$5.00

GOULDS PUMPS

SUBMERSIBLE PUMPS

3Ø Service Manual

ITT Industries

Engineered for life

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This manual covers three phase submersible pumps, motors and controls.

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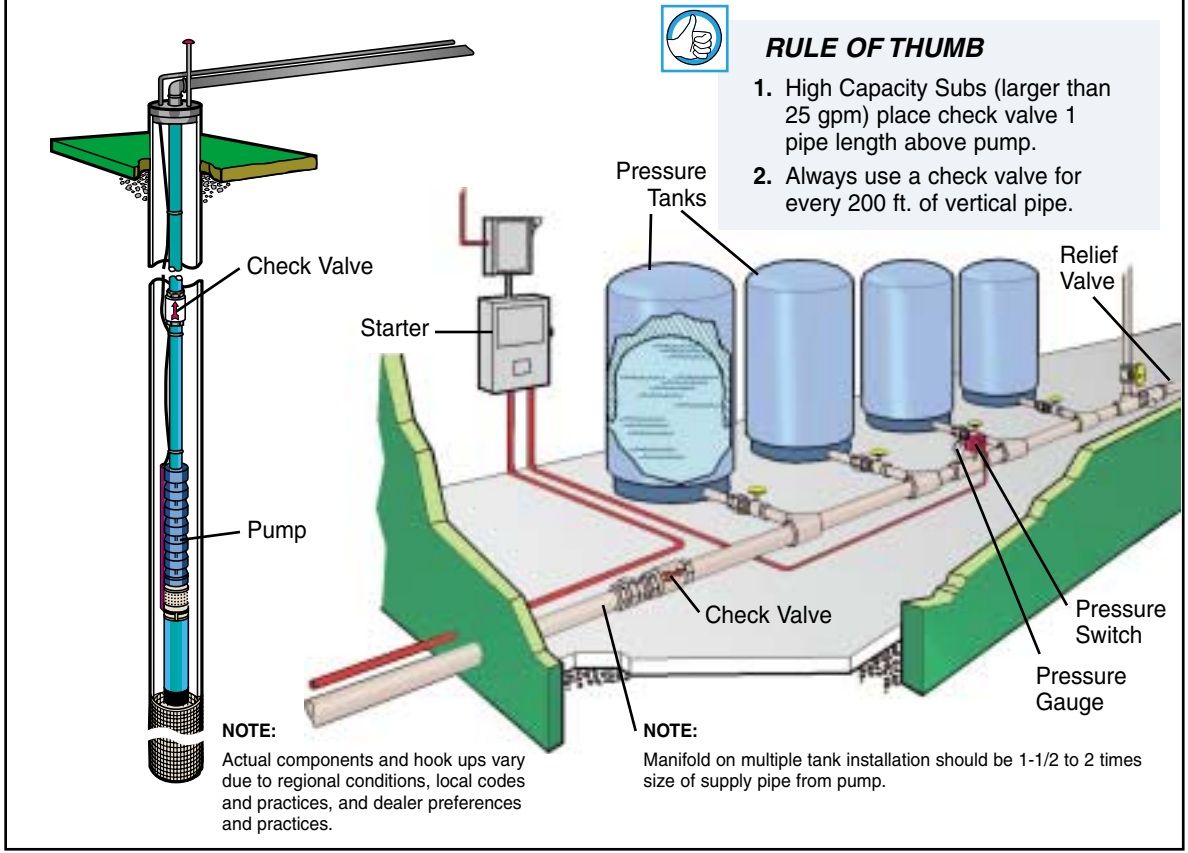
Typical Submersible System . . . 3ø

Multiple tank installation illustrated.

WARNING!
All electrical equipment must be connected to supply ground. Follow NEC and local code requirements.



TYPICAL SYSTEMS

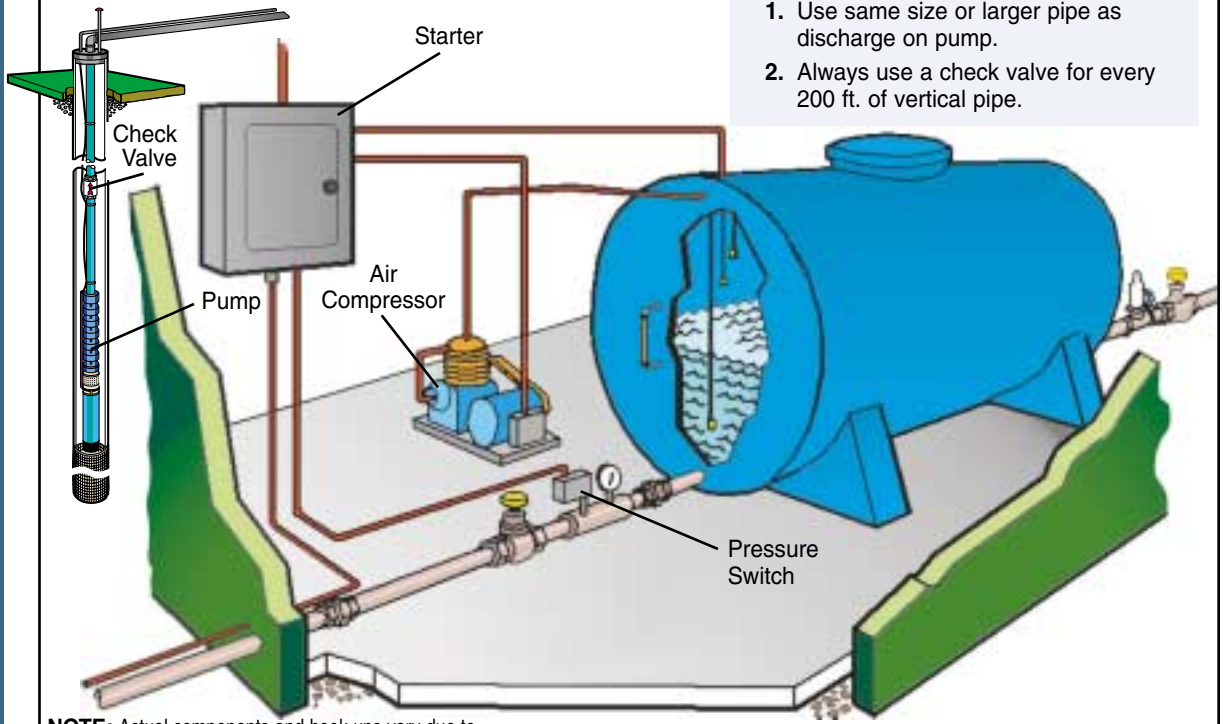
Typical 3ø Submersible System...

Large capacity tank system illustrated with compressor.

WARNING!
All electrical equipment must be connected to supply ground. Follow NEC and local applicable code requirements.

RULE OF THUMB

1. Use same size or larger pipe as discharge on pump.
2. Always use a check valve for every 200 ft. of vertical pipe.



NOTE: Actual components and hook ups vary due to regional conditions, local codes and dealer preferences and practices.

TYPICAL SYSTEMS

Troubleshooting

INDEX

The following pages (8 through 13) cover troubleshooting of submersible pumps.

The use of an amprobe and ohmmeter are two essential items to properly check a system. Use of the amprobe is explained on page 14. Use of the ohmmeter is explained on page 15.

Find the basic problem . . . for which numerous symptoms are listed and possible solutions are given for each:

Page

- Pump Will Not Start. 9
- Pump Will Not Run 10
- Pump Runs, But 11
- Reduced Capacity or Insufficient Tank Pressure 12
- Pump Starts Too Frequently 13

RULE OF THUMB

Remember, there may be other system problems caused by auxiliary controls not covered in this booklet.

IMPORTANT

This manual is intended ONLY for use by Goulds Pumps, ITT Industries Dealers familiar with NEC (National Electrical Code) electrical codes and hydraulic and safety procedures of pump installations.

Troubleshooting

Pump Will Not Start . . .

If fuses and heaters check ok...

PROBLEM:		ANSWER:
1.	No power or incorrect voltage	For detailed checking procedure, see **C** pages 40, 41.
2.	Defective pressure switch or control device	Inspect switch and/or control – replace if necessary.
3.	Defective or loose connection in starter, cable or motor	For detailed checking procedure, see **E** pages 46-48. Condition causes improper resistance reading.
4.	Magnetic starter malfunction	For detailed checking procedure, see **B** pages 26-39.

TROUBLESHOOTING

Troubleshooting

Pump Will Not Run...

If motor overload trips or fuses blow...

PROBLEM:		ANSWER:
1.	Improper size fuses, circuit breakers or heaters	See checking procedure **B** pages 32-39.
2.	Incorrect voltage	See **C** pages 40, 41.
3.	Phase loss or unbalance	See **G** pages 54, 55.
4.	Incorrect starter size	See **B** for sizing information pages 36-39.
5.	Defective or loose connections in starter, cable or motor	See **E** pages 44-49. Condition causes improper resistance readings.
6.	Defective pressure switch or control device	Inspect switch and/or control - replace if necessary.
7.	Cable insulation, splice or motor defective	See **E** pages 48, 49. Condition causes improper resistance readings.
8.	Defective starter	See **B** pages 36-39.
9.	Pump bound by abrasives/debris	Pull pump and clean. See **D** pages 42, 43. Condition causes high amperage.
10.	Inadequate motor cooling	See **J** pages 62, 63.

