OWNERS MANUAL

INSTALLATION AND OPERATING INSTRUCTIONS
REPAIR PARTS LIST

40 and 70 GPM Models
4" SUBMERSIBLE PUMPS
1-1/2 through 7-1/2 H.P.

NOTICE: Mount model and serial nameplate labels at well head or on control box. Provide complete nameplate information with any service or part inquiries. Record the following nameplate information here for future reference:

Pump Model No. _____

Pump Serial No. _____

Motor Model No. _____

Motor Serial No. _____

H.P. _____ Volts/Hz/Ph _____

Rated Amp Draw _____

U49 (Rev. 2/20/95)

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

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

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

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

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

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

To avoid serious or fatal personal injury and possible property damage, carefully read and follow the safety instructions.

1. **⚠ WARNING Hazardous pressure** **Under certain conditions, submersible pumps can develop extremely high pressure. Install a pressure relief valve capable of passing entire pump flow at 75 PSI (517 kPa).**

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

2. **⚠ WARNING Hazardous voltage** **Can shock, burn or cause death. To avoid dangerous or fatal electric shock hazard, use pump only in a water well.**

   Install, ground and wire pump according to local code requirements.

   Disconnect electrical power supply before installing or servicing pump.

   Make sure line voltage and frequency of power supply match motor nameplate voltage and frequency.

3. Install pump according to all plumbing, pump and well code requirements.
4. Test well water for purity before using well. Call your local health department for testing procedure.
5. During installation, keep well covered as much as possible to prevent leaves and foreign matter from falling into well. Foreign objects in well can contaminate the water and cause serious mechanical damage to the pump.

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PRE-INSTALLATION

Inspect pump and motor for delivery damage. Report any damage immediately to the shipping carrier or to your dealer.

The well driller should thoroughly develop the well (that is, pump out all fine sand and foreign matter) before pump is installed.

Pump performance is based on pumping clear, cold, solid water.

Warranty is void in the following conditions:

- If pump has pumped excessive sand – excessive sand can cause premature wear to pump.
- If water is corrosive.
- If entrained gas or air are present in the water being pumped – these can reduce flow and cause cavitation which can damage pump.
- If pump has been operated with discharge valve closed – severe internal damage will result.

Install pump at least 15 to 20' (4.5 to 6M) below the lowest water level reached with pump running (lowest draw-down water level), and at least 5' (1.5M) above the bottom of the well.

Wiring/Grounding:

⚠ WARNING Hazardous voltage **Can shock, burn, or cause death. Permanently ground pump, motor and control box before connecting power supply to motor.**

Ground pump and motor in accordance with all codes and ordinances that apply. Use a copper ground wire at least as large as wires carrying current to motor.

Motor is supplied with a copper ground wire. Splice this ground wire to a copper conductor that matches motor wire size specified in Table IV, Page 5. See Pages 10 to 12 for cable splicing instructions.

Permanently ground pump, motor and control box before connecting power cable to power supply. Connect ground wire to approved ground first and then connect to equipment being installed.

Do not ground to a gas supply line.

⚠WARNING Fire and electrical shock hazard. If using a drop cable larger than No. 10 (5mm²) (for example, No. 8 (7mm²) wire) between pump and control box, run cable to a separate junction box. Connect junction box to control box with a No. 10 (5mm²) or smaller wire (depending on amp rating of pump – see Table II and III).

For more information, contact your local code officials.

Wiring Connections:

All wiring must meet local code requirements.

Use only copper wire when making connections to pump and control box.

To avoid over-heating wire and excessive voltage drop at motor, be sure that wire size is at least as large as size listed in Table IV for your horsepower pump and length of wire run.

NOTICE: See Pages 8 through 10 for typical wiring hookups and control box identification.

⚠WARNING When built-in overheating protection is not provided, use with an approved overload equipped motor control that matches motor input in full load amps. Select or adjust overload element(s) in accordance with control instructions. When built-in overheating protection is provided, use with an approved motor control that matches input in full load amperes.

ROTATION – (3 PHASE ONLY)

To make sure motor is running in the right direction, proceed carefully as follows:

After electrical connections have been made as outlined, and with pump hanging in well supported from clamp on the discharge pipe, momentarily close the switch connecting the motor to the power supply line. Note direction of jerk as motor starts. If connections are properly made, pump will jerk clockwise when looking into the pump discharge when started. If jerk is counter-clockwise, this means the motor is running in the wrong direction. Interchange any two cable leads where they connect to the "lead" terminals in the magnetic starter. With connections properly made, and pump lowered into water, throw the switch again and the pump should deliver water according to the performance charts.

Overload Protection of Three Phase Submersible Motors

Submersible motors differ from standard motors and require the following for overload protection:

1. Ambient compensation: provides motor winding protection in low air temperatures, avoids nuisance tripping in high air temperatures.
2. Quick-trip overloads: To protect motor windings when motor stalls, overloads must trip within approximately 10 seconds.

The following table lists correct ambient-compensated quick-trip overloads for several manufacturers. Approval of other types may be requested from motor manufacturer.

NOTICE: Warranty on three phase submersible motors is void unless proper quick trip protection in all three motor lines is used.

TABLE I – Overloads for 3 Phase 60 Hertz 4" Franklin Electric Motors

HP	Volts	NEMA Starter Size	Heaters for Overload Relays			Adjustable Relays (Note 3) Set Max.	
			Furnas (Note 1)	Allen Bradley	GE (Note 2)		
1.5	230	00	K41	J22	L750A	5.89	6.4
	460	00	K29	J15	L380A	2.94	3.2
	575	00	K27	J13	L310A	2.39	2.6
2	230	0	K43	J25	L910A	7.36	8.0
	460	00	K33	J18	L463A	3.68	4.0
	575	00	K29	J15	L380A	2.94	3.2
3	230	0	K52	J28	L122B	9.75	10.6
	460	0	K37	J20	L618A	4.88	5.3
	575	0	K33	J18	L463A	3.86	4.2
5	230	1	K61	J32	L199B	16.0	17.4
	460	0	K49	J25	L100B	8.0	8.7
	575	0	K42	J23	L825A	6.44	7.0
7.5	230	1	K67	J36	L293B	23.5	25.5
	460	1	K55	J29	L147B	11.8	12.8
	575	1	K52	J27	L122B	9.38	10.2

FOOTNOTES:

NOTE 1: Heaters listed apply to Innova 45 designs and Definite Purpose Class 16 starters through their available range, and to standard starters in larger sizes. Set overload relay adjustments no higher than 100%, unless necessary to stop nuisance tripping with measured amps **in all lines** below nameplate maximum.

NOTE 2: General Electric heaters are type CR123 usable only on type CR124 overload relays. Adjustment should be set no higher than 100%, unless necessary to stop nuisance tripping with measured amps **in all lines** below nameplate maximum.

NOTE 3: Adjustable overload relay amp settings apply to approved types listed below. Request approval of other types from Franklin Electric. Set relay adjustment at **specified SET amps;** do not increase setting unless motor trips with measured amps in all lines within nameplate maximum amps. Do not increase setting past MAX value shown. Some approved types may not be available for all listed motor ratings. When using relays with current transformers, set relay to specified amps divided by transformer ratio. Approved relays include:

AEG series b175, b27S 11-17A and 15-23A, b27-2 11-17A and 15-23A.
ASEA type RVH40.

Allen Bradley bulletin 193.

Fanal types K7 or K7D through K400.

General Electric CR4G1T-, CR4G1W-, CR4G2W-, CR4G3W-.

Klockner-Moeller types Z00, Z1, Z4, PKZM3.

Lovato RC-22 to RC-80.

RTE Delta types DQ, LR1-D, LR1-F.

Sprecher and Schuh types CT, CT1, CTA1.

