OWNER'S MANUAL

**Submersible Turbine Pumps**

# 6TSP Series
# Radial Flow

**Installation/Operation/Parts**

*For further operating, installation, or maintenance assistance:*

**Call 1-888-237-5353**



BE959 (05/10/12)

## Important Safety Instructions

SAVE THESE INSTRUCTIONS - This manual contains important instructions that should be followed during installation, operation, and maintenance of the product. Save this manual for future reference.

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

⚠DANGER indicates a hazard which, if not avoided, *will* result in death or serious injury.

⚠WARNING indicates a hazard which, if not avoided, *could* result in death or serious injury.

***Table V: Cooling Flow Rates Past Submersible Motors In Feet Per Second (FPS), 6" Nominal Motor (5.38" OD)***

| Casing Size | GPM | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **20** | **40** | **60** | **80** | **100** | **120** | **140** | **160** | **180** | **200** | **220** | **240** |
| 6" ID | 1.2 | 2.3 | 3.5 | 4.6 | 5.8 | 7.0 | 8.1 | 9.3 | 10.4 | 11.6 | 12.7 | 13.9 |
| 8" ID | – | 0.5 | 0.7 | 0.9 | 1.2 | 1.4 | 1.6 | 1.9 | 2.1 | 2.3 | 2.6 | 2.8 |
| 10" ID | – | – | 0.3 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 | 1.1 | 1.3 | 1.4 |

Formula to find flow rate:

$$FPS = \frac{GPM \times .409}{D1^2 - D2^2}$$

D1 = Casing inside diameter

D2 = Motor outside diameter

***NOTICE*** If flow rate past motor is expected to be less than rate shown in Table V, install a shroud around motor to force cooling flow past shell. To minimize erosion to shell if flow rate is expected to be more than 10 FPS (especially if sand is present), reduce flow through pump to reduce flow past shell.

## Limited Warranty

BERKELEY warrants to the original consumer purchaser ("Purchaser" or "You") of the products listed below, that they will be free from defects in material and workmanship for the Warranty Period shown below.

| **Product** | **Warranty Period** |
|---|---|
| **Water Systems:** | |
| Water Systems Products — jet pumps, small centrifugal pumps, submersible pumps and related accessories | *whichever occurs first:* 12 months from date of original installation, or 18 months from date of manufacture |
| Pro-Source™ Composite Tanks | 5 years from date of original installation |
| Pro-Source™ Steel Pressure Tanks | 5 years from date of original installation |
| Pro-Source™ Epoxy-Lined Tanks | 3 years from date of original installation |
| Sump/Sewage/Effluent Products | 12 months from date of original installation, or 18 months from date of manufacture |
| **Agricultural/Commercial:** | |
| Centrifugals – close-coupled motor drive, frame mount, SAE mount, engine drive, VMS, SSCX, SSHM, solids handling, submersible solids handling | 12 months from date of original installation, or 24 months from date of manufacture |
| Submersible Turbines, 6" diameter and larger | 12 months from date of original installation, or 24 months from date of manufacture |

Our limited warranty will not apply to any product that, in our sole judgement, has been subject to negligence, misapplication, improper installation, or improper maintenance. Without limiting the foregoing, operating a three phase motor with single phase power through a phase converter will void the warranty. Note also that three phase motors must be protected by three-leg, ambient compensated, extra-quick trip overload relays of the recommended size or the warranty is void.

Your only remedy, and BERKELEY's only duty, is that BERKELEY repair or replace defective products (at BERKELEY's choice). You must pay all labor and shipping charges associated with this warranty and must request warranty service through the installing dealer as soon as a problem is discovered. No request for service will be accepted if received after the Warranty Period has expired. This warranty is not transferable.

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

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

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

This Limited Warranty is effective June 1, 2011 and replaces all undated warranties and warranties dated before June 1, 2011.

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

**In Canada: 269 Trillium Dr., Kitchener, Ontario N2G 4W5**

7. Wrap each joint tightly with electrical tape - cover wire for about 1-1/2" (4cm) on each side of joint. Make four passes with the tape - when finished you should have four layers of tape tightly wrapped around the wire. Press edges of tape firmly down against the wire (see Figure 4).

   ***NOTICE*** Since the tightly wound tape is the only means of keeping water out of the splice, the efficiency of the splice will depend on the care used in wrapping the tape.

   ***NOTICE*** For wire sizes larger than AWG 8 (8.4mm²), use a soldered joint rather than a butt connector (see Figure 3).