Troubleshooting

Pump Runs, But...

Little or no water delivered...

PROBLEM:		ANSWER:
1.	Incorrect pump rotation	See **F** pages 52, 53.
2.	Line check valve stuck or installed backwards	Inspect and replace if necessary.
3.	Defective or loose connections in starter	Inspect connections.
4.	Incorrect voltage	See **C** pages 40, 41.
5.	Pump not sufficiently submerged (air bound)	Check water level in well.
6.	Leak in piping system	Inspect and replace if necessary.
7.	Suction screen or impellers clogged	Pull pump and clean.
8.	Broken pump shaft or coupling	Pull pump and inspect.
9.	Air trapped under check valve (air bound)	Pump must be submerged a minimum of 10'.
10.	Gases in well	Start and stop pump several times. If this does not remedy conditions, well may contain too much gas for pump to operate properly.
11.	Worn pump or motor	Inspect and replace if necessary.
12.	Incorrect pump	See catalog performance data.

Troubleshooting

Reduced Capacity or Insufficient Pressure...

PROBLEM:		ANSWER:
1.	Incorrect voltage	See **C** pages 40, 41.
2.	Incorrect pump rotation	See **F** pages 52, 53.
3.	Improper pressure switch setting	See **H** pages 58.
4.	Excessive pump wear	Inspect and replace if necessary.
5.	Leaks in piping system	Inspect and replace if necessary.
6.	Incorrect pump	See catalog performance data.

Franklin Electric Maximum Starts Per 24 Hour Day

Motor Ratings	Maximum starts Per 24 Hr. Day	
	Single Phase	Three Phase
Up to ¾ HP	300	300
1 HP - 5 HP	100	300
7 ½ HP - 30 HP	50	100
40 HP and over		100

TROUBLESHOOTING

Troubleshooting

Pump Starts Too Frequently...

If motor overload trips or fuses blow...

PROBLEM:		ANSWER:
1.	Waterlogged tank	
	a. Standard galvanized	Check tank for leaks. Check drain and "Y" fittings, snifter valve for proper operation.
	b. Pneumatic	Check compressor and controller for proper operation.
	c. Pressurized type type	See **I** pages 60, 61.
2.	Check valve stuck open	Inspect and replace if necessary.
3.	Improper pressure switch setting	See **H** pages 58.
4.	Leaks in piping system	Inspect and replace if necessary.
5.	Improper tank precharge	Precharge tank at 2 lbs. less than pressure switch cut in.
6.	Pressure tank improperly sized	Must be sized to allow a minimum of run time per cycle. See rule of thumb below.

RULE OF THUMB

For pumps 1.5 hp and smaller allow a minimum of one minute run time per cycle. For pumps 2 hp and larger allow a minimum of two minutes run time per cycle. (See table page 12)

Amprobe Instructions

1. Voltmeter Scales:	150 VOLTS	600 VOLTS
2. Ammeter Scales:	5 AMPS 15 AMPS	40 AMPS 100 AMPS

1. When used as an ammeter, the tongs are placed around the wire being measured with the rotary scale on the **100 amp range**. Then rotate the scale back to the smaller ranges until an exact reading is indicated.
2. When used as a voltmeter, the two leads are clipped into the bottom of the instrument with the rotary scale on the **600 volt range**. If the reading is less than 150 volts, rotate the scale to the 150 volt range to get a more exact reading.

WARNING!
Checking has to be done with **power on**.

Ohmmeter Instructions

The Ohmmeter is used for measuring the electrical resistance of a wire circuit. The unit of measurement is called an Ohm.

1. The knob at the bottom of the Ohmmeter is adjustable through six ranges:

RX_1 = R x 1
RX_{10} = R x 10
RX_{100} = R x 100
RX_{1000} = R x 1,000
RX_{10K} = R x 10,000
RX_{100K} = R x 100,000

If your ohmmeter is digital readout type, refer to the instructions that came with it.

2. The round center knob is for the purpose of adjusting the instrument to zero (0) after clipping the two Ohmmeter leads together. **This must be done every time the range selection is changed.**

WARNING!
Use Ohmmeter only with **power off**.

Megger...

This instrument is used to measure insulation resistance to ground. It consists of a crank-turned magneto, on the side of the case, and will give very close readings calibrated directly in ohms. It is cranked at a moderate rate of speed, approximately 120 rpm, until the pointer reaches a steady deflection.

1. If the ohm value is normal, the motor windings are not grounded and the cable insulation is not damaged.

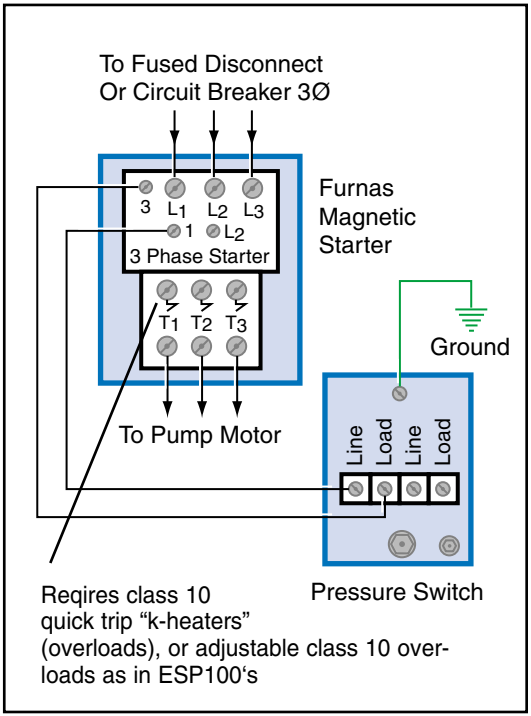
2. If the ohm value is below normal, either the windings are grounded or the cable insullation is damaged. Check the cable at the well seal as the insullation is sometimes damaged by being pinched.

Insulation Resistance Ratings

Condition of Motor and Leads	Ohm Value
A new motor (without drop cable)	20,000,000 (or more)
A used motor which can be reinstalled in the well	10,000,000 (or more)
MOTOR IN WELL. Ohm readings are for drop cable plus motor	
A new motor in the well	2,000,000 (or more)
A motor in the well in reasonably good condition	500,000 - 2,000,000
A motor which has been damaged by lightening or with damaged leads. Do not pull the pump for this reason	20,000 - 5000,000
A motor which definately has been damaged or with damaged cable. The pump should be pulled and repairs made to the cable or the motor replaced. The motor will not fail for this reason alone, but it will probably not operate for long	10,000 - 20,000
A motor which has failed or with completely destroyed cable insulation. The pump must be pulled and the cable repaired or the motor replaced	less than 10,000

A Typical Wiring Diagrams

Magnetic Starter & Pressure Switch

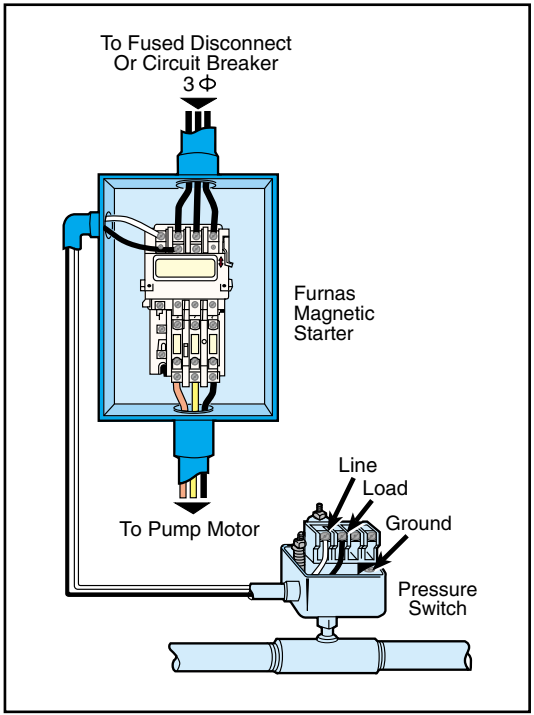


NOTE:

Check to be sure proper selection of pressure switch matched to system voltage has been made... refer to catalog data.

Check that starter has ground.

A Typical Wiring Diagrams



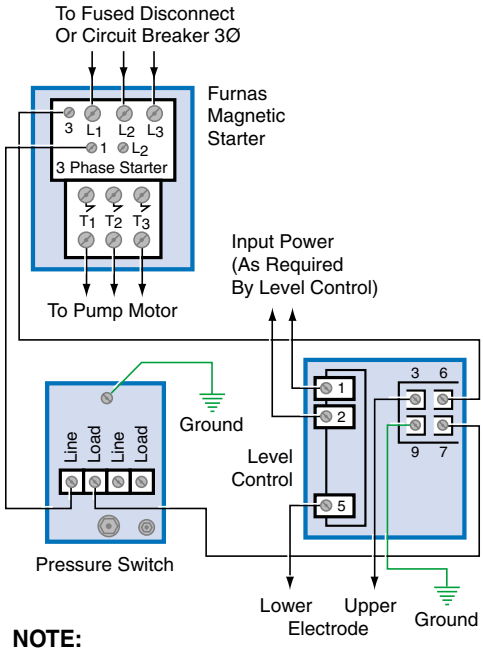
RULE OF THUMB

Check that starter has ground.

