

Music, Vicky

From: Steve.Stauffer@deq.idaho.gov
Sent: Friday, July 01, 2011 7:58 AM
To: Monty.Marchus@deq.idaho.gov; Music, Vicky
Subject: RE: Shadow Butte Industrial Park, Emmett

The PWS number for Shadow Butte Ind. Park is 3230078 (not sure about where it's located). This is a system run by SWDH, so if you have more questions you can contact Jami Delmore at 455-5403.

Steve Stauffer
Drinking Water Analyst
Dept. Environmental Quality – Boise Regional Office
1445 N. Orchard
Boise, ID 83706
Ph (208) 373-0301
Fax (208) 373-0287
steve.stauffer@deq.idaho.gov

From: Monty Marchus
Sent: Thursday, June 30, 2011 3:39 PM
To: 'Music, Vicky'; Steve Stauffer
Subject: RE: Shadow Butte Industrial Park, Emmett

I think Steve can get you that #, if it is a separate public water system.

Thanks, Monty

Monty G. Marchus, P.E.
Technical Engineer
208-373-0560
208-373-0287f

From: Music, Vicky [<mailto:Vicky.Music@idwr.idaho.gov>]
Sent: Thursday, June 30, 2011 3:30 PM
To: Monty Marchus
Subject: Shadow Butte Industrial Park, Emmett

Hi Monty –

I am working on a license for the above, in the name of the City of Emmett. Are PWS #s available on line, or can you provide me with the PWS # of the park, located in T6N, R2W, S10, S14, S15 and S16?

If I have not provided enough information, please let me know.

Thank you.

Vicky Music
Sr. Water Resource Agent
IDWR Western Region
2735 Airport Way
Boise, ID 83705
208.334.2190



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WATER RESOURCES
WESTERN REGION

December 29, 2010

Vicky Music
Sr. Water Resource Agent
Department of Water Resources-Western Region
2735 Airport Way
Boise, ID 83705-5082

**RE: City of Emmett – Permit No. 65-22918 (Shadow Butte) and
Permit No. 65-13805 (Well No. 9) Correspondence**

Dear Ms. Music:

I am writing on behalf of the City of Emmett to submit the additional information that you requested regarding Water Right Permit No. 65-22918 and Permit No. 65-13805.

Permit No. 65-13805 (Well 9)

System Water Capacity and Water Demand: Please find attached the available well flow rate documentation for Well 9. Four trend-line charts have been provided for Well 9. Two trend-lines represent flow patterns of which one shows the flow pattern for the entire 2010 year, and the second shows the flow pattern for the peak month of July 2010. Note that the maximum diversion rate from Well 9 equals approximately 2,000 GPM which is the permitted water right diversion rate of 4.46 cfs. The other two trend-line charts are pressure patterns for Well 9 for the same period. In addition, a summary of the daily system water demands for each of the City's wells for the last year have been provided. If the City is unable to justify a non-RAFN water right license, then the City respectfully requests that the water right be licensed as a RAFN water right.

Fire Protection: No, the water right permit for Well 9 has not been developed solely for fire protection.

Service Area: Find attached a map of the existing water system service area map (PDF is also on CD).

Well No. 9: See attached flow and pressure trend-line charts.

Permit No. 65-22918 (Shadow Butte Industrial Park)

1: Find attached pump specifications and pump curves for the submersible well pumps and the other booster station pumps.

2: Find attached CD with PDF of drawings of delivery system.

3: Based on the drillers log and pump test results, the drawdown at a pumping rate of 375 GPM is approximately 15-25' with a static water level of 8' below the ground surface. The tank into which the well pumps discharge has a maximum water elevation of 18'. Consequently, the calculated operating point for both well pumps is approximately 375 GPM at a total dynamic head of 50 feet.

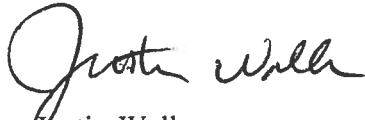
4: The SCADA (Supervisory Control and Data Acquisition) program for the Shadow Butte Industrial Park water system crashed the first part of October 2010. Consequently, no flow or pressure data prior to that date is available. Both flow and pressure trend-line charts have been provided. The flow trend-line for flow represents the flow out of the booster station. There is no flow meter on the well pumps.

5: A current place of use map for the Shadow Butte water system has been included. It is also shown on Sheet 4 of the *Shadow Butte IndPark Phase 1 As Built.pdf*.

If you should have any questions regarding this matter, please give me a call at (208) 288-1992.

Sincerely,

KELLER ASSOCIATES, INC.



Justin Walker
Project Engineer

Enclosures

cc: City of Emmett (Travis Capson)

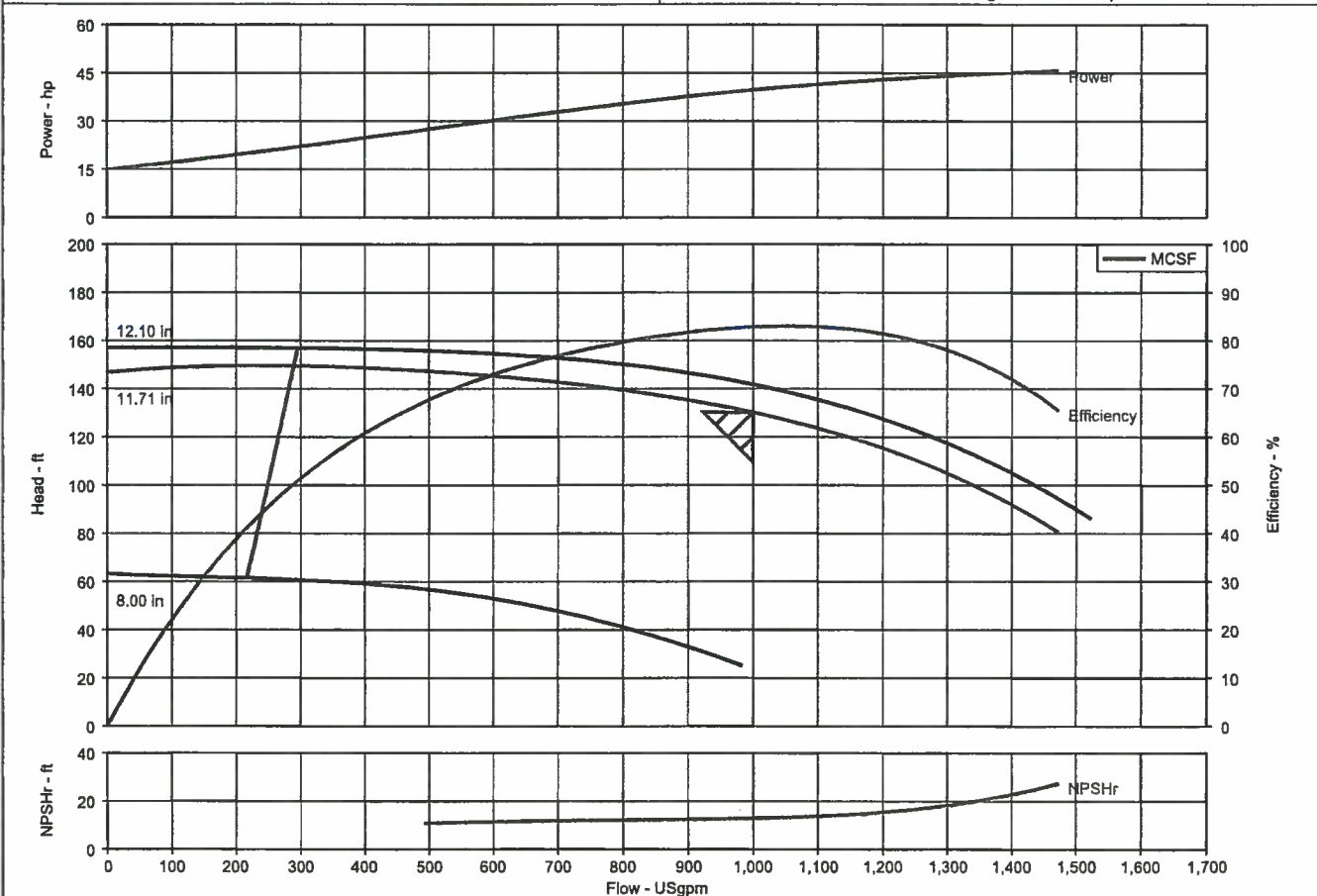
ITEM 1: SHADOW BUTTE INDUSTRIAL PARK BOOSTER STATION PUMPS

Pump Performance Datasheet

Project name / location	:	Tag Number	:
Consulting engineer	:	Service	:
Customer	:	Size	: 40129 LC
Customer ref. / PO	:	Quantity	: 1
Quote number	:	Quoted By (Sales Office)	:
Date last saved	: 23 Nov 2010 9:40 AM	Quoted By (Sales Engineer)	:

Operating Conditions	Liquid
Flow, rated	: 1,000.0 USgpm
Differential head / pressure, rated (requested)	: 130.0 ft
Differential head / pressure, rated (actual)	: 130.1 ft
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available, rated	: Ample
Frequency	: 60 Hz
Liquid type	: Water
Additional liquid description	:
Solids diameter, max	: 0.00 in
Temperature, max	: 68.00 deg F
Fluid density, rated / max	: 0.998 / 0.998 SG
Viscosity, rated	: 1.00 cP

Performance	Material
Speed, rated	: 1,750 rpm
Impeller diameter, rated	: 11.71 in
Impeller diameter, maximum	: 12.10 in
Impeller diameter, minimum	: 8.00 in
Efficiency	: 82.76 %
NPSH required / margin required	: 12.69 / 0.00 ft
nq (imp. eye flow) / S (imp. eye flow)	: 28 / 160 Metric units
MCSF	: 287.4 USgpm
Head, maximum, rated diameter	: 149.5 ft
Head rise to shutoff	: 12.84 %
Flow, best eff. point (BEP)	: 1,048.5 USgpm
Flow ratio (rated / BEP)	: 95.38 %
Diameter ratio (rated / max)	: 96.78 %
Head ratio (rated dia / max dia)	: 91.72 %
Cq/Ch/Ce [ANSI/HI 9.6.7-2004]	: 1.00 / 1.00 / 1.00
Selection status	: Acceptable
Material requested	: Auto
Material selected	: Cast iron
Pressure Data	
Maximum working pressure	: 64.69 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	
Driver sizing specification	: Rated power
Margin over specification	: 0.00 %
Service factor	: 1.00
Power, hydraulic	: 32.77 hp
Power, rated	: 39.60 hp
Power, maximum, rated diameter	: 45.65 hp
Minimum recommended motor rating	: 40.00 hp / 29.83 kW



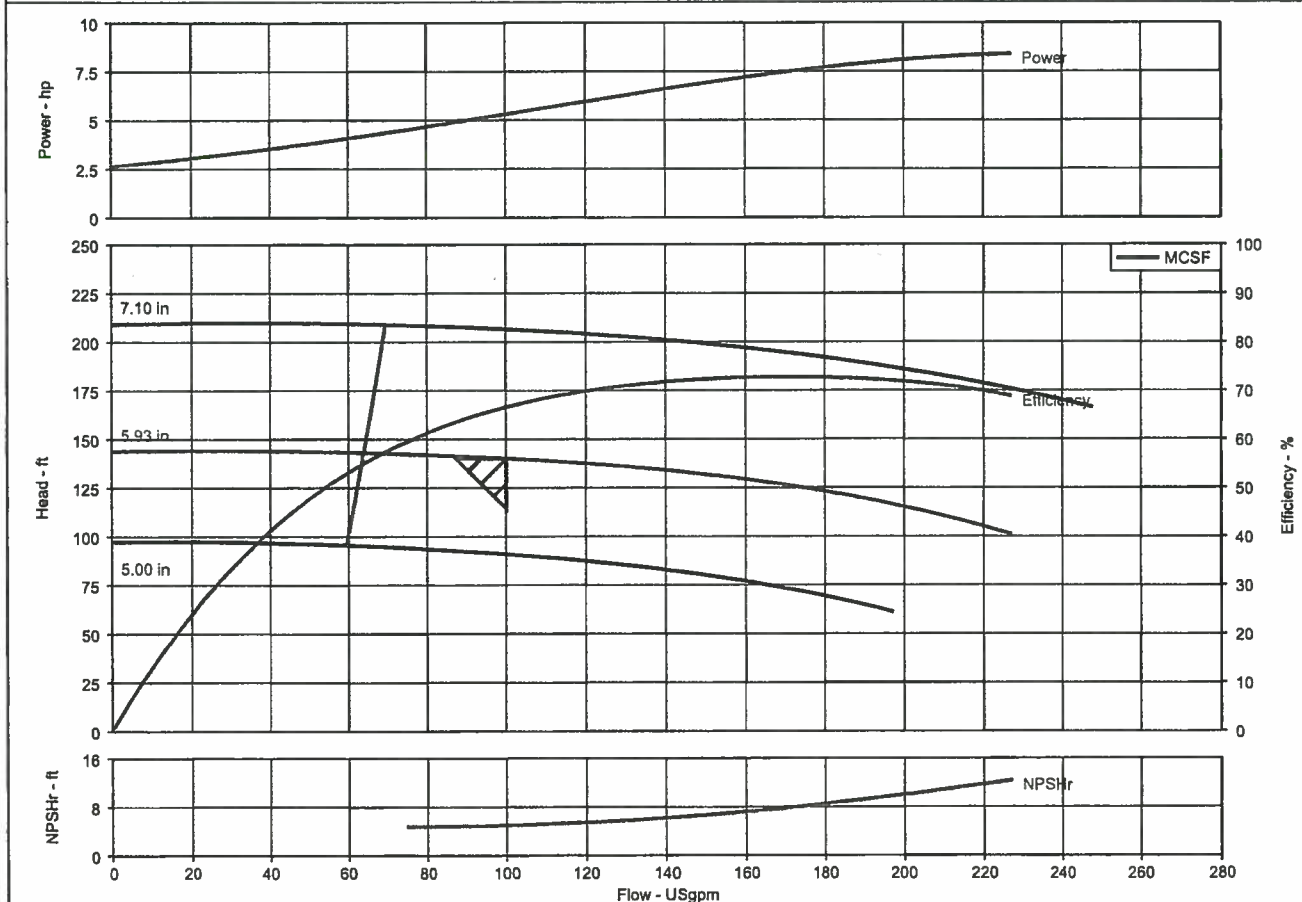


Pump Performance Datasheet

Project name / location	:	Tag Number	:
Consulting engineer	:	Service	:
Customer	:	Size	: 15705 LC
Customer ref. / PO	:	Quantity	: 1
Quote number	:	Quoted By (Sales Office)	:
Date last saved	: 23 Nov 2010 9:42 AM	Quoted By (Sales Engineer)	:

Operating Conditions	Liquid
Flow, rated	: 100.0 USgpm
Differential head / pressure, rated (requested)	: 140.0 ft
Differential head / pressure, rated (actual)	: 140.2 ft
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available, rated	: Ample
Frequency	: 60 Hz
	Liquid type : Water
	Additional liquid description :
	Solids diameter, max : 0.00 in
	Temperature, max : 68.00 deg F
	Fluid density, rated / max : 0.998 / 0.998 SG
	Viscosity, rated : 1.00 cP

Performance	Material
Speed, rated	: 3,500 rpm
Impeller diameter, rated	: 5.93 in
Impeller diameter, maximum	: 7.10 in
Impeller diameter, minimum	: 5.00 in
Efficiency	: 66.59 %
NPSH required / margin required	: 4.93 / 0.00 ft
nq (imp. eye flow) / S (imp. eye flow)	: 19 / 174 Metric units
MCSF	: 63.87 USgpm
Head, maximum, rated diameter	: 144.1 ft
Head rise to shutoff	: 2.66 %
Flow, best eff. point (BEP)	: 170.9 USgpm
Flow ratio (rated / BEP)	: 58.52 %
Diameter ratio (rated / max)	: 83.52 %
Head ratio (rated dia / max dia)	: 67.78 %
Cq/Ch/Ce [ANSI/HI 9.6.7-2004]	: 1.00 / 1.00 / 1.00
Selection status	: Acceptable
	Material requested : Auto
	Material selected : Cast iron
	Pressure Data
	Maximum working pressure : 62.34 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
	Driver sizing specification : Rated power
	Margin over specification : 0.00 %
	Service factor : 1.00
	Power, hydraulic : 3.53 hp
	Power, rated : 5.30 hp
	Power, maximum, rated diameter : 8.39 hp
	Minimum recommended motor rating : 7.50 hp / 5.59 kW



Pump Performance Datasheet

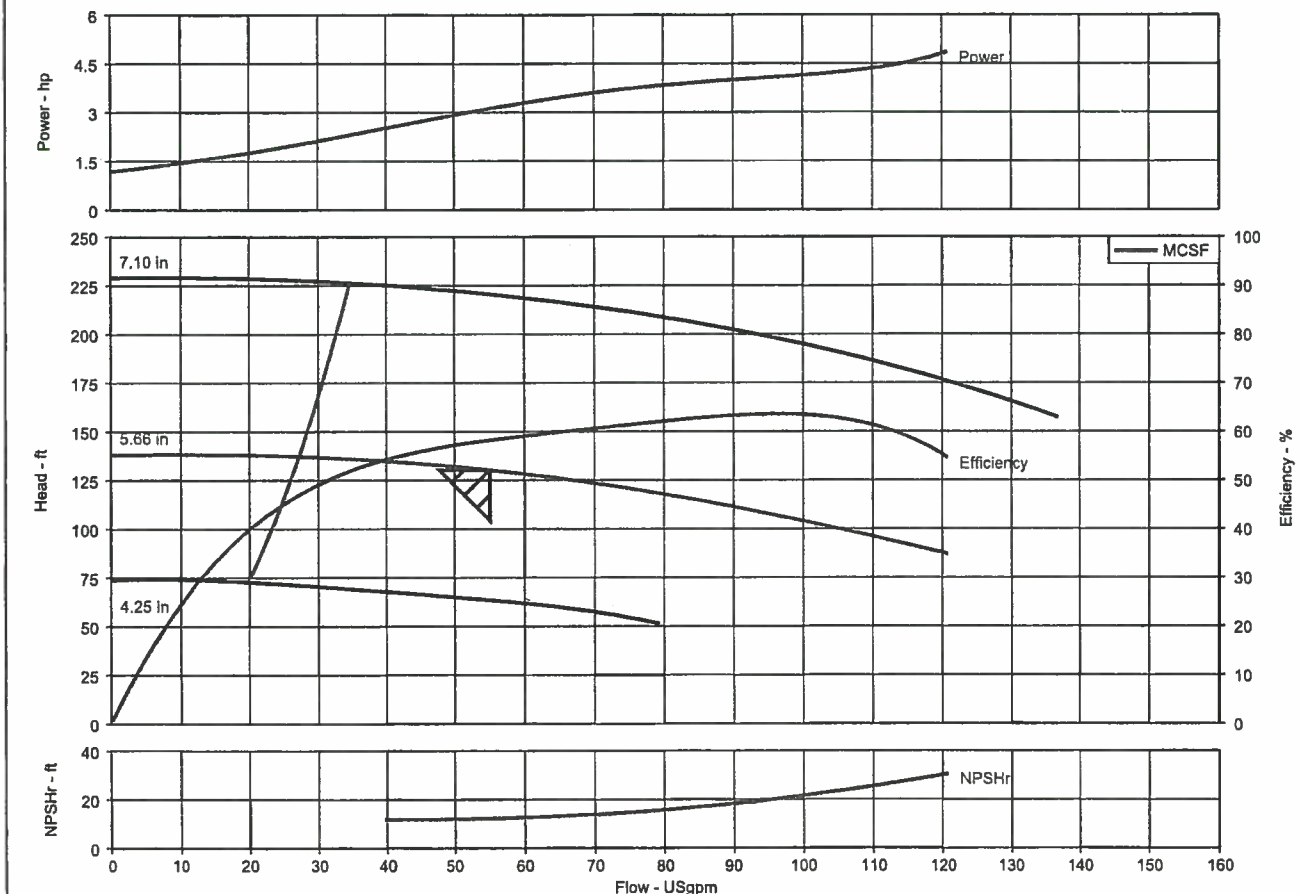
Project name / location :	Tag Number :
Consulting engineer :	Service :
Customer :	Size : 10707 LC
Customer ref. / PO :	Quantity : 1
Quote number :	Quoted By (Sales Office) :
Date last saved : 23 Nov 2010 9:44 AM	Quoted By (Sales Engineer) :

Operating Conditions	Liquid
Flow, rated : 55.00 USgpm	Liquid type : Water
Differential head / pressure, rated (requested) : 130.0 ft	Additional liquid description :
Differential head / pressure, rated (actual) : 129.8 ft	Solids diameter, max : 0.00 in
Suction pressure, rated / max : 0.00 / 0.00 psi.g	Temperature, max : 68.00 deg F
NPSH available, rated : Ample	Fluid density, rated / max : 0.998 / 0.998 SG
Frequency : 60 Hz	Viscosity, rated : 1.00 cP

Performance	Material
Speed, rated : 3,500 rpm	Material requested : Auto
Impeller diameter, rated : 5.66 in	Material selected : Cast iron
Impeller diameter, maximum : 7.10 in	
Impeller diameter, minimum : 4.25 in	
Efficiency : 58.15 %	
NPSH required / margin required : 12.02 / 0.00 ft	
nq (imp. eye flow) / S (imp. eye flow) : 14 / 65 Metric units	
MCSF : 27.21 USgpm	
Head, maximum, rated diameter : 138.1 ft	
Head rise to shutoff : 5.98 %	
Flow, best eff. point (BEP) : 96.33 USgpm	
Flow ratio (rated / BEP) : 57.09 %	
Diameter ratio (rated / max) : 79.72 %	
Head ratio (rated dia / max dia) : 58.96 %	
Cq/Ch/Ce [ANSI/HI 9.6.7-2004] : 1.00 / 1.00 / 1.00	
Selection status : Acceptable	

Pressure Data
Maximum working pressure : 59.75 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
Driver sizing specification : Rated power
Margin over specification : 0.00 %
Service factor : 1.00
Power, hydraulic : 1.80 hp
Power, rated : 3.10 hp
Power, maximum, rated diameter : 4.86 hp
Minimum recommended motor rating : 5.00 hp / 3.73 kW



INSTALLATION, OPERATING & MAINTENANCE INSTRUCTIONS

Type L End Suction Pumps

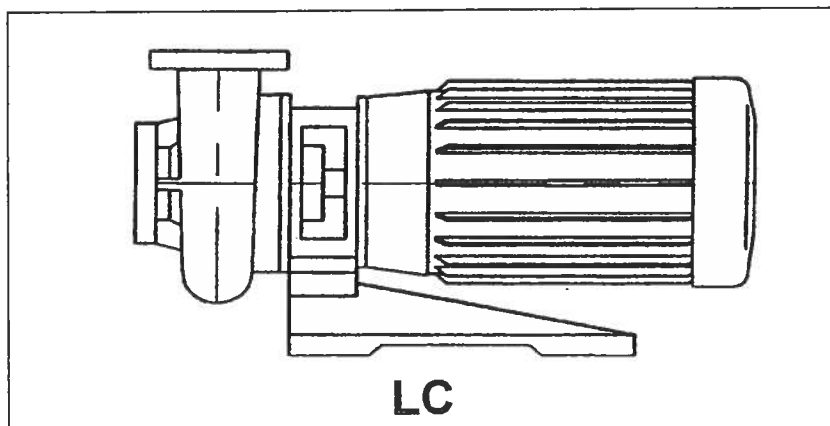
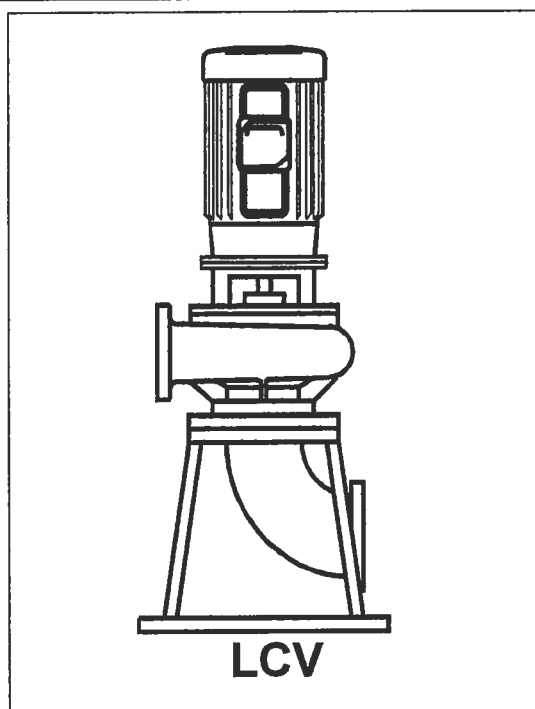
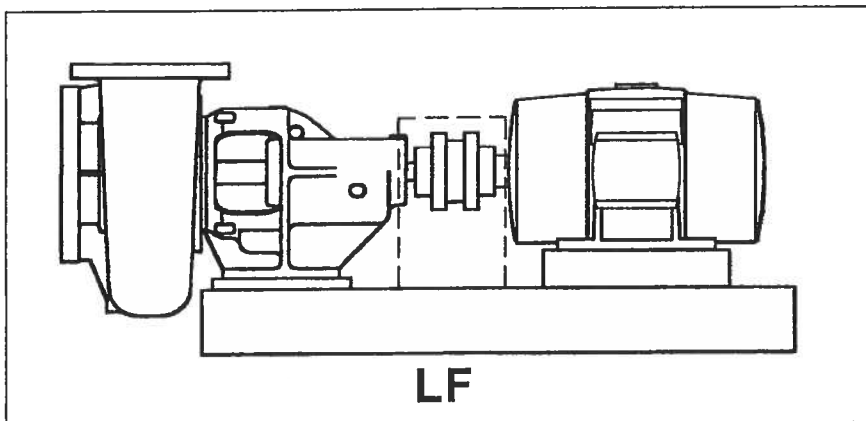


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CAUTIONS and **WARNINGS** are inserted at key points of this manual to provide check points for personnel and machinery safety. **CAUTIONS:** Apply to personnel. **WARNINGS:** Apply to personnel and machinery.

I. INSTALLATION-MECHANICAL

Read these instructions thoroughly before installing and operating your PACO Type L Centrifugal Pump. Successful operation depends on careful attention to the procedures described in Sections I, II, III and IV of this manual. Keep this instruction manual handy for future use.

