PENTAIR

BERKELEY®

Owner's/Operator's Manual

TMH Series Submersible Turbine

INSTALLATION / OPERATION MAINTENANCE

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BE972 (Rev. 05/25/16)

READ AND FOLLOW SAFETY INSTRUCTIONS!

⚠ This is the safety alert symbol. When you see this symbol on your pump or in this manual, be alert to the potential for personal injury.

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

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

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

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

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

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

California Proposition 65 Warning

⚠WARNING This product and related accessories contain chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

GENERAL CONSIDERATIONS

Before installing your submersible turbine pump, review the following:

Clear well of sand and abrasive material before installing pump. Abrasive materials in the water cause component wear and reduce pump capacity and discharge pressure. Never use the pump to develop or clean the well. Permanent pump damage can result within the first few hours of operation.

Align well casing. If the well casing is suspected of being crooked, check it with a gauge of identical length and diameter as the pump and motor with two lengths of pipe attached. Serious damage can result if the pump becomes lodged in a crooked casing.

Be sure the well can supply a high-capacity turbine pump. The well should be deep enough to cover the pump unit with water, even at extreme pumping rates. Typically, the pump should be submerged 10 to 20 feet below the lowest water level and at least 5 feet above the bottom of the well.

Prime pump. Air entrained in the water reduces performance and will damage the pump.

NOTICE: Do not interchange controls with other models. Serious damage can result to the unit if pump and controls do not match.

Motor control systems and pump units are repairable in the field. To avoid serious damage to the unit, use only parts obtained from authorized dealers/suppliers. System controls and pump must match.

Average number of starts per day will influence motor and control component life (starters, relays, capacitors, etc). Select pump size, tank size and control components for lowest practical number of starts per day. Excessive cycling accelerates bearing, spline, and pump wear and control contact erosion.

Your pump is designed to provide maximum efficiency under specific capacity and head conditions. Do not operate it beyond specified limits.

SPECIFICATIONS

Table 1: Frequency of Starts

	Avg. No. of Starts per 24 Hr. Day	
HP Rating	**Single Phase**	**Three Phase**
1 to 5	50	150
7-1/2 to 30	25	50
40 and over	–	50

Table 2: Weight of Pipe (Column)

	Weight per Foot (Lbs)	
Pipe Size (In)	**Full**	**Empty**
2-1/2	7.9	5.8
3	10.8	7.6
4	16.3	10.8
5	23.3	14.62
6	31.5	18.97

Table 3: Weight of Cable per 1000 Ft. (lbs.)

AWG	3-Phase		1-phase	
Size	**Nom. Dia.**	**Weight**	**Nom. Dia.**	**Weight**
12-3	.500	140	.487	130
10-3	.545	186	.517	161
8-3	.771	328	.750	293
6-3	.965	525	.826	400
4-3	1.071	717		
2-3	1.243	1066		

Table 4: Cable Wire Resistance

AWG Wire Size	**Resist (Ohms/Ft)**
14	.0050
12	.0032
10	.0020
8	.0013
6	.0008
4	.0005
2	.0003

Table 5: Minimum Cooling Water Flow

ID of Casing	4" Motors		6" Motors	
	Flow GPM (LPM)	**FPS**	**Flow GPM (LPM)**	**FPS**
7	20 (76)	0.23	15 (57)	0.33
8	30 (114)	0.25	30 (114)	0.36
10	50 (189)	0.24	60 (227)	0.35
12	80 (303)	0.25	100 (379)	0.36
14	110 (416)	0.25	140 (530)	0.35
16	150 (568)	0.25	180 (681)	0.33

Formula to find flow rate:

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

D1 = Casing inside diameter
D2 = Motor outside diameter

PRE-INSTALLATION PROCEDURES

Electrical Splices and Connections

Splices must be waterproof. Make a strong mechanical bond between the motor leads and the cable to avoid high resistance at the connection. A poor mechanical connection, or a poorly wrapped splice, can cause motor problems and motor failure.

Before connecting the motor to the cable, perform a ground check to assure that the motor has not been damaged. Attach one end of an ohmmeter lead to any of the three motor leads and the other ohmmeter lead to the pump intake bracket. A new motor must have a resistance of 2 megohms or greater. If not, contact your dealer. Repeat for all three leads.

Prepare the cable and make the mechanical connections (Figure 1A) and splices as follows:

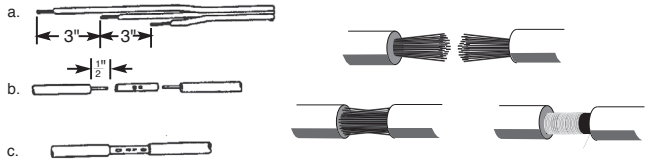


Figure 1A: Cable Splicing: Solid Wire, Stranded Wire

1. Cut motor leads and corresponding cable ends at 3-inch spacings to stagger connections for a smooth splice.
2. Cut connecting cable to match the motor leads. **NOTICE:** Match color coded wires, red to red, black to black, and white to white.
3. When using a butt connector, expose bare wire for about 1/2". When using stranded wire, expose about 1" of wire.

   NOTICE: Butt connectors may be used with solid wires through 8 AWG, or stranded wires through 10 AWG.
4. Clean exposed ends of wire thoroughly with emery cloth or sandpaper to assure good electrical connections.

5A. BUTT CONNECTORS (Figure 1A): Insert wires into connector until insulation butts up against connector. Crimp connector to wires with a pair of crimping pliers. Pull on cable to make sure the connection is solid and tight.

5B. SOLDERED CONNECTIONS (Figure 1A):

NOTICE: Do not use acid core solder or corrosive solder paste.

I. Straighten individual cable strands and spread apart slightly.

II. Clean each strand and push strands of cable into matching (color-coded) open strands of the motor leads.

NOTICE: If flow rate past motor is expected to be less than rate shown in table, 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.