A. WIRING DIAGRAMS

A Typical Wiring Diagrams

Magnetic Starter, Pressure Switch & B/W Liquid Level Control



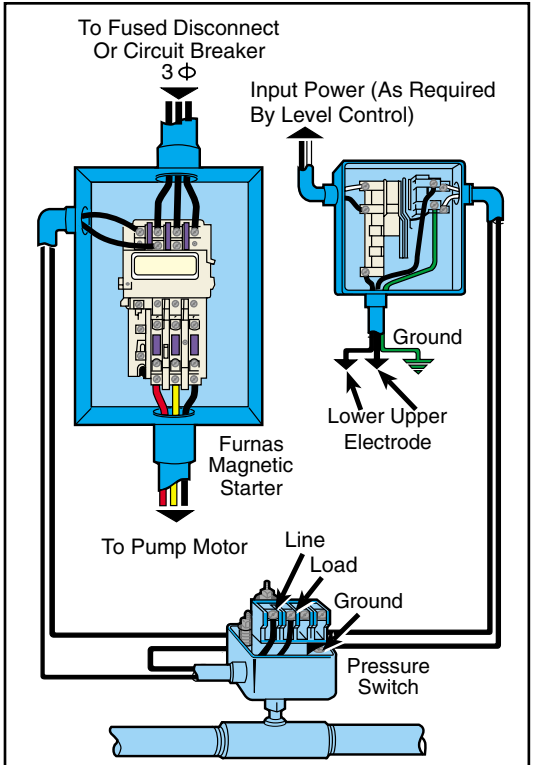
NOTE:

Check to be sure proper selection of pressure switch matched to system voltage has been made... refer to catalog data.

Check that starter has ground.

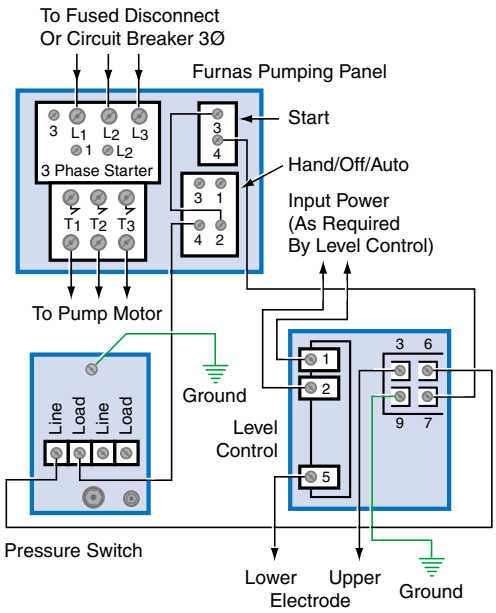
A. WIRING DIAGRAMS

A Typical Wiring Diagrams



A Typical Wiring Diagrams

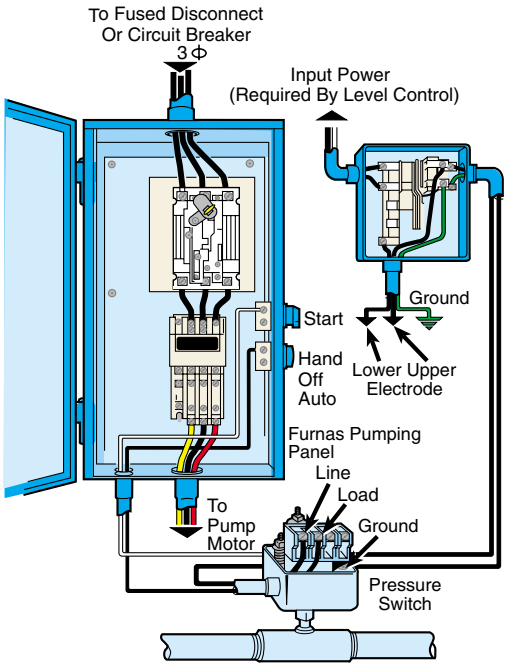
Furnas Pumping Panel, Pressure Switch & B/W Liquid Level Control



NOTE:

Check to be sure proper selection of pressure switch matched to system voltage has been made... refer to catalog data.

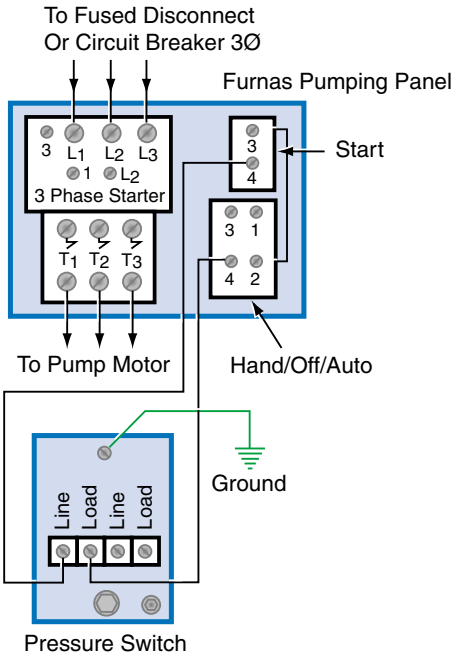
A Typical Wiring Diagrams



A. WIRING DIAGRAMS

A Typical Wiring Diagrams

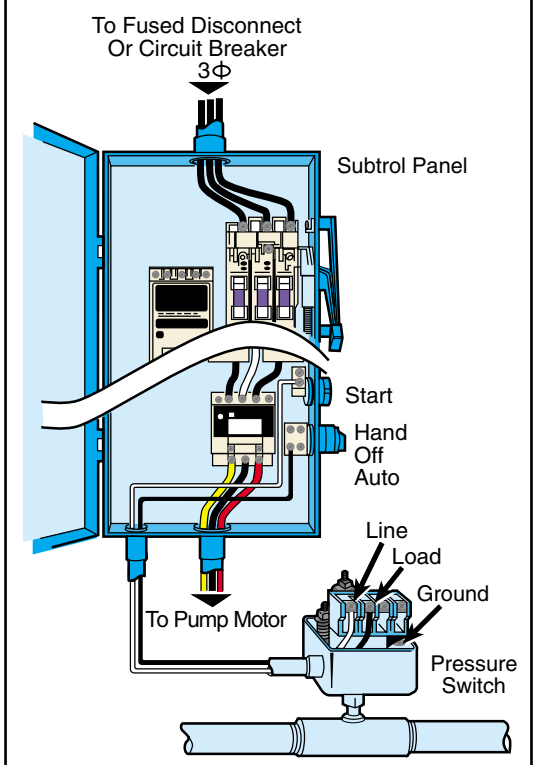
Subtrol & Pressure Switch



NOTE:

Check to be sure proper selection of pressure switch matched to system voltage has been made... refer to catalog data.

A Typical Wiring Diagrams



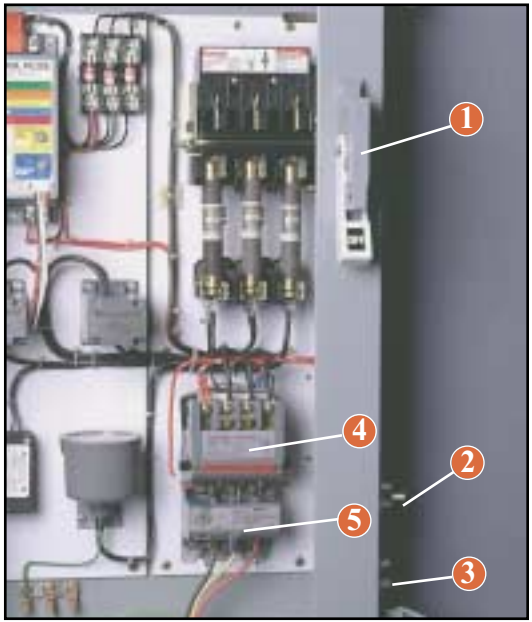
A. WIRING DIAGRAMS

B Pump Control Panels

Combination Magnetic Starter (Furnas)

The portion of the total cable, which is between the service entrance and a 3ø motor starter should not exceed 25% of the total maximum length of cable used to assure reliable starter operation.

B. PUMP CONTROL PANELS



1. Disconnect switch.
2. H-O-A switch.
3. Start switch.
4. Magnetic starter.
5. Solid state motor protection device.

B Pump Protection Devices

Subtrol Plus Receiver

1. Subtrol Plus receiver programmed to match motor rating.
2. Control fuse block with fuse.
3. Class K-5 dual element type fuse clips with built-in fuse puller.
4. Subtrol sensor coils.