A. PUMP IDENTIFICATION

- All PACO Pumps are identified by Catalog and Serial Numbers. These numbers are stamped on the pump nameplate (Fig. 1 a) affixed to each pump volute casing, and should be referred to in all correspondence with the Company.

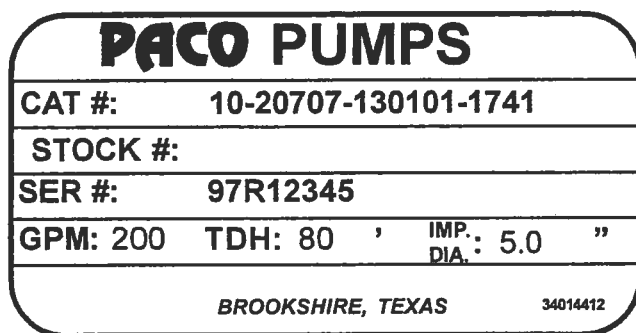


FIGURE 1a

B. 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. **Do not lift unit by eye bolts on the motor!**

C. 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 periodically to coat bearing with lubricant to retard oxidation and corrosion.

- Follow motor manufacturer's storage recommendations where applicable.

D. LOCATION

- Locate the pump as close to the suction supply as possible. Use the shortest and most direct suction piping practical. Refer to paragraph H. 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 unit.
- 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 II and III.
- Avoid pump exposure to sub-zero temperatures to prevent pump liquid from freezing. If freezing conditions exist during shutdown periods, see Sections IIIE and IIIF for specific recommendations.

E. HORIZONTAL PUMP FOUNDATION

- Horizontal pumps should be permanently installed on a firm, concrete foundation mounting pad of sufficient size to dampen any vibration and prevent any deflection or misalignment. The pad may float on springs or be a raised part of the equipment room floor. The foundation should be poured without interruption to 3/4 to 1-1/2 inches below the final pump elevation. The top surface should be well scored or grooved before the concrete sets to provide a suitable bonding surface for the grout. Anchor bolts should be set in pipe sleeves for positioning allowance, as shown in (Fig. 2a) on page 4. Allow enough bolt length for grout, lower base plate flange, nuts and washers. Allow the foundation to cure several days before proceeding with pump installation.

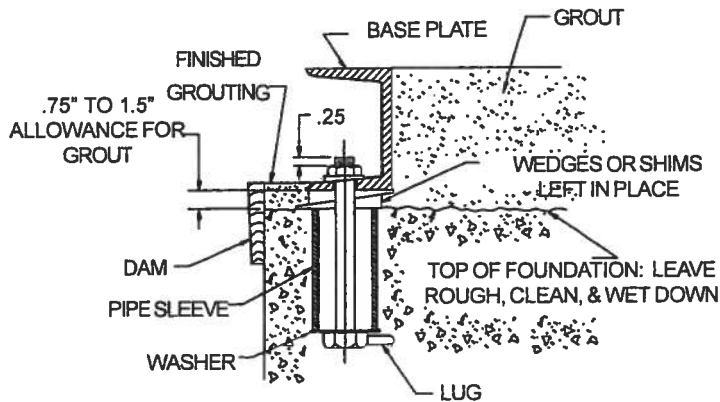


FIGURE 2a: Anchor Bolt Installation

F. SECURING THE BASE PLATE

- After the concrete pad has been poured and set, lower the pump base plate over the anchor bolts and rest it on loose adjustment wedges or shims placed near each anchor bolt and at intervals not to exceed 24" along each side.

Shims or wedges must be placed to raise the bottom of the base $\frac{3}{4}$ " to $1\frac{1}{4}$ " above the pad, allowing clearance for grout. Level the pump shaft, flanges, and base plate using a spirit level, adjusting the wedges or shims, as required.

- Check to make sure that the piping can be aligned to the pump flanges without placing any strain on either flange.
- After pump alignment has been established, put nuts on foundation bolts and tighten them just enough to keep the unit base plate from moving. Construct a form or dam around the concrete pad and pour grout in and around the pump base, as shown in (Fig. 2a). Grout compensates for uneven foundation, distributes the weight of the unit, and prevents shifting. Use an approved, nonshrinking grout (such as Embeco 636 by Master Builders, Cleveland, Ohio or equivalent). Allow at least 24 hours for this grout to set before proceeding with piping connections.
- After the grout has thoroughly hardened, check the foundation bolts and tighten if necessary. Recheck the pump alignment after the foundation bolts are secured.

G. VERTICAL MOUNTING INSTRUCTIONS

The PACO LCV Vertical Close Coupled pump need not be grouted to its foundation, but should be anchored with 4 anchor bolts set in concrete similar to the horizontal anchoring arrangement (Fig. 2a).

H. PIPING-GENERAL

- 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!**

I. 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.

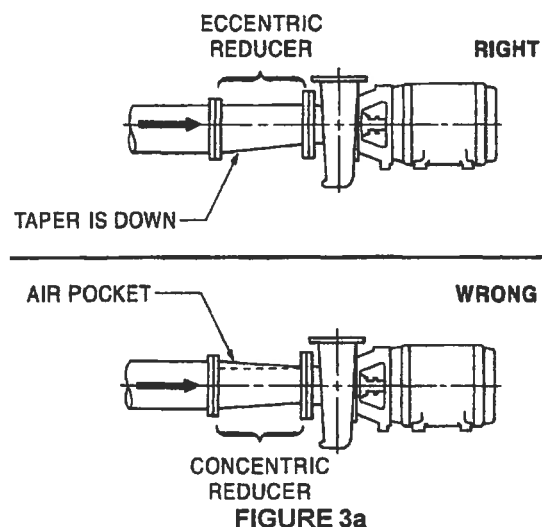


FIGURE 3a

- Use an eccentric reducer, with the eccentric side down (Fig. 3a) when reducing the pipe diameter to the diameter of suction opening.
- **At no point should suction piping be smaller in diameter than the pump suction opening.**
- Horizontal suction lines should follow an even gradient, if possible. A gradual upward slope to the pump is recommended for suction lift conditions, and a gradual downward slope for positive suction head.
- Avoid any high points, such as pipe loops (Fig. 4a), that may create air pockets and throttle the system or produce erratic pumping.
- 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 duplicate gate valves to isolate each pump from the line.
- Gate 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.

J. 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.
- If the possibility of liquid hammer exists, (i.e. check valves are used) close the discharge gate valve before pump shutdown.

K. SHAFT SEALING-GENERAL COMMENTS

- PACO offers both mechanical seals and packed stuffing boxes as a means to seal the shaft. Pumps with 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 lubrication. If the pump is stored for a longer period, 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. When pumps are equipped with mechanical seals, no maintenance or adjustment is required. Mechanical seals are preferred to packing on most applications because they require less maintenance.

L. PACKING GLAND ADJUSTMENT

- With the pump running, the packing gland should be adjusted to permit 40 to 60 drops per minute leakage. This is required for shaft lubrication. After initial start up, additional packing and adjustment may be required. Pumps with mechanical seals require no adjustment.

M. MECHANICAL SEALS

All PACO Type L pumps that are equipped with mechanical seals are matched to conditions for which the pump was sold. Observe the following precautions to avoid seal damage and obtain maximum seal life:

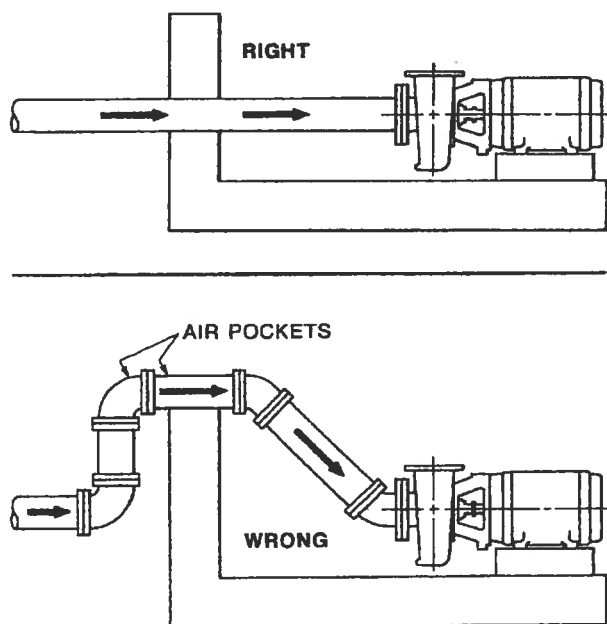
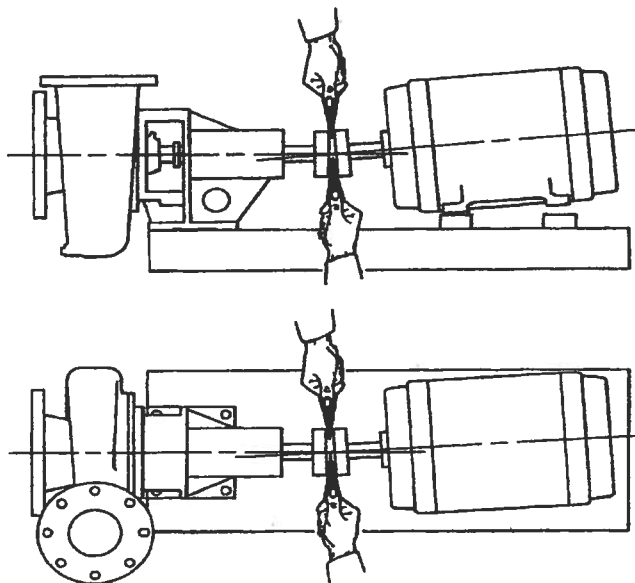


FIGURE 4a

CHECKING ANGULAR ALIGNMENT



CHECKING PARALLEL ALIGNMENT

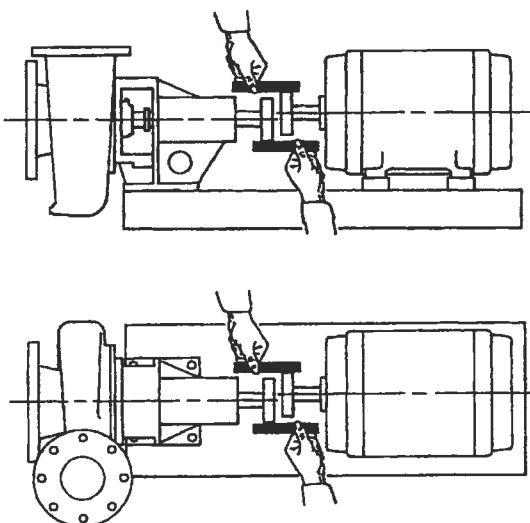


FIGURE 5a: Checking Alignment

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

N. COUPLING ALIGNMENT

- The following anchoring and alignment procedure is typical and, if performed with care, should result in a smooth running, trouble-free installation.
- If the pump and motor were shipped mounted on the pump base as an assembly, remove the coupling guard.
- The pump and motor were accurately aligned at the factory, but handling during shipment usually alters this pre-alignment. Using a small straight edge and feeler gauges or a dial indicator, check for horizontal, vertical, and angular misalignment of the coupling hubs (Fig. 5a).
- Coupling alignment is proper when the dial indicator reads no more than .005" run out in any direction (or when the straight edge contacts both hubs evenly in both horizontal and vertical positions). If misalignment is detected, loosen the motor and shift or shim as necessary to re-align, then re-tighten bolts. **Always align the motor to the pump as piping strain will occur if the pump is shifted. Never reposition pump on base!**
- After final piping connections to the pump have been made, motor wiring compared, correct rotation has been established, and piping filled with liquid, check shaft alignment once again.
- Leave the coupling guards off until the pump priming procedure is completed for a final shaft alignment check.
- To protect personnel from rotating machinery, **Always install coupling guards after installation is complete; before starting pump!**

II. INSTALLATION—ELECTRICAL

A. MOTORS, GENERAL

The motor control circuit must have the following compo-

nents in order to comply with the National Electrical Code.

- **Motor Disconnecting Device:** A motor disconnecting device must be installed that 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):**

These components must be installed in accordance with applicable local and state electrical codes in addition to the National Electrical Code.

B. INSTALLATION WIRING

- 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.

III. OPERATION

A. PRIMING

- The PACO Type L pump is 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 air vents at this time, and make sure all air is forced from pump by liquid before closing.
- 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.

B. PRE-START CHECKLIST

WARNING: In the interest of operator safety, the unit must not be operated above the nameplate conditions. Such operation could result in unit failure causing injury to operating personnel. Consult instruction book for proper operation and maintenance of the pump and its supporting components.

Make the following inspections before starting your Sulzer Type L pump:

- ☐ Make sure all wiring connections to the motor (and starting device) match the wiring diagram and produce clockwise rotation as viewed from the back 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.

C. MOTOR ROTATION

CAUTION: *Never check driver rotation unless pump and driver couplings are disconnected and physically separated. Failure to follow this instruction 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.
- **IMPORTANT:** The pumps must not be operated while dry. Use extreme caution that motors are energized only momentarily to determine proper rotation.

D. STARTING THE PUMP

WARNING: *The pump must not be operated without an approved coupling guard in place. Failure to observe this warning could result in injury to operating personnel.*

- Install coupling guard on flexible coupled units.
- Fully open gate valve (if any) in suction line, and close gate valve in discharge line.
- Fill suction line with liquid and completely prime pump.
- Start the motor (pump).
- Immediately make a visual check of pump and suction piping for pressure leaks.
- Immediately after pump reaches full operating speed, slowly open the discharge gate valve until complete system flow is achieved.
- Check discharge piping for pressure leaks.
- 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.

- Check and record voltage, amperage per phase, and

kilowatts, if a wattmeter is available.

E. 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%.

F. PUMP SHUTDOWN

The following shutdown procedures will apply in most normal shutdowns for the PACO Type L 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.

G. 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.

H. EXTENDED PERIOD SHUTDOWN

- For long shutdown periods, or to isolate the pump for maintenance, 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.

IV. MAINTENANCE

WARNING: Do not attempt any maintenance, inspection, repair or cleaning in the vicinity of rotating equipment. Such action could result in personal injury to operating personnel.

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.

A. 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.

MOTOR RPM	MOTOR HP	OPERATING CONDITIONS		
		STANDARD	SEVERE	EXTREME
1750 & BELOW	1/3-7-1/2	3 YRS.	1 YR.	6 MOS.
	10-40	1-3 YRS.	6 MOS.-1 YR.	3 MOS.
	50-150	1 YR.	6 MOS.	3 MOS.
	200 & UP	1 YR.	6 MOS.	3 MOS.
ABOVE 1750	(ALL HP)	6 MOS.	3 MOS.	3 MOS.
STANDARD CONDITIONS: 8 Hours per day operation, normal or light loading, clean air, 100°F, maximum ambient temperature.				
SEVERE CONDITIONS: Continuous 24-hour operation, shock loading or vibration, poor ventilation, 100°-150°F, ambient temperature.				
EXTREME CONDITIONS: Continuous operation, heavy shock or vibration, dirt or dust in air, extreme ambient temperature.				

TABLE 6a: Recommended Lubrication Periods.

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 Table 6a for recommended lubrication periods.

- Table 7a lists recommended types of grease for both pump and motor lubrication. These types have all been thoroughly tested and should be used whenever possible.

B. PUMP LUBRICATION

- PACO Type LF pumps on horizontal bearing frames have bearing that may be sealed for life (requiring no lubrication), regreasable or oil lubricated.

MANUFACTURER	LUBRICANT
SHELL	DOLIUM® R™
EXXON	POLYREX®
CHEVRON	SRI GREASE NLGI 2
	BLACK PEARL - NLGI 2
PHILIPS	POLYTAC™
TEXACO	POLYSTAR RB

TABLE 7a

- To lubricate regreasable bearings, remove grease drain plug (if any) and filler plug. Add clean ball bearing lubricant until grease appears at drain hole or along shaft. On units with drain hole, all old grease can be purged out ahead of new. In such cases, the drain should be left unplugged for several minutes during pump operation to allow excess grease to be forced out.
- Lubricate bearing frame bearings at intervals of one to three months, depending on severity of environment. Pumps in a clean, dry, moderate temperature (100° F maximum) environment should be regreased at three month intervals. Too much grease can cause premature bearing failure—do not over-grease.
- On those PACO Type LF Centrifugal End Suction pumps ordered with oil lubricated bearings, (Fig. 8a) a regular oil maintenance program must be enforced. Pumps with oil lubricated bearings are fitted with a transparent reservoir (constant level oiler) that maintains oil level about the centerline of the bearing. When necessary, the oil supply in the reservoir of the constant level oiler must be renewed.
- After the first 200 hours of operation the oil should be changed. 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 housing. After draining oil, replace the fittings and refill with an acceptable oil selected from Table 9a. After the first oil change, the oil should be changed again at 2000 hours and then at intervals of 8000 hours or once yearly, thereafter.

OIL LEVEL

FIGURE 8a

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 Company	CALYPSOLBISON OIL SR 25 or SR 36
Standard Oil Company	CHEVRON HYDRAULIC OIL 11 CIRCULATING OIL 45
Esso Corporation	ESSO-MAR 25 TERESSO 47 ESSTIC 50
Fina Oil Company	FINA HYDRAN 34 FINA CIRKAN 32
Gulf Refining Company	GULF HARMONY 47 GULF PARAMOUNT 45
Socony Mobil Oil Co.	VAC HLP 25 MOBILUX D.T.E. 25
Shell Oil Company	SHELL Tellus OIL 29
Sundco Oil Company	SUNVIS 821
The Texas Company	TEXACO Ursa Oil P 20 DEA VISCIBIL Sera 4
Wisura Refining Company	WISURA Norma 25 (36) WISURA Tempo 25 (36)

TABLE 9a: List of Acceptable Lube Oils

C. DISASSEMBLY OF PUMPS

(Refer to drawing on page 11).

- Complete disassembly instructions are outlined below. Proceed only as far as required to perform the maintenance work needed.
- Turn off power.
- Drain system. Flush, if necessary.
- Closed coupled units: Remove motor hold down bolts.

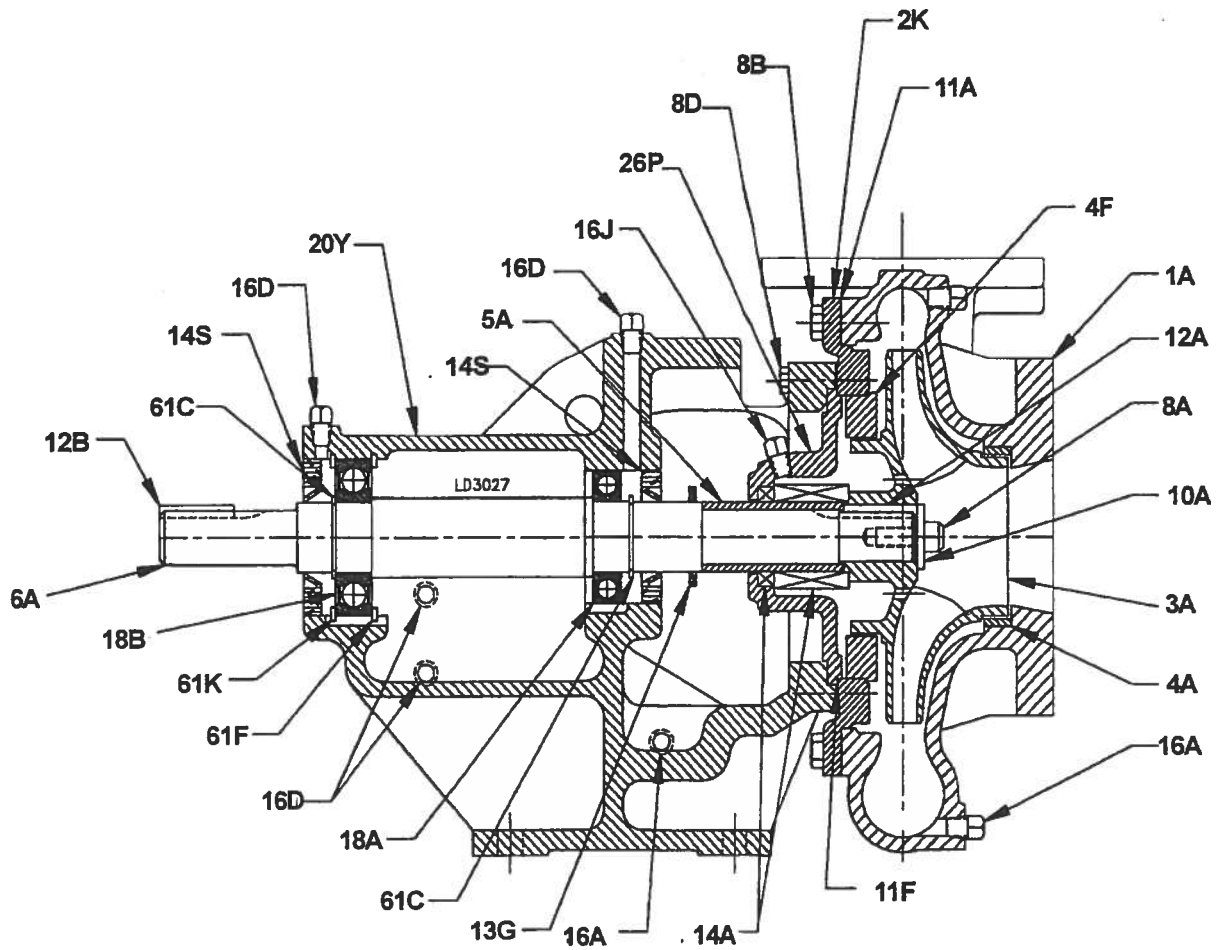
DISASSEMBLY OF LIQUID END.

- Remove casing bolts (8B)
- Remove back pull-out bearing frame assembly (20Y) from casing (1A)
- Unscrew impeller nut (8A)
- **CAUTION: Do not insert screwdriver between impeller vanes to prevent rotation.** It may be necessary to use a strap wrench around the impeller or shaft to prevent rotation.
- Use appropriate size gear puller aligned behind impeller vanes to remove impeller (3A) from shaft (6A).
- Remove impeller key (12A).
- Remove backplate bolts (8D). Remove backplate (2K) and seal housing (26P).
- Place seal housing on flat surface and press out seal seat (14A).
- If shaft sleeve (5A) requires replacement, it must be evenly heated to approximately 350°F to loosen locktite. Twist sleeve off shaft (6A).

DISASSEMBLY OF BEARING FRAME.

- Remove slinger (13G).
- Remove grease seal(s), (14S) if any.
- Remove bearing house retaining ring (61K).
- Press or tap on the pump end of the bearing-shaft assembly until one bearing is out.
- When one bearing is out, remove second retaining ring (61F), then remove complete assembly from bearing housing.
- Remove shaft retaining ring (61C) and press off bearings.
- Press on new bearings. Remember to press only on inner race of bearing while pressing them on.
- Assemble frame in the reverse procedure used for disassembly.
- Observe the following when reassembling the bearing frame.

TYPE LF, CROSS SECTION AND PARTS LIST



ITEM NO	PART NAME	ITEM NO	PART NAME	ITEM NO	PART NAME
1A	Casing	*10A	Washer, Packing	16L	Plug, Seal Chamber
2K	Backplate	10A	Washer, Impeller	18A	Bearing, Inboard
3A	Enclosed Impeller	11A	Gasket, Casing	18B	Bearing, Outboard
4A	Case Wear Ring	11F	Gasket, Backplate	20Y	Bearing Frame
**4F	Balance Ring	12A	Key, Impeller	*22A	Stud, Packing Gland
5A	Shaft Sleeve	12B	Key, Coupling	26P	Seal Housing
*5L	Lantern Ring	*13A	Packing	*26U	Packing Box
6A	Shaft	13G	Slinger	*35F	Nut, Packing Gland
7A	Packing Gland	14A	Shaft Seal	61C	Snap Ring
8A	Cap Screw, Impeller	14S	Lip Seal	*61J	Snap Ring
8B	Cap Screw, Casing	16A	Plug, Drain	Packed Pumps Only **If Applicable	
8D	Cap Screw, Brg. Frame	16D	Plug, Grease/Oil Filter		

- Replace lip seals (14S) if worn or damaged.
- Replace bearings (18A), (18B) if loose, rough or noisy when rotated.
- Check shaft (6A) for runout at the sleeve (5A) area. Maximum permissible is .002" T.I.R.

D. REASSEMBLY OF PUMPS

- All parts should be cleaned before reassembly.
- Refer to parts list to identify required replacement items. Specify pump serial or catalog number when ordering parts.
- Reassembly is the reverse of disassembly.
- Observe the following when reassembling the liquid end:
 - All mechanical seal components must be in good condition or leakage may result. Replacement of complete seal assembly is recommended.
- New shaft sleeves are installed by bonding to shaft with hydraulic setting locktite.

V. ORDERING PARTS

- **PACO Pumps** has over 175 years of experience in the design, manufacture, and application of centrifugal pumps and pumping systems. 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 A1b.2, attached, 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.

VI. TROUBLE SHOOTING

A.

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*41
Shaft seal or packing fails prematurely.	12*13*27*28*29*30*33*34*35*36*37*38*39*41
Pump uses too much power.	15*16*18*19*20*23*25*27*28*31*33*34*35*37*38*44
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*41*42*45*46*
Bearings overheat and/or fail prematurely.	27*28*29*30*31*32*33*34*40*41*42*43*44*45*46

B. POSSIBLE CAUSES

- The pump has not been properly bled of air.
- The pump suction line have not been completely primed.
- 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.
- The fluid pumped contains too much entrained air or gas.
- There are air pockets in the suction line.
- An entry of air has suddenly occurred in the suction line.
- An entry of air past the shaft seal into the pump has occurred.
- The inlet of the suction line is insufficiently submerged.
- The suction valve is closed or only partially open.
- The suction strainer is clogged with dirt or debris.
- The foot valve is clogged or undersized.
- Little or no cooling fluid supplied to the shaft seals.
- The lantern ring is not positioned opposite the flushing inlet thereby restricting fluid flow.
- Pump drive rotational speed too low.
- Pump drive rotational speed too high.
- Pump rotation wrong or impeller installed backwards.
- Total head of installation (back Pressure) higher than rated total head of the pump.
- Total head of installation (back Pressure) lower than rated total head of the pump.
- Density of fluid pumped differs from that specified when the pump was purchased.
- Viscosity of fluid pumped differs from that specified when the pump was purchased.
- The pump is operating at too low a rate of flow (The discharge valve may be throttled too much).
- If pumps are operating in parallel, the pump characteristics may not be suitable for parallel operation.
- The impeller may be clogged with debris.
- The impeller may be damaged.
- The casing and impeller wear rings may be excessively worn.