Siemens types 3UA50, -52, -54, -58, -59, -62.

Square D Class 9065 types TUP, MR, TD, TE, TF, TR, TJE.

Telemecanique type LR1-D, LR1-F.

Westinghouse types FT13, FT23, FT33, FT43, K7D, K27D, K67D

Other relay types from these and other manufacturers should not be used without approval of Franklin Electric.

Surge Arresters in Control Box

Grounding: When the box has a surge arrester, it MUST be grounded, metal to metal, all the way to the water strata for the arrester to be effective. Grounding the arrester to a driven ground rod provides little or no protection for the motor.

NOTICE: Surge arresters DO NOT protect against direct lightning strikes.

Install grounded surge arresters to protect pump from high-voltage surges. Install arrester on the incoming power line to control box or pressure switch, as close to pump motor as possible. See Figures 1 and 2 for installation wiring diagrams for arresters.

NOTICE: Ground the arrester with a No. 10 or larger bare wire. Ground according to local code requirements.

NOTICE: If surge arresters wired into the control box are against local electrical code, contact power company or hydro authority for correct wiring information.

Liquid Level (Pump Down) Controls:

Use pump down controls on wells with low flow to prevent pumping well dry. See Wiring diagrams, Pages 8 through 10, for proper installation.

NOTICE: Ground controls according to local code requirements.

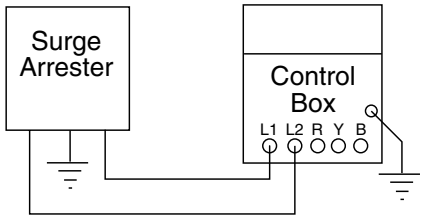


FIGURE 1 – Typical 3 Wire, Single Phase, 230 Volt Surge Arrester

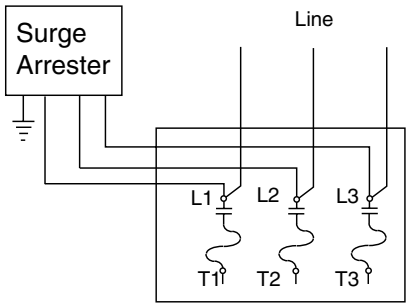


FIGURE 2 - Three Phase Surge Arrester (650 Volt Maximum)

TABLE II: Recommended Fusing Data - 60 Hz, Single Phase, Franklin Submersible Pump Motors

3-Wire Application - Capacitor Run						
HP	Volts/Hz/ Phase	Winding Resistance* R to Y	B to Y	Max Load Amps	Locked Rotor Amps	Fuze Size Standard/ Dual Element
1-1/2	230/60/1	6.2-12.0	1.5-2 3	11.5	52.8	30/15
2	230/60/1	5.2-7.1	1.6-2 3	13.2	51.0	30/15
3	230/60/1	3.0-4.9	0.9-1.5	17.0	71.0	45/20
5	230/60/1	2.1-2.8	0.68-1.0	27.5	118.0	70/30
2-Wire Application - Induction Run**						
1-1/2	230/60/1	1.5-1.9		13.1	56.8	35/15

*Red to Yellow = start winding resistance;
Black to Yellow = main winding resistance.
**NOTE: 2-Wire motor leads are not color coded.
Overload is located in motor and cannot be tested from above ground.

TABLE III: Recommended Fusing Data - 60 Hz., 3 Phase Franklin Submersible Pump Motors

HP	Volts/ Hz./Ph.	Max. Output (S.F. Load) Amps	Watts	Line to Line Resistance	Locked Rotor Amps	Fuse Size Stand.	Dual Elem.
1.5	230/60/3	6.3	2000	3.2-4.1	34	20	8
	460/60/3	3.1	2000	11.3-15.0	17	15	4
	575/60/3	2.5	2000	17.6-23.4	14	15	3
2	230/60/3	8.1	2580	2.4-3.0	46	20	10
	460/60/3	4.1	2580	9.7-12.0	23	15	5
	575/60/3	3.2	2690	15.1-18.7	18	15	4
3	230/60/3	10.9	3420	1.8-2.2	61	30	15
	460/60/3	5.5	3420	7.0-8.7	31	15	7
	575/60/3	4.4	3420	10.9-13.6	24	15	6
5	230/60/3	17 8	5810	0.93-1.2	104	45	20
	460/60/3	8.9	5810	3.6-4.4	52	25	10
	575/60/3	7.1	5810	5.6-6.9	42	20	8
7.5	230/60/3	26.4	8450	.61-.75	164	70	30
	460/60/3	13 2	8450	2.4-3.4	82	35	15
	575/60/3	10 6	8450	3.5-5.1	65	30	12

NOTE:

1. Maximum cable lengths shown maintain motor voltage at 95% of service entrance voltage, running at maximum nameplate amperes. If service entrance voltage will be at least motor nameplate voltage under normal load conditions, 50% additional length is permissible for all sizes.
2. Sizes given are for copper wire. For aluminum wire, go two sizes larger. For example, if table lists #12 ($3mm^2$) copper wire, use #10 ($5mm^2$) aluminum wire.
3. For reliable 3 Phase starter operation, length of wire between starter and service entrance should be not more than 25% of total wire length.

Table IV Cable Length in Feet and Meters – Service to Motor, Copper Conductors

Meets NEC for jacketed 75°C cable (except lengths marked *. Lengths marked * meet NEC for individual conductor 75°C cable).

1 Phase, 2 or 3 Wire, 60 Hz., 230 Volts

	Wire Size – AWG										
H.P.	**14**	**12**	**10**	**8**	**6**	**4**	**3**	**2**	**1**	**0**	
1.5	190	310	480	770	1200	1870	2320	2850	3500	4280	} Cable Length in Feet
2	150	250	390	620	970	1530	1910	2360	2930	3620	
3	120*	190	300	470	750	1190	1490	1850	2320	2890	
5	0	0	180	280	450	710	890	1110	1390	1740	
	Wire Size - Millimeters Squared										
H.P.	**1.5**	**2.5**	**4**	**6**	**10**	**16**	**25**	**35**	**50**	**70**	
1.5	57	93	144	231	360	561	696	855	1050	1284	} Cable Length in Meters
2	45	75	117	186	291	459	573	708	879	1086	
3	36	57	90	141	225	357	447	555	696	867	
5	0	0	54	84	135	213	267	333	417	522	

3 Phase, 3 Wire Cable, 60 Hz., 230 Volts

	Wire Size – AWG										
H.P.	**14**	**12**	**10**	**8**	**6**	**4**	**3**	**2**	**1**	**0**	
1.5	420	670	1060	1670	2610	4050	5030	6160	7530	9170	} Cable Length in Feet
2	320	510	810	1280	2010	3130	3890	4770	5860	7170	
3	240	390	620	990	1540	2400	2980	3660	4480	5470	
5	140*	230	370	590	920	1430	1790	2190	2690	3290	
7.5	0	160*	260	420	650	1020	1270	1560	1920	2340	
	Wire Size - Millimeters Square										
H.P.	**1.5**	**2.5**	**4**	**6**	**10**	**16**	**25**	**35**	**50**	**70**	
1.5	126	201	318	501	783	1215	1509	1848	2259	2751	} Cable Length in Meters
2	96	153	243	384	603	939	1167	1431	1758	2151	
3	72	117	186	297	462	720	894	1098	1344	1641	
5	42	69	111	177	276	429	537	657	807	987	
7.5	0	48	78	126	195	306	381	468	576	702	