B. PUMP CONTROL PANELS

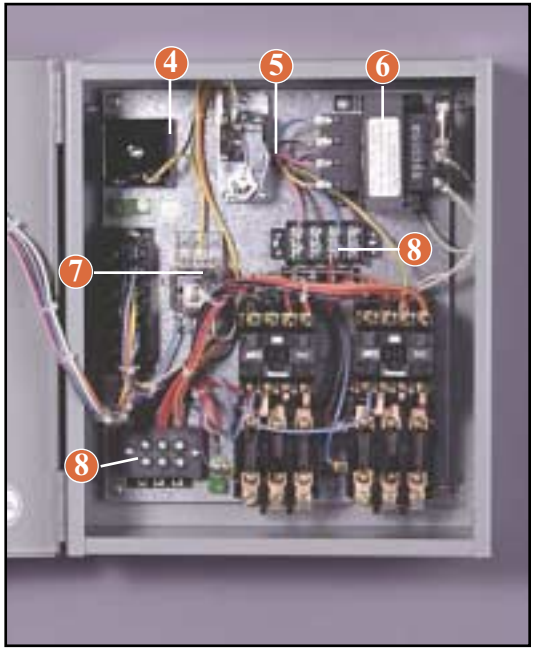
B Pump Control Panels

AWA503

Duplex alternator panel may be used to alternate two submersible or centrifugal pumps.

1. Use one switch for a simple alternating system
2. Use two switches when the system is required to:
   - A. Alternate two pumps
   - B. Start the second pump in the event the first pump cannot meet the system demand.

Auxiliary contacts allow the operation of one or two chemical feed pumps, such as chlorine or ozone injectors.



1. NEMA 1 enclosure.
2. Two hand-off auto switches.
3. Two pump run lamps.
4. Time delay.
5. Alternator circuit.
6. 120 VAC control circuit transformer.
7. Relay.
8. Terminals blocks for external wiring connections.

B. PUMP CONTROL PANELS

B Fuse Checkout...

1. Set R x 1.
2. Connect leads as shown.
3. Reading: Should register zero.

What It Means –

Zero reading indicates fuse OK. Infinity (∞) reading indicates bad fuse.

B Coil Checkout...

WARNING!
Open master breaker and disconnect all leads from starter to avoid damage to meter or electric shock hazard. Connect the ohmmeter leads as shown above.

Coil with Ohmmeter

1. Set R x 100.
2. Connect leads as shown.
3. Reading: Should register some value, Approx. 200-1000 ohms.

What It Means –

Infinity reading indicates coil is open. Zero reading indicates coil is shorted. In either case, the coil should be replaced.

A reading of 200-1000 ohms indicates coil is ok.

B Contact Point Inspection...

WARNING!
Open (turn off) master breaker or disconnect all leads from starter (CB lid) to avoid damage to meter or electric shock hazard.

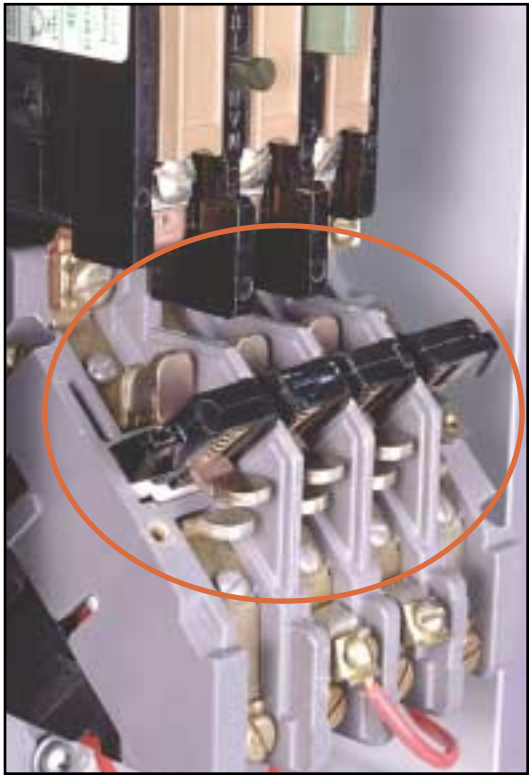
1. Remove contact point cover as shown.

2. Visually inspect all contact points.

3. Replace if necessary.

What It Means –

Burned, welded, or misaligned contacts may cause starter malfunction.



What It Means –

Burned, welded, or misaligned contacts may cause starter malfunction.

B. CONTACT POINT INSPECTION

B Starter & Heater Sizing Checkout...

WARNING! TURN POWER OFF!

1. Check for correct starter and heater size referring to starter and heater selection chart.
2. Double check to see that all **three** heaters are of the same size and installed properly and are tight.

WARNING! TURN POWER ON!

3. Push the reset button; listen for click.
4. If overload was tripped, investigate the cause.

What It Means –

Improper starter and heater sizing provides inadequate overload protection that may lead to motor failure or nuisance tripping.

B Furnas Starter & Quick Trip Heater Selection...

TABLE 1 4" Three Phase Submersible Motors

		Furnas Class 16		ESP 100		Fuse Size	
HP	Volts	Starter Size	Heaters	Starter Size	Starter No.	Circ.bkr. or std.	Dual Ele.
.5	200	16AD	K29	0	CSBD	10	5
	230	16AG	K28	0	CSBA	8	4
	460	16AH	K21	0	CSBC	4	2
.75	200	16AD	K34	0	CSBD	12	6
	230	16AG	K32	0	CSBA	11	5
	460	16AH	K23	0	CSBC	5	3
1	200	16AD	K37	0	CSDD	14	6
	230	16AG	K34	0	CSDA	12	6
	460	16AH	K26	0	CSBC	6	3
1.5	200	16AD	K42	0	CSDD	20	9
	230	16AG	K39	0	CSDA	20	8
	460	16AH	K29	0	CSDC	15	4
	575	16AE	K26	0	CSBE	15	3
2	200	16AD	K50	0	CSDD	20	10
	230	16AG	K43	0	CSDA	20	10
	460	16AH	K33	0	CSDC	15	5
	575	16AE	K29	0	CSDE	15	4
3	200	16AD	K55	0	CSED	35	15
	230	16AG	K52	0	CSEA	30	15
	460	16AH	K37	0	CSDC	15	7
	575	16AE	K34	0	CSDE	15	6
5	200	16AD	K62	1	DSFD	50	25
	230	16AG	K61	1	DSFA	45	20
	460	16AH	K49	0	CSDC	25	10
	575	16AE	K42	0	CSDE	20	8
7.5	200	16CD	K70	1	DSFD	80	35
	230	16BG	K67	1	DSFA	70	30
	460	16AH	K55	1	DSEC	35	15
	575	16AE	K52	1	DSEE	30	12
10	460	16AH	K61	1	DSEC	45	20
	575	16AE	K57	1	DSEE	40	20

continued next page...

TABLE 2 6" Three Phase Submersible Motors

		Furnas Class 16		ESP 100		Fuse Size	
HP	Volts	Starter Size	Heaters	Starter Size	Starter No.	Circ.bkr. or std.	Dual Ele.
5	200	DD	K61	1	DSFD	50	25
	230	DG	K60	1	DSFG	45	20
	460	BH	K49	0	CSDH	25	10
	575	BE	K41	0	CSDE	20	8
7.5	200	ED	K68	1	DSFD	70	30
	230	EG	K67	1	DSFG	70	30
	460	CH	K55	1	DSEH	30	15
	575	CE	K52	1	DSEE	25	12
10	200	QD	K72	1¾	ESGD	100	40
	230	QG	K70	1¾	ESGG	80	35
	460	DH	K58	1	DSEH	40	20
	575	CE	K55	1	DSEE	35	15
15	200	GD	K76	2½	GSJD	150	60
	230	FG	K75	2	FSHG	125	60
	460	EH	K64	1¾	ESFH	60	30
	575	DE	K61	1¾	ESFE	50	25
20	200	HD	K78	3	HSKD	200	60
	230	GG	K77	2½	GSJG	175	70
	460	QH	K70	2	FSHH	80	35
	575	EE	K64	2	FSHE	70	30
25	200	ID	K86	3	HSKD	225	100
	230	IG	K83	3	HSKG	200	90
	460	FH	K72	2	FSHH	100	45
	575	QE	K70	2	FSHE	80	35
30	200	ID	K88	3½	ISLD	300	125
	230	IG	K87	3	HSKG	250	110
	460	FH	K74	2½	GSHH	125	50
	575	FE	K72	2½	GSHE	100	40
40	460	GH	K77	3	HSKH	150	70
	575	FE	K76	3	HSKE	125	70
50	460	IH	K83	3	HSKH	200	90
	575	HE	K77	3	HSKE	150	70
60	460	IH	K87	4	ISLH	250	100
	575	JE	K78	4	ISLE	200	80

TABLE 3 8" Three Phase Submersible Motors

		Furnas Class 16		ESP 100		Fuse Size	
HP	Volts	Starter Size	Heaters	Starter Size	Starter No.	Circ.bkr. or std.	Dual Ele.
40	460	GH	K77	3	HSKH	175	70
50	460	IH	K83	3	HSKH	200	90
60	460	IH	K86	3½	ISLH	225	100
75	460	IH	K89	3½	ISLH	300	125
100	460	JH	K93	4	JTMH	400	175
150*	460	I	K33	N/A	N/A	600	250
	575		K28			450	200
175*	460	I	K33	N/A	N/A	700	300
	575		K31			700	300
200*	460	I	K26	N/A	N/A	800	350
	575		K32			600	300

*** Call Texas Turbine Division**

806-743-5700

Ask for Technical Assistance.