III. Wrap entire length of joint with fine copper wire until strands are compressed.

IV. Apply heat and solder. Solder will follow the heat; make sure solder flows throughout the joint. Pull firmly on cable to test joint.

6. Repeat Step 5 for each lead.

7. Taping splice (Figure 1B):

⚠ CAUTION Because friction tape is not water resistant, never use friction tape on a water-tight splice. Use Scotch® Number 33, or equivalent.

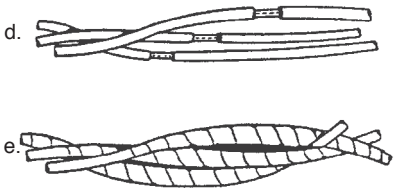


Figure 1B: Stagger splices and tape

7A. Clean joints and adjoining cable/wire insulation of all grease and dirt, and build up joint area with tape until it matches diameter of cable.

7B. Starting 1-1/2" back from the joint, firmly apply one layer of tape, overlapping about half the previous lap and continuing approximately 1-1/2" beyond joint. Cut tape evenly and press both ends firmly against cable.

7C. Apply two additional layers of tape, as described in Step 7B, beginning and ending 1-1/2" beyond the previous starting/ending points.

Splice and Cable Continuity Test

Before installing pump check cable and splices as follows (see Figure 1C):

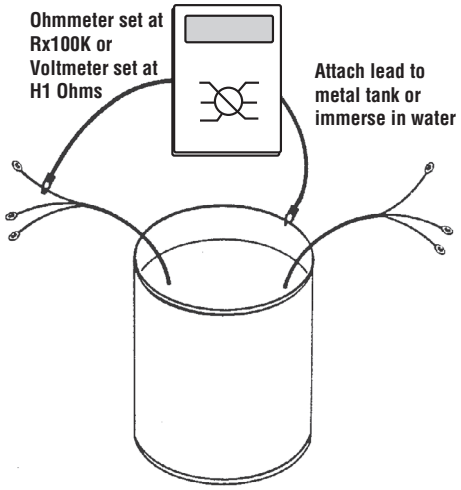


Figure 1C: Splice and Cable continuity

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", Page 2.

Rotation Check (3-Phase Only)

After satisfactorily completing continuity test, connect cable to pump controller. Check 3-phase motors for correct rotation. If necessary, reverse any two cable leads at the controller and recheck rotation. Permanently mark and match to control box terminals for future reference. 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 and note direction of rotation. The shaft should rotate counterclockwise when viewed from the top or shaft end of the motor. If rotation is incorrect, reverse any two wires; 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, 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.

⚠ CAUTION Use extreme care when lowering pump and cable to avoid damage to cable insulation.

Anchor power cable to pipe every 20 feet with adjustable steel band clamps. Protect insulation from clamps with pieces of split rubber hose inserted between clamps and cable. Attach cable to pipe halfway between clamps with waterproof tape.

SUBMERGENCE

Be sure the pump is always submerged, especially at extreme pumping rates. Install pump at least 10 to 20 feet below the lowest "drawdown" water level and at least 5 feet above bottom of well.

Check Valves

NOTICE: Pump back spin and hydraulic shock can cause severe damage to pump and motor. Install at least one check valve to help prevent this.

Install check valve in discharge pipe, not more than 25 feet above pump. For 6" and larger submersible pumps installed more than 600 feet deep, install a second check valve at the pipe joint nearest to the half-way point between pump and ground level.

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NOTICE: To avoid water hammer and pipe breakage, distance from first check valve to second check valve should not equal distance from second check valve to ground level.

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.

Do not operate pump with discharge valve closed. Operate pump only within pressure and flow limits of operating range established by performance curve. Operating pump outside of pressure and flow limits can damage bearings and over heat the motor.

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. Operating with sand in the water or while cavitating can cause serious internal erosion to impellers and bowls.

Installation - Electrical Tests

⚠ WARNING Risk of high voltage electrical shock when testing. Can stun, 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 (Figure 2)

Low or high voltages can cause motor failure. While pump is operating, check voltage across each pair of leads at motor controller.

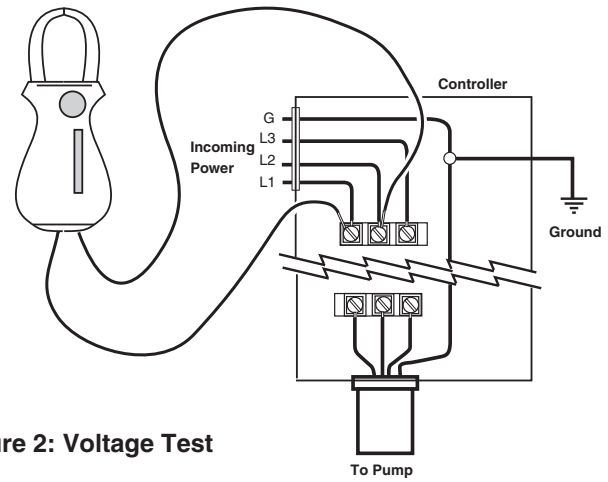


Figure 2: Voltage Test

NOTICE: 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. 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.

Load current test (Figure 3)

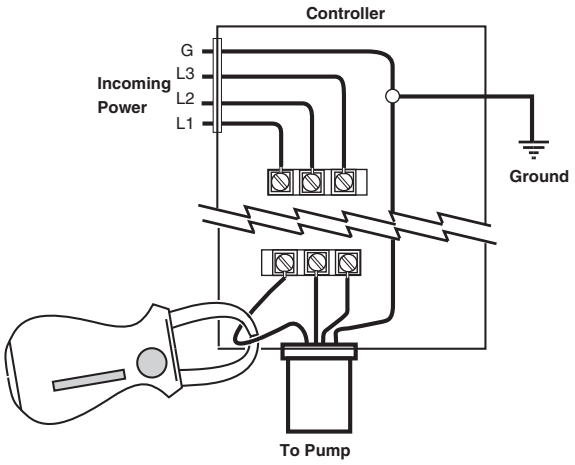


Figure 3: Load Current Test

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. Compare reading with motor nameplate rating. If reading is 15 percent 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.