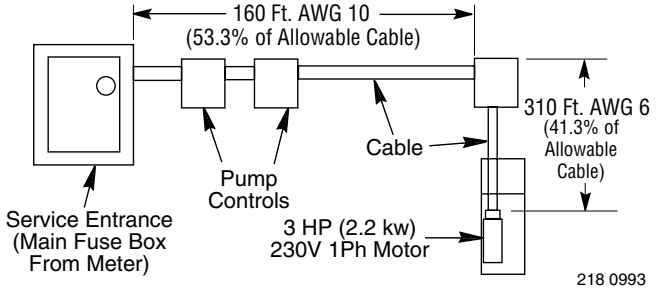
3 Phase, 3 Wire Cable, 60 Hz., 460 Volt

	Wire Size – AWG						
H.P.	**14**	**12**	**10**	**8**	**6**	**4**	
1.5	1700	2710	4270	6580			} Cable Length in Feet
2	1300	2070	3270	5150	8050		
3	1000	1600	2520	3970	6200		
5	590	950	1500	2360	3700	5750	
7.5	420	650	1070	1690	2640	4100	
	Wire Size - Millimeters Squared						
H.P.	**.5**	**2.5**	**4**	**6**	**10**	**16**	
1.5	510	813	1281	1974			} Cable Length in Meters
2	390	621	981	1545	2415		
3	300	480	756	1191	1860		
5	177	285	450	708	1110	1725	
7.5	126	195	321	507	792	1230	

3 Phase, 3 Wire Cable, 60 Hz., 575 Volt

	Wire Size – AWG						
H.P.	**14**	**12**	**10**	**8**	**6**		
1.5	2620	4180	6730			}	Cable Length in Feet
2	2030	3250	5110	8060			
3	1580	2530	3980	6270			
5	920	1480	2330	3680	5750		
7.5	660	1060	1680	2650	4150		
	Wire Size - Millimeters Squared						
H.P.	**1.5**	**2.5**	**4**	**6**	**10**		
1.5	786	1254	2019			}	Cable Length in Meters
2	609	975	1533	2418			
3	474	759	1194	1881			
5	276	444	699	1104	1725		
7.5	198	318	504	795	1245		

How to size Wire Cable correctly when using more than one gauge of wire



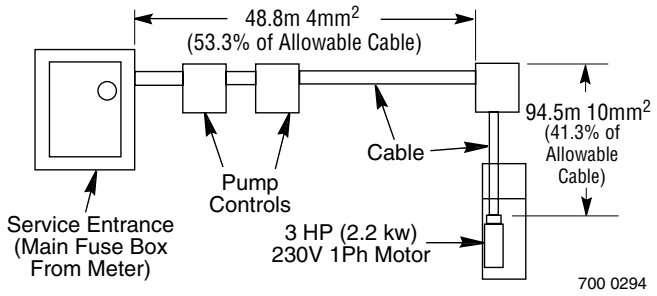


FIGURE 3

English Measurement

Calculating cable size when two different sizes can be used.

Sometimes conditions make it desirable to use more than one cable size in an installation.

For example: Replace a pump with a 3 HP, 230 volt, single phase motor, with the motor setting at 310' down the well and with 160' of #10 cable buried between the service entrance and the well head. In order to avoid replacing the buried cable, the question is: What size cable is required in the well? Calculate as follows:

1. According to Table IV, a total of 300' of #10 cable is allowed to power the 3 HP motor. The per cent of this total that has been used by the 160' of cable in the buried run is: 160'/300' = .533 = 53.3%.
2. With 53.3% of the allowable cable already used, 46.7% of the total length is left for use in the well. To avoid running a cable that is too long and lowering the voltage to the motor, we have to find a cable size large enough so that 310' is *less* than 46.7% of the total length allowed for that size.
3. Trying #8 cable, Table IV shows that the total allowable length for a 3 HP motor is 470'.
   470' x 46.7% = 470' x .467 = 219.5'.
   This is not long enough.
4. Trying #6 cable, Table IV shows that the total allowable length is 750'.
   750' x 46.7% = 750' x .467 = 350.25'.
   This is longer than needed. Therefore, #6 cable can be used for the 310' of cable in the well.
   Any combination of sizes can be used, provided that the total percentage of the length of the two sizes of cable does not exceed 100% of the total allowed lengths.

Metric Measurement

Calculating cable size when two different sizes can be used.

Sometimes conditions make it desirable to use more than one cable size in an installation.

For example: Replace a pump with a 3 HP, 230 volt, single phase motor, with the motor setting at 94.5M down the well and with 48.8M of 4mm^2 cable buried between the service entrance and the well head. In order to avoid replacing the buried cable, the question is: What size cable is required in the well? Calculate as follows:

1. According to Table IV, a total of 91.4M of 4mm^2 cable is allowed to power the 3 HP motor. The per cent of this total that has been used by the 48.8M of cable in the buried run is: 48.8M/91.4M = .534 = 53.4%.
2. With 53.4% of the allowable cable already used, 46.6% of the total length is left for use in the well. To avoid running a cable that is too long and lowering the voltage to the motor, we have to find a cable size large enough so that 94.5M is *less* than 46.6% of the total length allowed for that size.
3. Trying 6mm^2 cable, Table IV shows that the total allowable length for a 3 HP motor is 143M.
   143M x 46.6% = 143M x .466 = 66.6M.
   This is not long enough.
4. Trying 10mm^2 cable, Table IV shows that the total allowable length is 225M.
   225M x 46.6% = 225M x .466 = 105M.
   This is longer than needed. Therefore, 10mm^2 cable can be used for the 94.5M of cable in the well.
   Any combination of sizes can be used, provided that the total percentage of the length of the two sizes of cable does not exceed 100% of the total allowed lengths.

Installation Wiring Diagrams

Single Phase, 3 Wire

⚠WARNING Hazardous voltage. Can shock, burn, or kill.

Ground control box, all metal plumbing, and motor frame with copper wire in compliance with local codes. Use a ground wire at least as large as the wires supplying power to motor.

Permanently close all unused openings in this and other equipment.

Disconnect power to control box before working on or around control box, pipes, cable, pump, or motor.

To be sure that starting relay will function and that overload will not "nuisance trip", install control box vertically with top side up.

Wire control box as shown on pages 8 through 10. Pump will not operate without control box, and deluxe boxes require a switch or a jumper lead between 'SW' and 'L2' terminals. Operation without control box will burn out motor.

Installation must include circuit and component protection which meet local code requirements.

If main overload trips, look for:

1. Shorted Capacitor
2. Voltage Problems
3. Overloaded or locked pump.

If start overload or both overloads trip(s), replace start relay. Reset and analyze for tripping cause. To avoid motor burnout, do not remove or short circuit overload protection.

Single Phase, 2 Wire

2-Wire pumps have two power supply wires (Red/Black) and one ground wire (Green). Control box **is not** required.

See Figure 4 for correct hook-up information for 230 Volt **2-Wire motors** only.

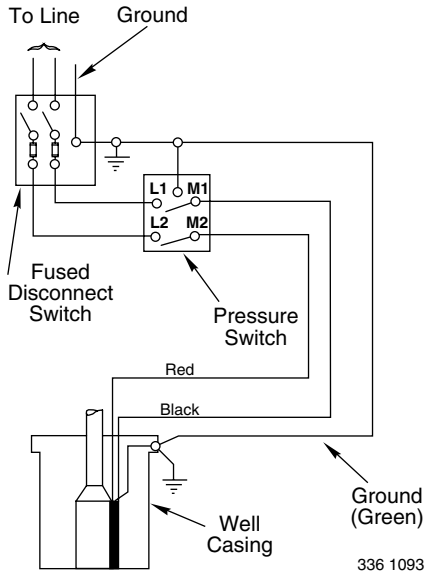


Figure 4 - Single Phase, 2 Wire Connections

NOTICE: Match motor to control box as shown below. Franklin motor and control box model numbers may include additional suffix numbers to the right of the numbers shown here. These additional numbers are not important for control box selection.