TROUBLE SHOOTING-POSSIBLE CAUSES (Cont'd)

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.
41. The bearings may be worn.
42. The bearings may have been damaged during installation and/or dirt or other foreign matter may have entered the bearings during greasing or oiling.
43. Excessive greasing may cause the bearings to overheat.
44. Inadequate lubrication may be causing bearing failure.
45. Dirt may have entered the bearings past the O-Rings.
46. Moisture may have entered the bearing housing causing the bearings to rust.

Terms And Conditions Of Sale

SECTION 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.

SECTION 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.

SECTION 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.

SECTION 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.

SECTION 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.

SECTION 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.

SECTION 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.

SECTION 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.

SECTION 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.

SECTION 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.

SECTION 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.

SECTION 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.

SECTION 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.

SECTION 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.

A1d.1

4/06

Supersedes 9/05

PACO
PUMPS

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www.paco-pumps.com

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ITEM 3: PUMP TEST RESULTS

Idaho Department of Water Resources

Listing of Driller Reports

Contact	Use	TWP	RNG	SEC	Tract	Gov. Lot	WellAddress	Sub	Bl	L	Gallons Per Minute	Static Water Level	Total Depth	Casing Depth	CSG. DIA.	Construction Date	Permit Number	Tag Number
GEM COUNTY	Municipal	06N	02W	15	NENE		SHADOW BUTTE INDUSTRIAL PARK; HWY 52	WELL #1			375	7.5	133	73	8	10/11/2005	835637	D0041854
Related Documents																		

• Well Seal

From Depth	To Depth	Material	Amount	Method
0	63	Bentonite granuals	20,000 LBS	Pour

• Well Screen

Type	From Depth	To Depth	Slot Size	# of Slots	Diameter	Perforation Method	Screen Type	Material	Installed Flag
Screen	73	123	.035		8		JOHNSON	Stainless steel	Y

• Well Casing

From Depth	To Depth	Diameter	Type	Gauge	Join Type	Material
2	73	8	Casing	0.322	Welded	Steel

• Well Lithologic Layer

Bore Diameter	From Depth	To Depth	Water	Color	Material	Texture	Descriptor
---------------	------------	----------	-------	-------	----------	---------	------------

• Construction Details

Drilling Company	License Number	Metal Tag Number
		D0041854

65

Form 238-7
6/02

Shadow Butte - well 1

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

835637

Office Use Only		
Well ID No.	406134	
Inspected by		
Twp	Rge	Sec
1/4	1/4	1/4
Lat:	:	Long:

1. WELL TAG NO. D 0041854
 DRILLING PERMIT NO. 890655-835637
 Water Right or Injection Well No. 65-22918

2. OWNER:

Name GEM COUNTY
 Address 415 EAST MAIN
 City EMMETT State ID Zip 83617

3. LOCATION OF WELL by legal description: WELL #1

You must provide address or Lot, Blk, Sub. or Directions to well.

Twp. 6 North ☒ or South ☐
 Rge. 2 East ☐ or West ☒
 Sec. 15 1/4 NE 1/4 NE 1/4
 Gov't Lot _____ County GEM

Lat: _____ Long: _____
 Address of Well Site SHADOW BUTTE INDUSTRIAL PARK, Hwy 52 City EMMETT
 (Give at least name of road or landmark)

Lt. _____ Blk. _____ Sub. Name N/A

4. USE:

☐ Domestic ☒ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other _____

5. TYPE OF WORK check all that apply

(Replacement etc.)

☒ New Well ☐ Modify ☐ Abandonment ☐ Other _____

6. DRILL METHOD:

☐ Air Rotary ☐ Cable ☐ Mud Rotary ☒ Other REVERSE

7. SEALING PROCEDURES

Seal Material	From	To	Weight / Volume	Seal Placement Method
<u>1" BENTONITE</u>	<u>0</u>	<u>63</u>	<u>20.000</u>	<u>DRY POUR</u>

Was drive shoe used? ☐ Y ☒ N Shoe Depth(s) _____

Was drive shoe seal tested? ☐ Y ☒ N How? _____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
<u>8"</u>	<u>+2</u>	<u>73</u>	<u>.322</u>	<u>STEEL</u>	☒	☐	☒	☐

Length of Headpipe _____ Length of Tailpipe 10'

Packer ☐ Y ☒ N Type _____

9. PERFORATIONS/SCREENS PACKER TYPE

Perforation Method _____

Screen Type & Method of Installation JOHNSON WIRE WRAP

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
<u>73</u>	<u>123</u>	<u>.035</u>		<u>8"</u>	<u>S.S.</u>	☒	☐

10. FILTER PACK

Filter Material	From	To	Weight / Volume	Placement Method
<u>#8-12 SAND</u>	<u>63</u>	<u>143</u>	<u>19.500</u>	<u>DRY POUR</u>

11. STATIC WATER LEVEL OR ARTESIAN PRESSURE:

7'6" ft. below ground Artesian pressure _____ lb.

Depth flow encountered _____ ft. Describe access port or control devices: _____

8" FLANGE ON TOP

12. WELL TESTS:

☒ Pump ☐ Bailor ☐ Air ☐ Flowing Artesian

Yield gal./min.	Drawdown	Pumping Level	Time
<u>375 gpm</u>	<u>25.4</u>	<u>33</u>	<u>8 hrs</u>

Water Temp. _____ Bottom hole temp. _____

Water Quality test or comments: _____

Depth first Water Encounter _____

13. LITHOLOGIC LOG: (Describe repairs or abandonment)

Water

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	Y	N
<u>20"</u>	<u>0</u>	<u>2</u>	<u>TOP SOIL</u>		
	<u>2</u>	<u>25</u>	<u>RIVER ROCK, GRAVEL, SAND</u>		
	<u>25</u>	<u>129</u>	<u>COARSE SAND, FEA GRAVEL</u>		
	<u>129</u>	<u>130</u>	<u>SANDY BLUE CLAY</u>		
	<u>130</u>	<u>131</u>	<u>COARSE WHITESAND, FEA GRAVEL</u>		
	<u>131</u>	<u>132</u>	<u>SANDY BLUE CLAY</u>		
	<u>132</u>	<u>143</u>	<u>COARSE WHITE SAND, FEA GRAVEL</u>		

RECEIVED

OCT 21 2005

WATER RESOURCES
WESTERN REGION

Completed Depth 133' (Measurable)

Date: Started 9-6-05 Completed 10-11-05

14. DRILLER'S CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Company Name RIVERSIDE INC. Firm No. 333

Principal Driller Justin Cleaver Date 10-20-05

and Driller or Operator II _____ Date _____

Operator I Justin Cleaver Date 10-20-05

Principal Driller and Rig Operator Required.

Operator I must have signature of Driller/Operator II.

FORWARD WHITE COPY TO WATER RESOURCES

Idaho Department of Water Resources

Listing of Driller Reports

Contact	Use	TWP	RNG	SEC	Tract	Gov. Lot	WellAddress	Sub	Bl	L	Gallons Per Minute	Static Water Level	Total Depth	Casing Depth	CSG. DIA.	Construction Date	Permit Number	Tag Number
GEM COUNTY	Municipal	06N	02W	15	NENE		SHADOW BUTTE INDUSTRIAL PARK; HWY 52	WELL #2			375	8.5	133	73	8	10/13/2005	835638	D0041855
Related Documents																		

65

Form 238-7
6/02

Shadow Butte - Well 2

IDAHO DEPARTMENT OF WATER RESOURCES

WELL DRILLER'S REPORT

1. WELL TAG NO. D 0041855
 DRILLING PERMIT NO. 890656-835638
 Water Right or Injection Well No. 65-22918

2. OWNER:

Name GEM COUNTY
 Address 415 EAST MAIN
 City EMMETT State ID Zip 83617

3. LOCATION OF WELL by legal description: WELL #2

You must provide address or Lot, Blk, Sub. or Directions to well.

Twp. 6 North ☒ or South ☐
 Rge. 2 East ☐ or West ☒
 Sec. 15 1/4 NE 1/4 NE 1/4
 Gov't Lot _____ County GEM

Lat. : : Long. : :
 Address of Well Site SHADOW BUTTE INDUSTRIAL
PARK, Hwy 52 City EMMETT
 (Give at least name of road - Distance to Road or Landmark)
 Lt. _____ Blk. _____ Sub. Name N/A

4. USE:

☐ Domestic ☒ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other _____

5. TYPE OF WORK check all that apply (Replacement etc.)

☒ New Well ☐ Modify ☐ Abandonment ☐ Other _____

6. DRILL METHOD:

☐ Air Rotary ☐ Cable ☐ Mud Rotary ☒ Other REVERSE

7. SEALING PROCEDURES

Seal Material	From	To	Weight / Volume	Seal Placement Method
<u>1" BENTONITE</u>	<u>0</u>	<u>63</u>	<u>20,000</u>	<u>DRY POUR</u>

Was drive shoe used? ☐ Y ☒ N Shoe Depth(s) _____

Was drive shoe seal tested? ☐ Y ☒ N How? _____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
<u>8"</u>	<u>+2</u>	<u>73</u>	<u>.332</u>	<u>STEEL</u>	☒	☐	☒	☐

Length of Headpipe _____ Length of Tailpipe 10'

Packer ☐ Y ☒ N Type _____

9. PERFORATIONS/SCREENS PACKER TYPE

Perforation Method _____

Screen Type & Method of Installation JOHNSON WIRE WRAP

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
<u>73</u>	<u>123</u>	<u>.035</u>		<u>8"</u>	<u>S.S.</u>	☒	☐

10. FILTER PACK

Filter Material	From	To	Weight / Volume	Placement Method
<u>#8-12</u>	<u>63</u>	<u>143</u>	<u>19,500</u>	<u>DRY POUR</u>

11. STATIC WATER LEVEL OR ARTESIAN PRESSURE:

8'5" ft. below ground Artesian pressure _____ lb.

Depth flow encountered _____ ft. Describe access port or control devices: _____

8" FLANGE ON TOP

835638

Office Use Only

Well ID No. 406135

Inspected by _____

Twp _____ Rge _____ Sec _____

1/4 1/4 1/4

Lat. : : Long. : :

12. WELL TESTS:

☒ Pump ☐ Bailor ☐ Air ☐ Flowing Artesian

Yield gal./min.	Drawdown	Pumping Level	Time
<u>375 gpm</u>	<u>14.5</u>	<u>23</u>	<u>8 hrs</u>

Water Temp. _____ Bottom hole temp. _____

Water Quality test or comments: _____

Depth first Water Encounter _____

13. LITHOLOGIC LOG: (Describe repairs or abandonment)

Water

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	Y	N
<u>20'</u>	<u>0</u>	<u>1</u>	<u>TOP SOIL</u>		
<u>↓</u>	<u>1</u>	<u>35</u>	<u>SAND, GRAVEL, RIVER ROCK</u>		
	<u>35</u>	<u>141</u>	<u>COARSE SAND</u>		

RECEIVED

OCT 21 2005

WATER RESOURCES
WESTERN REGION

Completed Depth 133' (Measurable)

Date: Started 9-26-05 Completed 10-13-05

14. DRILLER'S CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Company Name RIVERSIDE INC. Firm No. 333

Principal Driller _____ Date _____

and _____

Driller or Operator II _____ Date 10-20-05

Operator I Jeff Hark Date _____

Principal Driller and Rig Operator Required.

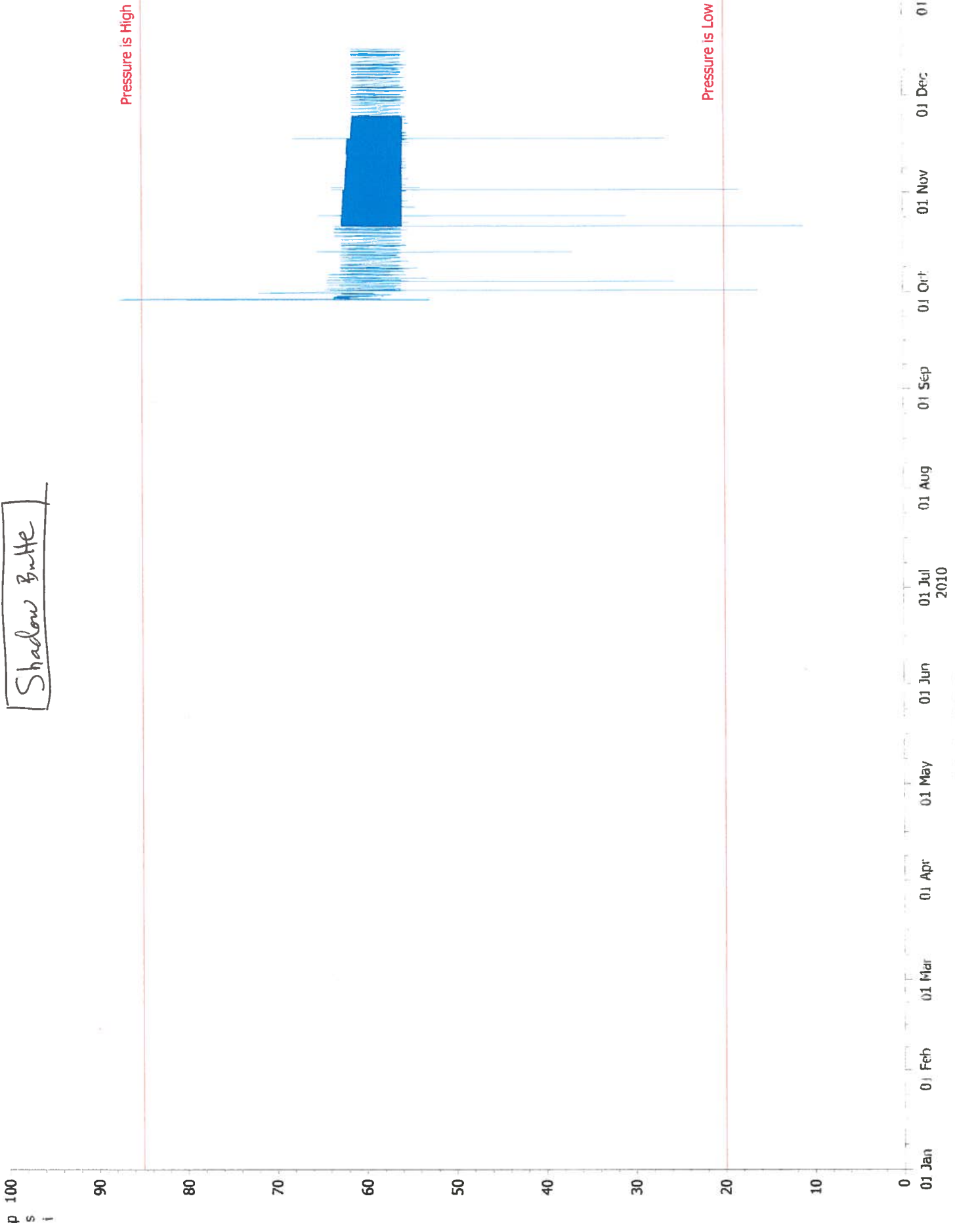
Operator I must have signature of Driller/Operator II.

FORWARD WHITE COPY TO WATER RESOURCES

ITEM 4: PRESSURE AND FLOW TRENDS

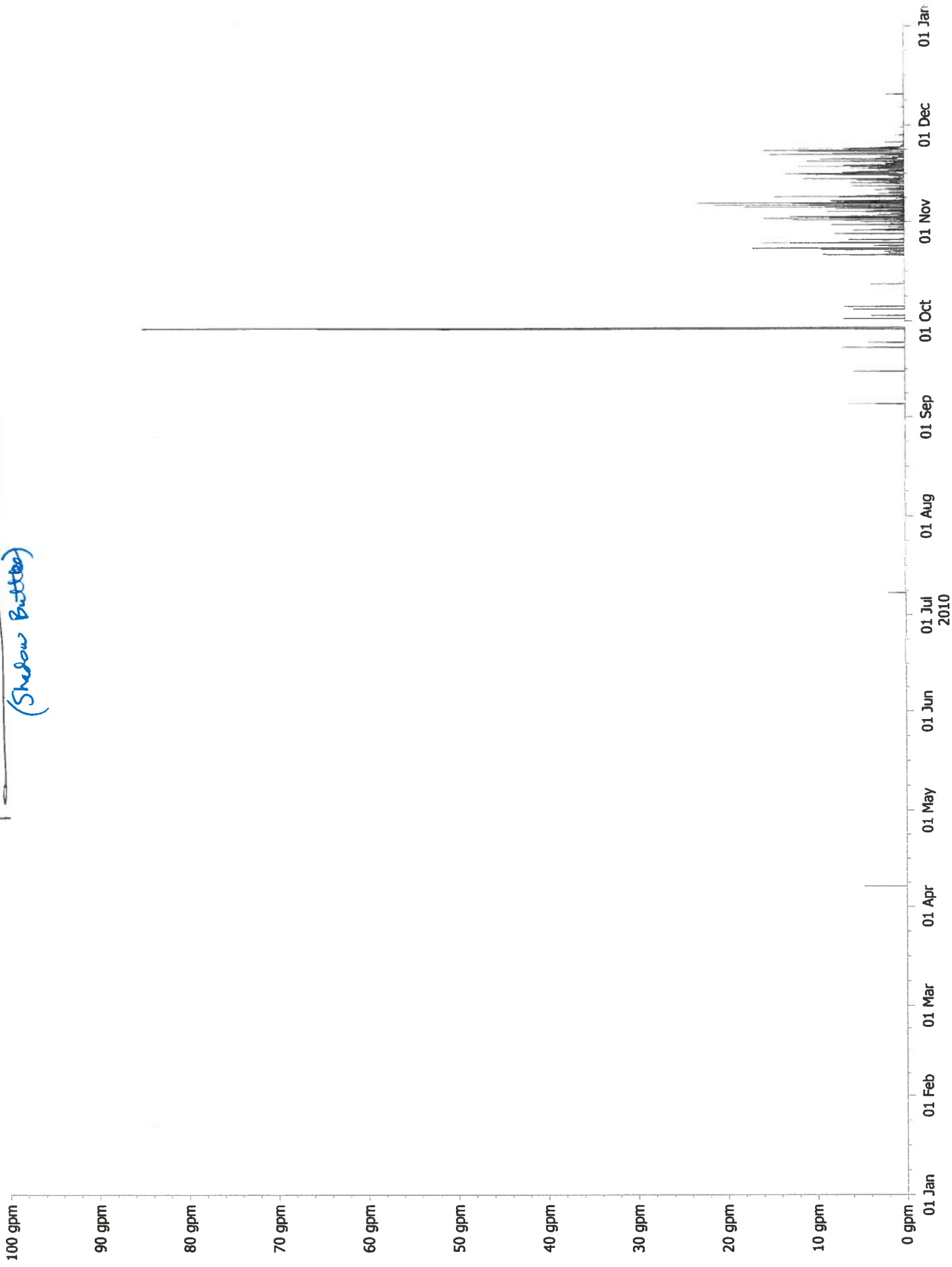
Pressure Trend

Shadow Butte



WTS.Industrial Park Booster Station.4 Inch Flow.Flow Rate

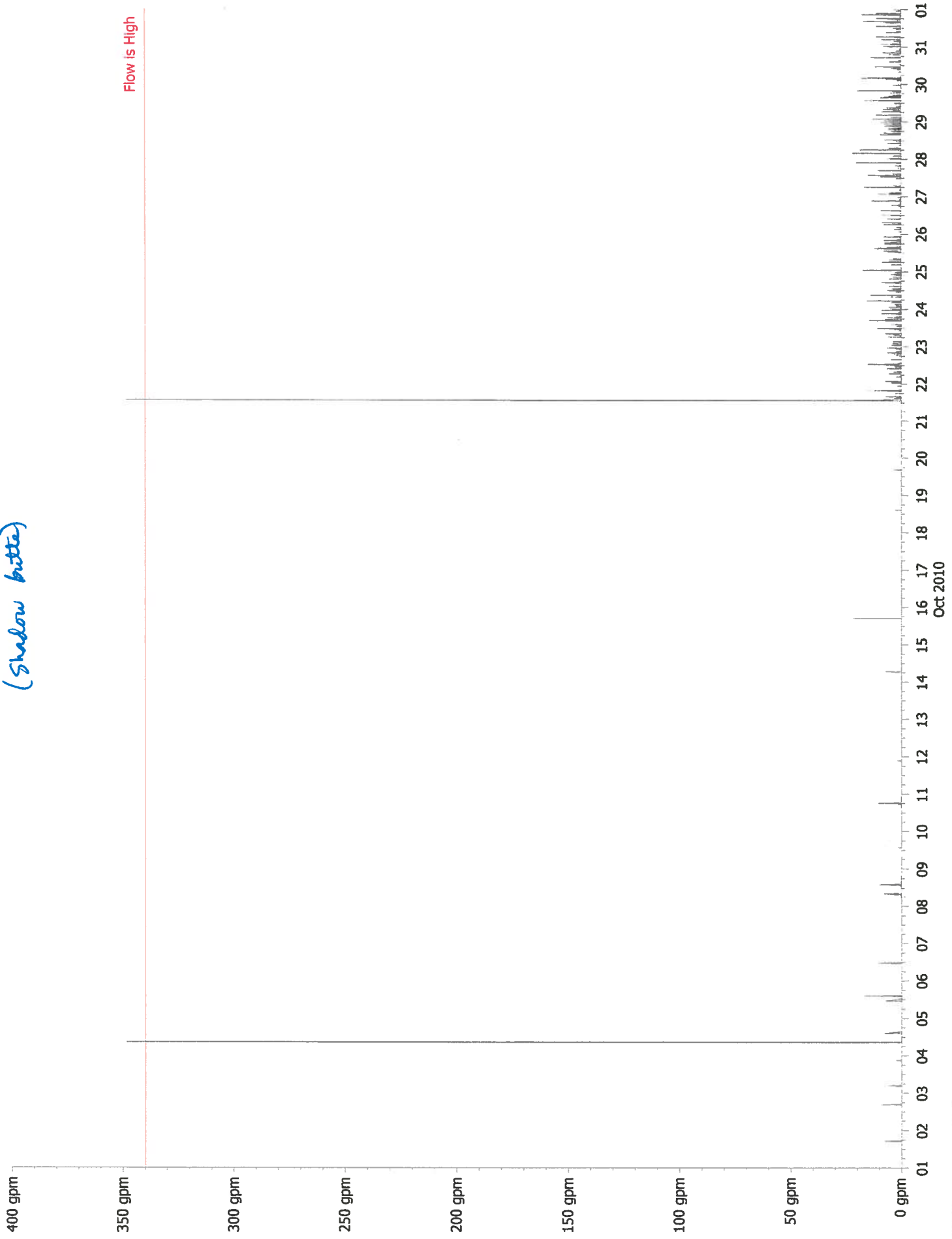
(Shadow Button)



Trace	Type	Ruler Value
WTS.Industrial Park Booster Station.4 Inch Flow.Flow Rate	Processed Historic	-

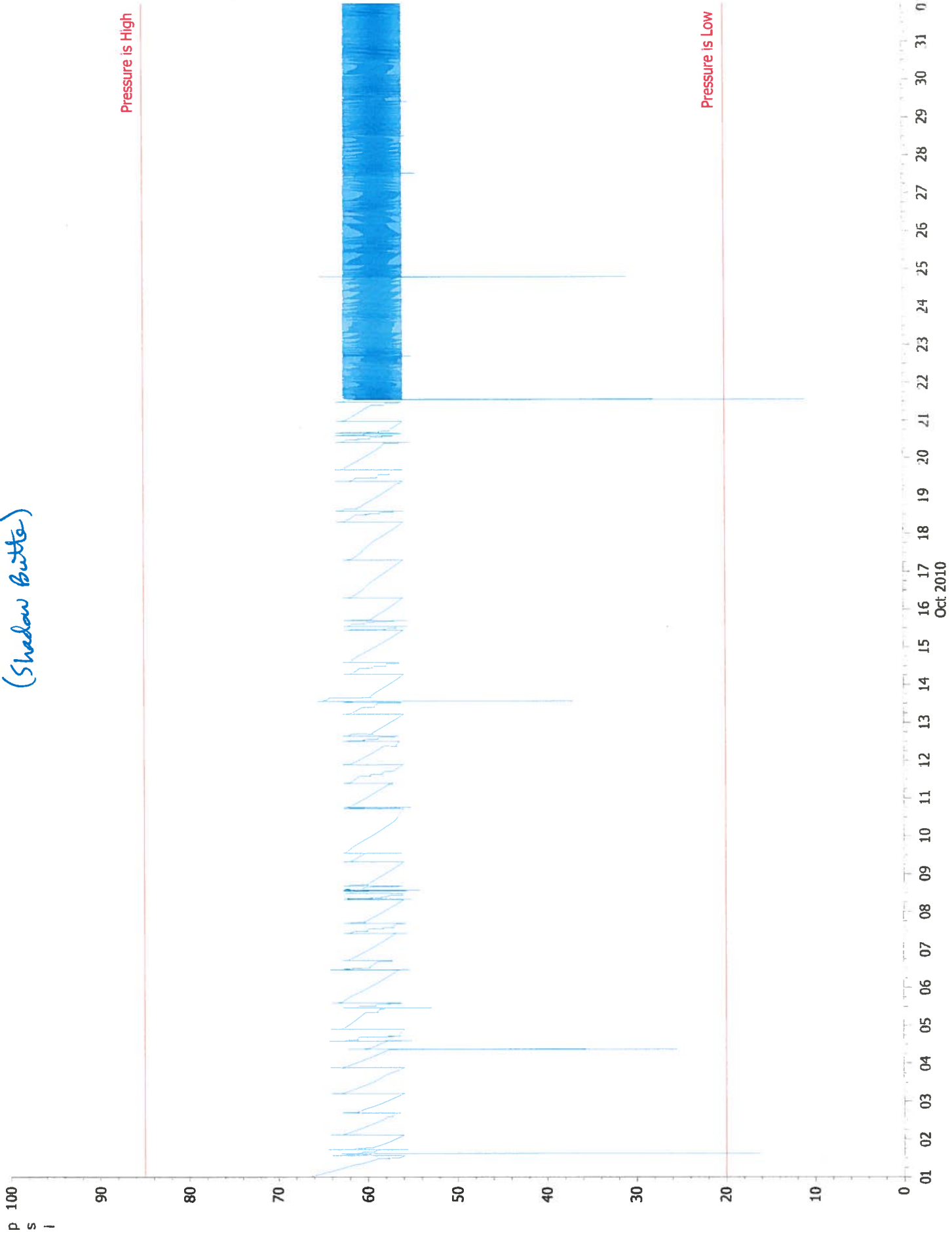
WTS.Industrial Park Booster Station.4 Inch Flow.Flow Rate

(Shadow bitter)



Trace	Type	Ruler Value
WTS.Industrial Park Booster Station.4 Inch Flow.Flow Rate	Processed Historic	-

Pressure Trend
(Shadow Butte)



ITEM 5: SHADOW BUTTER PLACE OF USE MAP

Current Place of Use (Dec. 2010)

PERMIT NO. 65-22918
(SHADOW BUTTE)

10/09

RECEIVED

STATE OF IDAHO
NOV 27 2009 DEPARTMENT OF WATER RESOURCES

DEPARTMENT OF
WATER RESOURCES

ASSIGNMENT OF PERMIT

To change the ownership of a permit

\$25 fee per permit

For Office Use Only

Receipt Amt \$ 25.00

Receipt No 6089700

Date 12-10-09

I, Gem County, Idaho, hereby assign to City of Emmett, Idaho
Current Owner(s) New Owner(s)
of, 501 E Main St., Emmett, ID 83617
Full address including city, state and ZIP Phone

All my right, title, and interest in and to Permit No(s). 65-22918 to appropriate
the public waters of the State of Idaho.