THREE-PHASE CURRENT UNBALANCE

Determine current unbalance by measuring current in each power lead. Measure current for all three possible hookups. Use example and worksheet (Page 5) 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.

Current Unbalance Example and Worksheet

3-Phase Current Unbalance - 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:

Ex. 1: 4/50 = .08 x 100 = 8%
Ex. 2: 2/50 = .04 x 100 = 4%
Ex. 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 current 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.

SERVICE

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 (check winding resistance with an ohmmeter – see Page 6). 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 sand-locked pump. Do not bypass overload circuit or exceed electrical rating when trying to start a seized 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.
3. If pump cannot be freed, disconnect pump from motor, disassemble liquid end (see Page 6) and backwash sand from each part.

Checking Pump Performance:

Water containing abrasives can cause impeller wear and reduce impeller efficiency, resulting in reduced performance. 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, replace with genuine parts available from your dealer.

ELECTRICAL TESTS

The following electrical checks can be made with pump installed.

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

Circuit (Winding) Resistance Test (Figure 4)

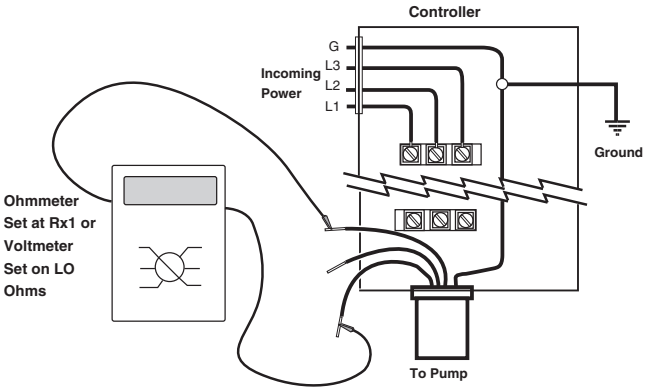


Figure 4: Circuit (Winding) Resistance Test

1. Shut off main power supply and disconnect motor wires.
2. Attach two ohmmeter leads to pairs of cable wires in turn (black and red wires on three wire single phase units). Compare readings with data provided in motor manual.
3. If reading is considerably higher than chart, an open circuit (broken wire) is indicated; if reading is considerably lower, a short circuit is indicated. In either case, remove pump from well and repair unit.

NOTICE: Be sure to include cable and winding resistance. Multiply cable length by the per-foot cable resistance (see Table 4, Page 2) and add winding resistance from motor chart to get total.

Ground Check (Figure 5)

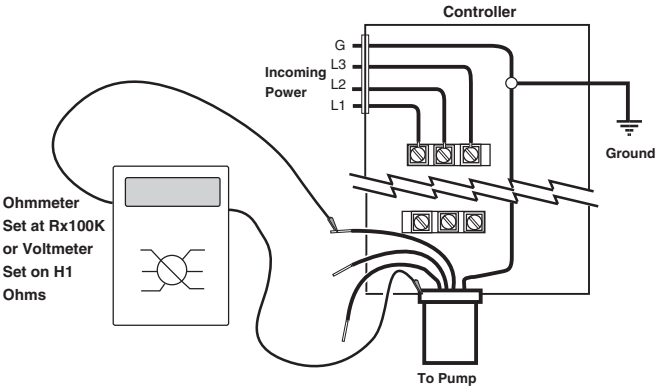


Figure 5: Ground Check

1. Shut off main power supply and disconnect motor wires.
2. Attach one ohmmeter lead to pipe or METAL well casing and the other lead, in turn, to each individual motor wire.
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.

PUMP / MOTOR SEPARATION

NOTICE: Refer to Repair Parts, Page 10.

Removing Pump From Motor

1. Remove the cable guard from the pump; cut the cable off of the motor leads just above the splice.
2. Remove the nuts (4" motors) or bolts (6" motors) holding the pump to the motor. Using suitable lifting apparatus, hoist pump off of motor.
3. If you are returning the motor to the factory, cut motor lead above cable splice, leaving motor lead installed in motor. Don't work on the motor before returning it. To prevent damage in transit, crate the motor as it was when shipped new.

Pump Disassembly

1. Remove the suction screen.
2. Remove coupling from shaft.
3. Fasten pump in chain vise.
4. Remove the discharge.
5. Remove the last stage bowl. Bowls are held together with thread-locking compound. You may need to heat the bowls to loosen the threads.

   NOTE: Threads are left hand.

   ⚠ CAUTION Risk of burns. Use proper safety equipment when handling hot bowls.
6. Bolt the fixture to the pump suction bracket. Add 3/16" spacer between shaft and fixture to lift shaft assembly and aid in impeller removal.
7. Slip the collet driver, large end first, over the shaft and tap on the impeller to loosen the collet. **Do not** use a pipe wrench or any other tool that could damage or scar the impeller or the pump shaft.
8. Remove the impeller and the collet. Mark the impeller and the bowl as they come off so that they can be reassembled as a pair.
9. Repeat steps 5, 7 and 8 for all stages.
10. Clean each part. Dress down any burrs raised during disassembly. Make sure all flanges and mating fits are free of burrs, rust, and dirt.