TABLE V: Control Box Selection

HP	Voltage	Motor No.	Control Box No.
1/2	115	214304 214504	28010449
1/2	230	214305 214505	28010549
3/4	230	214307 214507	28010749
1	230	214308 214508	28010849
1-1/2	230	224300	28230081
2	230	224301	28230181 28230183
3	230	224302	28230281 28230283
5	230	224303	28211381 28211383

Pressure Switch Wiring Information

NOTICE: Starting current (inrush current) from large motors may damage pressure switch. Pressure switches installed with motors of 1-1/2 HP (1.1 KW) or larger should be wired through a magnetic contactor to avoid burning out pressure switch. Consult factory for further information.

NOTICE:

See **Control box checking procedures**, Page 15.

Important Electrical Grounding Information

⚠WARNING Hazardous voltage. Can shock, burn, or kill. To reduced the risk of electrical shock during pump operation, ground and bond the pump and motor as follows:

A. To reduce risk of electrical shock from metal parts of the assembly other than the pump, bond together all metal parts accessible at the well head (including metal discharge pipe, metal well casing, and the like). Use a metal bonding conductor at least as large as the power cable conductors running down the well to the pump's motor.

B. Clamp or weld (or both if necessary) this bonding conductor to the grounding means provided with the pump, which will be the equipment-grounding terminal, the grounding conductor on the pump housing, or an equipment-grounding lead. The equipment-grounding lead, when provided, will be the conductor having green insulation; it may also have one or more yellow stripes.

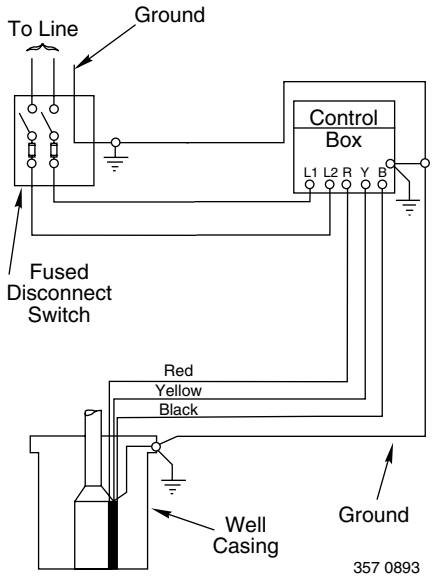
C. Ground the pump, motor, and any metallic conduit that carries power cable conductors. Ground these back to the service by connecting a copper conductor from the pump, motor, and conduit to the grounding screw provided within the supply-connection box wiring compartment. This conductor must be at least as large as the circuit conductors supplying the pump.

Save these instructions.

Installation Wiring Diagrams - Single Phase

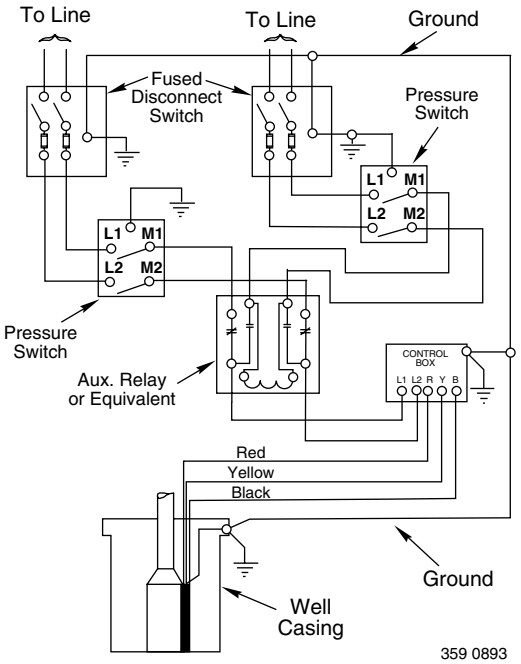
Follow color coding when connecting control box (Yellow to Y, Red to R, Black to B).
For 1-1/2 HP (1.1 KW) and larger, install magnetic contactor when system includes a pressure switch.

Open System - Single Phase - 1/2 HP thru 5 HP Standard Control Box

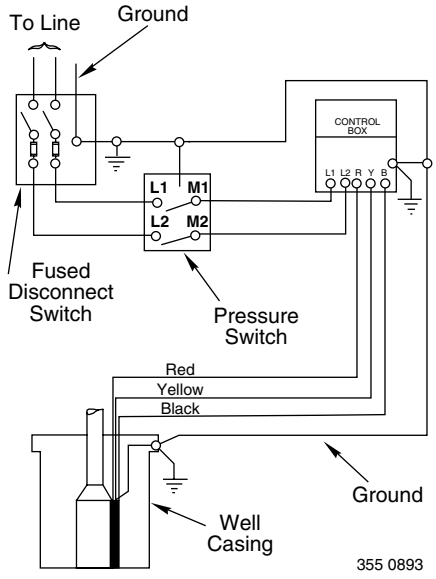


Single Phase - 1/2 HP thru 5 HP Standard Control Box with Pressure Switch

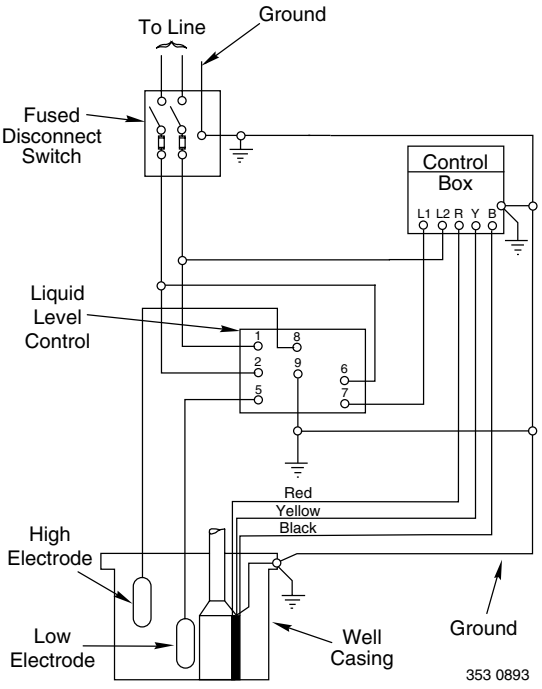
(One Pump for Two Houses) with Adequate Rated Pressure Switch



Single Phase - 1/2 thru 5 HP Standard Control Box with Adequate Rated Pressure Switch



Single Phase - 1/2 thru 5 HP Standard Control Box with Liquid Level Control



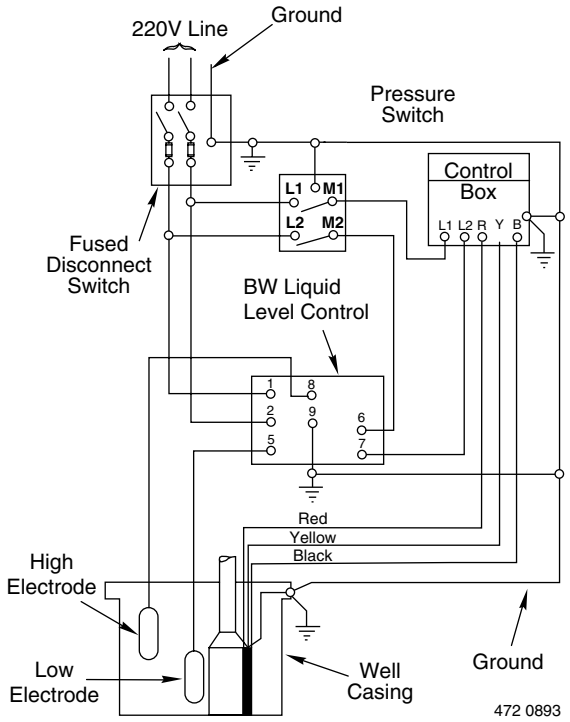
NOTICE:

See **Control box checking procedures**, Page 15.
See **Pressure Switch Wiring Information**, Page 7.