OR (for partial assignments)

The following described portion of my right, title, and interest in and to Permit Number(s):
_____, to appropriate the public waters of the State of Idaho.

Describe in detail the portion of the permit assigned, listing the number of acres in each 40 acre subdivision, point
of diversion location, and amount of the water in cubic feet per second.

Does the new permit holder own the property at the:

Point of Diversion? ☒ Yes ☐ No

Place of Use? ☒ Yes ☐ No

If no, describe the arrangement enabling the new owner to access the point of diversion and/or the
place of use: _____

Made this 23rd day of November, 2009.

Michele Sherrer Commissioner

Signature of Permit Holder

Title (if applicable)

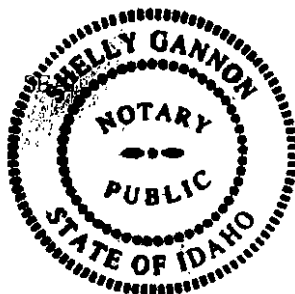
Signature of Permit Holder

Title (if applicable)

State of Idaho)

County of Gem)ss

On this 23rd day of November, 2009, personally appeared before me the signer(s) of the above
instrument, who duly acknowledged to me that he/she/they executed the same.



Shelly Gannon
Notary Public Residing in Emmett, ID
My commission expires: 1-11-13

State of Idaho
Department of Water Resources
Permit to Appropriate Water

NO. 65-22918

Priority. April 30, 2003

Maximum Diversion Rate 1.12 CFS

This is to certify, that COUNTY OF GEM
415 E MAIN ST
EMMETT ID 83617

has applied for a permit to appropriate water from

Source: GROUND WATER

and a permit is APPROVED for development of water as follows

<u>BENEFICIAL USE</u>	<u>PERIOD OF USE</u>	<u>RATE OF DIVERSION</u>
MUNICIPAL	01/01 to 12/31	1.12 CFS

LOCATION OF POINTS OF DIVERSION:

GROUND WATER	NE¼NE¼	Sec. 15, Twp 06N, Rge 02W, B.M., GEM County
GROUND WATER	NE¼NE¼	Sec. 15, Twp 06N, Rge 02W, B.M., GEM County

CONDITIONS OF APPROVAL

- 1 Proof of application of water to beneficial use shall be submitted on or before **November 01, 2009**.
- 2 Subject to all prior water rights.
- 3 Project construction shall commence within one year from the date of permit issuance and shall proceed diligently to completion unless it can be shown to the satisfaction of the Director of the Department of Water Resources that delays were due to circumstances over which the permit holder had no control.
4. Right holder shall comply with the drilling permit requirements of Section 42-235, Idaho Code and applicable Well Construction Rules of the Department.
- 5 Place of use is within Shadow Butte Industrial Park. The place of use is generally located within Sections 10, 14 & 15, Township 06N, Range 02W.
- 6 Prior to the diversion and use of water under this approval, the right holder shall comply with applicable water quality standards of the Department of Environmental Quality.
- 7 The right holder shall not provide water diverted under this right for the irrigation of land having appurtenant surface water rights as a primary source of irrigation water except when the surface water rights are not available for use. This condition applies to all land with appurtenant surface water rights, including land converted from irrigated agricultural use to other land uses but still requiring water to irrigate lawns and landscaping.
- 8 After specific notification by the Department, the right holder shall install a suitable measuring device or shall enter into an agreement with the Department to determine the amount of water diverted from power records and shall annually report the information to the Department.

State of Idaho
Department of Water Resources
Permit to Appropriate Water

NO. 65-22918

- 9 The Director retains jurisdiction to require the right holder to provide purchased or leased natural flow or stored water to offset depletion of Lower Snake River flows if needed for salmon migration purposes. The amount of water required to be released into the Snake River or a tributary, if needed for this purpose, will be determined by the Director based upon the reduction in flow caused by the use of water pursuant to this permit.

This permit is issued pursuant to the provisions of Section 42-204, Idaho Code. Witness the signature of the Director, affixed at Boise, this 12th day of November, 2004.


for KARL J DREHER, Director

ITEM 1: SHADOW BUTTE WELL PUMPS

Shadow Butte Industrial Park
Pump Specs.

SECTION 3: PUMPS

Manufacturers / Suppliers

Booster Pumps: Main, Intermediate & Jockey:

Supplier:
Sabol & Rice
Contact: Greg Hood
1834 South 900 West
Salt Lake City, Utah 84104
(801) 973-2300

Manufacturer:
Paco Pumps
800 Koomey Road
Brookshire, Texas 77423
(800) 955-5847
www.paco-pumps.com

Well Pump

Supplier:
Riverside Inc.
Contact: Terry
111 South Roswell Blvd
Parma, Idaho 83660
(208) 722-6731

Manufacturer:
Grundfos Pumps Corporation
17100 W 118th Terrace
Olathe, KS 66061
(800) 333-1366
www.grundfos.com

Lift Station Submersible Pump

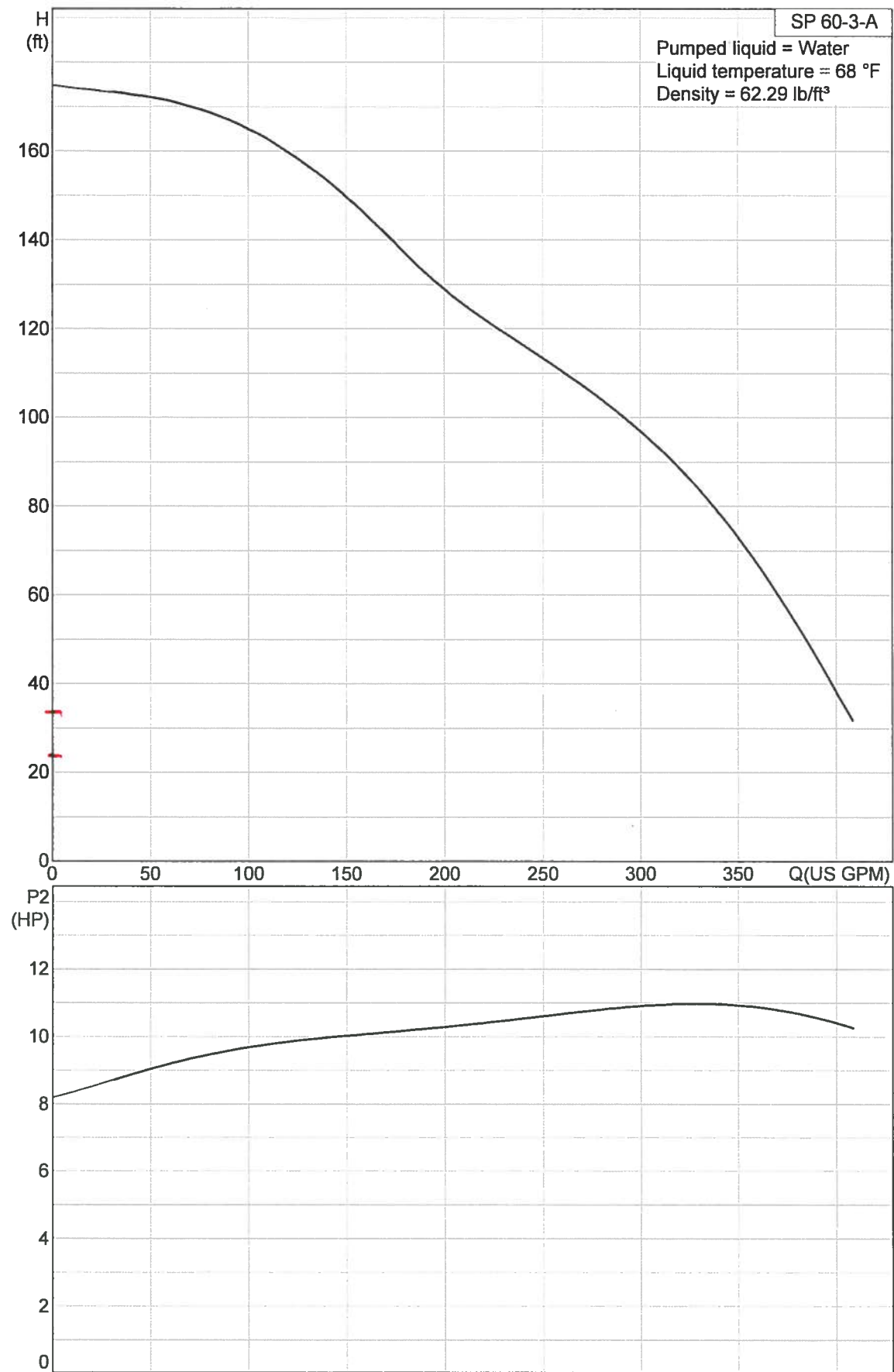
Supplier:
C.H. Spencer
Contact: Danny Beck
1075 S Pioneer Road
Salt Lake City, Utah 84014
(801) 975-0300

Manufacturer:
ABS Pumps Inc.
140 Pond View Dr.
Meriden, CT 06450
(203) 238-2700
www.abspumps.com

N/A

Shadow Butte Park Well Pump Curve

14BH00A3 SP 60-3-A 60 Hz



Disclaimer

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Justin Walker

From: Marcelo Silveira [msilveira@grundfos.com]
Sent: Tuesday, October 26, 2010 9:50 AM
To: Justin Walker
Cc: residentialae@grundfos.com
Subject: Re: Grundfos Pump Curve
Attachments: WinCAPS.pdf

Hello Justin.

Please see curve attached. Let me know if you have any questions.
The SP 60-3A description is equivalent to a 300S100-3A.

Kind Regards,

Marcelo Silveira
Applications Engineering
Grundfos Corporation

Pump Curves / Specs / Sizing / Literature
<http://net.grundfos.com/Apl/WebCAPS/custom?userid=GPU-4>

=====

For NEW inquiries, please use — residentialae@grundfos.com or industryae@grundfos.com rather than emailing directly.
This will provide the fastest support.

From: Justin Walker <jwalker@Kellerassociates.com>
To: "msilveira@grundfos.com" <msilveira@grundfos.com>
Cc: Justin Walker <jwalker@Kellerassociates.com>, "tcapson@qwestoffice.net" <tcapson@qwestoffice.net>
Date: 10/26/2010 09:36 AM
Subject: Grundfos Pump Curve

Per our phone conversation this morning, will be you please send me a pump curve for the pump illustrated with the attached pump spec. Thank you.

Justin Walker, P.E.
Keller Associates, Inc.
Office (208) 288-1992

-----Original Message-----

From: copier@kellerassociates.com [mailto:copier@kellerassociates.com]
Sent: Tuesday, October 26, 2010 6:33 AM
To: Justin Walker
Subject:

This E-mail was sent from "RNPDFE1F2" (Pro 906EX).

6", 8" & 10" STAINLESS STEEL SUBMERSIBLE PUMPS

Installation and Operating Instructions

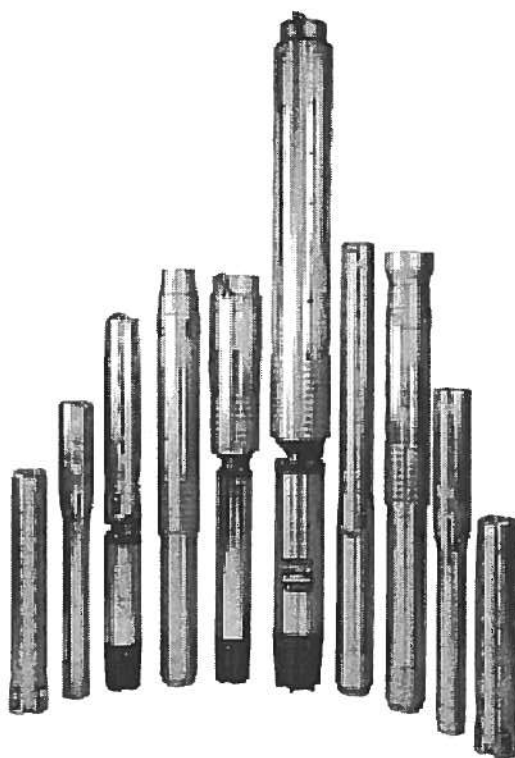


TABLE OF CONTENTS

	<i>Page(s)</i>		<i>Page(s)</i>
Shipment Inspection	1	Electrical	5-7
Pre-Installation Checklist	1	Start-Up	8-10
Wire Cable Type	2	Troubleshooting	10-14
Splicing the Motor Cable	3	Technical Data	15-21
Installation	4-5	Limited Warranty	23

Please leave these instructions with the pump for future reference.

SAFETY WARNING

Grundfos Stainless Steel Submersible Pumps

Your Grundfos Submersible Pump is of the utmost quality. Combined with proper installation, your Grundfos pump will give you many years of reliable service.

To ensure the proper installation of the pump, carefully read the complete manual before attempting to install the pump.

Shipment Inspection

Examine the components carefully to make sure no damage has occurred to the pump-end, motor, cable or control box during shipment.

This Grundfos Submersible Pump should remain in its shipping carton until it is ready to be installed. The carton is specially designed to protect it from damage. During unpacking and prior to installation, **make sure that the pump is not dropped or mishandled.**

The motor is equipped with an electrical cable. Under no circumstance should the cable be used to support the weight of the pump.

You will find a loose data plate with an adhesive backing with the pump. The nameplate should be completed in pen and attached to the control box.

Pre-Installation Checklist

Before beginning installation, the following checks should be made. They are all critical for the proper installation of this submersible pump.

A. Condition of the Well

If the pump is to be installed in a new well, the well should be fully developed and bailed or blown free of cuttings and sand. The stainless steel construction of the Grundfos submersible make it resistant to abrasion; however, no pump, made of any material, can forever withstand the destructive wear that occurs when constantly pumping sandy water.

If this pump is used to replace an oil-filled submersible or oil-lubricated line-shaft turbine in an existing well, **the well must be blown or bailed clear of oil.**

Determine the maximum depth of the well, and the draw-down level at the pump's maximum capacity. Pump selection and setting depth should be based on this data.

The inside diameter of the well casing should be checked to ensure that it is not smaller than the size of the pump and motor.

B. Condition of the Water

Submersible pumps are designed for pumping clear and cold water that is free of air and gases. Decreased pump performance and life expectancy can occur if the water is not cold and clear or contains air and gasses.

Maximum water temperature should not exceed 102°F. Special consideration must be given to the pump and motor if it is to be used to pump water above 102°F.

The Grundfos stainless steel submersible is highly resistant to the normal corrosive environment found in some water wells. If water well tests determine the water has an excessive or unusual corrosive quality, or exceeds 102°F, contact your Grundfos representative for information concerning specially designed pumps for these applications.

C. Installation Depth

A check should be made to ensure that the installation depth of the pump will always be at least (5) five to (10) ten feet below the maximum draw-down level of the well. For flow rates exceeding 100 gpm, refer to performance curves for recommended minimum submergence.

The bottom of the motor should never be installed lower than the top of the well screen or within five feet of the well bottom.

If the pump is to be installed in a lake, pond, tank or large diameter well, the water velocity passing over the motor must be sufficient to ensure proper motor cooling. The minimum recommended water flow rates which ensure proper cooling are listed in Table A.

D. Electrical Supply

The motor voltage, phase and frequency indicated on the motor nameplate should be checked against the actual electrical supply.

Wire Cable Type

The wire cable used between the pump and control box or panel should be approved for submersible pump applications. The conductor may be solid or stranded. The cable may consist of individually insulated conductors twisted together, insulated conductors molded side by side in one flat cable or insulated conductors with a round overall jacket.

The conductor insulation should be type RW, RUW, TW, TWU or equivalent and must be suitable for use with submersible pumps. An equivalent Canadian Standards Association certified wire may also be used. See Table D for recommended sizes of cable lengths.

Splicing the Motor Cable

A good cable splice is critical to proper operation of the submersible pump and must be done with extreme care.

If the splice is carefully made, it will work as well as any other portion of the cable, and will be completely watertight.

Grundfos recommends using a heat shrink splice kit. The splice should be made in accordance with the kit manufacture's instructions. Typically a heat shrink splice can be made as follows:

1. Examine the motor cable and the drop cable carefully for damage.
2. Cut the motor leads off in a staggered manner. Cut the ends of the drop cable so that the ends match up with the motor leads (See Figure 4-A). On single-phase motors, be sure to match the colors.
3. Strip back and trim off 1/2 inch of insulation from each lead, making sure to scrape the wire bare to obtain a good connection. Be careful not to damage the copper conductor when stripping off the insulation.
4. Slide the heat shrink tubing on to each lead. Insert a properly sized "Sta-kon" type connector on each lead, making sure that lead colors are matched. Using a "Sta-kon" crimping pliers, indent the lugs (Figure 4-B). Be sure to squeeze hard on the pliers, particularly when using large cable.
5. Center the heat shrink tubing over the connector. Using a propane torch, lighter, or electric heat gun, uniformly heat the tubing starting first in the center working towards the ends (Figure 4-C).
6. Continue to apply the heat to the tubing using care not to let the flame directly contact the tubing. When the tubing shrinks and the sealant flows from the ends of the tubing, the splice is complete (Figure 4-D).

FIGURE 4-A

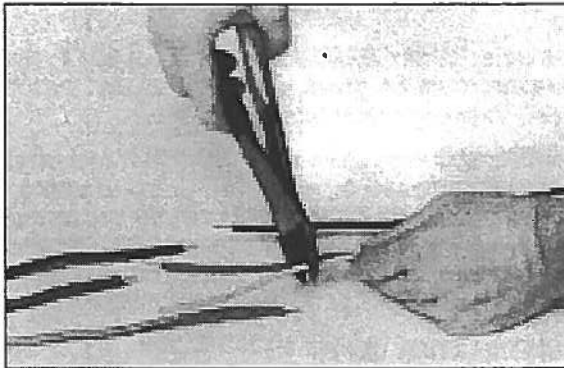


FIGURE 4-B

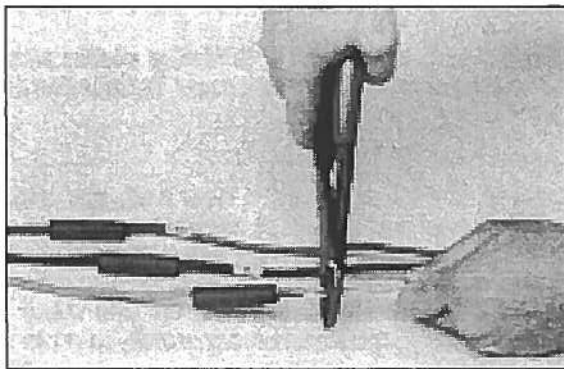


FIGURE 4-C

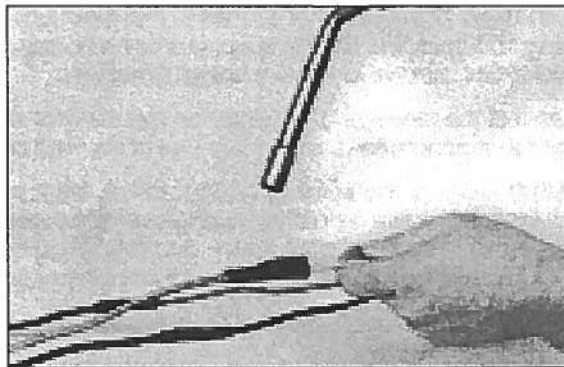
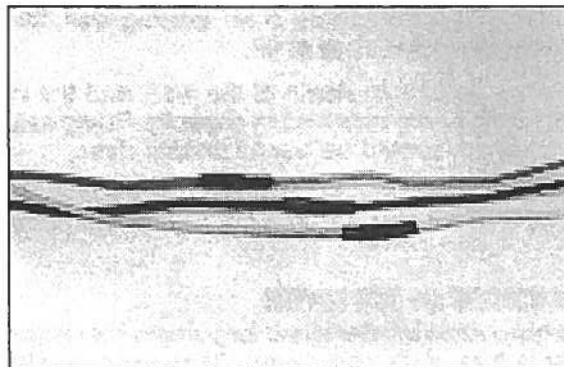


FIGURE 4-D



Installation

The riser pipe or hose should be properly sized and selected based on estimated flow rates and friction-loss factors.

If An Adapter Needs To Be Installed:

It is recommended to first install the drop pipe to the pipe adapter. Then install the drop pipe with the adapter to the pump discharge.

A back-up wrench should be used when the riser pipe is attached to the pump. The pump should be gripped only by the flats on the top of the discharge chamber. The body of the pump, cable guard or motor should not be gripped under any circumstance.

If Steel Riser Pipe Is Used:

We recommend that steel riser pipes always be used with the larger submersibles. An approved pipe thread compound should be used on all joints. Make sure the joints are adequately tightened in order to resist the tendency of the motor to loosen the joints when stopping and starting.

When tightened, the first section of the riser pipe must not come in contact with the check valve retainer in the discharge chamber of the pump.

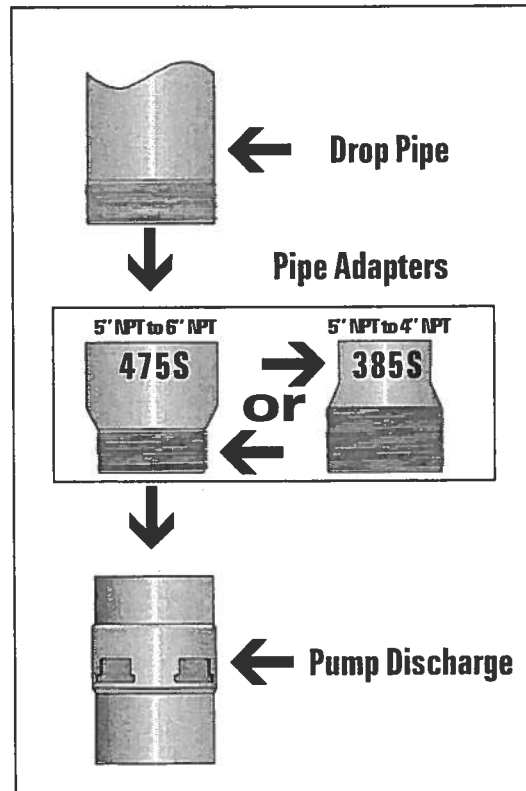
After the first section of the riser pipe has been attached to the pump, the lifting cable or elevator should be clamped to the pipe. **Do not clamp the pump.** When raising the pump and riser section, be careful not to place bending stress on the pump by picking it up by the pump-end only.

Make sure that the electrical cables are not cut or damaged in any way when the pump is being lowered in the well.

The drop cable should be secured to the riser pipe at frequent intervals to prevent sagging, looping or possible cable damage. Nylon cable clips or waterproof tape may be used. The cable splice should be protected by securing it with clips or tape just above and below the splice.

If Plastic or Flexible Riser Pipe Is Used:

It is recommended that plastic type riser pipe be used only with the smaller domestic submersibles. The pipe manufacturer or representative should be contacted to insure the pipe type and physical characteristics are suitable for this use. Use the correct joint compound recommended by the pipe manufacturer. In addition to making sure that joints are securely fastened, the use of a torque arrester is recommended when using plastic pipe.



Installation

Do not connect the first plastic or flexible riser section directly to the pump. Always attached a metallic nipple or adapter into the discharge chamber of the pump. When tightened, the threaded end of the nipple or adapter must not come in contact with the check valve retainer in the discharge chamber of the pump.

The drop cable should be secured to the riser pipe at frequent intervals to prevent sagging, looping and possible cable damage. Nylon cable clips or waterproof tape may be used. The cable splice should be protected by securing it with clips or tape just above each joint.

IMPORTANT – Plastic and flexible pipe tend to stretch under load. This stretching must be taken into account when securing the cable to the riser pipe. Leave 3 to 4 inches of slack between clips or taped points to allow for this stretching. This tendency for plastic and flexible pipe to stretch will also affect the calculation of the pump setting depth. As a general rule, you can estimate that plastic pipe will stretch to approximately 2% of its length. For example, if you installed 200 feet of plastic riser pipe, the pump may actually be down 204 feet. If the depth setting is critical, check with the manufacturer of the pipe to determine who to compensate for pipe stretch.

When plastic riser pipe is used, it is recommended that a safety cable be attached to the pump to lower and raise it.

Check valves:

A check valve should always be installed at the surface of the well. In addition, for installations deeper than 200 feet, check valves should be installed at no more than 200 foot intervals.

Protect the well from contamination:

To protect against surface water entering the well and contaminating the water source, the well should be finished off above grade, and a locally approved well seal or pitless adapter unit utilized.

Electrical

WARNING: To reduce the risk of electrical shock during operation of this pump requires the provision of acceptable grounding. If the means of connection to the supply connected box is other than grounded metal conduit, ground the pump back to the service by connecting a copper conductor, at least the size of the circuit supplying the pump, to the grounding screw provided within the wiring compartment.