PREVENTIVE MAINTENANCE

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

TEST	RESULT SHOULD BE	POSSIBLE INDICATIONS
1. Measure and record the standing water level (from top of well casing).	1. Reference number.	1. To aid in monitoring pump performance.
2. Measure electrical resistance between motor leads and well casing with motor cold.	2. See motor manual.	2. See motor manual.
3. Check pump flow capacity (gallons per minute).	3. At least 90% of readings at installation.	3. Lower readings may indicate pump needs repair.
4. Check pump discharge pressure (PSI) at operating conditions.	4. At least 90% of readings at installation.	4. Lower reading indicates pump wear, increased friction losses, or change in standing water level in well.
5. Check drawdown level (in feet) from standing water level.	5. High enough so that pump does not break suction.	5. Cavitation can damage pump; increased drawdown may indicate reduced well flow.
6. Measure voltage across motor leads while pump is operating.	6. Within ±10% of rated voltage.	6. If voltage is more than 110% or less than 90% of rated voltage, consult power company.

PUMP INSPECTION / MAINTENANCE

Wear: While pump is disassembled, visually check the following for wear:

Bearings	Bowl Skirts	Upthrust Screw	Impellers	Pump Shaft

Shaft Runout (TIR): Pump shaft must be straight to within .002" TIR, measured every 6" along the shaft.

Impeller to Intake Adapter Insert/Bowl Clearance (see Table 6, below): Measure bowl ID and impeller eye OD. Subtract the impeller dimension from the bowl dimension; check against maximum/minimum differences given in Table 6, below. Replace the impeller or the bowl (or both) if the dimensions are outside the parameters given in Table 6.

Discharge Bearing to Shaft Clearance (See Table 7, below): Measure the shaft OD at the top of the shaft and the discharge bearing ID. Subtract the shaft OD from the bearing ID; check against maximum/minimum differences given in Table 7, below. Replace the bearing or the shaft (or both) if the dimensions are outside the parameters given in Table 7.

NOTICE: Axial wear may indicate improper upthrust adjustment. See Step 10 or Step 11, Page 9.

Shaft Diameter - TMH Series: 1.00" Diameter

Bearing Replacement:

TMH models come standard with all neoprene bearings in the bowls and a composite discharge bearing. Bronze bearings are available as an option.

Neoprene Bearing Replacement:

A. Use a wooden or plastic tool to push neoprene bearing out of bowl. Push from discharge side of bowl toward suction side.

B. Remove all fragments from bowl bearing bore and clean up the bore .

C. Lubricate the new bearing with talcum powder or water (oil or glycerin do not give sufficient flow to adequately lubricate the bearing) and push it into the bearing bore.

Bronze Bearing Replacement:

1. Press old bearing out with an arbor press or tap it out with a hammer and dowel. Do not score the bearing bore.
2. Wipe the bearing bore clean.
3. Press the new bearing into the bore; use light oil if necessary to aid the pressing. Make sure the bearing is aligned with the bearing bore.

Table 6: Intake Adapter Insert/Bowl to Impeller Clearance - NOTICE: For clearance PER SIDE, divide 'Difference' by 2. If clearances check out OK but impeller still binds on bowl, check impeller concentricity.

Model	A: Intake Adapter Insert/Bowl ID Max/Min	B: Impeller Eye OD Max/Min	A-B = Difference Max/Min
TMH Series	3.500/3.498"	3.491/3.489"	0.011"/0.007"

Table 7: Bearing to Shaft Clearance - NOTICE: For clearance PER SIDE, divide 'Difference' by 2.

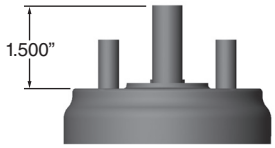
Model	A: Neoprene Bowl Bearing ID Max/Min	A-B: Bronze Bowl/Discharge Bearing ID Max/Min	Composite Discharge Bearing ID Max/Min	B: Shaft OD Max/Min	A-B = Difference Max/Min (Neoprene)	A-B = Difference Max/Min (Bronze)	A-B = Difference Max/Min (Composite)
TMH Series	1.0133" / 1.0113"	1.016" / 1.014"	1.0124 / 1.0122	1.000" / 0.998"	0.0135" / 0.0113"	0.016" / 0.014"	0.0144" / 0.0122"

ASSEMBLY INSTRUCTIONS

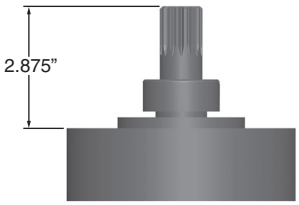
- Top Upthrust. No Intake Adapter Insert.
- Use an assembly fixture for disassembly/assembly; purchase it from Pentair. When ordering, please specify pump model number, motor size, and horsepower.
- All TMH Series threaded-bowl units have left-hand bowl threads.
- The stub shaft stick-up is 2-7/8” for 6” motors; the stick-up is 1.50” for 4” motors.

Motor Interface

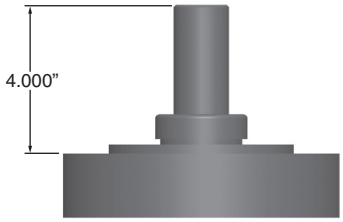
5TMH and 6TMH motor adapters are dual regestered to allow the use of either a 4” or 6” motor. 6TMH has a seperate 8” motor adapter, 7TMH has seperate 6” and 8” motor adapters.