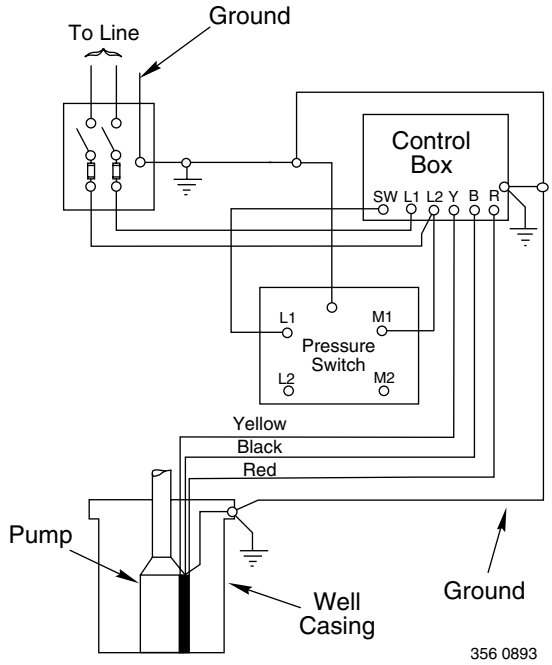
Installation Wiring Diagrams - Single Phase

Follow color coding when connecting control box (Yellow to Y, Red to R, Black to B).
For 1-1/2 HP (1.1 KW) and larger, install magnetic contactor when system includes a pressure switch.

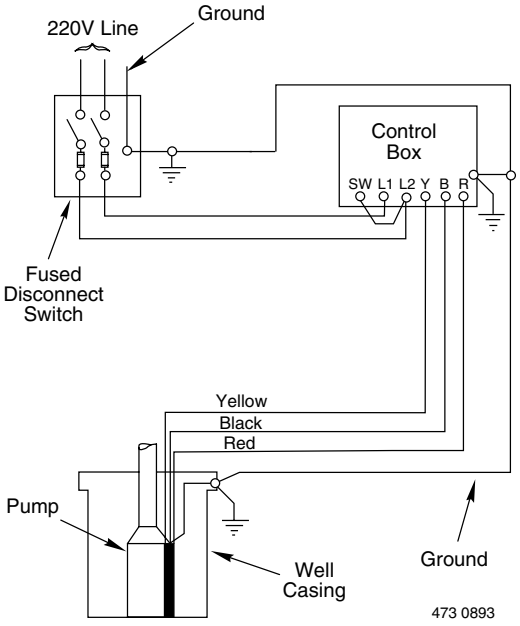
Single Phase - 1/2 thru 5 HP Standard Control Box with Pressure Switch & Liquid Level Control



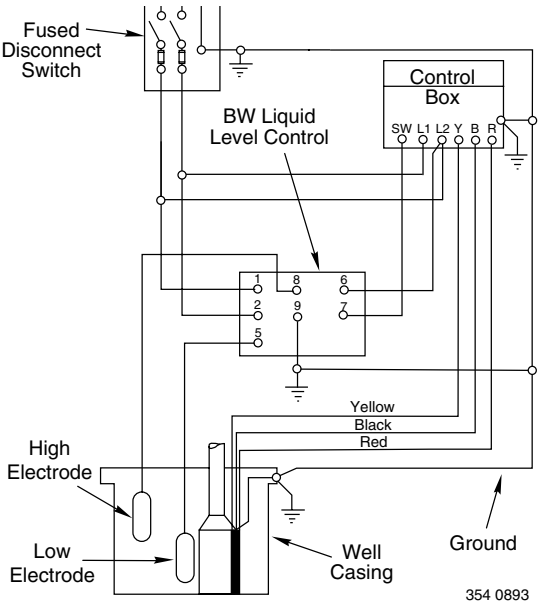
Single Phase - 2, 3 & 5 HP Deluxe Control Boxes with Pressure Switch



Single Phase - 2, 3 & 5 HP Deluxe Control Boxes Open System



Single Phase - 2, 3 & 5 HP Deluxe Control Boxes with Liquid Level Control



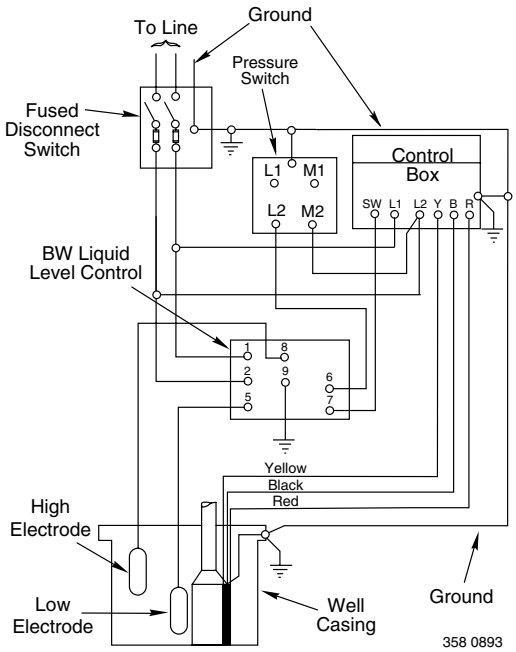
NOTICE:

See **Control box checking procedures**, Page 15.
See **Pressure Switch Wiring Information**, Page 7.

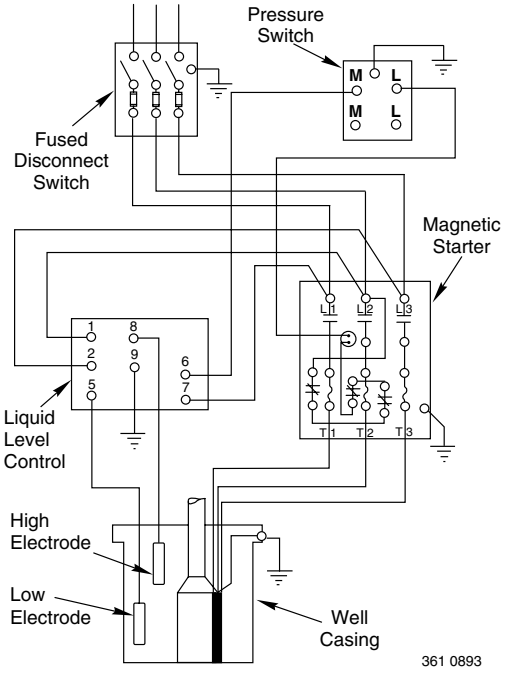
Installation Wiring Diagrams - Single and Three Phase

Follow color coding when connecting control box (Yellow to Y, Red to R, Black to B).
For 1-1/2 HP (1.1 KW) and larger, install magnetic contactor when system includes a pressure switch.