Note: FURNAS ESP100 starters with heaterless overloads include ambient compensated o/l and single phase protection.

TOLL FREE ACTION NUMBER

Answers to your installation questions on submersible pump motors are as close as your telephone...

A Franklin submersible motor expert will handle your motor application inquires right away... and it's toll free.

Franklin Electric SERVICE HOTLINE

800-348-2420

(Also for Indiana)

C Voltage Checkout... 3ø Starter

Checking Voltage at Fused Disconnect and Magnetic Starter

WARNING!
Power is ON during voltage checking.

1. To check voltage: Use voltmeter on L1, L2 and L3 in sequence. Check should be made at four locations.

   Step 1 Checking incoming power supply.

   Step 2 Checking fuses.

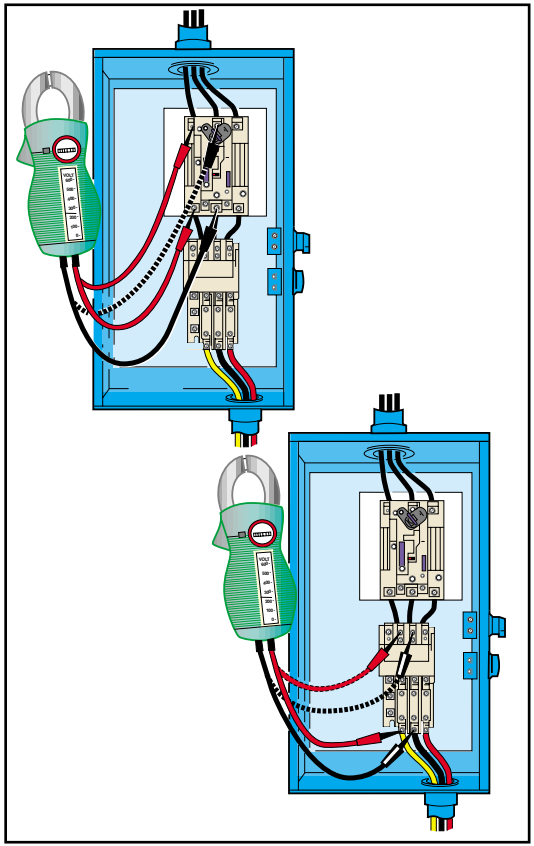
   Step 3 Checking contact points

   Step 4 Checking heaters.

2. When checking voltage, all other major electrical appliances (that could be in use at the same time) should be running.
3. If incoming power supply readings are not within the limits (see chart), call your power supplier.

Voltage Limits		
Name Plate ▼	Measured Volts	
	Min.	Max.
208V 3ø	188	228
230V 3ø	207	253
460V 3ø	414	506
575V 3ø	518	632

NOTE: Phase to phase – full line voltage.
Phase to neutral – ½ full line voltage.
(depending on transformer connection)



RULE OF THUMB

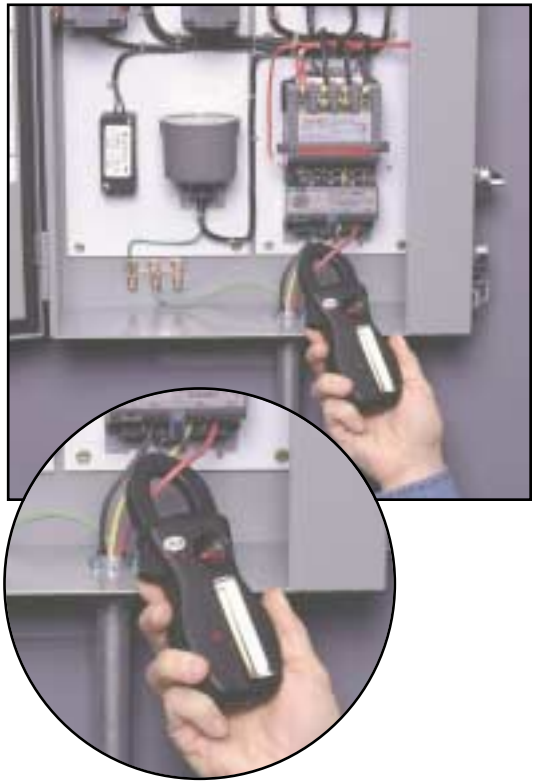
Incoming power should be within 5% of power supply voltage. Motors are rated ±10% of nameplate. The other 5% is used for cable voltage drop.

D Current Checkout

WARNING!
Power is ON during voltage checking.

TABLE 4 Three Phase Motors... Max. Amps

HP	Dia.	Lbs.	200V	230V	460V	575V
.5	4"	300	6.8	5.9	3.0	2.4
.75	4"	300	9.3	8.1	4.1	3.2
1	4"	650	12.5	10.9	5.5	4.4
5	4"	1500	20.5	17.8	8.9	7.1
7.5	4"	1500	30.5	26.4	13.2	10.6
10	4"	1500	–	–	18.8	15.0
5	6"	1,500	19.1	16.6	8.3	6.6
7.5	6"	1,500	28.3	24.6	12.3	9.8
10	6"	3,500	37.0	32.2	16.1	12.9
15	6"	3,500	54.5	47.4	23.7	19.0
20	6"	3,500	69.7	60.6	30.3	24.4
25	6"	3,500	86.3	75.0	37.5	30.0
30	6"	3,500	104.0	90.4	45.2	36.2
40	6"	3,500	–	–	62.0	49.6
50	6"	3,500	–	–	77.0	61.6
60	6"	3,500	–	–	91.0	72.8
40	8"	10,000	–	–	53.0	42.0
50	8"	10,000	–	–	65.0	53.0
60	8"	10,000	–	–	79.0	61.0
75	8"	10,000	–	–	97.0	78.0
100	8"	10,000	–	–	125.0	104.0
125	8"	10,000	–	–	165.0	136.0
150	8"	10,000	–	–	193.0	154.0
175	8"	10,000	–	–	218.0	174.0
200	8"	10,000	–	–	245.0	196.0



Using Amprobe

1. Set scale to highest amp range.
2. Connect amprobe around lead as shown.
3. Rotate scale to proper range and read value.
4. Compare value with Table.

What It Means –

Currents above these values indicate system problems.

D. CURRENT CHECKOUT

E Motor Winding Resistance Checkout...

1. Set the scale lever to R x 1 for values under 10 ohms. For values over 10 ohms, set the scale lever to R x 10. Zero balance the ohmmeter as described earlier on page 15.

WARNING!
Open master breaker and disconnect all leads from starter to avoid damage to meter or electric shock hazard. Connect the ohmmeter leads as shown below.

2. Connect the ohmmeter leads as shown below.

TABLE 5 Cable Resistance — Copper

Size Cable	Paired Wire Resistance (ohms per foot)
14	.0050
12	.0032
10	.0020
8	.0013
6	.0008
4	.0005
2	.0003
0	.0002
00	.00015
000	.00013
0000	.00010

If aluminum cable is used the readings will be higher. Divide the ohm readings on this chart by 0.61 to determine the actual resistance of aluminum cable.

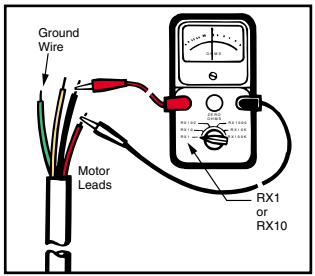


TABLE 6 Motor Resistance 3ø Motors
Resistance Motor Only (Ohms) – any 2 leads

HP	Dia.	Lbs.	200V	230V	460V	575V
.5	4"	900	6.64-7.3	9.5-10.4	38.4-41.6	–
.75	4"	900	4.66-5.12	7.24-7.84	27.8-30.2	–
1.5	4"	900	2.5-3.0	3.2-4.0	13.0-16.0	20.3-25.0
2.0	4"	900	1.9-2.4	2.4-3.0	9.7-12.0	15.1-18.7
3.0	4"	900	1.3-1.7	1.8-2.2	7.0-8.7	10.9-13.6
5.0	4"	900	.70-.94	.93-1.20	3.60-4.40	5.60-6.90
7.5	4"	900	.46-.57	.61-.77	2.40-3.40	–
5.0	6"	1,500	.68-.84	.88-1.09	3.53-4.37	–
7.5	6"	1,500	.39-.48	.57-.71	2.17-2.68	3.65-4.41
10	6"	3,500	.33.42	.44-.55	1.76-2.17	2.87-3.47
15	6"	3,500	.22-.27	.27-.33	1.07-1.32	1.70-2.10
20	6"	3,500	.14-.17	.20-.25	.76-.94	1.22-1.52
25	6"	3,500	.11-.14	.15-.19	.59-.73	1.01-1.25
30	6"	3,500	.10-.12	.12-.15	.48-.60	.78-.95
40	6"	3,500	–	–	.32-.40	.53-.59
50	6"	3,500	–	–	.25-.32	.39-.48
60	6"	3,500	–	–	.22-.27	–
40	8"	10,000	–	–	.256-.283	–
50	8"	10,000	–	–	.188-.207	–
60	8"	10,000	–	–	.148-.163	–
75	8"	10,000	–	–	.110-.121	–
100	8"	10,000	–	–	.076-.084	–
125	8"	10,000	–	–	.057-.063	–
150	8"	10,000	–	–	.049-.054	–
175	8"	10,000	–	–	.045-.050	.067-.074
200	8"	10,000	–	–	.038-.042	.060-.066

What It Means –

1. If all ohm values are normal, the motor windings are neither shorted nor open.
2. If any one ohm value is less than normal, the motor is shorted.
3. If any one ohm value is greater than normal, the winding or the cable is open or there is a poor cable joint or connection.