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

Verification of the electrical supply should be made to ensure the voltage, phase and frequency match that of the motor. Motor voltage, phase, frequency and full-load current information can be found on the nameplate attached to the motor. Motor electrical data can be found in Table E.

If voltage variations are larger than $\pm 10\%$, do not operate the pump.

Engine-Driven Generators

If power is going to be supplied through transformers, Table C outlines the minimum KVA rating and capacity required for satisfactory pump operation.

Control Box/Panel Wiring

Single-phase motors must be connected as indicated in the motor control box. A typical single-phase wiring diagram using a Grundfos control box is shown (Figure 6-A).

Three-phase motors must be used with the proper size and type of motor starter to ensure the motor is protected against damage from low voltage, phase failure, current unbalance and overload current. A properly sized starter with ambient-compensated extra quick-trip overloads must be used to give the best possible motor winding protection. ***Each of the three motor legs must be protected with overloads.*** The thermal overloads must trip in less than 10 seconds at locked rotor (starting) current. For starter and overload protection guide, see Table H. A three-phase motor wiring diagram is illustrated below (See Figure 6-B).

FIGURE 6-A

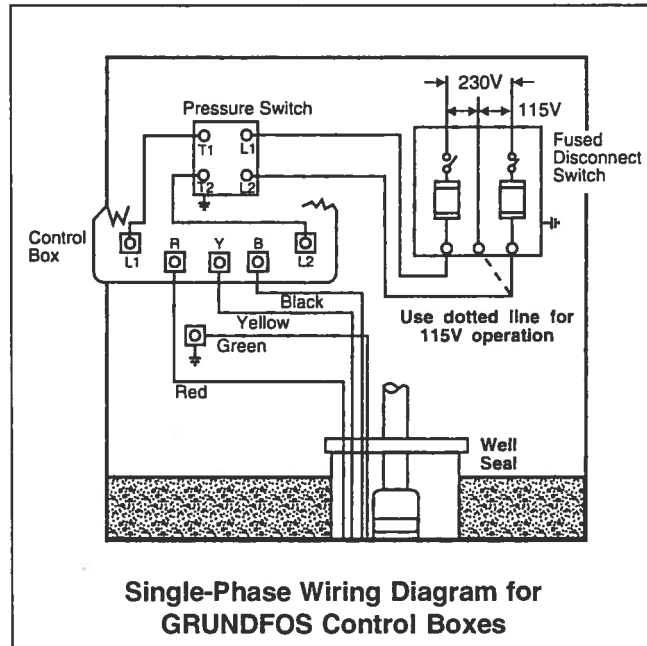
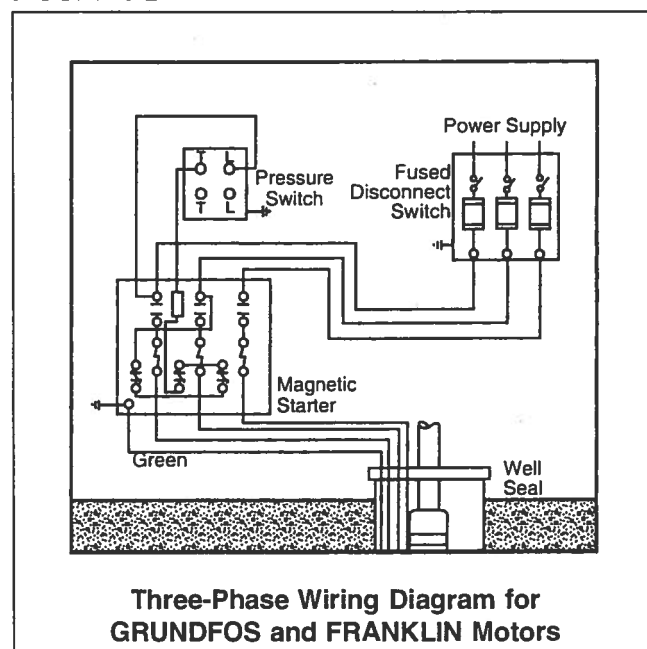


FIGURE 6-B



Electrical

High Voltage Surge Arresters

A high voltage surge arrester should be used to protect the motor against lightning and switching surges. Lightning voltage surges in power lines are caused when lightning strikes somewhere in the area. Switching surges are caused by the opening and closing of switches on the main high-voltage distribution power lines.

The correct voltage-rated surge arrester should be installed on the supply (line) side of the control box (Figure 6-C and 6-D). The arrester must be grounded in accordance with the National Electrical Code and local codes and regulations

FIGURE 6-C

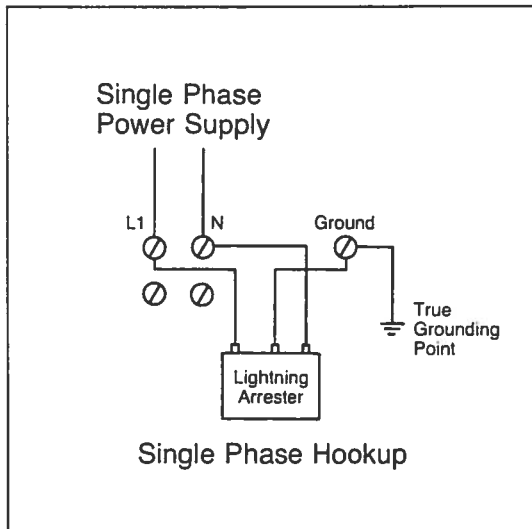
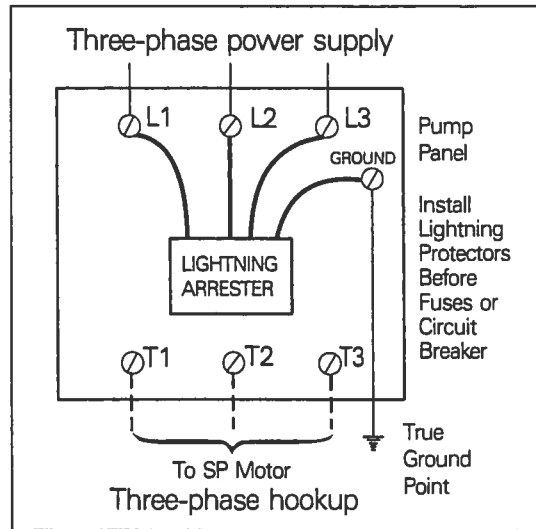


FIGURE 6-D



The warranty on all three-phase submersible motors is VOID if:

1. The motor is operated with single-phase power through a phase converter.
2. Three-leg ambient compensated extra quick-trip overload protectors are not used.
3. Three-phase current unbalance is not checked and recorded. (See START-UP Section 7 for instructions.)
4. High voltage surge arresters are not installed.

Control Box/Panel Grounding

The control box or panel shall be permanently grounded in accordance with the National Electrical Code and local codes or regulations. The ground wire should be a bare copper conductor at least the same size as the drop cable wire size. The ground wire should be run as short a distance as possible and be securely fastened to a true grounding point.

True grounding points are considered to be: a grounding rod driven into the water strata, steel well casing submerged into the water lower than the pump setting level, and steel discharge pipes without insulating couplings. If plastic discharge pipe and well casing are used or if a grounding wire is required by local codes, a properly sized bare copper wire should be connected to a stud on the motor and run to the control panel. Do not ground to a gas supply line. Connect the grounding wire to the ground point first and then to the terminal in the control box or panel.

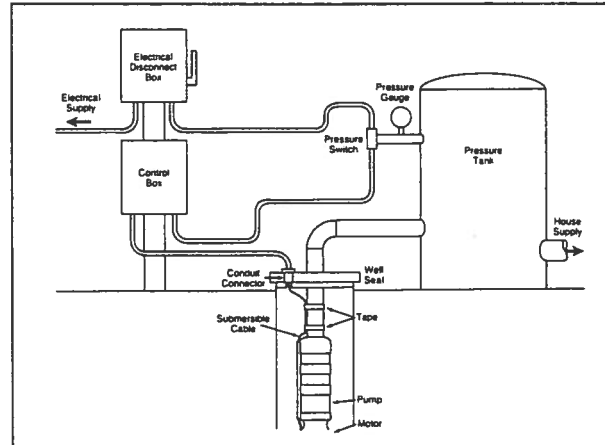
Operating Procedures

Wiring Checks and Installation

Before making the final surface wiring connection of the drop cable to the control box or panel, it is a good practice to check the insulation resistance to ensure that the cable and splice are good. Measurements for a new installation must be at least 2,000,000 ohm. Do not start the pump if the measurement is less than this.

If it is higher than 2,000,000 ohm, the drop cable should then be run through the well seal by means of a conduit connector in such a way as to eliminate any possibility of foreign matter entering the well casing. Conduit should always be used from the pump to the control box or panel to protect the drop cable (See Figure 6-E). Finish wiring and verify that all electrical connections are made in accordance with the wiring diagram. Check to ensure the control box or panel and high voltage surge arrester have been grounded.

FIGURE 6-E



Start-Up

After the pump has been set into the well and the wiring connections have been made, the following procedures should be performed:

- A. Attach a temporary horizontal length of pipe with installed gate valve to the riser pipe.
- B. Adjust the gate valve one-third of the way open.
- C. On three-phase units, check direction of rotation and current unbalance according to the instructions below. For single-phase units proceed directly to "Developing the Well."
- D. Under no circumstances should the pump be operated for any prolonged period of time with the discharge valve closed. This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed at the well head to prevent the pump from running against a closed valve.

Three-Phase Motors

1. Check the direction of rotation

Three-phase motors can run in either direction depending on how they are connected to the power supply. When the three cable leads are first connected to the power supply, there is a 50% chance that the motor will run in the proper direction. To make sure the motor is running in the proper direction, carefully follow the procedures below:

- A. Start the pump and check the water quantity and pressure developed.
- B. Stop the pump and interchange any two leads.
- C. Start the pump and again check the water quantity and pressure.
- D. Compare the results observed. The wire connection which gave the highest pressure and largest water quantity is the correct connection.

Start-Up

2. Check for current unbalance

Current unbalance causes the motor to have reduced starting torque, overload tripping, excessive vibration and poor performance which can result in early motor failure. It is very important that current unbalance be checked in all three-phase systems. **Current unbalance between the legs should not exceed 5% under normal operating conditions.**

The supply power service should be verified to see if it is a two or three transformer system. If two transformers are present, the system is an "open" delta or wye. If three transformers are present, the system is true three-phase.

Make sure the transformer ratings in kilovolt amps (KVA) is sufficient for the motor load. See Table C.

The percentage of current unbalance can be calculated by using the following formulas and procedures:

$$\text{Average current} = \frac{\text{Total of current values measured on each leg}}{3}$$
$$\% \text{ Current unbalance} = \frac{\text{Greatest amp difference from the average}}{\text{average current}} \times 100$$

To determine the percentage of current unbalance:

- A. Measure and record current readings in amps for each leg (hookup 1). Disconnect power.
- B. Shift or roll the motor leads from left to right so the drop cable lead that was on terminal 1 is now on 2, lead on 2 is now on 3, and lead on 3 is now on 1 (hookup 2). Rolling the motor leads in this manner will not reverse the motor rotation. Start the pump, measure and record current reading on each leg. Disconnect power.
- C. Again shift drop cable leads from left to right so the lead on terminal 1 goes to 2, 2 to 3 and 3 to 1 (hookup 3). Start pump, measure and record current reading on each leg. Disconnect power.
- D. Add the values for each hookup.
- E. Divide the total by 3 to obtain the average.
- F. Compare each single leg reading from the average to obtain the greatest amp difference from the average.
- G. Divide this difference by the average to obtain the percentage of unbalance.

Use the wiring hookup which provides the lowest percentage of unbalance. (See Table F for a specific example of correcting for three-phase power unbalance.)

Developing the Well

After proper rotation and current unbalance have been checked, start the pump and let it operate until the water runs clear of sand, silt and other impurities.

Slowly open the valve in small increments as the water clears until the desired flow rate is reached. Do not operate the pump beyond its maximum flow rating. **The pump should not be stopped until the water runs clear.**

Start-Up

If the water is clean and clear when the pump is first started, the valve should still be **slowly opened until the desired flow rate is reached**. As the valve is being opened, the drawdown should be checked to ensure the pump is always submerged. **The dynamic water level should always be more than 3 feet above the inlet strainer of the pump.**

Disconnect the temporary piping arrangements and complete the final piping connections.

Under no circumstances should the pump be operated for any prolonged period of time with the discharge valve closed. This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed at the well head to prevent the pump from running against a closed valve.

Start the pump and test the system. Check and record the voltage and current draw on each motor lead.

Operation

1. The pump and system should be periodically checked for water quantity, pressure, drawdown, periods of cycling and operation of controls.
2. If the pump fails to operate, or there is a loss of performance, refer to Troubleshooting, Section 8.

Troubleshooting

The majority of problems that develop with submersible pumps are electrical, and most of these problems can be corrected without pulling the pump from the well. The following chart covers most of the submersible service work. As with any troubleshooting procedure, start with the simplest solution first; always make all the above-ground checks before pulling the pump from the well.

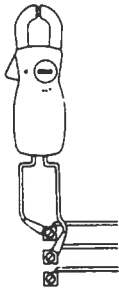
Usually only two instruments are needed – a combination voltmeter/ammeter, and an ohmmeter. These are relatively inexpensive and can be obtained from most water systems suppliers.

WHEN WORKING WITH ELECTRICAL CIRCUITS, USE CAUTION TO AVOID ELECTRICAL SHOCK. It is recommended that rubber gloves and boots be worn and that care is taken to have metal control boxes and motors grounded to power supply ground or steel drop pipe or casing extending into the well. **WARNING:** Submersible motors are intended for operation in a well. When not operated in a well, failure to connect motor frame to power supply ground may result in serious electrical shock.

Troubleshooting

Preliminary Tests

SUPPLY VOLTAGE



How to Measure

By means of a voltmeter, which has been set to the proper scale, measure the voltage at the control box or starter.

On single-phase units, measure between line and neutral.

On three-phase units, measure between the legs (phases).

What it Means

When the motor is under load, the voltage should be within $\pm 10\%$ of the nameplate voltage. Larger voltage variation may cause winding damage.

Large variations in the voltage indicate a poor electrical supply and the pump should not be operated until these variations have been corrected.

If the voltage constantly remains high or low, the motor should be changed to the correct supply voltage.

CURRENT MEASUREMENT



How to Measure

By use of an ammeter, set on the proper scale, measure the current on each power lead at the control box or starter. See Electrical Data, Table E, for motor amp draw information.

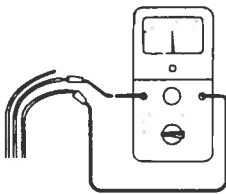
Current should be measured when the pump is operating at a constant discharge pressure with the motor fully loaded.

What it Means

If the amp draw exceeds the listed service factor amps (SFA) or if the current unbalance is greater than 5% between each leg on three-phase units, check for the following:

1. Burnt contacts on motor starter.
2. Loose terminals in starter or control box or possible cable defect. Check winding and insulation resistances.
3. Supply voltage too high or low.
4. Motor windings are shorted.
5. Pump is damaged, causing a motor overload.

WINDING RESISTANCE



How to Measure

Turn off power and disconnect the drop cable leads in the control box or starter. Using an ohmmeter, set the scale selectors to Rx1 for values under 10 ohms and Rx10 for values over 10 ohms.

Zero-adjust the meter and measure the resistance between leads. Record the values.

Motor resistance values can be found in Electrical Data, Table E. Cable resistance values are in Table G.

What it Means

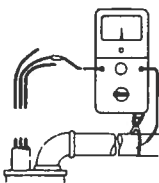
If all the ohm values are normal, and the cable colors correct, the windings are not damaged.

If any one ohm value is less than normal, the motor may be shorted.

If any one ohm value is greater than normal, there is a poor cable connection or joint. The windings or cable may also be open.

If some of the ohm values are greater than normal and some less, the drop cable leads are mixed. To verify lead colors, see resistance values in Electrical Data, Table E.

INSULATION RESISTANCE



How to Measure

Turn off power and disconnect the drop cable leads in the control box or starter. Using an ohm or mega ohmmeter, set the scale selector to Rx 100K and zero-adjust the meter.

Measure the resistance between the lead and ground (discharge pipe or well casing, if steel).

What it Means

For ohm values, refer to table below. Motors of all HP, voltage, phase and cycle duties have the same value of insulation resistance.

Troubleshooting Chart

OHM VALUE	MEGAOHM VALUE	CONDITION OF MOTOR AND LEADS
2,000,000 (or more)	2.0	Motor not yet installed: New Motor.
1,000,000 (or more)	1.0	Used motor which can be reinstalled in the well.
500,000 - 1,000,000	0.5 - 1.0	Motor in well (Ohm readings are for drop cable plus motor): A motor in reasonably good condition.
20,000 - 500,000	0.02 - 0.5	A motor which may have been damaged by lightning or with damaged leads. Do not pull the pump for this reason.
10,000 - 20,000	0.01 - 0.02	A motor which definitely has been damaged or with damaged cable. The pump should be pulled and repairs made to the cable or the motor replaced. The motor will still operate, but probably not for long.
less than 10,000	0 - 0.01	A motor which has failed or with completely destroyed cable insulation. The pump must be pulled and the cable repaired or the motor replaced. The motor will not run in this condition.

A. Pump Does Not Run

POSSIBLE CAUSES	HOW TO CHECK	HOW TO CORRECT
1. No power at pump panel.	Check for voltage at panel.	If no voltage at panel, check feeder panel for tripped circuits.
2. Fuses are blown or circuit breakers are tripped.	Remove fuses and check for continuity with ohmmeter.	Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation and motor must be checked.
3. Motor starter overloads are burnt or have tripped out (three-phase only).	Check for voltage on line or load side of starter.	Replace burnt heaters or reset. Inspect starter for other damage. If heater trips again, check the supply voltage and starter holding coil.
4. Starter does not energize (three-phase only).	Energize control circuit and check for voltage at the holding coil.	If no voltage, check control circuit. If voltage, check holding coil for shorts. Replace bad coil.
5. Defective controls.	Check all safety and pressure switches for operation. Inspect contacts in control devices.	Replace worn or defective parts.
6. Motor and/or cable are defective.	Turn off power. Disconnect motor leads from control box. Measure the lead-to-lead resistances with the ohmmeter (Rx1). Measure lead-to-ground values with ohmmeter (Rx100K). Record measured values.	If open motor winding or ground is found, remove pump and recheck values at the surface. Repair or replace motor or cable.
7. Defective capacitor (single-phase only).	Turn off the power, then discharge capacitor. Check with an ohmmeter (Rx100K). When meter is connected, the needle should jump forward and slowly drift back.	If there is no needle movement, replace the capacitor.

Troubleshooting Chart

B. Pump Runs But Does Not Deliver Water

POSSIBLE CAUSES	HOW TO CHECK	HOW TO CORRECT
1. Groundwater level in well is too low or well is collapsed.	Check well draw-down. Water level should be at least 3 ft. above pump inlet during operation.	If not, lower pump if possible, or throttle discharge valve and install water level control.
2. Integral pump check valve is blocked.	Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shut-off. After taking reading, open valve to its previous position. Convert PSI to feet. (For water: $\text{PSI} \times 2.31 \text{ ft/PSI} = \text{ft.}$), and add this to the total vertical distance from the pressure gauge to the water level in the well while the pump is running. Refer to the specific pump curve for the shut-off head for that pump model. If the measured head is close to the curve, pump is probably OK.	If not close to the pump curve, remove pump and inspect discharge section. Remove blockage, repair valve and valve seat if necessary. Check for other damage. Rinse out pump and re-install.
3. Inlet strainer is clogged.	Same as B.2 above.	If not close to the pump curve, remove pump and inspect. Clean strainer, inspect integral check valve for blockage, rinse out pump and re-install.
4. Pump is damaged.	Same as B.2 above.	If damaged, repair as necessary. Rinse out pump and re-install.

C. Pump Runs But at Reduced Capacity

POSSIBLE CAUSES	HOW TO CHECK	HOW TO CORRECT
1. Wrong rotation (three-phase only).	Check for proper electrical connection in control panel.	Correct wiring and change leads as required.
2. Draw-down is larger than anticipated.	Check draw-down during pump operation.	Lower pump if possible. If not, throttle discharge valve and install water level control.
3. Discharge piping or valve leaking.	Examine system for leaks.	Repair leaks.
4. Pump strainer or check valve are clogged.	Same as B.2 above.	If not close to the pump curve, remove pump and inspect. Clean strainer, inspect integral check valve for blockage, rinse out pump and re-install.
5. Pump worn.	Same as B.2 above.	If not close to pump curve, remove pump and inspect.

Troubleshooting Chart

D. Pump Cycles Too Much

POSSIBLE CAUSES	HOW TO CHECK	HOW TO CORRECT
1. Pressure switch is not properly adjusted or is defective.	Check pressure setting on switch and operation. Check voltage across closed contacts.	Re-adjust switch or replace if defective.
2. Level control is not properly set or is defective.	Check setting and operation.	Re-adjust setting (refer to manufacturer data.) Replace if defective.
3. Insufficient air charging or leaking tank or piping.	Pump air into tank or diaphragm chamber. Check diaphragm for leak. Check tank and piping for leaks with soap and water solution. Check air to water volume.	Repair or replace damaged component.
4. Plugged snifter valve or bleed orifice.	Examine valve and orifice for dirt or corrosion.	Clean and/or replace if defective.
5. Tank is too small.	Check tank size. Tank volume should be approximately 10 gallons for each gpm or pump capacity.	If tank is too small, replace with proper size tank.

E. Fuses Blow or Circuit Breakers Trip

POSSIBLE CAUSES	HOW TO CHECK	HOW TO CORRECT
1. High or low voltage.	Check voltage at pump panel. If not within $\pm 10\%$, check wire size and length of run to pump panel.	If wire size is correct, contact power company. If not, correct and/or replace as necessary.
2. Three-phase current unbalance.	Check current draw on each lead. Unbalance must be within $\pm 5\%$.	If current unbalance is not within $\pm 5\%$, contact power company.
3. Control box wiring and components (single-phase only).	Check that control box parts match the parts list. Check to see that wiring matches wiring diagram. Check for loose or broken wires or terminals.	Correct as required.
4. Defective capacitor (single-phase only).	Turn off power and discharge capacitor. Check using an ohmmeter (Rx100K). When the meter is connected, the needle should jump forward and slowly drift back.	If no meter movement, replace the capacitor.
5. Starting relay (Franklin single-phase motors only).	Check resistance of relay coil with an ohmmeter (Rx1000K). Check contacts for wear.	Replace defective relay.

Technical Data

Table A

Minimum Water Flow Requirements for Submersible Pump Motors

MOTOR DIAMETER	CASING OR SLEEVE I.D. IN INCHES	MIN. FLOW PAST THE MOTOR (GPM)
4"	4	1.2
	5	7
	6	13
	7	21
	8	30
6"	6	10
	7	28
	8	45
	10	85
	12	140
	14	198
	16	275
8"	8	10
	10	55
	12	110
	14	180
	16	255
10"	10	30
	12	85
	14	145
	16	220
	18	305

NOTES:

1. A flow inducer or sleeve must be used if the water enters the well above the motor or if there is insufficient water flow past the motor.
2. The minimum recommended water velocity over 4" motors is 0.25 feet per second.
3. The minimum recommended water velocity over 6, 8, and 10" motors is 0.5 feet per second.

Table B

Guide for Engine-Driven Generators in Submersible Pump Applications

MINIMUM KILOWATT RATING OF GENERATOR FOR THREE-WIRE SUBMERSIBLE PUMP MOTORS		
MOTOR HP SINGLE OR THREE PHASE UNITS	EXTERNALLY REGULATED GENERATOR	INTERNALLY REGULATED GENERATOR
0.33 HP	1.5 KW	1.2 KW
0.50	2.0	1.5
0.75	3.0	2.0
1.0	4.0	2.5
1.5	5.0	3.0
2.0	7.5	4.0
3.0	10.0	5.0
5.0	15.0	7.5
7.5	20.0	10.0
10.0	30.0	15.0
15.0	40.0	20.0
20.0	60.0	25.0
25.0	75.0	30.0
30.0	100.0	40.0
40.0	100.0	50.0
50.0	150.0	60.0
60.0	175.0	75.0
75.0	250.0	100.0
100.0	300.0	150.0
125.0	375.0	175.0
150.0	450.0	200.0
200.0	600.0	275.0

NOTES:

1. Table is based on typical 80°C rise continuous duty generators with 35% maximum voltage dip during start-up of single-phase and three-phase motors.
2. Contact the manufacturer of the generator to assure the unit has adequate capacity to run the submersible motor.
3. If the generator rating is in KVA instead of kilowatts, multiply the above ratings by 1.25 to obtain KVA.

Table C

Transformer Capacity Required for Three-Phase Submersible Pump Motors

THREE-PHASE MOTOR HP	MINIMUM TOTAL KVA REQUIRED*	MINIMUM KVA RATING FOR EACH TRANSFORMER	
		2 TRANSFORMERS OPEN DELTA OR WYE	3 TRANSFORMERS DELTA OR WYE
1.5	3	2	1
2	4	2	1-1/2
3	5	3	2
5	7-1/2	5	3
7.5	10	7-1/2	5
10	15	10	5
15	20	15	7-1/2
20	25	15	10
25	30	20	10
30	40	25	15
40	50	30	20
50	60	35	20
60	75	40	25
75	90	50	30
100	120	65	40
125	150	85	50
150	175	100	60
200	230	130	75

* Pump motor KVA requirements only, and does not include allowances for other loads.

Technical Data

Table D

Submersible Pump Cable Selection Chart (60 Hz)

The following tables list the recommended copper cable sizes and various cable lengths for submersible pump motors.

These tables comply with the 1978 edition of the National Electric Table 310-16, Column 2 for 75°C wire. The ampacity (current carrying properties of a conductor) have been divided by 1.25 per the N.E.C., Article 430-22, for motor branch circuits based on motor amps at rated horsepower.

To assure adequate starting torque, the maximum cable lengths are calculated to maintain 95% of the service entrance voltage at the motor when the motor is running at maximum nameplate amps. Cable sizes larger than specified may always be used and will reduce power usage.

The use of cables smaller than the recommended sizes will void the warranty. Smaller cable sizes will cause reduced starting torque and poor motor operation.