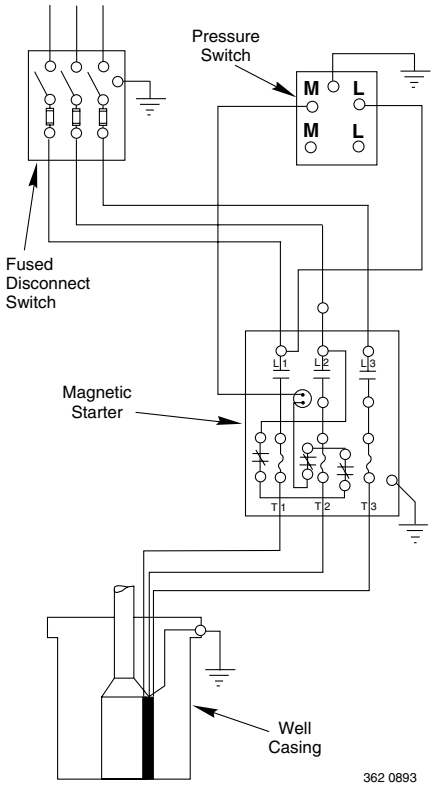
Single Phase - 2, 3 & 5 HP Deluxe Control Boxes with Pressure Switch and Liquid Level Control



Three Phase - 1½ HP & Larger with Pressure Switch & Liquid Level Control



Three Phase - 1½ HP & Larger with Pressure Switch



Cable Splicing:

1. Splice cable to motor leads. Use one of the three methods outlined below. Use only copper wire for connections to pump motor and control box.
   A. Taped splice (Wire sizes No. 8 (7mm²) and larger):
   1. Cut off motor leads. Stagger lead and wire length so that 2nd lead is 2" (50mm) longer than 1st lead and 3rd lead is 2" (50mm) 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. Insert motor lead ends and cable ends into butt connectors (see Figure 5). Be sure to match wire colors between drop cable and motor leads.
   5. Using crimping pliers (Figure 8), indent butt connector lugs (see Figure 6) to attach wires.
   6. Cut "Scotchfil" electrical insulation putty into 3 equal parts and form tightly around butt connectors. Be sure scotchfil overlaps insulated part of wire.
   7. Using #33 Scotch tape, wrap each joint tightly; cover wire for about 1-1/2" (38mm) on each side of joint. Make four passes with the tape. In other words, when finished you should have four layers

NOTICE:

See **Control box checking procedures**, Page 15.
See **Pressure Switch Wiring Information**, Page 7.

of tape tightly wrapped around the wire. Press edges of tape firmly down against the wire (see Figure 9).

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 #8, (7mm²) use a soldered joint rather than Scotchfil putty (see Figure 7).

B. Heat-shrink splice (For wire sizes #14, 12 and 10 AWG, or 2, 3, and 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 Figures 5 and 6). **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).

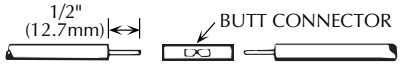


FIGURE 5

FIGURE 6

FIGURE 7

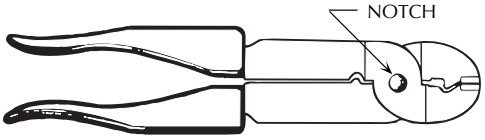


FIGURE 8

FIGURE 9

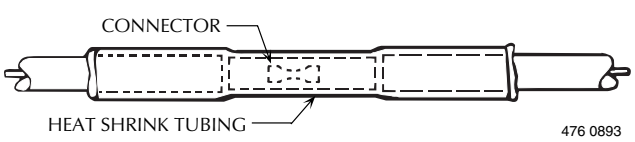


FIGURE 10

NOTICE: Keep torch moving. Too much concentrated heat may damage tubing (see Figure 10).

C. Butt Connectors with plastic insulators (for 14, 12 and 10 Gauge AWG Wire, or 2, 3 and 5mm² wire):

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 11).
5. Slide insulator body onto one wire end (Fig. 11).
6. Insert wire end into butt connector and crimp (see Figure 12). **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 13) and tighten by hand for a strong, waterproof splice.

2. To test submersible, momentarily connect it to proper power supply. Power supply frequency and voltage must match motor nameplate frequency and voltage to within ±10%. (3 Phase pumps – see "Rotation," Page 3).
3. Fasten cable leads securely to pump discharge section; leave 4-5" (100-127mm) of slack in leads at this point. Securely fasten leads to plastic pipe within 6" (150mm) of the pump discharge section. Use torque arresters to protect pump and pipe from twisting damage as pump starts and stops.
4. Connect copper ground wire to motor bracket. Ground wire must be at least as large as wires supplying current to motor. Consult local codes for grounding information.
5. Use only submersible cable supplied by pump manufacturer. When lowering pump into well, secure cable to

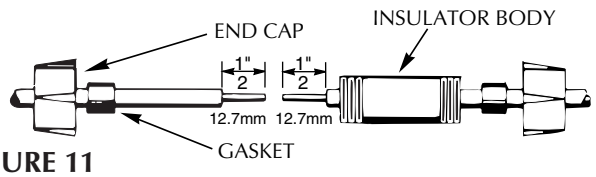


FIGURE 11

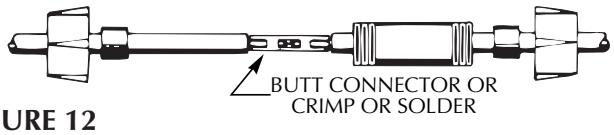


FIGURE 12

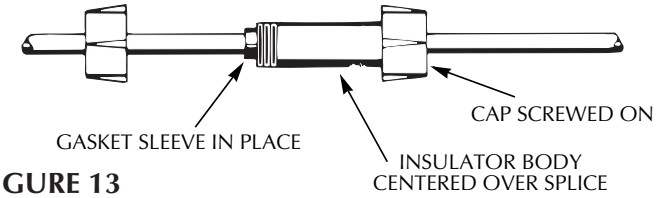


FIGURE 13

discharge pipe at 10' (30.5M) intervals with Scotch #33 electrical tape. Take care not to damage pump cable.
NOTICE: To avoid dropping the pump down the well or damaging cable or cable splices, **NEVER** allow pump cable to support weight of pump.

6. If a standard galvanized pressure tank is being used, install two bleeder orifices about 2' (.6M) apart as shown in Figure 16, Page 13. These orifices will automatically charge tank with air. See Table III to determine orifice location.
NOTICE: If Pre-charged (bladder) tank is used, DO NOT install bleeder orifices. If pump and pre-charged tank are replacing a standard tank system, remove bleeder orifices before installing pump in well.

INITIAL START-UP

NOTICE: NEVER operate pump with discharge valve completely closed. Pump can destroy itself if run with discharge shut off ("deadheaded") and warranty will be void.

NOTICE: To avoid sand-locking pump, follow procedure below when starting pump for the first time. NEVER start a pump with discharge completely open unless you have done this procedure first.

1. Connect a pipe elbow, a short length of pipe and a gate valve to pump discharge at well head (see Figure 14).
2. Mount motor control box (3-wire pump), or magnetic starter (3-phase pump) in a permanently weather proofed place. Make sure that controls will not be subjected to extreme heat or excess moisture.
3. Make sure controls are in OFF position.
4. Connect motor leads and power supply to motor control box or magnetic starter (see Wiring Diagrams, Pages 8 through 10). DO NOT START PUMP YET.
5. Set gate valve on discharge 1/3 open; start pump (see Figure 14).
6. Keep gate valve at this setting while water pumps out on ground. Let it run until water is clear of sand or silt. (To check solids in water, fill a glass from pump and let solids settle out).
7. When water is completely clear at 1/3 setting, open gate valve to approximately two-thirds open and repeat process.
8. When water is completely clear at 2/3 setting, open gate valve completely and run pump until water is completely clear.
9. Remove gate valve for permanent installation near tank (see Figures 15 and 16, Page 13).
10. Install sanitary well seal or pitless adapter unit, well unit, electrical conduit and surface piping according to local code requirements.

CONNECTING TO TANK/WATER SYSTEM

⚠WARNING Hazardous pressure. Submersible pumps can develop very high pressure in some situations. To prevent tank blowup, install a pressure relief valve able to pass full pump flow at 100 PSI (690kPa). Install this relief valve between pump and tank.