**Heat-shrink splice - For wire sizes AWG 14, 12 and 10 (2, 3, and 5.5mm²):**

1. Remove 3/8" (10mm) insulation from ends of motor leads and drop cable wires.
2. Put plastic heat shrink tubing over motor leads.
3. Match wire colors and lengths in drop cable to wire colors and lengths of motor leads.
4. Insert cable and motor wire ends into butt connectors and crimp (See Figure 2). BE SURE to match wire colors between drop cable and motor leads. Pull leads to check connections.
5. Center tubing over butt connector and apply heat evenly with a torch (a match or lighter will not supply enough heat).

   ***NOTICE*** Keep torch moving. Too much concentrated heat may damage tubing (see Figure 6).

**Butt Connectors with plastic insulators - For wire sizes AWG 14, 12 and 10 (2, 3, and 5.5mm²):**

1. Cut off motor leads. Stagger lead and wire length so that 2nd lead is 4" (100mm) longer than 1st lead and 3rd lead is 4" (100mm) longer than second.
2. Cut off cable ends. Be sure to match colors and lengths of wires in drop cable to colors and lengths of motor leads.
3. Trim insulation back 1/2" (13mm) from cable ends and motor lead ends.
4. Unscrew plastic caps from insulators. Place a cap and a neoprene gasket sleeve on each wire end to be spliced (see Figure 7).


*Figure 7*


*Figure 8*

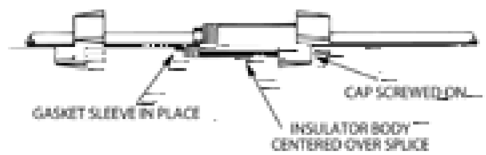


*Figure 9*

5. Slide insulator body onto one wire end (Figure 7).
6. Insert wire end into butt connector and crimp (see Figure 8). Be sure to match cable and motor wire colors.
7. Center insulator body over splice and slide neoprene sleeves into body as far as they will go. Screw caps onto insulator body (Figure 9) and tighten by hand for a strong, waterproof splice.

## Splice and Cable Continuity Test

Before installing pump, check cable and splices as follows (see Figure 10):

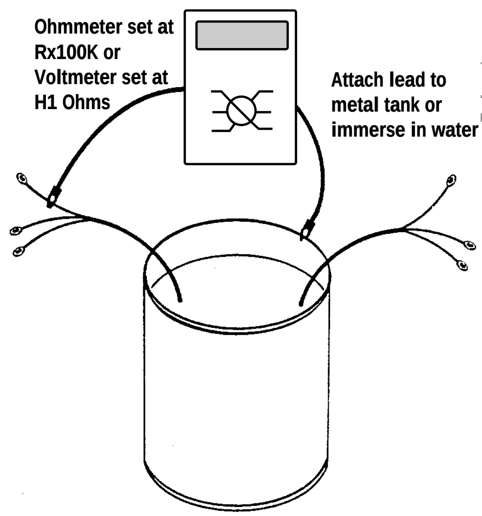


*Figure 10 - Splice and Cable continuity*

1. Submerge cable and splice in steel barrel filled with water. Make sure both ends of cable are out of water.
2. Clip one ohmmeter lead to barrel. Test each lead in cable successively by connecting the other ohmmeter lead to the three cable leads, one after the other.
3. If resistance reading goes to zero on any cable lead, a leak to ground is present. Pull splice out of water. If meter reading changes to "infinity" (no reading) the leak is in the splice.
4. If leak is not in splice, slowly pull cable out of water until reading changes to "infinity". Reading will change to "infinity" when leak comes out of water.
5. Repair cable by splicing as explained under *Electrical Splices and Connections*.

### Rotation Check (3-Phase Only)

After satisfactorily completing continuity test, connect cable to motor controller and then wire controller to disconnect switch. Connect temporary jumper wire between proper terminals in controller to temporarily energize magnetic coil.

Momentarily engage disconnect switch. Observe the rotation of pump as motor starts. If connections are properly made, pump will "jerk" clockwise when looking into the pump discharge when started. If the "jerk" is counter-clockwise, the motor is running in the wrong direction. Interchange any two cable leads where they connect to the "lead" terminals in the magnetic starter. Mark wires to correspond with the controller terminal numbers.

***NOTICE*** Pump is water lubricated. Do not operate the pump for more than 5 seconds while it is out of water.

## Installation

### General

After completing all connections and tests so far, connect a 5-foot length of pipe to pump.

Lower pump into well with pipe clamps attached to the 5-foot pipe. Attach a standard length of pipe to 5-foot length and lower pump CAREFULLY into well.