**Single-Phase Motor Maximum Cable Length
(Motor to service entrance) (2)**

VOLTS	HP	14	12	10	8	6	4	2	0	00	000	0000	250	300
115	1/3	130	210	340	540	840	1300	1960	2910					
	1/2	100	160	250	390	620	960	1460	2160					
230	1/3	550	880	1390	2190	3400	5250	7960						
	1/2	400	650	1020	1610	2510	3880	5880						
	3/4	300	480	760	1200	1870	2890	4370	6470					
	1	250	400	630	990	1540	2380	3610	5360	6520				
	1-1/2	190	310	480	770	1200	1870	2850	4280	5240				
	2	150	250	390	620	970	1530	2360	3620	4480				
	3	120	190	300	470	750	1190	1850	2890	3610				
	5			180	280	450	710	1110	1740	2170				
	7-1/2				200	310	490	750	1140	1410				
	10					250	390	600	930	1160				

CAUTION: Use of wire size smaller than listed will void warranty.

FOOTNOTES:

1. If aluminum conductor is used, multiply lengths by 0.5. Maximum allowable length of aluminum is considerably shorter than copper wire of same size.
2. The portion of the total cable which is between the service entrance and a 3Ø motor starter should not exceed 25% of the total maximum length of assure reliable starter operation. Single-phase control boxes may be connected at any point of the total cable length.
3. Cables #14 to #0000 are AWG sizes, and 250 to 300 are MCM sizes.

Technical Data

Three-Phase Motor Maximum Cable Length (Motor to service entrance) (2)

VOLTS	HP	14	12	10	8	6	4	2	0	00	000	0000	250	300
208	1-1/2	310	500	790	1260									
	2	240	390	610	970	1520								
	3	180	290	470	740	1160	1810							
	5		170	280	440	690	1080	1660						
	7-1/2			200	310	490	770	1180	1770					
	10				230	370	570	880	1330	1640				
	15					250	390	600	910	1110	1340			
	20						300	460	700	860	1050	1270		
	25							370	570	700	840	1030	1170	
	30							310	470	580	700	850	970	1110
230	1-1/2	360	580	920	1450									
	2	280	450	700	1110	1740								
	3	210	340	540	860	1340	2080							
	5		200	320	510	800	1240	1900						
	7-1/2			230	360	570	890	1350	2030					
	10				270	420	660	1010	1520	1870				
	15					290	450	690	1040	1280	1540			
	20						350	530	810	990	1200	1450		
	25						280	430	650	800	970	1170	1340	
	30							350	540	660	800	970	1110	1270
460	1-1/2	1700												
	2	1300	2070											
	3	1000	1600	2520										
	5	590	950	1500	2360									
	7-1/2	420	680	1070	1690	2640								
	10	310	500	790	1250	1960	3050							
	15			540	850	1340	2090	3200						
	20			410	650	1030	1610	2470	3730					
	25				530	830	1300	1990	3010	3700				
	30				430	680	1070	1640	2490	3060	3700			
	40						790	1210	1830	2250	2710	3290		
	50						640	980	1480	1810	2190	2650	3010	
	60							830	1250	1540	1850	2240	2540	2890
	75								1030	1260	1520	1850	2100	2400
	100									940	1130	1380	1560	1790
	125										1080	1220	1390	
	150											1050	1190	
	200											1080	1300	
	250												1080	
575	1-1/2	2620												
	2	2030												
	3	1580	2530											
	5	920	1480	2330										
	7-1/2	660	1060	1680	2650									
	10	490	780	1240	1950									
	15		530	850	1340	2090								
	20			650	1030	1610	2520							
	25			520	830	1300	2030	3110						
	30				680	1070	1670	2560	3880					
	40					790	1240	1900	2860	3510				
	50						1000	1540	2310	2840	3420			
	60						850	1300	1960	2400	2890	3500		
	75							1060	1600	1970	2380	2890	3290	
	100								1190	1460	1770	2150	2440	2790

CAUTION: Use of wire size smaller than listed will void warranty. FOOTNOTES: 1. If aluminum conductor is used, multiply lengths by 0.5. Maximum allowable length of aluminum is considerably shorter than copper wire of same size. 2. The portion of the total cable which is between the service entrance and a 3Ø motor starter should not exceed 25% of the total maximum length of assure reliable starter operation. Single-phase control boxes may be connected at any point of the total cable length. 3. Cables #14 to #0000 are AWG sizes, and 250 to 300 are MCM sizes.

Technical Data

Electrical Data

Submersible Pump Motors - 60Hz

GRUNDFOS MOTORS

HP	PH	VOLT	S.F.	CIR. BRKR OR FUSES		AMPERAGE		FULL LOAD		MAX. THRUST (LBS)	NAMEPLATE NO.	GRUNDFOS PRODUCT NO.
				STD.	DELAY	START	MAX.	EFF. (%)	PWR FACT.			

4-Inch, Single Phase, 2-Wire Motors (control box not required)

1/3	1	230	1.75	15	5	25.7	4.6	59	77	750	79952101	791595016
1/2	1	230	1.60	15	7	34.5	6.0	62	76	750	79952102	791595026
3/4	1	230	1.50	20	9	40.5	8.4	62	75	750	79952103	791595036
1	1	230	1.40	25	12	48.4	9.8	63	82	750	79952104	791595046
1-1/2	1	230	1.30	35	15	62.0	13.1	64	85	750	79952105	791595056

4-Inch, Single Phase, 3-Wire Motors

1/3	1	230	1.75	15	5	14.0	4.6	59	77	750	79453101	791545016
1/2	1	230	1.60	15	7	21.5	6.0	62	76	750	79453102	791545026
3/4	1	230	1.50	20	9	31.4	8.4	62	75	750	79453103	791545036
1	1	230	1.40	25	12	37.0	9.8	63	82	750	79453104	791545046
1-1/2	1	230	1.30	35	15	45.9	11.6	69	89	750	79453105	791545056

4-Inch, Three Phase, 3-Wire Motors

1-1/2	3	230	1.30	15	8	40.3	7.3	75	72	750	79302005	791530056
		460	1.30	10	4	20.1	3.7	75	72	750	79362005	791536056
		575	1.30	10	4	16.1	2.9	75	72	750	79392005	791539056
2	3	230	1.25	20	10	48	8.7	76	75	750	79302006	791530066
		460	1.25	10	5	24	4.4	76	75	750	79362006	791536066
		575	1.25	10	4	19.2	3.5	76	75	750	79392006	791539066
3	3	230	1.15	30	15	56	12.2	77	75	1000	79304507	96405801
		460	1.15	15	7	28	6.1	77	75	1000	79354507	96405810
		575	1.15	15	6	22	4.8	77	75	1000	79394507	96405815
5	3	230	1.15	40	25	108	19.8	80	82	1000	79304509	96405802
		460	1.15	20	12	54	9.9	80	82	1000	79354509	96405811
		575	1.15	15	9	54	7.9	80	82	1000	79394509	96405816
7-1/2	3	230	1.15	60	30	130	25.0	81	82	1000	79305511	96405805
		460	1.15	35	15	67	13.2	81	82	1000	79355511	96405814
		575	1.15	30	15	67	10.6	81	82	1000	79395511	96405819

6-Inch, Three Phase, 3-Wire Motors

7-1/2	3	230	1.15	60	35	119	26.4	80.5	76	1000	78305511	96405781
		460	1.15	30	15	59	13.2	80.5	76	1000	78355511	96405794
10	3	230	1.15	80	45	156	34.0	82.5	79	1000	78305512	96405782
		460	1.15	40	20	78	17.0	82	79	1000	78355512	96405795
15	3	230	1.15	150	80	343	66.0	84	81	4400	78305516	96405784
		460	1.15	60	30	115	24.5	82.5	82	440	78355514	96405796
20	3	230	1.15	150	80	343	66.0	84	81	4400	78305516	96405784
		460	1.15	80	40	172	33.0	84	82	4400	78355516	96405797
25	3	460	1.15	100	50	217	41.0	84.5	80	4400	78355517	96405798
30	3	460	1.15	110	60	237	46.5	85	83	4400	78355518	96405799
40	3	460	1.15	150	80	320	64.0	85	82	4400	78355520	96405800

Technical Data

HITACHI MOTORS

6 Inch (Three Wire) Motors

60 HZ

HP	PH	Volts	Service Factor	Circuit Breaker or Standard Fuse	Dual Element Fuse	AMPERAGE			FULLLOAD		Line-to-Line Resistance (Ohms)		KVA Code ***	Three-Phase Overload Protection		Maximum Thrust (lbs.)	GRUNDFOS PART NO.
						Full Load	Locked Rotor	S.F. Amps	Eff.	Power Factor	Resistance (Ohms)			Starter Size	Furnas Amb. Comp		
											Blk-Yel	Red-Yel					
Delta																	
5	1	230	1.15	80	35	23.8	124	27.1	74.8	91.2	0.51	2.2	G	-	-	1500	82.4119H
	3	230	1.15	45	20	14.8	110	16.4	76.8	82.5	0.81		K	1	K58	1500	82.9915H3
	3	460	1.15	25	10	7.4	55	8.2	76.8	82.5	3.05		K	1	K43	1500	82.9915H6
7-1/2	1	230	1.15	125	45	35.2	167	40.9	72.9	94.9	0.40	1.40	F	-	-	1500	82.4121H
	3	230	1.15	70	30	21.8	144	24.4	78.5	81.8	0.65		J	1	K64	1500	82.9116H3
	3	460	1.15	35	15	10.9	72	12.2	78.5	81.8	2.43		J	1	K54	1500	82.9916H65
10	1	230	1.15	175	60	48.0	202	54.0	73.6	93.2	0.32	1.05	#	-	-	3500	82.4123H
	3	230	1.15	80	40	28.2	208	32.0	79.3	82.8	0.45		K	1.75	K68	3500	82.9117H3
	3	460	1.15	40	20	14.3	104	16.0	79.3	82.8	1.62		K	1	K58	3500	82.9117H6
15	1	230	1.15	250	100	70.8	275	84.9	73.7	93.2	0.23	0.68	D	-	-	3500	82.9118H3
	3	230	1.15	125	60	41.4	320	46.2	81.7	83.2	0.31		K	2	K74	3500	82.9118H3
	3	460	1.15	60	30	20.7	160	23.1	81.7	83.2	1.07		K	1.75	K63	3500	82.9118H6
20	3	230	1.15	175	70	53.0	392	63.0	83.2	84.9	0.26		K	2.5	K77	3500	82.9119H3
	3	460	1.15	90	35	26.5	196	30.0	83.2	84.9	0.86		K	2	K67	3500	82.9119H6
25	3	230	1.15	200	90	67.2	530	75.4	83.0	83.9	0.21		K	3	K83	3500	82.9120H3
	3	460	1.15	100	45	33.6	265	37.7	83.0	83.9	0.67		K	2	K72	3500	82.9120H6
30	3	230	1.15	250	110	80.8	610	90.6	82.5	84.3	0.16		K	3	K86	3500	82.9121H3
	3	460	1.15	125	50	40.4	305	45.3	82.5	84.3	0.55		K	2.5	K74	3500	82.9121H6
40	3	460	1.15	150	70	51.7	340	58.8	84.0	86.3	0.46		H	3	K76	5000	82.3228H
50	3	460	1.15	200	90	69.7	465	78.8	82.5	81.4	0.39		J	3	K83	5000	82.3229H
60	3	460	1.15	225	100	80.8	465	92.8	82.4	84.4	0.39		G	3.5	K86	5000	82.3230H

8 Inch Motors

40	3	460	1.15	150	70	54.3	380	60.9	83.9	82.1	0.37		J	3	K76	10,000	82.3270H
50	3	460	1.15	200	90	64.9	435	73.6	84.1	85.7	0.33		H	3	K78	10,000	82.3271H
60	3	460	1.15	225	100	77.8	510	88.5	84.7	85.3	0.28		H	3.5	K86	10,000	82.3272H
75	3	460	1.15	350	150	96.7	650	110	84.9	85.9	0.22		H	3.5	K88	10,000	82.3274H
100	3	460	1.15	400	175	127	795	145	85.2	86.6	0.16		H	4	K89	10,000	82.3275H
125	3	460	1.15	500	225	172.0	980	192	84.2	80.9	0.14		G	4.5	K28	10,000	82.36H042
150	3	460	1.15	600	250	187.0	1060	216	85.6	87.9	0.13		G	4.5	K29	10,000	82.36H043

10 Inch Motors

200	3	460	1.15	800	350	233.0	1260	270	87.2	92.2	0.09		F	5	K33	10,000	82.36H064
250	3	460	1.15	900	450	294.0	1500	344	86.5	92.1	0.08		E	6	K27	10,000	82.36H066

FRANKLIN MOTORS

(refer to the Franklin Submersible Motors Application Maintenance Manual)

Table F

Example: Correcting for Three-Phase Power Unbalance

Example: Check for current unbalance for a 230 volt, 3 phase, 60 Hz submersible pump motor, 18.6 full load amps.

Solution: Steps 1 to 3 measure and record amps on each motor drop lead for Hookups 1, 2 and 3.

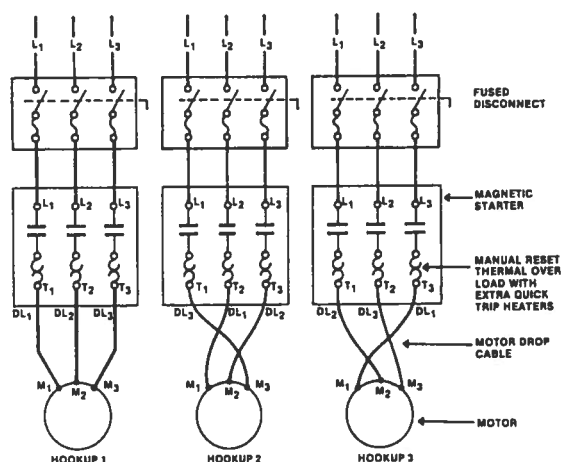
	Step 1 (Hookup 1)	Step 2 (Hookup 2)	Step 3 (Hookup 3)
(T ₁)	DL ₁ = 25.5 amps	DL ₃ = 25 amps	DL ₂ = 25.0 amps
(T ₂)	DL ₂ = 23.0 amps	DL ₁ = 24 amps	DL ₃ = 24.5 amps
(T ₃)	DL ₃ = 26.5 amps	DL ₂ = 26 amps	DL ₁ = 25.5 amps
Step 4	Total = 75 amps	Total = 75 amps	Total = 75 amps
Step 5	Average Current =	$\frac{\text{total current}}{3 \text{ readings}}$	$\frac{75}{3} = 25 \text{ amps}$
Step 6	Greatest amp difference from the average:	(Hookup 1) = 25-23 = 2 (Hookup 2) = 26-25 = 1 (Hookup 3) = 25.5-25 = .5	
Step 7	% Unbalance	(HOOKUP 1) = $\frac{2}{25} \times 100 = 8$ (HOOKUP 2) = $\frac{1}{25} \times 100 = 4$ (HOOKUP 3) = $\frac{.5}{25} \times 100 = 2$	

As can be seen, Hookup 3 should be used since it shows the least amount of current unbalance. Therefore, the motor will operate at maximum efficiency and reliability.

By comparing the current values recorded on each leg, you will note the highest value was always on the same leg, L₃. This indicates the unbalance is in the power source. If the high current values were on a different leg each time the leads were changed, the unbalance would be caused by the motor or a poor connection.

If the current is greater than 5%, contact your power company for help.

*For a detailed explanation of three-phase balance procedures, see Three-Phase Motor, section 2, page 6.



Technical Data

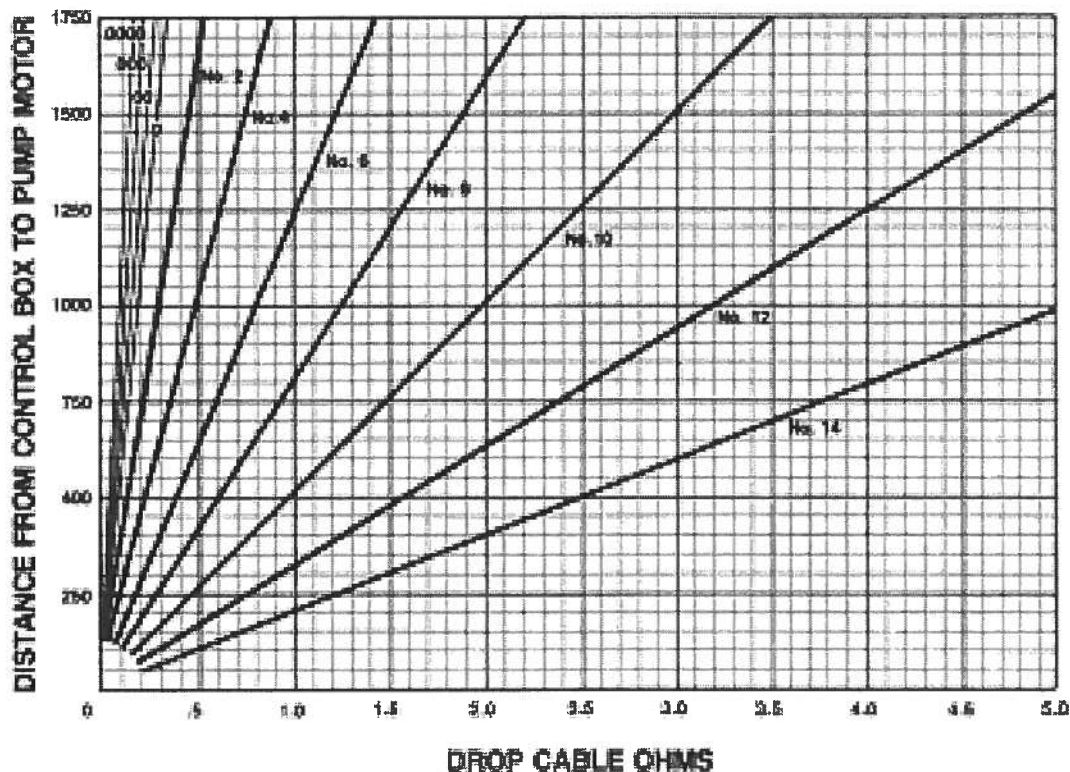
Table G

Total Resistance of Drop Cable (OHMS)

The values shown in this table are for copper conductors. Values are for the total resistance of drop cable from the control box to the motor and back.

To determine the resistance:

1. Disconnect the drop cable leads from the control box or panel.
2. Record the size and length of drop cable.
3. Determine the cable resistance from the table.
4. Add drop cable resistance to motor resistance. Motor resistances can be found in the Electrical Data Chart, Table E.
5. Measure the resistance between each drop cable lead using an ohmmeter. Meter should be set on Rx1 and zero-balanced for this measurement.
6. The measured values should be approximately equal to the calculated values.



LIMITED WARRANTY

Products manufactured by GRUNDFOS PUMPS CORPORATION (GRUNDFOS) are warranted to the original user only to be free of defects in material and workmanship for a period of 18 months from date of installation, but not more than 24 months from date of manufacture. GRUNDFOS' liability under this warranty shall be limited to repairing or replacing at GRUNDFOS' option, without charge, F.O.B. GRUNDFOS' factory or authorized service station, any product of GRUNDFOS' manufacture. GRUNDFOS will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by GRUNDFOS are subject to the warranty provided by the manufacturer of said products and not by GRUNDFOS' warranty. GRUNDFOS will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with GRUNDFOS' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of GRUNDFOS' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact GRUNDFOS or an authorized service station for instructions. Any defective product to be returned to GRUNDFOS or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limitations on how long implied warranties may last. Therefore, 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 jurisdiction to jurisdiction.



Leaders in Pump Technology

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SP

- Ⓒ GB Installation and operating instructions
- Ⓒ D Montage- und Betriebsanleitung
- Ⓒ F Notice d'installation et d'entretien
- Ⓒ I Istruzioni di installazione e funzionamento
- Ⓒ E Instrucciones de instalación y funcionamiento
- Ⓒ P Instruções de instalação e funcionamento
- Ⓒ GR Οδηγίες εγκατάστασης και λειτουργίας
- Ⓒ NL Installatie- en bedieningsinstructies
- Ⓒ S Monterings- och driftsinstruktion
- Ⓒ SF Asennus- ja käyttöohjeet
- Ⓒ DK Monterings- og driftsinstruktion



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Before beginning installation procedures, these installation and operating instructions should be studied carefully. The installation and operation should also be in accordance with local regulations and accepted codes of good practice.

These instructions apply to GRUNDFOS submersible motors, types MS and MMS, and GRUNDFOS submersible pumps, type SP, fitted with submersible motors, types GRUNDFOS MS or MMS, FRANKLIN 4"-8", MERCURY 6"-12" and PLEUGER 6"-12".

If the pump is fitted with a motor of another motor make than GRUNDFOS MS or MMS, please note that the motor data may differ from the data stated in these instructions.

1. Delivery and storage

1.1 Delivery

GRUNDFOS submersible pumps are supplied from the factory in proper packing in which they should remain until they are to be installed.

During unpacking and prior to installation, care must be taken when handling the pump to ensure that misalignment does not occur due to bending.

Note: The pumps should remain in the packing until they are placed in vertical position during installation.

When the pump part and motor are supplied as separate units (long pumps), fit the motor to the pump as described in section 5.1 *Fitting the motor to the pump*.

The loose data plate supplied with the pump should be fixed close to the installation site.

The pump should not be exposed to unnecessary impact and shocks.

1.2 Storage and handling

Storage temperature:

Pump: -20°C to +60°C.

Motor: -20°C to +70°C.

The motors must be stored in a closed, dry and well ventilated room.

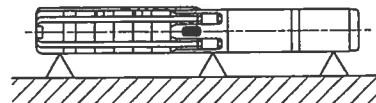
Note: If MMS motors are stored for more than one year, the shaft must be turned by hand at least once a month.

If a motor has been stored for more than one year before installation, the rotating parts of the motor must be dismantled and checked before use.

The pump should not be exposed to direct sunlight.

If the pump has been unpacked, it should be stored horizontally, adequately supported, or vertically to prevent misalignment of the pump. Make sure that the pump cannot roll or fall over. During storage, the pump can be supported as shown in fig. 1.

Fig. 1



1.2.1 Frost protection

If the pump has to be stored after use, it must be stored on a frost-free location, or it must be ensured that the motor liquid is frost-proof.

2. General data

2.1 Applications

GRUNDFOS submersible pumps, type SP, are designed for a wide range of water supply and liquid transfer applications, such as the supply of fresh water to private homes or waterworks, water supply to nursery gardens or farms, drawdown of groundwater and pressure boosting, and various industrial jobs.

The pump must be installed so that the suction interconnector is completely submerged in the liquid. The pump can be installed either horizontally or vertically, see also section 3.2 *Positional requirements*.

2.2 Pumped liquids

Clean, thin, **non-explosive** liquids without solid particles or fibres.

The maximum sand content of the water must not exceed 50 g/m³. A larger sand content will reduce the life of the pump and increase the risk of blocking.

Note: When pumping liquids with a density higher than that of water, motors with correspondingly higher outputs must be used.

If liquids with a viscosity higher than that of water are to be pumped, please contact GRUNDFOS.

The special SP A N, SP A R, SP N, SP R and SPE types are designed to accommodate liquids with higher aggressiveness than drinking water.

The maximum liquid temperature appears from section 3.4 *Liquid temperatures/cooling*.

2.3 Sound pressure level

The sound pressure level has been measured in accordance with the rules laid down in the EC machinery directive 98/37/EEC.

Sound pressure level of pumps:

Applies to pumps submerged in water, without external regulating valve.

Pump Type	L_{pA} [dB(A)]
SP 1A	<70
SP 2A	<70
SP 3A	<70
SP 5A	<70
SP 8A	<70
SP 14A	<70
SP 17	<70
SP 30	<70
SP 46	<70
SP 60	<70
SP 77	<70
SP 95	<70
SP 125	79
SP 160	79
SP 215	82

Sound pressure level of motors:

The sound pressure level of GRUNDFOS MS and MMS motors is lower than 70 dB(A).

Other motor makes: See installation and operating instructions for these motors.

3. Preparation



Before starting work on the pump, make sure that the electricity supply has been switched off and that it cannot be accidentally switched on.

3.1 Checking of liquid in motor

The submersible motors are factory-filled with a special non-poisonous liquid, which is frost-proof down to -20°C .

Note: The level of the liquid in the motor must be checked and the motor must be refilled, if required.

Note: If there is a risk of frost, special GRUNDFOS liquid must be used to refill the motor. Otherwise clean water may be used for refilling (however, **never** use distilled water).

Refilling of liquid is carried out as described below.

3.1.1 GRUNDFOS submersible motors MS 4000 and MS 402

The filling hole for motor liquid is placed in the following positions:

MS 4000: in one of the staybolts.

MS 402: in the bottom of the motor.

1. Position the submersible pump as shown in fig. 2. The filling screw must be at the highest point of the motor.
2. Remove the screw from the filling hole.
3. Inject liquid into the motor with the filling syringe, fig. 2, until the liquid runs back out of the filling hole.
4. Replace the screw in the filling hole and tighten securely before changing the position of the pump.

Torques:

MS 4000: 0.5 Nm.

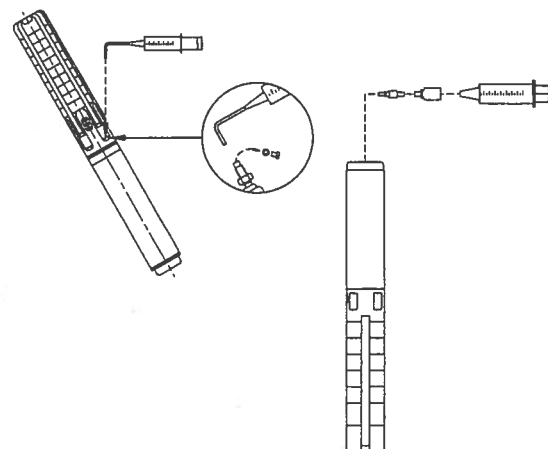
MS 402: 2.0 Nm.

The submersible pump is now ready for installation.

Fig. 2

MS 4000

MS 402



TM00 6423 3695

3.1.2 GRUNDFOS submersible motors MS 6000

- If the motor is delivered from stock, the liquid level must be checked before the motor is fitted to the pump, see fig. 3.
- On pumps delivered directly from GRUNDFOS, the liquid level has already been checked.
- In the case of service, the liquid level must be checked, see fig. 3.