NOTICE: Allowing pump or piping system to freeze may severely damage pump and will void warranty. Protect pump and entire piping system (including pressure tank) from freezing.

Standard Tank Hookup:

See Figure 16, Page 13 for piping connections to standard pressure tank and for correct distance of bleeder orifices from pressure tank.

Pre-charged Pressure Tank Hookup:

See Figure 15, Page 13 for piping connections to pre-charged pressure tank.
NOTICE: Check air pre-charge in tank before starting pump. Adjust pre-charge to 2 PSI (13.8kPa) below pump cut-in setting. (For example, a pre-charge tank used with a 30-50 switch should be pre-charged with air to 28 PSI (193kPa). Adjust pre-charge by either adding or bleeding air through tire valve located on top of tank. Check pre-charge annually and adjust as needed.

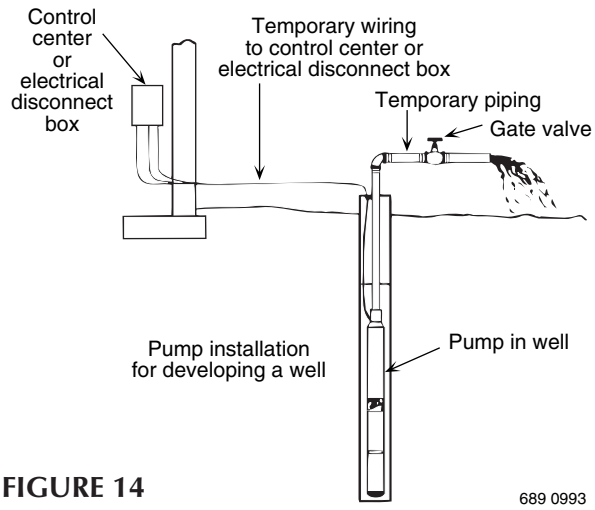
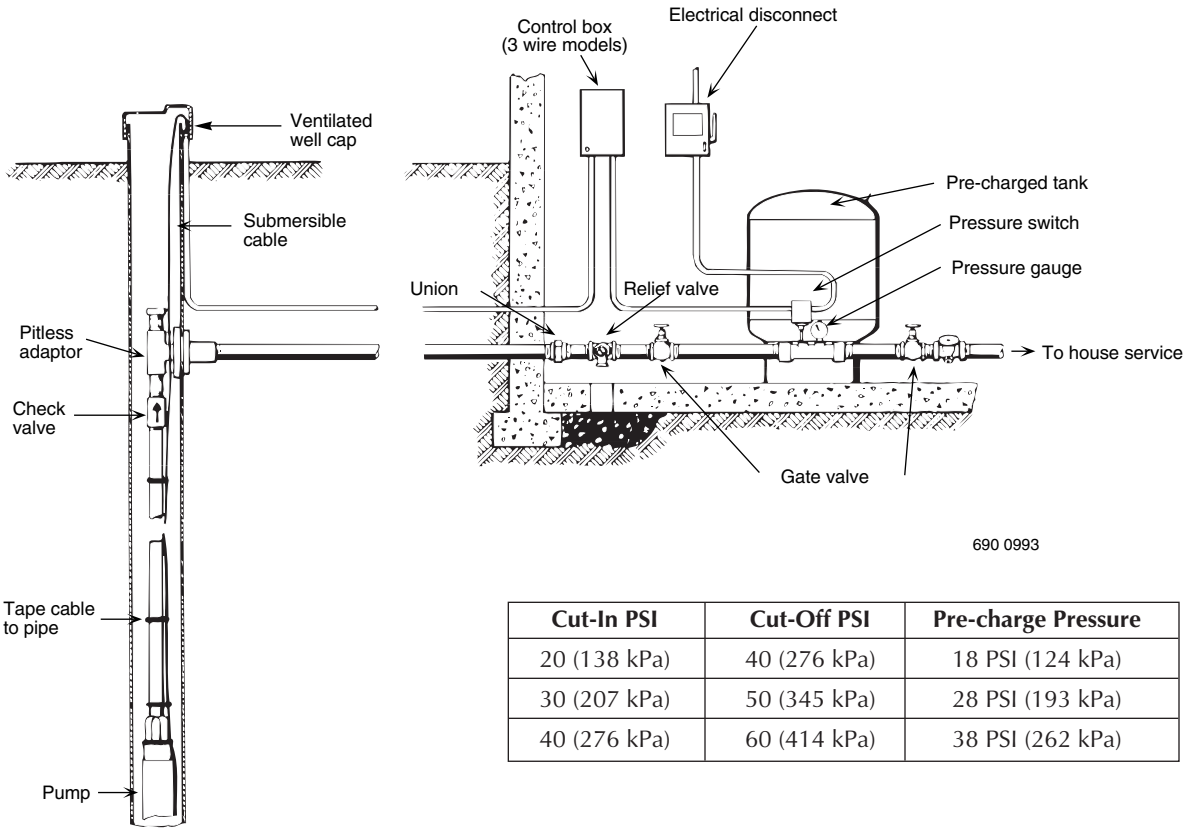


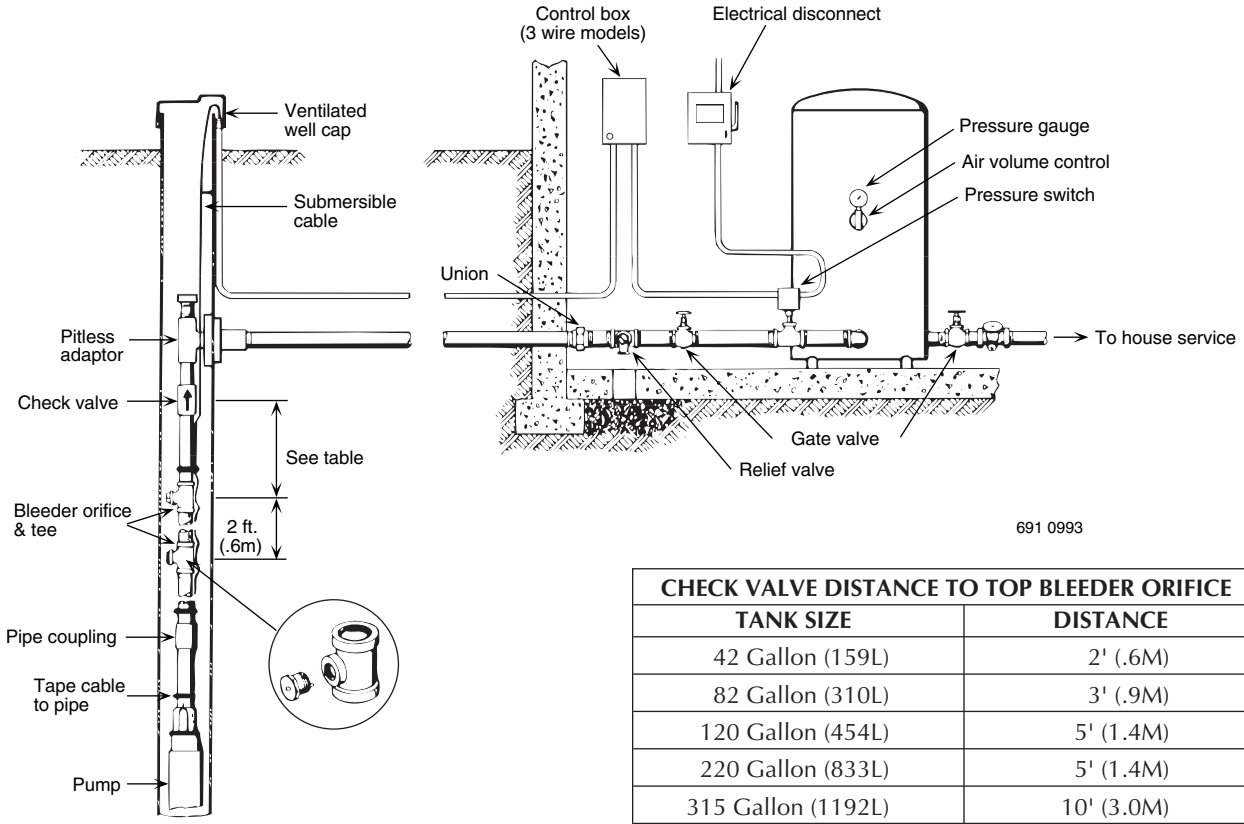
FIGURE 14

FIGURE 15 – Typical Submersible Installation with Pre-charged Tank



Cut-In PSI	Cut-Off PSI	Pre-charge Pressure
20 (138 kPa)	40 (276 kPa)	18 PSI (124 kPa)
30 (207 kPa)	50 (345 kPa)	28 PSI (193 kPa)
40 (276 kPa)	60 (414 kPa)	38 PSI (262 kPa)