Winding Resistance Measuring

When measured as shown on page 44, motor resistance only should fall within the values in Table 6. When measured through the drop cable, the size and length of the cable must be known and the correct cable resistance from Table 6 subtracted from the ohmmeter reading to get the winding resistance for comparison with Table 6.

E Electrical Short Checkout . . .

Measuring Insulation Resistance

1. Set the scale lever to R x 100K (R x 100,000) and set the ohmmeter on zero.

> **WARNING!**
> Open (turn off) master breaker or disconnect all leads from starter (CB lid) to avoid damage to meter or electric shock hazard.

2. Connect an ohmmeter lead to any one of the motor leads and the other to the metal drop pipe. If the drop pipe is plastic, connect the ohmmeter lead to the metal well casing or ground wire.

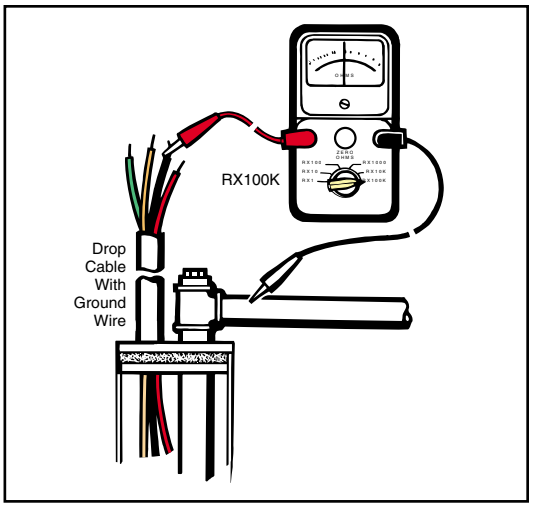


Table 7 Normal Ohm and Megohm Values (Insulation Resistance) Between All Leads and Ground

Insulation resistance does not vary with rating. All motors of all HP, voltage and phase rating have similar values of insulation resistance.

Condition of Motor and Leads	Ohm Value	Megohm Value
A new motor (without drop cable).	20,000,000 (or more)	20.0
A used motor which can be reinstalled in the well.	10,000,000 (or more)	10.0
Motor in Well. Ohm readings are for drop cable plus motor. A new motor in the well.	2,000,000 (or more)	2.0
A motor in the well in reasonably good condition.	500,000 - 2,000,000	0.5 - 2.0
A motor which may have been damaged by lightning or with damaged leads. Do not pull the pump for this reason.	20,000 - 500,000	0.02 - 0.5
A motor which definitely has been damaged or with damaged cable. The pump should be pulled and repairs made to the cable or the motor replaced. The motor will not fail for this reason alone, but it will probably not operate for long.	10,000 - 20,000	0.01 - 0.02
A motor which has failed or with completely destroyed cable insulation. The pump must be pulled and the cable repaired or the motor replaced.	less than 10,000	0 - 0.01

What It Means –

1. If the ohm value is normal, the motor windings are not grounded and the cable insulation is not damaged.
2. If the ohm value is below normal, either the windings are grounded or the cable insulation is damaged. Check the cable at the well seal as the insulation is sometimes damaged by being pinched.

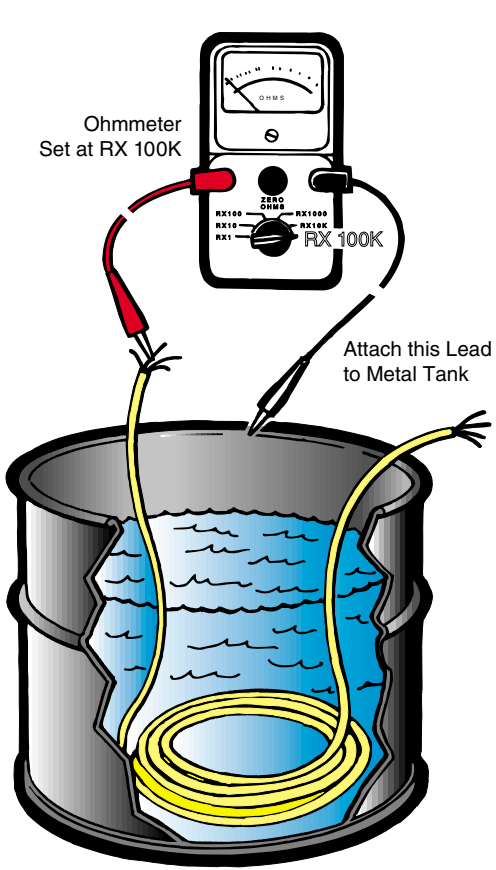
E. ELECTRICAL SHORT CHECKOUT

E Cable Checkout...

Checking Cable and Splice

1. Submerge cable and splice in steel barrel of water with both ends out of water.
2. Set ohmmeter selector on Rx100K and adjust needle to zero (0) by clipping ohmmeter leads together.
3. After adjusting ohmmeter, clip one ohmmeter lead to barrel and the other to each cable lead individually, as shown.
4. If the needle deflects toward zero (0) on any of the cable leads, pull the splice up out of the water. If the needle falls back to (∞) (no reading) the leak is in the splice.
5. If leak is not in the splice, pull the cable out of the water slowly until needle falls back (∞) (no reading). When the needle falls back, the leak is at that point.
6. If the cable or splice is bad, it should be repaired with waterproof electrical tape, or replaced.

Checking Cable and Splice Test



Pump Disassembly...

Some disassembly procedures differ between Series E and Series GS (newer).

1. **Remove discharge head and casing.**

   Remove 4 screws in cable guard, remove cable guard and set aside. On "GS" reinstall the two top screws. Remove the discharge head and casing as one assembly, the threads are left-hand.

   On "E" you can remove the discharge head and casing as one piece by reinstalling the two top screws or you can remove them as separate pieces. The "E" threads are right hand.

GS: Left hand Thread.
Series E: Right hand Thread.

2. Place the unit in a vertical position if you have a pump vise...otherwise lay pump on floor to loosen.
3. With two wrenches, one placed on the motor adapter and the other on the discharge head, unscrew the casting at the motor adapter. It should then lift off readily, exposing the stacked bowls.
4. **Series E:** If snap ring is provided on end of shaft, remove with snap ring pliers. If Klip Ring is provided, remove with screwdriver.

   Series GS: Remove Klip Ring with screwdriver**.**

5. The complete stages consisting of bowl, impeller and diffuser, may be lifted off the shaft one at a time and the respective parts disassembled for inspection and/or renewal.
6. Remove nuts holding the motor adapter to the motor and remove the motor adapter.
7. Remove shaft sleeve.
8. Remove pump shaft and coupling assembly. Do not try to remove the coupling from the pump shaft.

Note: to identify an "E" series model number look on the OD of bottom motor adapter flange 180° from cutout for motor leads. All pumps were stamped with water end model number, ex. 7EH05 or 18E15. To cross to "GS" simply replace the "E_ with GS, ex 7EH05 = 7GS05, 18E15 = 18GS15.

On gaseous wells using "GS". Rather than trying to remove the check valve we suggest you drill a 3/16" hole in it and install a line check one pipe joint above the pump.

For other disassembly detail, see instruction manual.

Series GS has built-in check valve.

F Rotation...

Correct rotation is a must on all 3ø installations. Rotation can be checked by one of these three ways:

VISUAL 1

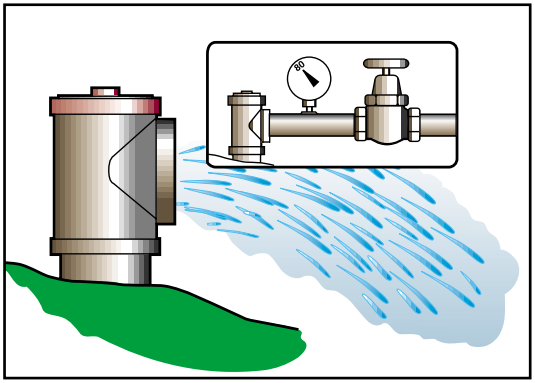
1. Connect 3 motor leads to starter, run unit at open discharge.
2. Switch any 2 leads and again run unit at open discharge.
3. Largest quantity of water indicates correct rotation.