4” Motor Stickup



6” Motor Stickup

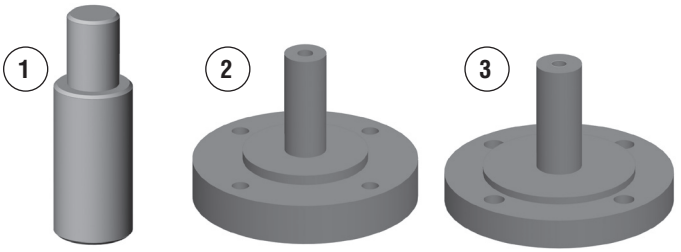


8” Motor Stickup

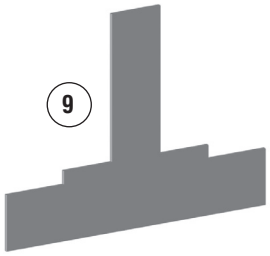
Assembly Fixtures & Tools		
Key No.	**Part Number**	**Description**
1	M16666	TMH Bearing Press Tool
2	M16667	4-6IN Assembly Fixture (0.100” Reduced Height)
3	M16668	8IN Assembly Fixture
4	M16768	Horizontal Build Assembly Sleeve
5	M16769	4-6IN Fixture Horizontal Assembly
6	M16788	Collet Driver
7	M16676/7/8/9	TMH Assembly Wrenches
Inspection Tools		
8	M16822	Shaft Free Rotation Tool
9	M16670	4-6IN Shaft Position Inspection Tool
10	M16671	8IN Shaft Position Inspection Tool

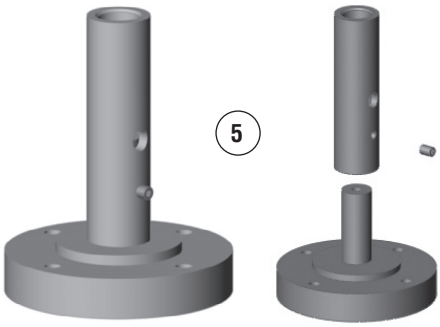


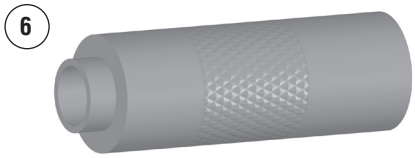
Wrench	M16676	M16677	M16678	M16679
5TMH-75	X			
5TMH-110	X			
5TMH-170	X			
5TMH-250		X		
5TMH-375	X			
5TMH-425		X		
6TMH-140	X			
6TMH-200	X			
6TMH-300			X	
6TMH-450				X
7TMH-230		X		
7TMH-350		X		
7TMH-500				X
7TMH-750				X

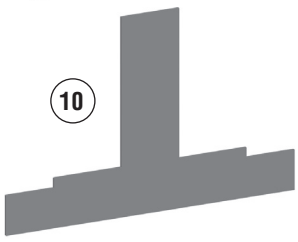














Assembly Procedure

The recommended and preferred method of assembly is vertical with 2.775" stickup. There are (3) key build variations that impact the assembly process. They are:

1. Vertical with 2.875" stickup, secured shaft
2. Vertical with 2.875" stickup, unsecured shaft
3. Horizontal assembly

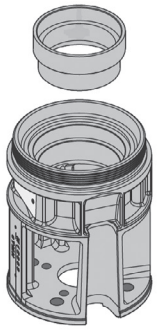
Conditions related to these variances are:

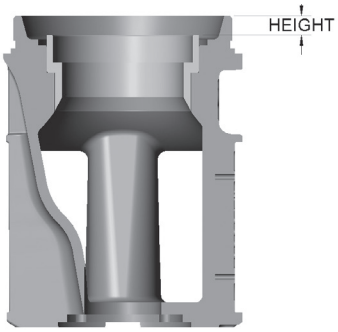
- If using a fixture with stickup height of 2.775", the shaft SHOULD be secured.
- If the shaft is NOT secured, the "spacer washer" method SHOULD be used for assembly of each stage. Building with "Washers" at each stage is advised to minimize the potential for shaft bounce (when striking with collet driver), and also to allow for easier removal of impeller if necessary.

4" or 6" Motor Assembly (Recommended: Vertical w/ 2.775" Stickup)

Using fixture M16667 with 2.775" stickup, building vertically, and secured shaft (preferred method):

1. Using arbor press, press insert ring into suction bracket (if insert required)
   - Apply Loctite® 271 (20 min cure time, 24 hours for full cure)
   - Refer to table below for final press depth
   - Insert ring fit should not be loose fitting (a slip fit is acceptable with Loctite)

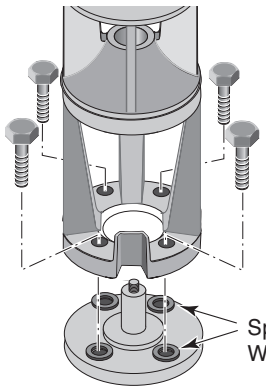




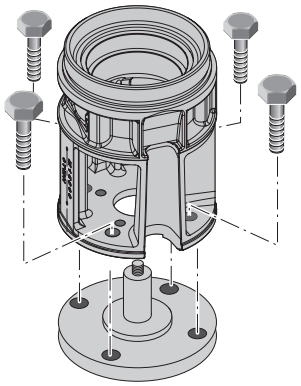
SERIES	6" BRACKET	8" BRACKET	INSERT	HEIGHT
5TMH-75	M16053	—	M16272	0.36"
5TMH-110	M16053	—	M16273	0.57"
5TMH-170	M16053	—	M16273	0.57"
5TMH-250	M16053	—	M16274	0.51"
5TMH-375	M16053	—	Not Required	N/A
5TMH-425	M16053	—	Not Required	N/A
6TMH-140	M15869	M16428	M15876	.63
6TMH-200	M15869	M16428	M15876	.63
6TMH-300	M15869	M16428	M15877	.48
6TMH-450	M15869	M16428	Not Required	N/A
7TMH-230	M16386	M16573	M16596	.48
7TMH-350	M16386	M16673	M16627	.48
7TMH-500	M16386	M16673	M16586	.51
7TMH-750	M16386	M16673	Not Required	N/A

Variation 1: Vertical w/ 2.875" Stickup, secured shaft

1.1 Place (4) 0.125" spacer washers on assembly fixture equally spaced.

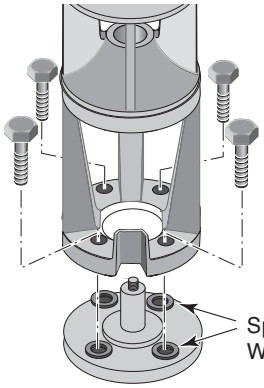


2. Place suction bracket on fixture, and secure bracket to fixture (bolt bracket to fixture)
   - **NO spacer washers should be used with 2.775" stickup fixture.**
   - Tighten at least 2 bolts 180 degrees apart.