FIGURE 16 – Standard Pressure Tank Installation



CHECK VALVE DISTANCE TO TOP BLEEDER ORIFICE	
TANK SIZE	**DISTANCE**
42 Gallon (159L)	2' (.6M)
82 Gallon (310L)	3' (.9M)
120 Gallon (454L)	5' (1.4M)
220 Gallon (833L)	5' (1.4M)
315 Gallon (1192L)	10' (3.0M)
525 Gallon (1987L)	15' (4.6M)

TROUBLESHOOTING GUIDE

PROBLEM	CHECK	CORRECTIVE ACTION
Motor will not start but fuses do not blow		
No voltage	No voltage at fuse box.	Replace blown fuses.
	No voltage at pressure switch	Replace faulty pressure switch.
	No voltage at control box.	Rewire supply to control box.
	Cable or splices bad.	Consult licensed electrician or serviceman.
	Control box incorrectly wired.	Reconnect control box correctly (see wiring diagrams, Pages 7 through 9).
Fuses blow or overload protector trips when motor starts		
Wrong size fuse or wrong size time delay fuse.	Check fuse size against chart, Page 4.	Install correct fuse or time delay fuse.
Wire size too small.	Check wire size against chart, Page 5.	Install correct size wire.
Starting capacitor defective or blown.	Check control box to see if starting capacitor has blown out.	Replace starting capacitor.
Low or high voltage.	Check that line voltage is within ±10% of nameplate rated voltage while motor is running.	If voltage variation is greater than ±10%, call power company to adjust voltage.
Cable leads not correctly connected to control box.	Check control box wiring diagram against incoming power hookup. Check drop cable color coding.	Reconnect leads to match wiring diagram in control box cover. Reconnect drop cable so cable color code matches motor lead color code.
Broken wire in control box.	Examine all connections and wiring in control box.	Disconnect power and repair or replace faulty wire.
Pump or motor stuck or binding.	Check for locked rotor in pump.	If necessary, pull pump (make all possible above ground checks first). If pump is locked, replace it. Clean well of all sand or lime before reinstalling pump.
Fuses blow or overload protector trips when motor is running		
Low or high voltage.	Check that line voltage is within ±10% of rated nameplate voltage while motor is running.	If voltage variation is more than ±10%, call power company to adjust voltage.
High ambient (atmospheric) temperature.	Check temperature of control box.	Do not mount control box in direct sunlight.
Control box with wrong voltage or horsepower rating.	Compare voltage and horsepower on motor nameplate with those given on control box nameplate or on circuit diagram inside control box cover.	Replace control box if numbers do not match.
Wire size too small.	Check wire size against chart, Page 5.	Install correct wire size.
Cable splices or motor leads grounded, shorted, or open.	Consult licensed electrician or qualified serviceman.	Do not attempt to disassemble pump or motor.
Pump starts too frequently		
Leaks in system.	Check all tank connections with soapsuds for air leaks. Check plumbing for leaks.	System must be air and water tight.
Pressure switch.	Check for defective switch or switch out of adjustment.	Re-adjust or replace pressure switch.
Tank waterlogged.	Pre-charged tanks; check tank pre-charge air pressure, check for leak in bladder.	Pre-charge tanks: adjust air pressure to 2 PSI (13.8 kPa) less than pump cut-in pressure (when there is no water pressure on system). Replace bladder if necessary.
	Standard tanks: check for air leaks. Check Air Volume Control (AVC). Check snifter valve operation.	Standard tanks: repair or replace tanks; replace snifter valves if necessary.
Leak in drop pipe.	Raise drop pipe one length at a time until water stands in pipe.	Replace pipe above that point.
Pressure switch too far from tank.	Measure distance from pressure switch to tank.	Move switch to within one foot of tank.

TROUBLESHOOTING GUIDE

PROBLEM	CHECK	CORRECTIVE ACTION
Little or no water delivered		
Bleeder orifice check valve stuck or installed backwards (standard tank only).	Examine valve.	If stuck, free valve; if installed backwards, reverse it.
Low water level.	Determine lowest water level in well while pump is running and compare to pump depth setting.	Lower pump further into well (but it must be at least 5' (1.6M) above bottom of well). Throttle pump discharge until discharge equals recovery rate of well. **NOTICE:** Running pump while airlocked can cause loss of prime and seriously damage pump.
Low voltage.	Check voltage at control box with pump running. Check incoming wire size and drop cable size against chart, Page 5.	Install larger wire from meter to control box. Install larger wire from control box to pump. If necessary, have power company raise supply voltage.
Plugged intake screen.	Pull pump and check condition of screen.	Clean or replace as necessary.
Check valve at pump discharge stuck.	Pull pump and examine check valve.	Free check valve.
Worn impellers and diffusers.	Make sure system is clear of obstructions and pump is in solid water and operation normally.	Replace pump.
Air or milky water discharge from faucets		
Gas in well water.	Check for presence of gas in well water.	Remove bleeder orifices; plug tees. Be sure plugged tees do not leak. If necessary, separate gas from air before it enters pressure tank.
Air volume control not working (standard tanks only).	Make sure ports and ball check valves are clear.	Replace control if necessary.

CONTROL BOX CHECKING PROCEDURE (ALL BOXES):

⚠ DANGER **Hazardous voltage. Can shock, burn, or cause death.** Disconnect power to control box before doing these check procedures.

A. Overloads (push reset buttons to make sure contacts are closed.)

1. Ohmmeter setting: (R x 1).
2. Terminal connections: ohmmeter leads to overload terminals.
3. Ohmmeter reading: should not be over 0.5 ohms.

B. Capacitor (disconnect one lead from each capacitor prior to checking.)

1. Ohmmeter setting: (R x 1000).
2. Terminal connections; individual capacitor terminals.
3. 1-1/2 through 3 HP: ohmmeter reading: pointer should swing toward zero then drift back toward infinity.
4. 5 HP only – ohmmeter reading: pointer should swing toward zero then drift back toward infinity, except back to 15,000 ohms on any start capacitor with a resistor on terminals.

C. Relay coil (disconnect lead from terminal 5.)

1. Ohmmeter setting: (R x 1000).
2. Terminal connections: "5" and "2" on relay.
3. Ohmmeter reading: 4500-7000 ohms.

D. Relay contact (disconnect lead from terminal 1.)

1. Ohmmeter setting: (R x 1).
2. Terminal connections: "1" and "2" on relay.
3. Ohmmeter reading: should be zero.

E. Deluxe Boxes ONLY – Capacitor (disconnect 1 coil lead);

1. Ohmmeter setting: (R x 100).
2. Check coil resistance: 180-1400 ohms.
3. Remove contact cover and inspect contacts.