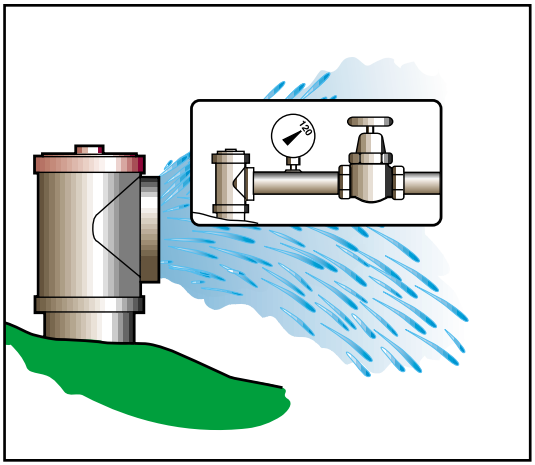
VISUAL 2

Remove water end from meter. Run motor and observe rotation

PRESSURE

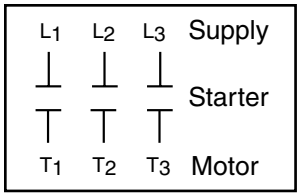
1. Connect 3 motor leads to starter. Run unit against closed discharge, take maximum pressure reading.
2. Switch any 2 leads and again run unit against closed discharge. Take maximum pressure reading.
3. Highest pressure reading indicates correct rotation.

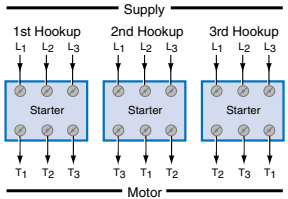




WARNING!
Prolonged reverse rotation operation can cause pump/motor damage.

G Unbalance...





For the best protection, we recommend no more than a 5% current deviation from average current.

Current readings in amps should be checked on each leg using the three possible hookups.

CAUTION

To prevent changing motor rotation, the motor leads should be reordered in the same direction, see example on page 51.

RULE OF THUMB

If the unbalance moves with the motor leads the unbalance is caused by the motor, wet splice, or damaged cable. If the unbalance remains with the terminals the unbalance is in the power supply.

Calculate percentage of current unbalance for all three hookups.

Example:

Hook Up 1	Hook Up 2	Hook Up 3
$T_1 = 51$ Amps	$T_3 = 50$ Amps	$T_2 = 50$ Amps
$T_2 = 46$ Amps	$T_1 = 48$ Amps	$T_3 = 49$ Amps
$T_3 = 53$ Amps	$T_2 = 52$ Amps	$T_1 = 51$ Amps

Add up all three readings for hook up number 1.

$T_1 = 51$ Amps
$T_2 = 46$ Amps
$+T_3 = 53$ Amps
Total 150 Amps

Divide the total by three to obtain the average.

50 Amps = Average
3 | 150 Amps

Calculate the greatest amp difference from the average. Could be greater than average.

50 Amps
-46 Amps
4 Amps

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

.08 or 8%
50 | 4.00 Amps

Hook Up #1 = 8%
Hook Up #2 = 4%
Hook Up #3 = 2%

Always use hook up with lowest % current unbalance.

Loads on a transformer bank vary. Readings should be taken at peak load period.

What It Means –

1. Hook ups below 5% = system balanced.
2. Hook ups not below 5% – if the unbalance moves with the motor leads the unbalance is caused by the motor, wet splice, or damaged cable. Check the motor on pages 44-45. If the unbalance remains with the terminals the unbalance is in the power supply – contact power company.

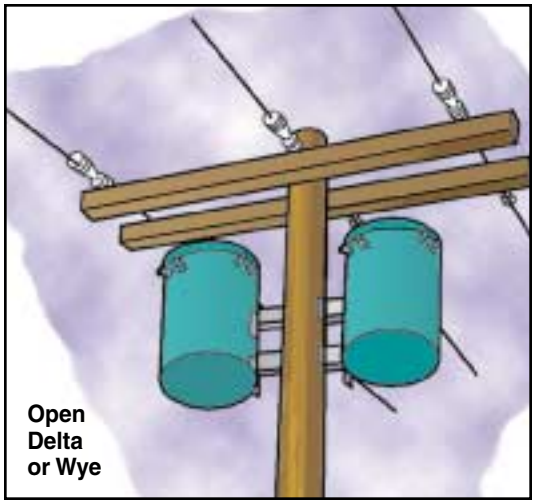
G Transformer Sizes...

A full three phase supply is recommended for all three phase motors, consisting of three individual transformers or one three phase transformer. "Open" delta or wye connections using only two transformers can be used, but are more likely to cause problems from current unbalance.

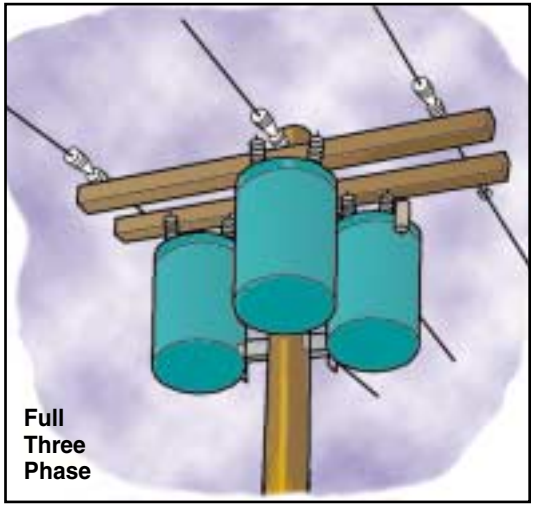
Transformer ratings should be no smaller than listed in the table for supply power to the motor alone.

TABLE 8 **Transformer Capacity Required for Submersible Motors**

Submersible 3ø Motor HP Rating	Total 3ø Motor HP Rating	Smallest KVA Rating - Each Transformer	
		Open WYE or Delta 2 Transformers	WYE Delta 3 Transformers
1.5	3	2	1
2	4	2	1.5
3	5	3	2
5	7.5	5	3
7.5	10	7.5	5
10	15	10	5
15	20	15	7.5
20	25	15	10
25	30	20	10
30	40	25	15
40	50	30	20
50	60	35	20
60	75	40	25
75	90	50	30
100	120	65	40
125	150	85	50
150	175	100	60
175	200	115	70
200	230	130	75



Open Delta or Wye



Full Three Phase

G. TRANSFORMER SIZES

H Pressure Switch Adjustment Checkout

Adjust in proper Sequence:

1. CUT-IN: Turn range nut down for higher cut-in pressure, or up for lower cut-in.
2. CUT-OUT: Turn differential nut down for higher cut-out pressure, or up for lower cut-out.

Note: Adjustment to range (cut-in) nut will also change cut-out pressure.

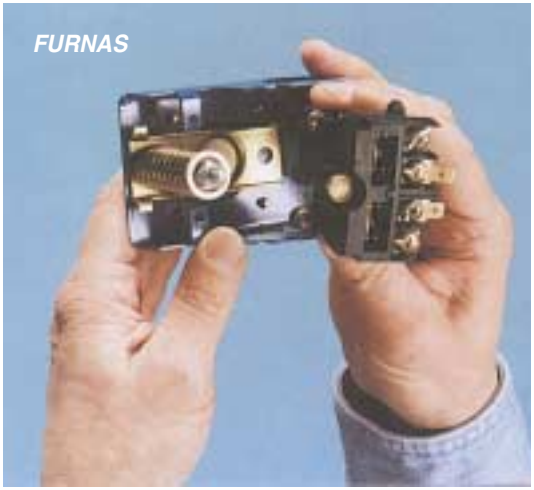
CAUTION

To avoid damage, do not exceed maximum allowable system pressure. Check switch operation after re-setting.

RULE OF THUMB

Check to be sure proper selection of pressure switch matched to system voltage has been made... refer to catalog data.

H. PRESSURE SWITCH ADJUSTMENT CHECKOUT



1. MAIN SPRING ADJUSTMENT: Turn clockwise to increase both Cut-Out and Cut-In pressure (2 psi / turn).
2. DIFFERENTIAL ADJUSTMENT: Turn differential nut clockwise to increase Cut-Out pressure without affecting Cut-In (3 psi / turn).

CAUTION

To avoid damage, do not exceed maximum allowable system pressure. Check switch operation after re-setting.

I Pressure Tank Checkout Procedure...

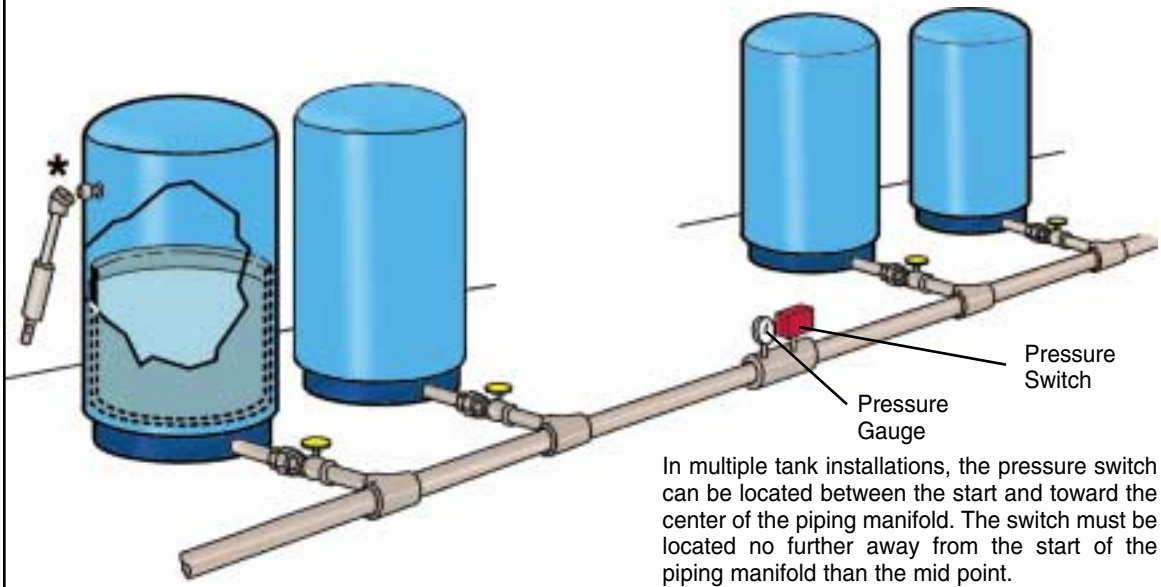
To check: Shut off power supply and fully drain system to "0" pressure. There should be no water left in the tank(s).