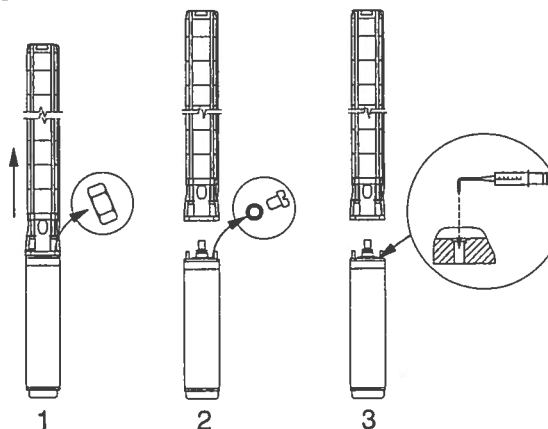
The filling hole for motor liquid is placed at the top of the motor.

1. Position the submersible pump as shown in fig. 3. The filling screw must be at the highest point of the motor.
2. Remove the screw from the filling hole.
3. Inject liquid into the motor with the filling syringe, fig. 3, until the liquid runs back out of the filling hole.
4. Replace the screw in the filling hole and tighten securely before changing the position of the pump.

Torque: 3.0 Nm.

The submersible pump is now ready for installation.

Fig. 3



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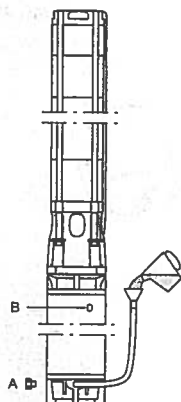
3.1.3 GRUNDFOS submersible motors MMS 6000, MMS 8000, MMS 10000 and MMS 12000

To refill the motor, proceed as follows:

1. Position the submersible pump as shown in fig. 4.
2. Remove the screw (A) from the filling hole and fit the nipple with pipe and funnel supplied with the motor.
3. Remove the air vent screw (B) to allow possible air in the motor to escape.
4. Hold the funnel higher than the vent hole and pour clean water into the motor until the liquid starts dripping out of the motor.
5. Stop pouring water into the motor. Refit the screw (B) to the vent hole and remove pipe and funnel. Replace the screw (A) in the filling hole and tighten securely.

The submersible pump is now ready for installation.

Fig. 4



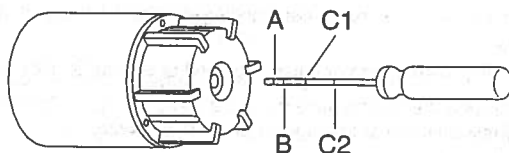
TM01 9143 1300

3.1.4 FRANKLIN submersible motors from 3 kW and up

The level of the motor liquid in FRANKLIN 4" and 6" submersible motors is checked by measuring the distance from the bottom plate to the built-in rubber diaphragm. This distance can be measured by inserting a rule or a small rod through the hole until it touches the diaphragm, fig. 5.

Note: Take care not to damage the diaphragm.

Fig. 5

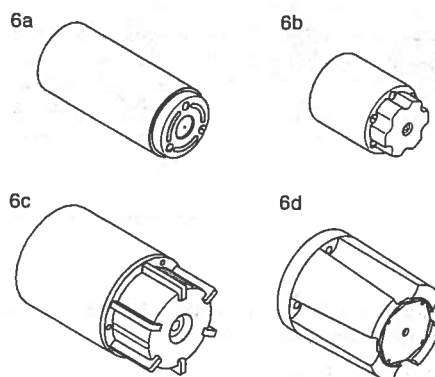


TM00 1353 5092

The following table shows the correct distance from the outside of the bottom plate to the diaphragm.

Motor	Dimension	Distance
FRANKLIN 4", 0.25 to 3 kW (see fig. 6a)	A	8 mm
FRANKLIN 4", 3 to 7.5 kW (see fig. 6b)	B	16 mm
FRANKLIN 6", 4 to 45 kW (see fig. 6c)	C1	35 mm
FRANKLIN 6", 4 to 22 kW (see fig. 6d)	C2	59 mm

Fig. 6



TM00 6422 3695

If the distance is not correct, carry out an adjustment as described in section 3.1.5 FRANKLIN submersible motors.

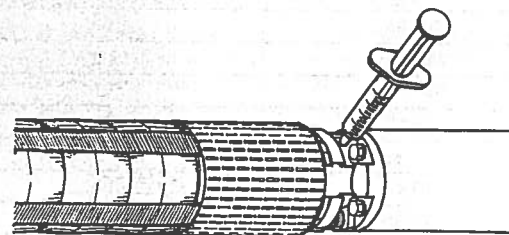
3.1.5 FRANKLIN submersible motors

The level of the motor liquid in FRANKLIN 8" submersible motors is checked as follows:

1. Prise out the filter in front of the valve at the top of the motor using a screwdriver. If the filter is slotted, unscrew. The position of the filling valve is shown in fig. 7.

2. Press the filling syringe against the valve and inject the liquid, fig. 7. If the valve cone is depressed too far, it may be damaged thus causing the valve to leak.
 3. Remove any air in the motor by pressing the point of the filling syringe lightly against the valve.
 4. Repeat the process of injecting liquid and releasing air until the liquid starts running out or the diaphragm is in its correct position (FRANKLIN 4" and 6").
 5. Reinstall the filter after refilling with liquid.
- The submersible pump is now ready for installation.

Fig. 7



TM00 1354 5092

3.1.6 MERCURY submersible motors

The level of the liquid in the motor is checked as described for FRANKLIN 8" motors, see section 3.1.5 FRANKLIN submersible motors.

3.1.7 PLEUGER submersible motors

The level of the liquid in the motor is checked as described for FRANKLIN 8" motors, see section 3.1.5 FRANKLIN submersible motors.

3.2 Positional requirements

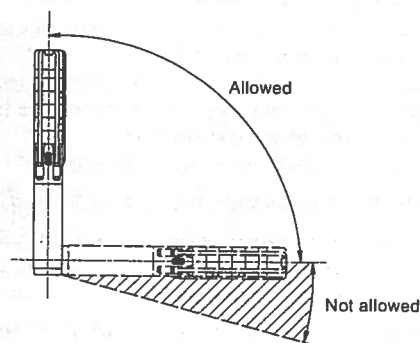


If the pump is to be installed in a position where it is accessible, the coupling must be suitably isolated from human touch. The pump can for instance be built into a flow sleeve.

Depending on motor type, the pump can be installed either vertically or horizontally. A complete list of motor types suitable for horizontal installation is shown in section 3.2.1.

If the pump is installed horizontally, the discharge port should never fall below the horizontal plane, see fig. 8.

Fig. 8



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If the pump is installed horizontally, e.g. in a tank, it is recommended to fit it in a flow sleeve.

3.2.1 Motors suitable for horizontal installation

Motor type	Power output 50 Hz	Power output 60 Hz
	[kW]	[kW]
MS	All sizes	All sizes
MMS 6000	3.7 to 18.5	3.7 to 18.5
MMS 8000	22.0 to 63.0	22.0 to 63.0
MMS 10000	75.0 to 110.0	75.0 to 110.0
MMS 12000	147.0 to 190.0	—

When FRANKLIN 4" submersible motors up to and including 2.2 kW are started more than 10 times a day, it is recommended to incline the motor at least 15° above the horizontal plane in order to minimize wearing of the upthrust disc.

Note: During operation, the suction interconnector of the pump must always be completely submerged in the liquid.

Note: If the pump is used for pumping hot liquids (40° to 60°C), care should be taken to ensure that persons cannot come into contact with the pump and the installation, e.g. by installing a guard.

3.3 Diameter of pump/motor

The maximum diameter of the pump/motor is as shown in the tables on pages 143 and 144.

It is recommended to check the borehole with an inside calliper to ensure unobstructed passage.

3.4 Liquid temperatures/cooling

The maximum liquid temperature and the minimum liquid velocity over the motor appear from the following table.

It is recommended to install the motor above the well screen in order to achieve proper motor cooling.

Note: In cases where the stated liquid velocity cannot be achieved, a flow sleeve must be installed.

If there is a risk of sediment build-up, such as sand, around the motor, a flow sleeve should be used in order to ensure proper cooling of the motor.

3.4.1 Maximum liquid temperature

Out of consideration for the rubber parts in pump and motor, the liquid temperature must not exceed 40°C (~105°F). See also the following table.

The pump can operate at liquid temperatures between 40°C and 60°C (~105°F and 140°F) provided that all rubber parts are replaced every third year.

Motor	Installation		
	Flow past the motor	Vertical	Horizontal
GRUNDFOS MS and MMS	Free convection 0 m/s	20°C (~68°F)	Flow sleeve recommended
GRUNDFOS MS	0.15 m/s	40°C (~105°F)	40°C (~105°F)
GRUNDFOS MS I *	0.15 m/s	60°C (~140°F) Flow sleeve recommended	60°C (~140°F) Flow sleeve recommended
GRUNDFOS MMS	0.15 m/s	25°C (~77°F)	25°C (~77°F)
FRANKLIN 4"	0.08 m/s	30°C (~85°F)	30°C (~85°F)
FRANKLIN 6" and 8"	0.16 m/s	30°C (~85°F)	30°C (~85°F)
MERCURY	0.15 m/s	25°C (~77°F)	25°C (~77°F)
PLEUGER	0.5 m/s	30°C (~86°F)	30°C (~86°F)

* At an ambient pressure of minimum 1 bar (1 MPa)

Note: By free convection is meant that the borehole diameter is at least 2" larger than the diameter of the submersible motor.

Other motor makes: See motor specifications.

3.5 Pipework connection

If noise may be transmitted to the building through the pipework, it is advisable to use plastic pipes.

Note: Plastic pipes are recommended for 4" pumps only.

When plastic pipes are used, the pump should be secured by an unloaded straining wire.



Make sure that the plastic pipes to be used are suitable for the actual liquid temperature and the pump pressure.

When connecting plastic pipes, a compression coupling should be used between the pump and the first pipe section.

4. Electrical connection



Before starting work on the pump, make sure that the electricity supply has been switched off and that it cannot be accidentally switched on.

4.1 General

The electrical connection should be carried out by an authorized electrician in accordance with local regulations.

The supply voltage, rated maximum current and cos φ appear from the loose data plate that **must** be fitted close to the installation site.

The required voltage quality for GRUNDFOS MS and MMS submersible motors, measured at the motor terminals, is -10%/+6% of the nominal voltage during continuous operation (including variation in the supply voltage and losses in cables).

Furthermore, it must be checked that there is voltage symmetry in the electricity supply lines, i.e. same difference of voltage between the individual phases, see also section 9. *Checking of motor and cable*, point 2.

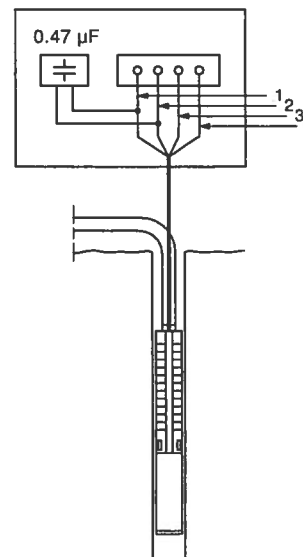


The pump must be earthed.

The pump must be connected to an external mains switch.

In order that the GRUNDFOS MS motors with a built-in and operational temperature transmitter can meet the EC EMC Directive (89/336/EEC), a 0.47 µF capacitor (in accordance with IEC 384-14) must always be connected over the two phases to which the temperature transmitter is connected, see fig. 9.

Fig. 9



- 1. Black
- 2. Blue
- 3. Yellow/green
- 4. Brown

TMD 7100 C596



The motors are wound for direct-on-line starting or star-delta starting and the starting current is between 4 and 6 times the full load current of the motor.

The run-up time of the pump is only about 0.1 second. Direct-on-line starting is therefore normally approved by the electricity supply authorities.

4.1.1 Frequency converter operation

GRUNDFOS motors:

Three-phase GRUNDFOS motors can be connected to a frequency converter.

Note: If a GRUNDFOS MS motor with temperature transmitter is connected to a frequency converter, a fuse incorporated in the transmitter will melt and the transmitter will be inactive. The transmitter cannot be reactivated. This means that the motor will operate like a motor without a temperature transmitter.

If a temperature transmitter is required, a Pt100 sensor for fitting to the submersible motor can be ordered from GRUNDFOS.

During frequency converter operation, it is not advisable to run the motor at a frequency higher than the nominal frequency (50 or 60 Hz). In connection with pump operation, it is important never to reduce the frequency (and consequently the speed) to such a level that the necessary flow of cooling liquid past the motor is no longer ensured.

To avoid damage to the pump part, it must be ensured that the motor stops when the pump flow falls below 0.1 x nominal flow.

Depending on the frequency converter type, it may expose the motor to detrimental voltage peaks.



Motors, type MS 402, for supply voltages up to and including 440 V (see motor nameplate) must be protected against voltage peaks higher than 650 V (peak-value) between the supply terminals.

It is recommended to protect other motors against voltage peaks higher than 850 V.

The above disturbance can be abated by installing an RC filter between the frequency converter and the motor.

Possible increased acoustic noise from the motor can be abated by installing an LC filter which will also eliminate voltage peaks from the frequency converter.

For further details, please contact your frequency converter supplier or GRUNDFOS.

Other motor makes than GRUNDFOS:

Please contact GRUNDFOS or the motor manufacturer.

4.2 Motor protection

4.2.1 Single-phase motors

Single-phase submersible motors, type MS 402, incorporate a thermal switch and require no additional motor protection.



When the motor has been thermally switched off, the motor terminals are still live.

When the motor has cooled sufficiently, it will restart automatically.

Single-phase submersible motors, type MS 4000, must be protected. A protective device can either be incorporated in a control box or be separate.

FRANKLIN 4" PSC motors must be connected to a motor starter.

4.2.2 Three-phase motors

GRUNDFOS MS motors are available with or without a built-in temperature transmitter.

Motors with a built-in and operational temperature transmitter must be protected by means of:

- a motor starter with thermal relay or
- an MTP 75 and a motor starter with thermal relay or
- a CU 3 and contactor(s).

Motors without or with a non-operational temperature transmitter must be protected by means of:

- a motor starter with thermal relay or
- a CU 3 and contactor(s).

GRUNDFOS MMS motors have no built-in temperature transmitter. A Pt100 sensor is available as an accessory.

Motors with a Pt100 sensor must be protected by means of:

- a motor starter with thermal relay or
- a CU 3 and contactor(s).

Motors without a Pt100 sensor must be protected by means of:

- a motor starter with thermal relay or
- a CU 3 and contactor(s).

4.2.3 Required motor starter settings

For cold motors, the tripping time for the motor starter must be less than 10 seconds at 5 times the rated maximum current of the motor.

Note: If this requirement is not met, the motor warranty will be invalidated.

In order to ensure the optimum protection of the submersible motor, the starter overload unit should be set in accordance with the following guidelines:

1. Set the starter overload to the rated maximum current of the motor.
2. Start the pump and let it run for half an hour at normal performance.
3. Slowly grade down the scale indicator until the motor trip point is reached.
4. Increase the overload setting by 5%.

The highest permissible setting is the rated maximum current of the motor.

For motors wound for star-delta starting, the starter overload unit should be set as above, but the maximum setting should be as follows:

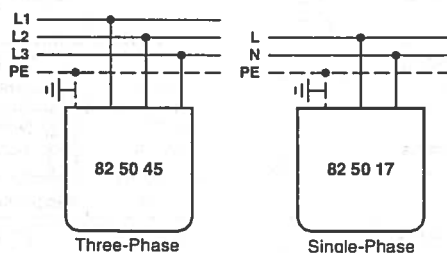
Starter overload setting = Rated maximum current x 0.58.

The highest permissible start-up time for star-delta starting or autotransformer starting is 2 seconds.

4.3 Lightning protection

The installation can be fitted with a special overvoltage protective device to protect the motor from voltage surges in the electricity supply lines when lightning strikes somewhere in the area, see fig. 10.

Fig. 10



The overvoltage protective device will not, however, protect the motor against a direct stroke of lightning.

The overvoltage protective device should be connected to the installation as close as possible to the motor and always in accordance with local regulations.

Ask GRUNDFOS for lightning protective devices.

Submersible motors, type MS 402, however, require no further lightning protection as they are highly insulated.

Ask for a special cable termination kit with a built-in overvoltage protective device for GRUNDFOS 4" submersible motors (part no. 79 99 11 / 79 99 12).

4.4 Cable sizing

Make sure that the submersible drop cable can withstand permanent submersion in the actual liquid and at the actual temperature.

GRUNDFOS can supply submersible drop cables for a wide range of installations.

The cross-section (q) of the cable should meet the following requirements:

1. The submersible drop cable should be dimensioned to the rated maximum current (I) of the motor.
2. The cross-section should be sufficient to make a voltage drop over the cable acceptable.

Use the largest of the cross sections found under points 1. and 2.

Re 1: The following table specifies the current value of GRUNDFOS submersible drop cables (i.e. the maximum current tolerated by the drop cable) at an ambient temperature of maximum 30°C. Please contact GRUNDFOS if the ambient temperature lies above 30°C.

When sizing the submersible drop cable, make sure that the rated maximum current does not exceed the current value (I_s).

For star-delta starting, however, size the cables so that 0.58 x the rated maximum current of the motor does not exceed the current value (I_s) of the cables.

q [mm ²]	I _s [A]	q [mm ²]	I _s [A]
1.5	18	50	153
2.5	25	70	196
4	34	95	238
6	43	120	276
10	60	150	319
16	80	185	364
25	101	240	430
35	126	300	497

If GRUNDFOS submersible drop cables are not used, the cross-section should be selected on the basis of the current values of the actual cables.

Re 2:

Note: The cross-section of the submersible drop cable must be large enough to meet the voltage quality requirements specified in section 4.1 General.

Determine the voltage drop for the cross-section of the submersible drop cable by means of the diagrams on pages 145 and 146, where

I = Rated maximum current of the motor.

For star-delta starting

I = rated maximum current of the motor x 0.58.

Lx = Length of cable converted to a voltage drop of 1% of the nominal voltage.

$$Lx = \frac{\text{length of drop cable}}{\text{permissible voltage drop in \%}}$$

q = Cross-section of submersible drop cable.

Draw a straight line between the actual I-value and the Lx-value. Where the line intersects the q-axis, select the cross-section that lies right above the intersection.

The diagrams are made on the basis of the formulas:

Single-phase submersible motor:

$$L = \frac{U \times \Delta U}{I \times 2 \times 100 \times (\cos \varphi \times \frac{p}{q} + \sin \varphi \times XI)}$$

Three-phase submersible motor:

$$L = \frac{U \times \Delta U}{I \times 1.73 \times 100 \times (\cos \varphi \times \frac{p}{q} + \sin \varphi \times XI)}$$

where

L = Length of submersible drop cable [m]

U = Nominal voltage [V]

ΔU = Voltage drop [%]

I = Rated maximum current of the motor [A]

cos φ = 0.9

p = Specific resistance: 0.02 [Ωmm²/m]

q = Cross-section of submersible drop cable [mm²]

sin φ = 0.436

XI = Inductive resistance: 0.078 x 10⁻³ [Ω/m]

4.5 Control of single-phase MS 402



The single-phase MS 402 submersible motor incorporates motor protection which cuts out the motor in case of excessive winding temperatures while the motor is still supplied with voltage. Allow for this, when the motor forms part of a control system.

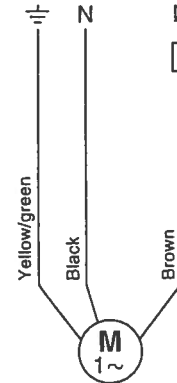
If a compressor is included in a control system together with an ochre filter, the compressor will run continuously once the motor protection has cut out the motor, unless other special precautions have been taken.

4.6 Connection of single-phase motors

4.6.1 2-wire motors

GRUNDFOS MS 402 2-wire motors incorporate motor protection and a starter device and can therefore be connected directly to the mains, see fig. 11.

Fig. 11



TM00 1359 5092

4.6.2 PSC motors

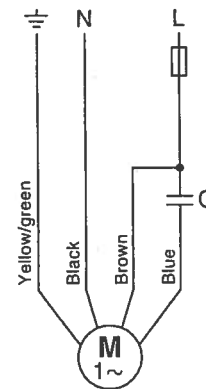
The PSC motors are connected to the mains via an operating capacitor which should be dimensioned for continuous operation.

Select the correct capacitor size from the following table:

Motor	Capacitor
0.25 kW	12.5 μF / 400 V / 50 Hz
0.37 kW	16 μF / 400 V / 50 Hz
0.55 kW	20 μF / 400 V / 50 Hz
0.75 kW	30 μF / 400 V / 50 Hz
1.10 kW	40 μF / 400 V / 50 Hz
1.50 kW	50 μF / 400 V / 50 Hz
2.20 kW	75 μF / 400 V / 50 Hz

The GRUNDFOS MS 402 PSC motor incorporates motor protection and should be connected to the mains as shown in fig. 12.

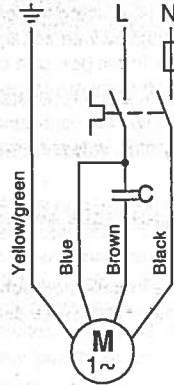
Fig. 12



TM00 1359 5092

The FRANKLIN 4" PSC motor should be connected to the mains via the motor protection, see fig. 13.

Fig. 13



TM00 1361 1200

4.6.3 3-wire motors

GRUNDFOS MS 4000 3-wire motors should be connected to the mains via a GRUNDFOS control box SA-SPM 2 or 3 incorporating motor protection.

GRUNDFOS MS 402 3-wire motors incorporate motor protection and should be connected to the mains via a GRUNDFOS control box SA-SPM 2 or 3 without motor protection.

The connection of MS 4000 and MS 402 motors appears from the following table:

Motor	Cable	Control box	Mains
Up to 0.75 kW	Black Brown Blue Yellow/green		N L PE
From 1.10 kW	Black Brown Blue Yellow/green		N L PE

4.7 Connection of three-phase motors

Three-phase submersible motors must be protected, see section 4.2.2 *Three-phase motors*.

For electrical connection by means of the CU 3, see the separate installation and operating instructions for this unit.

When a conventional motor starter is being used, the electrical connection should be carried out as described below.

4.7.1 Checking of direction of rotation

Note: The pump must not be started until the suction interconnector has been completely submerged in the liquid.

When the pump has been connected to the electricity supply, determine the correct direction of rotation as follows:

1. Start the pump and check the quantity of water and head developed.
2. Stop the pump and interchange two of the phase connections. In the case of motors wound for star-delta starting, exchange U1 by V1 and U2 by V2.
3. Start the pump and check the quantity of water and head developed.
4. Stop the pump.
5. Compare the results taken under points 1. and 3. The connection which gives the larger quantity of water and the higher head is the correct connection.

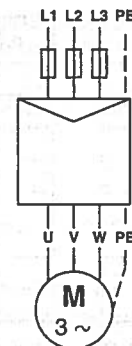
4.7.2 GRUNDFOS motors, direct-on-line starting

The connection of GRUNDFOS submersible motors wound for direct-on-line starting appears from the following table and fig. 14.

Mains	Cable/connection
	GRUNDFOS 4" and 6" Motors
L1	U
L2	V
L3	W
PE	PE

Check the direction of rotation as described in section 4.7.1 *Checking of direction of rotation*.

Fig. 14



TM00 1364 5092

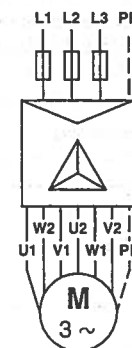
4.7.3 GRUNDFOS motors, star-delta starting

The connection of GRUNDFOS submersible motors wound for star-delta starting appears from the following table and fig. 15.

Connection	GRUNDFOS 6" motors
U1	Brown
V1	Blue
W1	Black
W2	Brown
U2	Blue
V2	Black
PE	Yellow/green

Check the direction of rotation as described in section 4.7.1 *Checking of direction of rotation*.

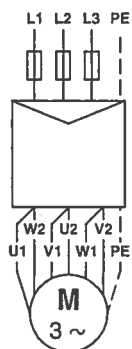
Fig. 15



TM00 1365 5092

If star-delta starting is not required, but direct-on-line starting is, the submersible motors should be connected as shown in fig. 16.

Fig. 16



TM00 1366 5092

4.7.4 Connection in the case of unidentified cable marking/connection

If it is unknown where the individual leads are to be connected to the mains in order to ensure the correct direction of rotation, proceed as follows:

Motors wound for direct-on-line starting:

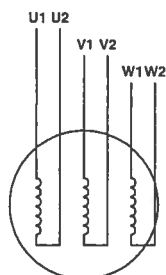
Connect the pump to the mains as is expected to be right.

Then check the direction of rotation as described in section 4.7.1 Checking of direction of rotation.

Motors wound for star-delta starting:

The windings of the motor are determined by means of an ohmmeter, and the lead sets for the individual windings are named accordingly: U1-U2, V1-V2 and W1-W2, see fig. 17.

Fig. 17



TM00 1367 5092

If star-delta starting is required, the leads should be connected as shown in fig. 15.

If direct-on-line starting is required, the leads should be connected as shown in fig. 16.

Then check the direction of rotation as described in section 4.7.1 Checking of direction of rotation.

4.7.5 FRANKLIN, MERCURY and PLEUGER motors

The connection of FRANKLIN, MERCURY and PLEUGER motors appears from section 4.7.4 Connection in the case of unidentified cable marking/connection.

5. Pump installation



Before starting any work on the pump/motor, make sure that the electricity supply has been switched off and that it cannot be accidentally switched on.

