ITT

Residential Water Systems

CentriPro

Motor Application and Installation Data

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ADDITIONAL TECHNICAL DATA IN THIS MANUAL

Although this is basically a Motor Manual our experience has proven that proper troubleshooting and motor installation also requires well and pump information. To that end we have added non-typical technical data to this manual to assist you in making informed, thorough troubleshooting and installation decisions. We hope you find these additions helpful.

MOTOR STORAGE

Water lubricated 4" motors are filled with a non-toxic, Propylene Glycol and water solution to prevent damage from freezing temperatures. We recommend storing 4" motors where temperatures are above 0° F. If stored in colder temperatures (down to -40° F) the fill solution will become slushy, in this case the motor should be allowed to sit in the well for several minutes before operating. If stored in an area where temperatures range from freezing to over 100° F some fill solution may be expelled from the motor. If the leakage appears significant we suggest installing (submerging) the motor for 10 minutes before starting to allow the check valve to do its job and replace the lost fluid. You may also contact the factory for fluid fill checking instructions. Six inch and larger motors are protected from freezing to -22° F (-30° C). Checking instructions are in the 6" and Larger Pump IOM.

When removing a used motor from a well it must be protected from freezing as it may have taken on well water and no longer have enough propylene glycol in solution to prevent freezing.

FREQUENCY OF STARTS

A one (1) minute minimum run cycle for pumps and motors up to 1.5 hp and two (2) minutes for 2 HP and larger motors is recommended. Motor, pressure switch, tank and pump life may be extended by limiting starts per hour and per day. Proper tank sizing is critical to control pump cycle times. Excessive or rapid cycling creates heat which can prematurely damage motors, switches and controls.

TEMPERATURE AND TIME RATINGS

All 4 inch CentriPro motors may be operated continuously in water up to 86° F. Motors of 2 HP and larger require a flow rate past the motor of .25 feet per second. Use a Flow Sleeve if velocity is below the .25'/sec, if the well is top feeding or when the pump is used in a large body of water or large tank.

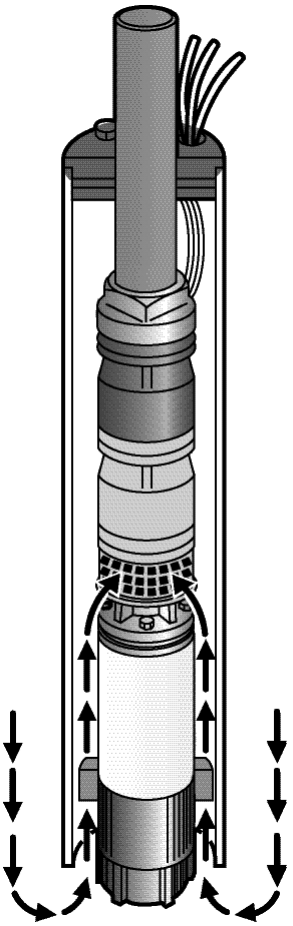
Six (6) inch canned design motors from 5 – 40 HP will operate in water up to 95° F (35° C), without any de-rating of horsepower, with a minimum flow rate of .5 ft./sec. past the motor. 6" – 50 HP and all 8" – 10" motors can operate in 77° F (25° C) water with .5'/sec velocity past the motor.

Minimum Flow Rates For Proper Motor Cooling

Well or Sleeve Diameter (inches)	3.75" Diameter 4" CP or FE Motor, 2 HP or larger .25'/sec	CP = 5.5" Dia. 6" CP Motor .5'/sec.	FE = 5.38" Dia. 6" FE Motor .5'/sec.	CP = 7.52" Dia. 8" CP Motor .5'/sec.
	GPM Required			
4	1.2	–	–	–
5	7	–	–	–
6	13	7	9	–
7	20	23	25	–
8	30	41	45	9
10	50	85	90	53
12	80	139	140	107
14	110	198	200	170
16	150	276	280	313

Multiply gpm by .2271 for m^3/Hr.
Multiply gpm by 3.785 for l/min.

One way to make a flow sleeve is to install a well seal above the pump discharge and slip a piece of casing over the pump and affix it to the well seal. Drill three holes at 120º intervals on the lower section of the casing and insert (3) screws and nuts through the casing, just touching the motor. Tighten the nuts out against the casing. Insure that the screws do not protrude out too far as you don't want them catching on well joints.