RULE OF THUMB

If water at air valve, replace tank.

Air pre-charge in top of pre-pressurized air tanks should be 2 psi less than the cut-in pressure of the pressure switch.

Example: If pressure switch setting is 30-50 psi, tank should be pre-charged with 28 lbs. air when empty of all water and pump turned off.



In multiple tank installations, the pressure switch can be located between the start and toward the center of the piping manifold. The switch must be located no further away from the start of the piping manifold than the mid point.

I. PRESSURE TANK CHECKOUT PROCEDURE

J Submersible Motor Cooling

A flow inducer sleeve should always be used when the pump is in a large body of water. Make sure that such an installation is grounded.

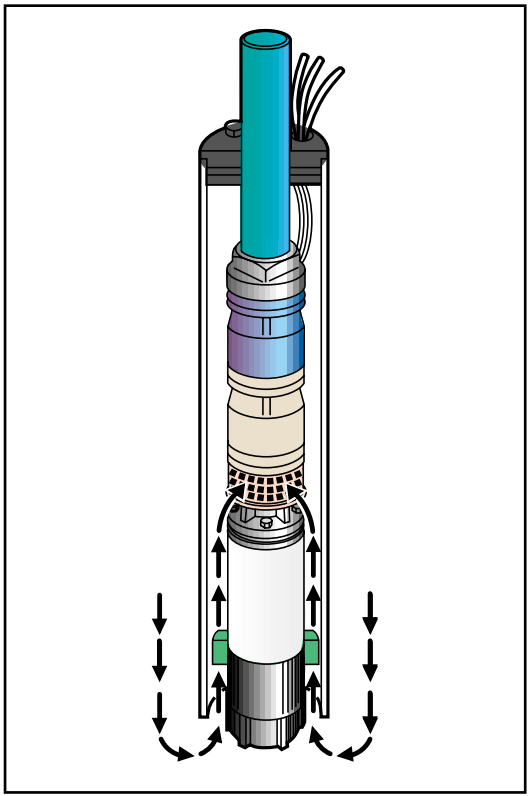
When the pump is below any screen openings or below the bottom of the casing a top feeding well condition can exist which reduces the rate of cooling water flow past the motor. If the flow rate is less than specified a flow inducer sleeve is needed.

Table 9 **Required Cooling Flow**

Minimum GPM required for motor cooling in water up to 86°F (30°C).

Inches casing or sleeve I.D.	4"high thrust motor .25 ft/sec GPM	6" motor .5 ft/sec GPM	8" motor .5 ft/sec GPM
4	1.2	—	—
5	7	—	—
6	13	9	—
7	20	25	—
8	30	45	10
10	50	90	55
12	80	140	110
14	110	200	170
16	150	280	245

J Submersible Motor Cooling



A flow inducer sleeve is a tube over the motor, closed off above the pump intake and extended to the bottom of the motor or lower. The sleeve material is corrosion resistant metal or heavy plastic.

J. SUBMERSIBLE MOTOR COOLING

200V 60Hz Three Phase Three Wire

	AWG Copper Wire Size										
HP	14	12	10	8	6	4	3	2	1	00	0
½	710	1140	1800	2840	4420						
¾	510	810	1280	2030	3160						
1	430	690	1080	1710	2670	4140	5140				
1 ½	310	500	790	1260	1960	3050	3780				
2	240	390	610	970	1520	2360	2940	3610	4430	5420	
3	180	290	470	740	1160	1810	2250	2760	3390	4130	
5	110*	170	280	440	690	1080	1350	1660	2040	2490	3050
7 ½	0	0	200	310	490	770	960	1180	1450	1770	2170
10	0	0	0	230*	370	570	720	880	1090	1330	1640
15	0	0	0	160*	250*	390	490	600	740	910	1110
20	0	0	0	0	190*	300	380	460	570	700	860
25	0	0	0	0	0	240	300*	370*	460	570	700
30	0	0	0	0	0	0	250*	310*	380*	470	580

230V 60Hz Three Phase Three Wire

½	930	1490	2350	3700	5760	8910					
¾	670	1080	1700	2580	4190	6490	8060	9860			
1	560	910	1430	2260	3520	5460	6780	8290			
1 ½	420	670	1060	1670	2610	4050	5030	6160	7530	9170	
2	320	510	810	1280	2010	3130	3890	4770	5860	7170	8780
3	240	390	620	990	1540	2400	2980	3660	4480	5470	6690
5	140*	230	370	590	920	1430	1790	2190	2690	3290	4030
7 ½	0	160*	260	420	650	1020	1270	1560	1920	2340	2870
10	0	0	190*	310	490	760	950	1170	1440	1760	2160
15	0	0	0	210*	330	520	650	800	980	1200	1470
20	0	0	0	0	250*	400	500	610	760	930	1140
25	0	0	0	0	0	320*	400	500	610	750	920
30	0	0	0	0	0	260*	330*	410*	510	620	760

460V 60Hz Three Phase Three Wire

	AWG Copper Wire Size										
HP	14	12	10	8	6	4	3	2	1	0	00
½	3770	6020	9460								
¾	2730	4350	6850								
1	2300	3670	5770	9070							
1 ½	1700	2710	4270	6730							
2	1300	2070	3270	5150	8050						
3	1000	1600	2520	3970	6200						
5	590	950	1500	2360	3700	5750					
7 ½	420	680	1070	1690	2640	4100	5100	6260	7680		
10	310	500	790	1250	1960	3050	3800	4680	5750	7050	
15	0	340*	540	850	1340	2090	2600	3200	3930	4810	5900
20	0	0	410*	650	1030	1610	2000	2470	3040	3730	4580
25	0	0	0	530*	830	1300	1620	1990	2450	3010	3700
30	0	0	0	430*	680	1070	1330	1640	2030	2490	3060
40	0	0	0	0	500*	790	980	1210	1490	1830	2250
50	0	0	0	0	0	640*	800	980	1210	1480	1810
60	0	0	0	0	0	540*	670*	830*	1020	1250	1540
75	0	0	0	0	0	0	0	680*	840*	1030	1260
100	0	0	0	0	0	0	0	0	620*	760*	940*
125	0	0	0	0	0	0	0	0	0	0	740*
150	0	0	0	0	0	0	0	0	0	0	0
175	0	0	0	0	0	0	0	0	0	0	0
200	0	0	0	0	0	0	0	0	0	0	0

Lengths marked * meet the NEC ampacity only for individual conductor 60° C cable in free air or water, not in conduit.

Flat molded cable is considered to be jacketed cable.

This table is based on copper wire.

CABLE SELECTION CHARTS

575V 60Hz Three Phase Three Wire

	AWG Copper Wire Size										
HP	14	12	10	8	6	4	3	2	1	0	00
½	5900	9410									
¾	4270	6810									
1	3630	5800	9120								
1 ½	2620	4180	6580								
2	2030	3250	5110	8060							
3	1580	2530	3980	6270							
5	920	1480	2330	3680	5750						
7 ½	660	1060	1680	2650	4150						
10	490	780	1240	1950	3060	4770	5940				
15	330*	530	850	1340	2090	3260	4060				
20	0	410*	650	1030	1610	2520	3140	3860	4760	5830	
25	0	0	520*	830	1300	2030	2530	3110	3840	4710	
30	0	0	430*	680	1070	1670	2080	2560	3160	3880	4770
40	0	0	0	500*	790	1240	1540	1900	2330	2860	3510
50	0	0	0	0	640*	1000	1250	1540	1890	2310	2840
60	0	0	0	0	0	850*	1060	1300	1600	1960	2440
75	0	0	0	0	0	690*	860*	1060*	1310	1600	1970
100	0	0	0	0	0	0	0	790*	970*	1190	1460
125	0	0	0	0	0	0	0	0	770*	950*	1160
150	0	0	0	0	0	0	0	0	0	800*	990*
175	0	0	0	0	0	0	0	0	0	0	870*
200	0	0	0	0	0	0	0	0	0	0	0

Lengths marked * meet the NEC ampacity only for individual conductor 60° C cable in free air or water, not in conduit.

Flat molded cable is considered to be jacketed cable.

This table is based on copper wire.

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