Variation 1: Vertical w/ 2.875" Stickup, secured shaft

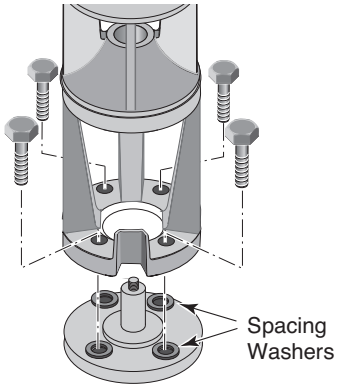
2. Place suction bracket on fixture (w/ spacer washers)
   - Spacer washers should remain between fixture and bracket during entire assembly



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Variation 2: Vertical w/ 2.875” Stickup, unsecured shaft

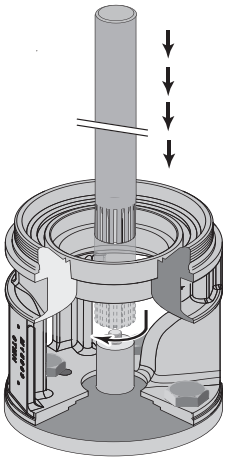
2. Remove spacer washers and resecure bracket to fixture.



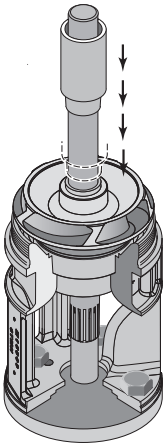
Variation 3: Horizontal

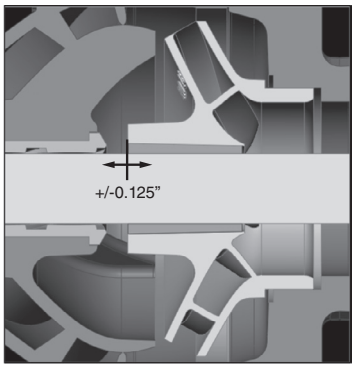
2.1 Add fixture sleeve M16769 to the assembly fixture. The sleeve will assist with holding the shaft when the assembly is horizontal.

3. Clean shaft to remove all contaminants and oils, and check shaft for straightness within 0.002 TIR measured every 6 inches. Straighten as required.
4. Place impeller into insert ring (or bracket if no insert required)
   - Impeller should slip easily into place and spin freely
   - Use largest trims first. Prioritize trim A, then trim B, and then trim C.
5. Place shaft through impeller bore and thread to fixture (hand tight)

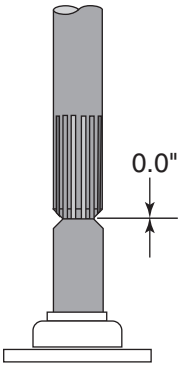


6. Clean collet of oil and contaminents. Place collet over shaft, slide into position in impeller bore. Then, using collet driver M16788, set the collet with two to three hard blows.
   - Collet position should be +/-0.125” from flush with impeller hub



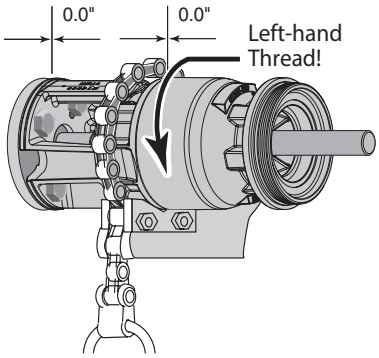


7. Check that there is no gap between the shaft and fixture stickup.



Variation 3: Horizontal

7.1 Clamp the assembly (with fixture attached) in a chain vice.



8. Install rubber bearing S13636, into diffuser bowl (if not pre-assembled).
   - Apply water or talcum powder to bearing, and fold for easier installation.
     ◊ Insert bearing press tool M16666 into rubber bearing to ensure it is properly seated.
   - If using bronze bearing S10708, or composite bearings (Vesconite: M15886), press bearing into diffuser bowl using an arbor press and bearing press tool M16666. Press bearing flush to shoulder.

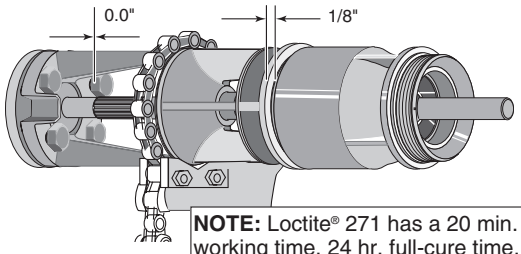
9. Apply Loctite 271 to bracket or bowl threads, and thread bowl to bracket
   - Loctite 271 → 20 min cure time, 24 hours for full cure
   - Tighten using strap, chain or spanner wrench per table:

SERIES	SPANNER WRENCH
5TMH-75	M16676
5TMH-110	M16676
5TMH-170	M16676
5TMH-250	M16677
5TMH-375	M16676
5TMH-425	M16677
6TMH-140	M16676
6TMH-200	M16676
6TMH-300	M16678
6TMH-450	M16679
7TMH-230	M16677
7TMH-350	M16677
7TMH-500	M16679
7TMH-750	M16679

- The bowls should be tightened snug using wrench.
  ◊ Excessive force is not required with a left-hand thread and Loctite.