FLOW SLEEVE

MOTOR INSTALLATION POSITION

Best service life is obtained when motors are installed in a vertical position. Installing in a horizontal position is allowable. It is best if the shaft end is at least 15º higher than the bottom of the motor. This places some weight on the thrust bearing which helps to prevent thrust bearing coast down wear as the motor slows down. When installed in horizontal installations we recommend keeping starts to a minimum and maintaining back pressure (head) on the system. Even when installed vertically, operating pumps at Open Discharge with little or no Head (to the far right of the pump curve) may create excessive upward thrust which may damage the motor's upthrust bearing and internal pump parts – in applications with high static water levels or little system head always use a throttling valve in the discharge line to create backpressure (head) on the pump and bearing.

CONTROL BOX MOUNTING

Single phase submersible control boxes feature NEMA 3R enclosures for indoor or outdoor mounting. They should be mounted in a vertical position as relay manufacturers recommend correct relay positioning for proper, trouble-free operation.

Control boxes should be shaded from direct sunlight in areas where temperatures exceed 90º F as excessive heat may shorten capacitor life. It is advisable to paint the enclosure white if outside in very hot, sunny climates.

2-WIRE MOTOR DATA

Two Wire PSC, Single Phase 4" Motors - Electrical data, 60 Hertz, 3450 RPM

							Full Load		Service Factor		Locked Rotor Amps	Winding Resistance
Type	CP Order No.	Alt. Order No.	HP	KW	Volts	SF	Amps	Watts	Amps	Watts		
2-Wire (PSC)	M05421	50C201	0.5	0.37	115	1.6	7.4	845	9.5	1088	36.4	1.4-1.7
	M05422	50C211	0.5	0.37	230	1.6	3.7	834	4.7	1073	19.5	4.6-5.6
	M07422	75C211	0.75	0.55	230	1.5	5.0	1130	6.4	1459	24.8	3.5-4.3
	M10422	100C211	1.0	0.75	230	1.4	7.9	1679	9.1	1990	22.0	4.2-5.2
	M15422	150C211	1.5	1.1	230	1.3	9.2	2108	11.0	2520	42.0	1.9-2.3

Two Wire PSC, Single Phase 4" Motors - Engineering Data

						Efficiency %		Power Factor %		RPM	
Type	CP Order No.	Alt. Order No.	HP	KW	Volts	F.L.	S.F.	F.L.	S.F.	F.L.	S.F.
2-Wire (PSC)	M05421	50C201	0.5	0.37	115	49.4	60.6	99.5	99.7	3528	3483
	M05422	50C211	0.5	0.37	230	50.1	61.5	97.4	98.8	3530	3489
	M07422	75C211	0.75	0.55	230	54.5	64.8	97.3	98.8	3520	3474
	M10422	100C211	1.0	0.75	230	51.0	59.0	92.3	95.0	3500	3462
	M15422	150C211	1.5	1.1	230	59.0	62.7	99.4	99.7	3503	3472

			Fuse or Circuit Breaker Amps			
Type	CP Order No.	Alternate Order No.	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker	KVA Code
2-Wire (PSC)	M05421	50C201	30	20	25	K
	M05422	50C211	15	10	15	K
	M07422	75C211	20	15	20	J
	M10422	100C211	25	15	20	F
	M15422	150C211	35	20	30	H