***NOTICE*** Do not use a pipe longer than 5 feet for the first connection. Hoisting pump upright with a long length of pipe can cause pump misalignment from excessive leverage.

**⚠WARNING** **Risk of electric shock.** Can shock, burn or kill. Use extreme care when lowerflf elect(k.)o

## Electrical Tests

**⚠ WARNING Risk of electric shock.** Can shock, burn or kill. Only qualified electricians should perform these tests. When testing, use all normal precautions for the voltages involved.

### Electrical Test Of Motor, Cable, Connections

The cable and splices can be damaged as the pump is lowered into the well. To electrically test them, attach one lead of ohmmeter to pipe. Attach other lead to each cable lead in turn. See motor owner's manual for required resistance in a good motor. A low reading indicates that cable or splice has developed a leak to ground. Remove pump from well and correct problem before proceeding with installation.

Measure electrical resistance between motor leads and well casing when motor is cold.

### Voltage Test

Low or high voltages can cause motor failure. While pump is operating, check voltage across each pair of leads at motor controller. Readings more than 10% above or below rated nameplate voltage can damage pump; correct before placing pump in service. Test as follows:

1. Disconnect main power supply and open controller.
2. Connect power and start pump (Figure 12). For 3-phase motors, read voltage across three pairs of leads (L1 – L3, L3 – L2, L2 – L1) while pump is operating. For single phase motors, read voltage across L1 and L2 while pump is operating. Voltage should be within ±10% of motor nameplate rated voltage. If not, consult power company.

## Well and Pump Test

Check and record static water level of well before starting tests. Before making final piping connections, test flow rate, capacity, and condition of well.

***NOTICE*** Do not operate pump with discharge valve closed. Operate pump only within pressure and flow limits of operating range established by performance curve.

***NOTICE***: If sand is present in discharge, allow pump to run with discharge completely open until water is clear. If loud rattling noises develop, pump is probably cavitating. Gradually close discharge valve until rattling stops.

### Load Current Test

Load current should be obtained on each motor lead at the controller. Partially close pump discharge valve (keep pressure and flow within specified operating range) until maximum amp reading has been obtained (Figure 13). Compare reading with motor nameplate rating. If reading is 15% or more over rated load, check for incorrect voltage in supply line or overload due to abrasives in pump. Find and correct problem before putting pump in service.

## Electrical Test

The following electrical checks can be made with pump installed.

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3. If resistance reading goes to zero after touching any of the wires, the pump should be raised to determine location of ground fault (cable, motor, or splice).
4. Raise pump, watching resistance reading. When resistance goes to infinity, fault has come out of the water. If ground fault is located in cable or splice, repair it.
5. If ground fault appears to be located in motor, remove pump from well. Cut cable at motor side of splice and determine whether or not motor is grounded. If motor indicates complete ground (resistance reading goes to zero) replace unit.

   If motor is not grounded, re-check splice and cable.

**Current Unbalance Test** (3 Phase only)

Determine current unbalance by measuring current in each power lead. Measure current for all three possible hookups. Use example and worksheet to calculate current unbalance on a three phase supply system and retain for future reference.

***NOTICE*** Current unbalance should not exceed 5%. If unbalance cannot be corrected by rolling leads, locate and correct source of unbalance.

If, on all three possible hookups, the reading furthest from average stays on the same power lead, most of the unbalance is coming from the power source.

However, if the reading furthest from average changes leads as the hookup changes (that is, stays with a particular motor lead), most of the unbalance is on the "motor side" of the starter. In this case, consider a damaged cable, leaking splice, poor connection, or faulty motor winding.

**3-Phase Current Unbalance and Example**

Here is an example of current readings at maximum pump loads on each leg of a three wire hookup. Make calculations for all three possible hookups.

A. For each hookup, add the readings for the three legs:

| Ex.: Hookup #1 | Hookup #2: | Hookup #3 |
|---|---|---|
| L1 = 51Amps | L1 = 50 Amps | L1 = 50 Amps |
| L2 = 46 Amps | L2 = 48 Amps | L2 = 49 Amps |
| L3 = 53 Amps | L3 = 52 Amps | L3 = 51 Amps |
| Total 150 Amps | Total 150 Amps | Total 150 Amps |

B. Divide each total by three to get average amps:

Example: 150/3 = 50
Example: 150/3 = 50
Example: 150/3 = 50

C. For each hookup, find current value farthest from average (Calculate the greatest current difference from the average).

| Ex. #1 | Ex. #2 | Ex. #3 |
|---|---|---|
| 50 Amps | 50 Amps | 50 Amps |
| –46 Amps | –48 Amps | –49 Amps |
| = 4 Amps | = 2 Amps | = 1 Amps |

D. Divide this difference by the average and multiply by 100 to obtain the percentage of unbalance.

Example 1: 4/50 = .08 x 100 = 8%
Example 2: 2/50 = .04 x 100 = 4%
Example 3: 1/50 = .02 x 100 = 2%

Use smallest percentage unbalance, in this case Ex. 3.