Variation 2: Vertical w/ 2.875" Stickup, unsecured shaft

9.1 Apply Loctite 271 to bracket or bowl threads, and thread bowl to within 0.125" of the bracket. Place 0.125" washers between bowl and bracket, and tighten to hand tight.Loctite 271 → 20 min cure time, 24 hours for full cure

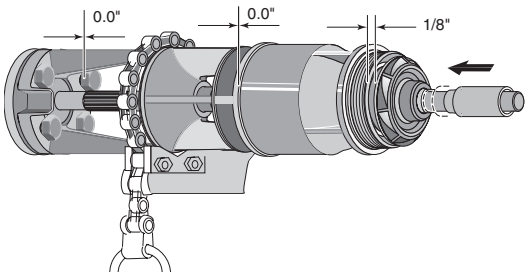


NOTE: Loctite® 271 has a 20 min. working time, 24 hr. full-cure time. For steps 7,8, and 9, work quickly!

10. Clean shaft and collet of contaminates. Then, slide the next impeller over shaft into position.

Variation 2: Vertical w/ 2.875" Stickup, unsecured shaft

10.1 Remove washers from between the bowl and bracket. Thread bowl to flush with bracket.

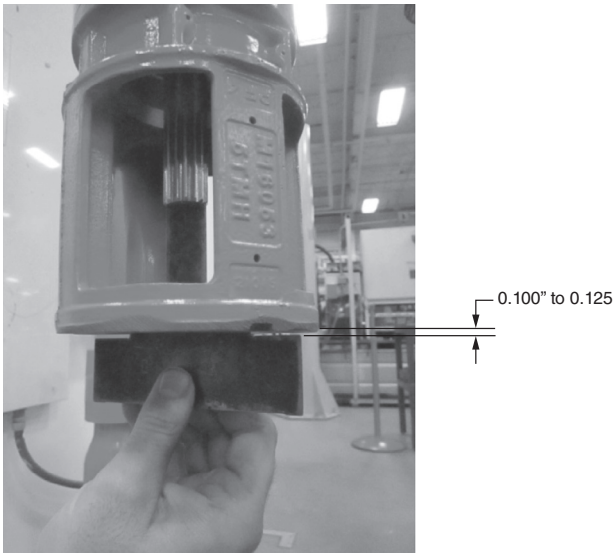


11. Repeat steps 6 – 10 until all stages are installed.
12. Loosely assemble discharge (see table below), up-thrust screw M15882, and nut M15881
    - **NOTICE:** Up-thrust screw should not protrude into bearing bore. Screw depth is set after assembling discharge to pump.

SERIES	PART NUMBER	THREAD "A"	THREAD "B"
5TMH-75	M16054	3" NPT	
	M10657	3" BSPT	
5TMH-110	M16054	3" NPT	
	M10657	3" BSPT	
5TMH-170	M16054	3" NPT	
	M10657	3" BSPT	
5TMH-250	M16055	4" NPT	
	M16058	4" BSPT	
5TMH-375	M16055	4" NPT	
	M16058	4" BSPT	
5TMH-425	M16055	4" NPT	
	M16058	4" BSPT	
6TMH-140	M15868	4" NPT	
	M15885	4" BSPT	
6TMH-200	M15868	4" NPT	
	M15885	4" BSPT	
6TMH-300	M15868	4" NPT	
	M15885	4" BSPT	
6TMH-450	M15868	4" NPT	
	M15885	4" BSPT	
7TMH-230	M16387	5"–8 FNPT	6"–8 NPT
	M11652	5"–11 FNPT	6"–11 NPT
7TMH-350	M16387	5"–8 FNPT	6"–8 NPT
	M11652	5"–11 FNPT	6"–11 NPT
7TMH-500	M16387	5"–8 FNPT	6"–8 NPT
	M11652	5"–11 FNPT	6"–11 NPT
7TMH-750	M16387	5"–8 FNPT	6"–8 NPT
	M11652	5"–11 FNPT	6"–11 NPT

13. Apply Loctite 271 to bowl threads, and thread discharge snug to bowl.
    - Loctite 271 → 20 min cure time, 24 hours for full cure.
    - Tighten using strap chain or spanner wrench per table above (as in step 12).
14. Thread screw down until it bottoms on shaft, then back screw out 3 full turns (1.5 turns for Variation 2).
    - Screw has 13 turns per inch = 0.077" per turn.
15. Tighten nut, torque to 40+/-3 (ft-lbs)
    - **NOTICE:** Maintain screw position while tightening the nut.
    - Apply Loctite 271 to nut.