3-WIRE MOTOR DATA

Three Wire, Single Phase 4" Motors - Electrical data, 60 Hertz, 3450 RPM

							Full Load		Service Factor		Locked Rotor Amps	Winding Resistance	
Type	CP Order No.	Alt. Order No.	HP	KW	Volts	SF	Amps	Watts	Amps	Watts		Main (B-Y)	Start (R-Y)
3-Wire with Cap. Start CB	M05411	50C301	0.5	0.37	115	1.6	Y – 11.0 B – 11.0 R – 0	637	Y – 12.6 B – 12.6 R – 0	916	49.6	1.1-1.4	5.7-7.0
	M05412	50C311	0.5	0.37	230	1.6	Y – 5.5 B – 5.5 R – 0	745	Y – 6.3 B – 6.3 R – 0	1033	22.3	4.0-4.9	16.3-19.9
	M07412	75C311	0.75	0.55	230	1.5	Y – 7.2 B – 7.2 R – 0	1014	Y – 8.3 B – 8.3 R – 0	1381	32.0	2.7-3.3	11.1-13.6
	M10412	100C311	1.0	0.75	230	1.4	Y – 8.4 B – 8.4 R – 0	1267	Y – 9.7 B – 9.7 R – 0	1672	41.2	2.5-3.1	10.6-13.0
3-Wire with Cap. Start/ Cap. Run CB	M05412	50C311	0.5	0.37	230	1.6	Y – 4.1 B – 4.1 R – 2.2	720	Y – 4.9 B – 4.4 R – 2.1	955	22.3	4.0-4.9	16.3-19.9
	M07412	75C311	0.75	0.55	230	1.5	Y – 5.1 B – 5.0 R – 3.2	1000	Y – 6.3 B – 5.6 R – 3.1	1300	32.0	2.7-3.3	11.1-13.6
	M10412	100C311	1.0	0.75	230	1.4	Y – 6.1 B – 5.7 R – 3.3	1205	Y – 7.2 B – 6.3 R – 3.3	1530	41.2	2.5-3.1	10.6-13.0
	M15412	150C311	1.5	1.1	230	1.3	Y – 9.7 B – 9.5 R – 1.4	1693	Y – 11.1 B – 11.0 R – 1.3	2187	47.8	1.9-2.4	7.4-9.1

Three Wire, Single Phase 4" Motors - Engineering Data

						Efficiency %		Power Factor %		RPM	
Type	CP Order No.	Alt. Order No.	HP	KW	Volts	F.L.	S.F.	F.L.	S.F.	F.L.	S.F.
3-Wire Capacitor Start	M05411	50C301	0.5	0.37	115	58.8	65.0	54.3	69.2	3523	3472
	M05412	50C311	0.5	0.37	230	50.2	57.6	58.3	71.3	3517	3466
	M07412	75C311	0.75	0.55	230	55.3	60.8	61.1	72.4	3510	3461
	M10412	100C311	1.0	0.75	230	58.9	62.4	65.6	75.2	3505	3461
	M15412	150C311	1.5	1.1	230	65.8	67.1	80.0	85.5	3489	3445

			Fuse or Circuit Breaker Amps			
Type	CP Order No.	Alternate Order No.	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker	KVA Code
All 3-Wire	M05411	50C301	35	20	30	N
	M05412	50C311	20	10	15	M
	M07412	75C311	25	15	20	L
	M10412	100C311	30	20	25	L
	M15412	150C311	35	20	30	J

CROSS REFERENCE

Control Box Cross Reference

			New Control Box #'s		=	Old Model Numbers			
Control Box Type	HP	Volts	CentriPro Brand	Goulds Pumps		Replaces F. E. Control Box	Replaces Goulds CB	Replaces Red Jacket	
								RJ CB	RJ - FE
QD	0.5	115	CB05411	CB05411G	New models « Left will replace all old model numbers to the Right »	2801044915	00043 (G)	-	50F301CB
	0.5	230	CB05412	CB05412G		2801054902	00044 (G)	-	50F311CB
	0.75	230	CB07412	CB07412G		2801074915	00054 (G)	-	75F311CB
	1	230	CB10412	CB10412G		2801084915	00064 (G)	-	100F311CB
CSCR or Integral	0.5	230	CB05412CR	CB05412CRG		2824055015	00044CR	S50N1CB	-
	0.75	230	CB07412CR	CB07412CRG		2824075015	00054CR	S75N1CB	-
	1	230	CB10412CR	CB10412CRG		2824085015	00064CR	S100N1CB	-
	1.5	230	CB15412CR	CB15412CRG		2823008110	00074	S150N1CB	150F311CB
	2	230	CB20412CR	CB20412CRG		2823018310	00084	S200N1CB	200F311CB
	3	230	CB30412CR	CB30412CRG		2823028110	00094	S300N1CB	300F311CB
	5	230	CB50412CR	CB50412CRG		2821138110	00104	S500N1CB	500F311CB
MC or Deluxe	1.5	230	CB15412MC	CB15412MCG		Not Available Before			
	2	230	CB20412MC	CB20412MCG		2823018310	00084MC	S200N1CBC	200F311CBC
	3	230	CB30412MC	CB30412MCG		2823028310	00094MC	S300N1CBC	300F311CBC
	5	230	CB50412MC	CB50412MCG		2821139310	00104MC	S500N1CBC	500F311CBC