**3-Phase Current Unbalance** - Worksheet

Use this worksheet to calculate curent unbalance for your installation.

A. Add the readings for the three legs:

| Ex.: Hookup #1 | | Hookup #2: | | Hookup #3 | |
|---|---|---|---|---|---|
| L1 = | Amps | L1 = | Amps | L1 = | Amps |
| L2 = | Amps | L2 = | Amps | L2 = | Amps |
| L3 = | Amps | L3 = | Amps | L3 = | Amps |
| Total | Amps | Total | Amps | Total | Amps |

B. Divide each total by three to get average amps:

Hookup #1: /3 =
Hookup #2: /3 =
Hookup #3: /3 =

C. For each hookup, find current value farthest from average (Calculate the greatest current difference from the average).

| Hookup #1 | Hookup #2 | Hookup #3 |
|---|---|---|
| Amps | Amps | Amps |
| Amps | Amps | Amps |
| Amps | Amps | Amps |

D. Divide this difference by the average to obtain the percentage of unbalance:

| | | | | |
|---|---|---|---|---|
| Hookup #1: | / | = | x100 = | % |
| Hookup #2: | / | = | x100 = | % |
| Hookup #3: | / | = | x100 = | % |

Use hookup with smallest percentage unbalance.

## General

When installed in a clear well and operated under normal conditions, the submersible turbine pump requires no special maintenance. The hermetically sealed motor is pre-filled and self-lubricating. Completely tested at the factory, it should provide many years of dependable service. The motor is a continuous duty type and can operate continuously for long periods.

## Removing Pump From Well

Most pump problems are caused by above-ground electrical problems. Minor control box components or outside electrical difficulties (such as low voltage) can cause a malfunction. Before removing pump from well, check motor windings for damage (see *Electrical Tests*). Eliminate all above-ground trouble causes before pulling pump. Pull the pump only as a last resort.

## Sandlocked Pump:

*NOTICE* Before pulling pump, make all possible above ground electrical tests. Most submersible pump problems are above ground, not in the pump itself.

*NOTICE* Motor failure can result from starting a sandlocked pump. Do not bypass overload circuit or exceed electrical rating when trying to start a siezed pump.

Remove a sandlocked pump from well for cleaning. To prevent pump from locking again when reinstalled, clean the well thoroughly before reinstalling the pump.

**Cleaning Sandlocked Pump:**

1. Insert a reducing bushing in discharge adapter cap to receive a hose coupling.
2. Use a hose to flush pump backwards (discharge to suction). Oscillate shaft backwards and forwards with a pump pliers and backwash pump for several minutes.

## Checking Pump Performance:

Water containing abrasives can cause impeller wear and reduce impeller efficiency, resulting in overload conditions. In such cases, it is necessary to remove the pump from the well and replace the impellers to maintain capacity and pressure. To assure quality and integrity of the unit, have your pump serviced by authorized Berkeley personnel.

## Preventive Maintenance

To avoid major repairs, make the checks listed below every 4 to 6 months.

| Test | Result Should Be | Possible Indications |
|---|---|---|
| Measure and record the standing water level (from top of well casing). | Reference number. | To aid in monitoring pump performance. |
| Measure electrical resistance between motor leads and well casing with motor cold. | See motor manual. | See motor manual. |
| Check pump flow capacity (gallons per minute). | At least 90% of readings at installation. | Lower readings may indicate pump needs repair. |
| Check pump discharge pressure (PSI) at operating conditions. | At least 90% of readings at installation. | Lower reading indicates pump wear, increased friction losses, or change in standing water level in well. |
| Check drawdown level (in feet) from standing water level. | High enough so that pump does not break suction. | Cavitation can damage pump; increased drawdown may indicate reduced well flow. |
| Measure voltage across motor leads while pump is operating. | Within ±10% of rated voltage. | If voltage is more than 110% or less than 90% of rated voltage, consult power company. |

**⚠ WARNING** **Risk of electric shock.** Can shock, burn or kill. When troubleshooting or servicing pump, use all normal precautions for the voltages involved.

1. Disconnect power unless required for testing.
2. Have electrical testing done by a qualified electrician.
3. Most problems occur above ground. Remove pump from well only as a last resort.