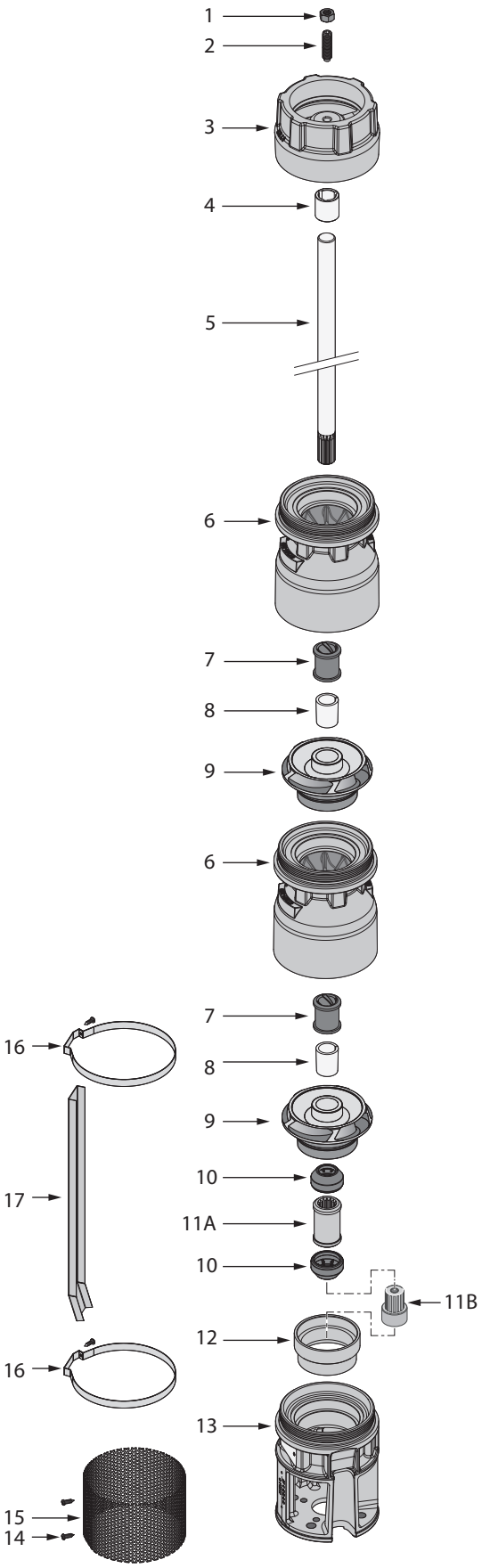
16. Use shaft position tool M16670 to check shaft height.
    - There should be between 0.100” and 0.125” lift when assembled to the motor. With the shaft in the full down position, use inspection tool M16670 to check for proper lift.
    - With the shaft in the full up position, there should be a gap of approximately 0.100” between the shaft position inspection tool and the pump shaft when the tool is flush with the bracket.



17. Use shaft rotation tool M16822 to check that pump rotates freely.
18. Assemble coupling M15872 and coupling guard M15874
    - Apply 3M® Scotch-Weld™ 2141 to permanently bond components or use B87051 coupling assembly.

3M® and Scotch-Weld™ are registered trademarks of 3M Company.

TMH Series



Repair Parts

TMH Series
Submersible Turbine Pumps

Key No.	Part Description
1	Upthrust Lock Nut
2	Upthrust Screw
3	Discharge
4	Discharge Bearing
5	Pump Shaft
6	Bowl
7	Neoprene Bearing
8	Collet
9	Impeller
10	Sand Boot
11A	Splined Coupling (6” Motors)
11B	4” Coupling Adapter (4” Motors)
12	Intake Adapter Insert
13	Motor Suction Bracket
14	Suction Screen Screws
15	Suction Screen
16	Lead Guard Clamp w/ Screws
17	Lead Guard

NOTICE: When using 11B, discard 10.

Please be sure to include pump model number, horsepower, GPM rating and any other pertinent information when ordering pump parts.

NOTICE: Please refer to Berkeley Submersible Repair Parts for detailed parts breakdown and part numbers.

TROUBLESHOOTING

⚠ WARNING Hazardous voltage. 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.

PROBLEM	POSSIBLE CAUSE	REMEDY
Fuses blow or overload circuit breaker trips when motor starts.	Pump sandlocked.	1. Check motor winding resistance - see "Circuit (Winding) Resistance Test", Page 6. 2. If motor is not shorted, turn on current and rap discharge pipe sharply to loosen sand. 3. If using a 3-phase motor, bump start the motor in reverse. Rewire correctly. Restart. 4. Pull pump and clean.
	Low or high voltage.	Check line voltage (see Page 4). If high or low, contact power company.
	Cable damaged or shorted.	Check pump cable for ground (see Page 6).
	Pump forced into crooked well	Forcing pump into a crooked hole will cause mis alignment of pump and motor. Consult well driller.
Fuses blow or overload trips while motor is running.	Low or high voltage.	Check voltage on service lines (see Page 4).
	Water contains excessive sand.	Remove pump and clean sand out of well.
	Motor or cable shorted and/or grounded.	See "Circuit (Winding) Resistance Test" and "Ground Check", Page 6.
Motor does not start but does not blow fuses or trip circuit breaker.	Fuses blown or circuit breaker tripped.	Reset circuit breakers or replace fuses.
	Voltage does not reach terminals.	3-Phase: Check voltage at controller between wire pairs: L1 – L3, L3 – L2, L2 – L1. Single Phase: Check voltage between L1 and L2 on box terminal strip.
	Loose wire in control box.	Check and tighten all wires.
	Defective magnetic controller coil.	Check starter and coil.
Pump does not shut off.	Cable leads improperly connected.	Check wiring diagram on box cover for correct connections.
Motor runs, but delivers little or no water.	Horizontal line check valve installed backwards.	Reinstall correctly.
	Motor running backwards (3-Phase only).	Reconnect motor for proper rotation (see Page 3).
	Pump air locked.	Start and stop pump several times allowing one minute between stops and starts.
	Water level in well has dropped.	1. Restrict pump flow to equal well production. 2. Install liquid level control. 3. Reset pump lower in well.
	Leak in discharge pipe.	Raise pipe until leak is found.
	Coupling between motor shaft and pump shaft broken.	Remove pump from well and check coupling.
	Pump parts worn from abrasives.	1. Check pump shut-off pressure. Pressure should be at least 90% of pressure at installation. 2. Replace worn parts.
	Intake screen clogged.	Remove pump from well and clean screen.
	Pump set below recommended depth.	1. Reduce pressure switch setting until pump will shut off. 2. Install pump producing higher pressure.
	Discharge pipe friction reduces output.	Install larger pipe or pump producing higher pressure.

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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: 490 Pinebush Road, Unit 4, Cambridge, Ontario N1T 0A5