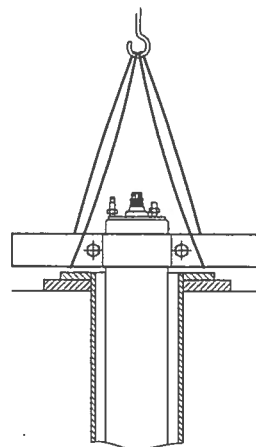


5.1 Fitting the motor to the pump

When the pump part and the motor are supplied as separate units (long pumps), fit the motor to the pump as follows:

1. Use pipe clamps when handling the motor.
2. Place the motor in vertical position at the borehole seal, see fig. 18.

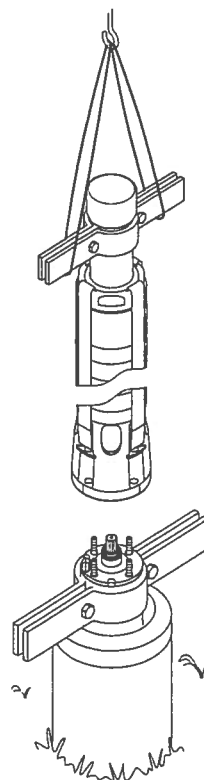
Fig. 18



TM00 5259 2402

3. Lift the pump part by means of pipe clamps fitted to the extension pipe, see fig. 19.

Fig. 19



TM02 5263 2502

4. Place the pump part on top of the motor.
5. Fit and tighten the nuts, see the following table.



The bolts and nuts securing the straps to the pump must be tightened diagonally to the torques stated in the following table:

Straps bolt/nut	Torque [Nm]
M8	18
M10	35
M12	45
M16	120
SP 215, 50 Hz, with more than 8 stages SP 215, 60 Hz, with more than 5 stages	150

Make sure that the coupling between the pump and motor engages properly.

When fitting the motor to the pump part, the nuts must be tightened diagonally to the torques stated in the following table:

Pump/motor staybolt diameter	Torque [Nm]
M8	18
M12	70
M16	150
M20	280

Note: Make sure that the pump chambers are aligned when assembly has been completed.

5.2 Removal and fitting of cable guard

For removal and fitting of cable guard(s), see pages 147 and 148. If the cable guard is screwed on to the pump, such as the SP 215 and sleeved pumps, the cable guard should be removed and fitted by means of screws.

Note: Make sure that the pump chambers are aligned when the cable guard has been fitted.

5.3 Fitting of submersible drop cable

5.3.1 GRUNDFOS MS submersible motors

Before fitting the submersible drop cable to the motor, make sure that the cable socket is clean and dry.

To facilitate the fitting of the cable, lubricate the rubber parts of the cable plug with non-conducting silicone paste.

Tighten the screws holding the cable to the torques stated:

MS 4000: 2.0 Nm.

MS 402: 2.0 Nm.

MS 6000: 4.0-5.0 Nm.

MMS 6000: 10 Nm.

MMS 12000: 15 Nm.

5.4 Riser pipe

If a tool, e.g. a chain pipe wrench, is used when the riser pipe is fitted to the pump, the pump must only be gripped by the pump discharge chamber.

The threaded joints on the riser pipe must all be well cut and fit together to ensure that they do not work loose when subjected to torque reaction caused by the starting and stopping of the pump.

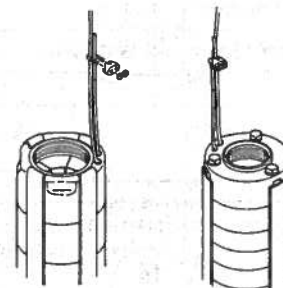
The thread on the first section of the riser pipe which is to be screwed into the pump should not be longer than the threads in the pump.

If noise may be transmitted to the building through the pipework, it is advisable to use plastic pipes.

Note: Plastic pipes are recommended for 4" pumps only.

When plastic pipes are used, the pump should be secured by an unloaded straining wire to be fastened to the discharge chamber of the pump, see fig. 20.

Fig. 20



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When connecting plastic pipes, a compression coupling should be used between the pump and the first pipe section.

Where flanged pipes are used, the flanges should be slotted to take the submersible drop cable and a water indicator hose, if fitted.

5.5 Maximum installation depth below water level

GRUNDFOS MS 4000: 600 m.

GRUNDFOS MS 402: 150 m.

GRUNDFOS MS 6000: 600 m.

GRUNDFOS MMS: 250 m.

FRANKLIN motors: 350 m.

MERCURY motors: 350 m.

PLEUGER motors: 350 m.

5.6 Cable fitting

Cable clips must be fitted every 3 metres to fix the submersible drop cable and the straining wire, if fitted, to the riser pipe of the pump.

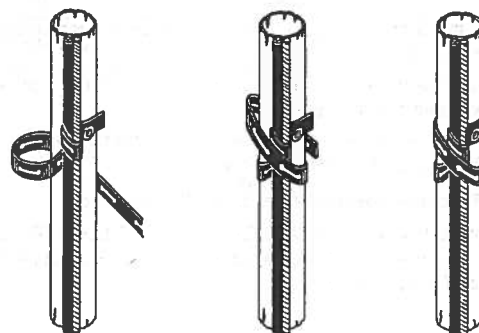
GRUNDFOS supplies cable clip sets on request. The set consists of a 1.5 mm thick rubber band and 16 buttons.

Cable fitting: Cut off the rubber band so that the piece with no slit becomes as long as possible.

Insert a button in the first slit.

Position the wire alongside the submersible drop cable, fig. 21.

Fig. 21



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Wind the band once around the wire and the cable.

Then wind it tightly at least twice around the pipe, wire and the cable.

Push the slit over the button and then cut off the band.

Where large cable cross-sections are used, it will be necessary to wind the band several times.

Where plastic pipes are used, some slackness must be left between each cable clip as plastic pipes expand when loaded.

When flanged pipes are used, the cable clips should be fitted above and below each joint.

5.7 Lowering the pump

It is recommended to check the borehole by means of an inside calliper before lowering the pump to ensure unobstructed passage.

Lower the pump carefully into the borehole, taking care not to damage the motor cable and the submersible drop cable.

Note: Do not lower or lift the pump by means of the motor cable.

5.8 Installation depth

The dynamic water level should always be above the suction interconnector of the pump, see section 3.2 *Positional requirements* and fig. 22.

Minimum inlet pressure is indicated in the NPSH curve for the pump.

The minimum safety margin should be 1 metre head.

It is recommended to install the pump so that the motor part is above the well screen in order to ensure optimum cooling, see section 3.4 *Liquid temperatures/cooling*.

When the pump has been installed to the required depth, the installation should be finished by means of a borehole seal.

Slacken the straining wire so that it becomes unloaded and lock it to the borehole seal by means of wire locks.

For pumps fitted with plastic pipes, the expansion of the pipes when loaded should be taken into consideration, when deciding on the installation depth of the pump.

6. Start-up and operation

6.1 Start-up

When the pump has been connected correctly and it is submerged in the liquid to be pumped, it should be started with the discharge valve closed off to approx. 1/3 of its maximum volume of water.

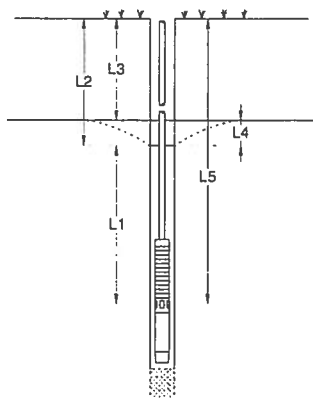
Check the direction of rotation as described in section 4.7.1 *Checking of direction of rotation*.

If there are impurities in the water, the valve should be opened gradually as the water becomes clearer. The pump should not be stopped until the water is completely clean, as otherwise the pump parts and the non-return valve may choke up.

As the valve is being opened, the drawdown of the water level should be checked to ensure that the pump always remains submerged.

The dynamic water level should always be above the suction interconnector of the pump, see section 3.2 *Positional requirements* and fig. 22.

Fig. 22



- L1 Minimum installation depth below dynamic water level. Minimum 1 metre is recommended.
- L2 Depth to dynamic water level.
- L3 Depth to static water level.
- L4 Drawdown. This is the difference between the dynamic and the static water levels.
- L5 Installation depth.

If the pump can pump more than yielded by the well, it is recommended to fit the GRUNDFOS control unit, type CU 3, or some other type of dry-running protection.

If no water level electrodes or level switches are installed, the water level may be drawn down to the suction interconnector of the pump and the pump will then draw in air.

Long time operation with water containing air may damage the pump and cause insufficient cooling of the motor.



6.2 Operation

6.2.1 Minimum flow rate

To ensure the necessary cooling of the motor, the pump should never be set so low that the cooling requirements specified in section 3.4 *Liquid temperatures/cooling* cannot be met.

6.2.2 Frequency of starts and stops

Motor type	Number of starts
MS 402	Minimum 1 per year is recommended. Maximum 100 per hour. Maximum 300 per day.
MS 4000	Minimum 1 per year is recommended. Maximum 100 per hour. Maximum 300 per day.
MS 6000	Minimum 1 per year is recommended. Maximum 30 per hour. Maximum 300 per day.
MMS 6000	Minimum 1 per year is recommended. Maximum 15 per hour. Maximum 360 per day.
MMS 8000	Minimum 1 per year is recommended. Maximum 10 per hour. Maximum 240 per day.
MMS 10000	Minimum 1 per year is recommended. Maximum 8 per hour. Maximum 190 per day.
MMS 12000	Minimum 1 per year is recommended. Maximum 5 per hour. Maximum 120 per day.
FRANKLIN	Minimum 1 per year is recommended. Maximum 100 per day.
MERCURY 6"	Minimum 1 per year is recommended. Maximum 20 per hour.
MERCURY 8"	Minimum 1 per year is recommended. Maximum 15 per hour.
MERCURY 10"	Minimum 1 per year is recommended. Maximum 10 per hour.
MERCURY 12"	Minimum 1 per year is recommended. Maximum 6 per hour.
PLEUGER	Minimum 1 per year is recommended. Maximum 100 per day.

7. Maintenance and service

The pumps are maintenance-free.

All pumps are easy to service.

Service kits and service tools are available from GRUNDFOS. The GRUNDFOS Service Manual is available on request.

The pumps can be serviced at a GRUNDFOS service centre.



If a pump has been used for a liquid which is injurious to health or toxic, the pump will be classified as contaminated.

If GRUNDFOS is requested to service the pump, GRUNDFOS must be contacted with details about the pumped liquid, etc. before the pump is returned for service. Otherwise GRUNDFOS can refuse to accept the pump for service.

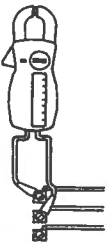
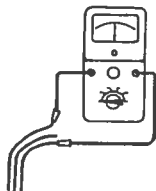
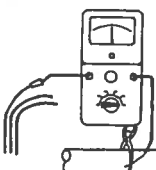
Possible costs of returning the pump are paid by the customer.

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8. Fault finding chart

Fault	Cause	Remedy
1. The pump does not run.	a) The fuses are blown.	Replace the blown fuses. If the new ones blow too, the electric installation and the submersible drop cable should be checked.
	b) The ELCB or the voltage-operated ELCB has tripped out.	Cut in the circuit breaker.
	c) No electricity supply.	Contact the electricity supply authorities.
	d) The motor starter overload has tripped out.	Reset the motor starter overload (automatically or possibly manually). If it trips out again, check the voltage. Is the voltage OK, see items e) - h).
	e) Motor starter/contactors is defective.	Replace the motor starter/contactors.
	f) Starter device is defective.	Repair/replace the starter device.
	g) The control circuit has been interrupted or is defective.	Check the electric installation.
	h) The dry-running protection has cut off the the electricity supply to the pump, due to low water level.	Check the water level. If it is OK, check the water level electrodes/level switch.
	i) The pump/submersible drop cable is defective.	Repair/replace the pump/cable.
2. The pump runs but gives no water.	a) The discharge valve is closed.	Open the valve.
	b) No water or too low water level in borehole.	See item 3 a).
	c) The non-return valve is stuck in its shut position.	Pull out the pump and clean or replace the valve.
	d) The inlet strainer is choked up.	Pull out the pump and clean the strainer.
	e) The pump is defective.	Repair/replace the pump.
3. The pump runs at reduced capacity.	a) The drawdown is larger than anticipated.	Increase the installation depth of the pump, throttle the pump or replace it by a smaller model to obtain a smaller capacity.
	b) Wrong direction of rotation.	See section 4.7.1 <i>Checking of direction of rotation</i> .
	c) The valves in the discharge pipe are partly closed/blocked.	Check and clean/replace the valves, if necessary.
	d) The discharge pipe is partly choked by impurities (ochre).	Clean/replace the discharge pipe.
	e) The non-return valve of the pump is partly blocked.	Pull out the pump and check/replace the valve.
	f) The pump and the riser pipe are partly choked by impurities (ochre).	Pull out the pump. Check and clean or replace the pump, if necessary. Clean the pipes.
	g) The pump is defective.	Repair/replace the pump.
	h) Leakage in the pipework.	Check and repair the pipework.
	i) The riser pipe is defective.	Replace the riser pipe.
4. Frequent starts and stops.	a) The differential of the pressure switch between the start and stop pressures is too small.	Increase the differential. However, the stop pressure must not exceed the operating pressure of the pressure tank, and the start pressure should be high enough to ensure sufficient water supply.
	b) The water level electrodes or level switches in the reservoir have not been installed correctly.	Adjust the intervals of the electrodes/level switches to ensure suitable time between the cutting-in and cutting-out of the pump. See installation and operating instructions for the automatic devices used. If the intervals between stop/start cannot be changed via the automatics, the pump capacity may be reduced by throttling the discharge valve.
	c) The non-return valve is leaking or stuck half-open.	Pull out the pump and clean/replace the non-return valve.
	d) The volume of air in the pressure/diaphragm tank is too small.	Adjust the volume of air in the pressure/diaphragm tank in accordance with its installation and operating instructions.
	e) The pressure/diaphragm tank is too small.	Increase the capacity of the pressure/diaphragm tank by replacing or supplementing with another tank.
	f) The diaphragm of the diaphragm tank is defective.	Check the diaphragm tank.

9. Checking of motor and cable

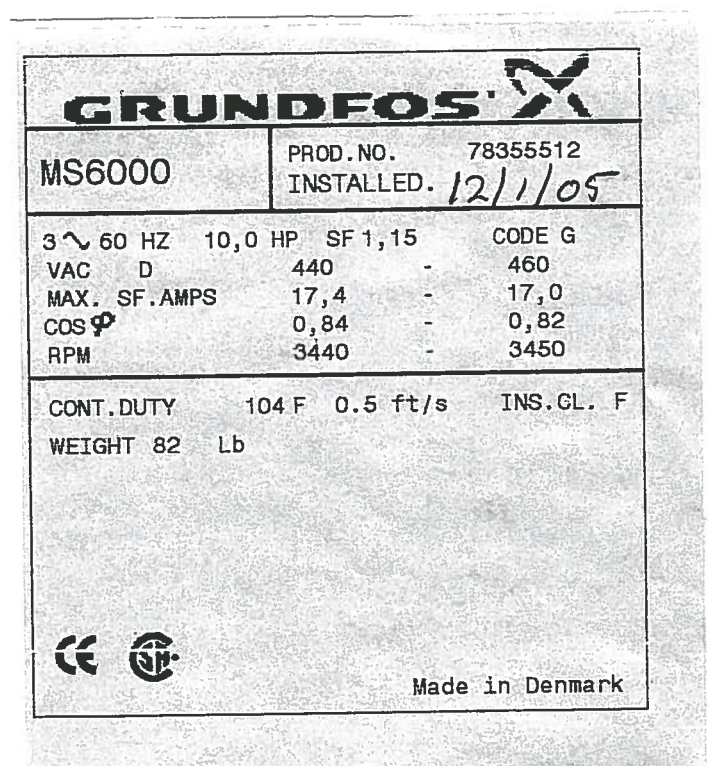
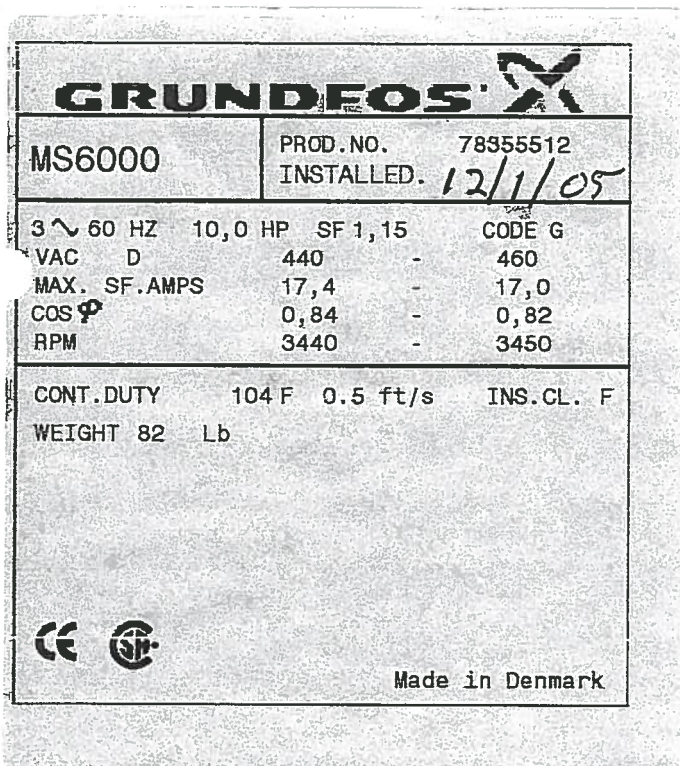
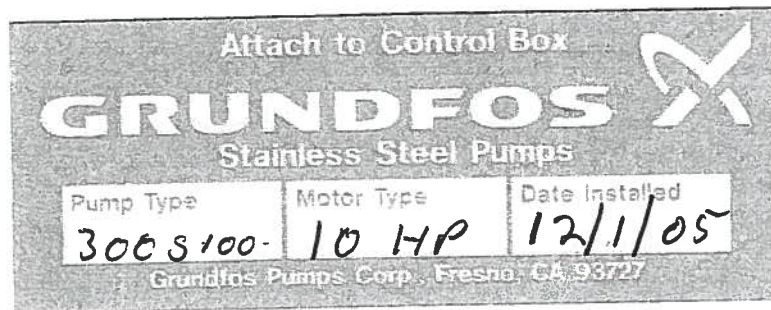
1. Supply voltage 	Measure the voltage between the phases by means of a voltmeter. On single-phase motors, measure between phase and neutral or between two phases, depending on the type of supply. Connect the voltmeter to the terminals in the motor starter.	The voltage should, when the motor is loaded, be within the range specified in section 4.1 <i>General</i>. The motor may burn if there are larger variations in voltage. Large variations in voltage indicate poor electricity supply, and the pump should be stopped until the defect has been remedied.
2. Current consumption 	Measure the amps of each phase while the pump is operating at a constant discharge head (if possible, at the capacity where the motor is most heavily loaded). For maximum operating current, see nameplate.	On three-phase motors, the difference between the current in the phase with the highest consumption and the current in the phase with the lowest consumption should not exceed 5%. If so, or if the current exceeds the full load current, there are the following possible faults: • The contacts of the motor starter burnt. Replace the contacts or the control box for single-phase operation. • Poor connection in leads, possibly in the cable joint. See item 3. • Too high or too low supply voltage. See item 1. • The motor windings are short-circuited or partly disjointed. See item 3. • Damaged pump is causing the motor to be overloaded. Pull out the pump for overhaul. • The resistance value of the motor windings deviates too much (three-phase). Move the phases in phase order to a more uniform load. If this does not help, see item 3.
Items 3 and 4: Measurement is not necessary when the supply voltage and the current consumption are normal.		
3. Winding resistance 	Disconnect the submersible drop cable at the motor starter. Measure the winding resistance between the leads of the drop cable.	For three-phase motors, the deviation between the highest and the lowest value should not exceed 10%. If the deviation is higher, pull out the pump. Measure motor, motor cable and drop cable separately, and repair/replace defective parts. Note: On single-phase, 3-wire motors, the operating winding will assume the lowest resistance value.
4. Insulation resistance 	Disconnect the submersible drop cable at the motor starter. Measure the insulation resistance from each phase to earth (frame). Make sure that the earth connection is made carefully.	If the insulation resistance is less than 0.5 MΩ, the pump should be pulled out for motor or cable repair. Local regulations may specify other values for the insulation resistance.

10. Disposal

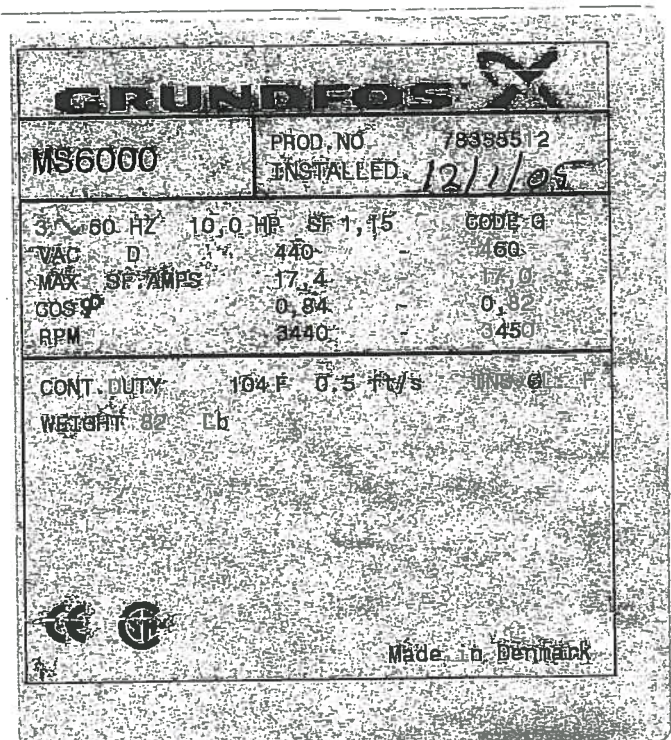
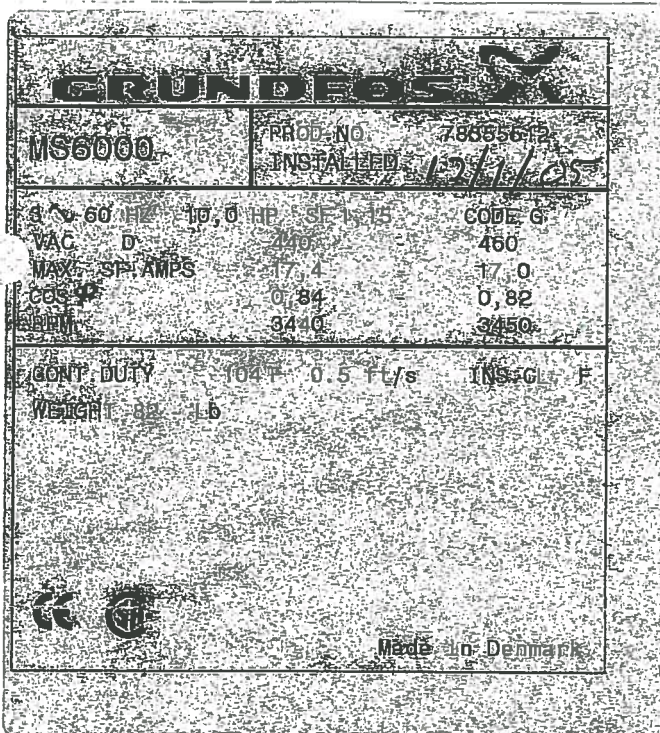
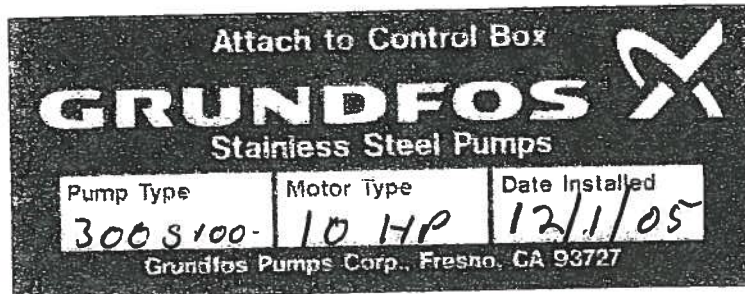
Disposal of this product or parts of it must be carried out according to the following guidelines:

1. Use the local public or private waste collection service.
2. In case such waste collection service does not exist or cannot handle the materials used in the product, please deliver the product or any hazardous materials from it to your nearest GRUNDFOS company or service workshop.

08 00 80 0902	30
Repl. 08 00 80 0502	



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KELLER
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208.288.1992 phone • 208.288.1999 fax • www.kellerassociates.com

October 19, 2010

RECEIVED

OCT 20 2010

WATER RESOURCES
WESTERN REGION

Vicky Music
Sr. Water Resource Agent
Department of Water Resources-Western Region
2735 Airport Way
Boise, ID 83705-5082

RE: City of Emmett - Permit No. 65-22918 [Shadow Butte] and
Permit No. 65-13805 [Well No. 9] Correspondence

Dear Ms. Music:

I am writing on behalf of the City of Emmett regarding two letters the City received from you regarding Water Right Permit No. 65-22918 and Permit No. 65-13805 in which you requested more information from the City of Emmett. The information you have requested will take additional time to locate. Some of the information may have to be retrieved from contractors, engineers, suppliers, and manufacturers. Consequently, we respectfully request an additional sixty (60) days for both permits. Thank you for your consideration in this important matter.

If you should have any questions regarding this matter, please give me a call at (208) 288-1992.

Sincerely,

KELLER ASSOCIATES, INC.

Justin Walker
Project Engineer

Enclosures

cc: City of Emmett (Travis Capson)



State of Idaho

DEPARTMENT OF WATER RESOURCES

Western Region, 2735 Airport Way, Boise, Idaho 83705-5082

Phone: (208) 334-2190 FAX: (208) 334-2348 www.idwr.idaho.gov

C.L. "BUTCH" OTTER
Governor

GARY SPACKMAN
Interim Director

September 24, 2010

Bruce Evans
Superintendent of Public Works
City of Emmett
316 E. Park St
Emmett, ID 83617

Re: Permit No. 65-22918 (Shadow Butte Industrial Park)

Dear Mr. Evans:

This letter is to follow up on the beneficial use field exams IDWR conducted on 8/26/2010, for the permit referenced above. As we mentioned to you that day, IDWR needs additional information to verify the beneficial use. Kindly provide the following for this facility.

Permit 65-22918 for the Shadow Butte Industrial Park

- 1 - pump specifications for each of the submersible pumps, including pump curves
- 2 - as-built drawing of the delivery and distribution system for the entire park
- 3 - results of pump tests conducted for the 2 wells
- 4 - any pressure or flow measurements taken of the wells
- 5 - a revised place of use map

Please submit the information requested for this application. You may seek additional time to provide the information by making a written request to interrupt processing for up to six months. Your response including the requested information, or a request for more time to seek the information, must be received by October 25, 2010. The application will be voided without a timely written reply. Call me at 334-2190 if you have questions. Thank you.

Sincerely,

Vicky Music
Sr. Water Resource Agent