow rate | Compare pump pressure and flow rate against pump characteristic curve. Inspect discharge piping system for breaks, leaks, open by-pass valves, etc. If necessary, reduce flow rate by partially closing discharge valve. |

Maintenance

Routine Inspection

Record

I. QUARTERLY INSPECTION

- Inspect all system piping connections for leakage or possible misalignment.
- Check pump foundation for soundness and see that all hold-down bolts are secure.
- Complete any lubrication requirements as dictated by pump and driver owner's manual.
- Inspect packing or mechanical seal for possible replacement. Examine shaft sleeve, if present, for wear and replace if necessary.
- Inspect pumping plant panel for signs of wear (ie: replace pitted contactors, etc., as needed).
- Check pump and motor bearings from signs of wear. Repack or replace as necessary.
- Check alignment of couplings and/or pulleys and belt tension if applicable.
- _____

II. QUARTERLY INSPECTION

- Inspect all system piping connections for leakage or possible misalignment.
- Check pump foundation for soundness and see that all hold-down bolts are secure.
- Complete any lubrication requirements as dictated by pump and driver owner's manual.
- Inspect packing or mechanical seal for possible replacement. Examine shaft sleeve, if present, for wear and replace if necessary.
- Inspect pumping plant panel for signs of wear (ie: replace pitted contactors, etc., as needed).
- Check pump and motor bearings from signs of wear. Repack or replace as necessary.
- Check alignment of couplings and/or pulleys and belt tension if applicable.
- _____

NOTES:

III. QUARTERLY INSPECTION

- Inspect all system piping connections for leakage or possible misalignment.
- Check pump foundation for soundness and see that all hold-down bolts are secure.
- Complete any lubrication requirements as dictated by pump and driver owner's manual.
- Inspect packing or mechanical seal for possible replacement. Examine shaft sleeve, if present, for wear and replace if necessary.
- Inspect pumping plant panel for signs of wear (ie: replace pitted contactors, etc., as needed).
- Check pump and motor bearings from signs of wear. Repack or replace as necessary.
- Check alignment of couplings and/or pulleys and belt tension if applicable.
- _____

IV. QUARTERLY INSPECTION

- Inspect all system piping connections for leakage or possible misalignment.
- Check pump foundation for soundness and see that all hold-down bolts are secure.
- Complete any lubrication requirements as dictated by pump and driver owner's manual.
- Inspect packing or mechanical seal for possible replacement. Examine shaft sleeve, if present, for wear and replace if necessary.
- Inspect pumping plant panel for signs of wear (ie: replace pitted contactors, etc., as needed).
- Check pump and motor bearings from signs of wear. Repack or replace as necessary.
- Check alignment of couplings and/or pulleys and belt tension if applicable.
- _____

ANNUAL INSPECTION

- Inspect pump and entire pumping system for signs of wear.
- Inspect system valves, screens, etc.
- If electric motor is used, check windings for degradation, rewind if necessary.
- Check pump impeller eye for clearance.
- Inspect impeller, volute case, and seal chamber for signs of excessive wear or corrosion.

Maintenance

Notes

Berkeley Warranty

Berkeley/Wicor Canada, Inc. ("Wicor") warrants to the original consumer purchaser ("Purchaser") of its products that they are free from defects in material or workmanship.

If within twelve (12) months from the date of installation or twenty-four (24) months from the date of manufacture any such product shall prove to be defective, it shall be repaired or replaced at Berkeley's/Wicor's option, subject to the terms and conditions set forth below.

General Terms and Conditions

Purchaser must pay all labor and shipping charges necessary to replace product covered by this warranty. This warranty shall not apply to products which, in the sole judgement of Berkeley/Wicor, have been subject to negligence, abuse, accident, misapplication, tampering, alteration; nor due to improper installation, operation, maintenance or storage; nor to other than normal application, use or service, including but not limited to, operational failures caused by corrosion, rust or other foreign materials in the system, or operation at pressures in excess of recommended maximums.

Requests for service under this warranty shall be made by contacting the installing Berkeley/Wicor dealer as soon as possible after the discovery of any alleged defect. Berkeley/Wicor will subsequently take corrective action as promptly as reasonably possible. No requests for service under this warranty will be accepted if received more than 30 days after the term of the warranty.

The warranty on all three phase submersible motors is void if three-leg overload protection of recommended size is not used.

This warranty sets forth Berkeley's/Wicor's sole obligation and purchaser's exclusive remedy for defective products.

BERKELEY/WICOR SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, OR CONTINGENT DAMAGES WHATSOEVER.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS WARRANTIES. IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, SHALL NOT EXTEND BEYOND THE DURATION OF THE APPLICABLE EXPRESS WARRANTIES PROVIDED HEREIN.

Some states do not allow the exclusion or limitation of incidental or consequential damages or limitations on how long an implied warranty lasts, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

In the U.S.: Berkeley, 293 Wright St., Delavan, WI 53115

In Canada: Wicor Canada, 4544 Fieldgate Parkway, Mississauga, Ontario L4W 3W6