Motor Cross Reference

Motor Type	HP	Volts	Old Motor Numbers			New Motor Order No.	
			Old GP #	Old RJ #	F.E. #	CentriPro	Red Jacket
2-wire	0.5	115	S04932	50F201	244504	M05421	50C201
	0.5	230	S04942	50F211	244505	M05422	50C211
	0.75	230	S05942	75F211	244507	M07422	75C211
	1	230	S06942	100F211	244508	M10422	100C211
	1.5	230	S07942	150F211	244309	M15422	150C211
3-wire	0.5	115	S04930	50F301	214505	M05411	50C301
	0.5	230	S04940	50F311	214505	M05412	50C311
	0.75	230	S05940	75F311	214507	M07412	75C311
	1	230	S06940	100F311	214508	M10412	100C311
	1.5	230	S07940	150F311	224300	M15412	150C311
	2	230	S08940	200F311	224301	M20412	200C311
	3	230	S09940	300F311	22430226	M30412	300C311
	3	230	S09940HT	300F311HT	22430252	N/R	N/R
	5	230	S10940	500F311	224303	M50412	500C311

Models in shaded area will be available in mid-2007.

* CentriPro Order No's are used on Goulds Pumps and Red Jacket Model No's are used on Red Jacket subs.

6" SINGLE PHASE MOTORS AND REQUIRED CONTROL BOXES

Motor Order No.	HP	kW	Volts	Phase	Motor Dia. vs Flange Dia.	S.F.	Rated Input		Service Factor		L.R. Amps	Control Box Order No.
							Amps	Watts	Amps	Watts		
6M051	5	3.7	230	1	6″ x 6″	1.15	24	4987	27.5	5735	124	CB05MC
6M071	7.5	5.5					36	7675	41	8950	167	CB07MC
6M101	10	7.5					50	10135	58	11830	202	CB10MC
6M151	15	11					72	15180	85	18050	275	CB15MC

6-10" THREE PHASE MOTORS

Motor Order No.	HP	kW	Volts	Phase	Motor Dia. vs Flange Dia.	S.F.	Rated Input		Service Factor		L.R. Amps	Class 14 Starter*
							Amps	Watts	Amps	Watts		
6M058	5	3.7	200	3	6" x 6"	1.15	17.5	4910	19.5	5610	124	DSFD
6M052	5	3.7	230				15.0	4857	17.0	5520	110	DSFC
6M054	5	3.7	460				7.5	4857	8.5	5520	55	DSDC
6M059	5	3.7	575				5.9	4850	6.5	5520	44	DSDE
6M078	7.5	5.5	200				25.4	7180	28.5	8230	158	ESGD
6M072	7.5	5.5	230				22.0	7127	26.0	8140	144	DSFC
6M074	7.5	5.5	460				11.0	7127	13.0	8140	72	DSEC
6M079	7.5	5.5	575				8.7	7070	9.7	8080	56	DSEE
6M108	10	7.5	200				33.3	9360	37.2	10700	236	ESGD
6M102	10	7.5	230				29.0	9407	33.0	10730	208	ESGC
6M104	10	7.5	460				14.5	9407	16.5	10730	104	DSEC
6M109	10	7.5	575				11.1	9200	12.5	10520	82	DSEE
6M158	15	11	200				47.4	13700	53.5	15710	347	GSJD
6M152	15	11	230				42.0	13700	46.0	15800	320	FSHC
6M154	15	11	460				21.0	13700	23.0	15800	160	ESFC
6M159	15	11	575				16.6	13850	18.6	15820	125	ESFE
6M208	20	15	200				61.2	18040	69.5	20820	431	HSKD
6M202	20	15	230				54.0	17930	60.0	20650	392	GSGC
6M204	20	15	460				27.0	17930	30.0	20650	196	FSHC
6M209	20	15	575				21.1	17920	23.9	20630	155	FSFE
6M258	25	18.5	200				77.3	22740	87.5	26190	578	HSKD
6M252	25	18.5	230				68.0	22470	76.0	25800	530	HSKC
6M254	25	18.5	460				34.0	22470	37.0	25800	265	FSHC
6M259	25	18.5	575				26.9	22440	30.2	25760	213	FSHE
6M308	30	22	200				91.8	27000	104.0	31120	674	ISLD
6M302	30	22	230				82.0	27130	94.0	31160	610	ISLC
6M304	30	22	460				41.0	27130	47.0	31160	305	HSJC

6-10" THREE PHASE MOTORS *(continued)*

Motor Order No.	HP	kW	Volts	Phase	Motor Dia. vs Flange Dia.	S.F.	Rated Input		Service Factor		L.R. Amps	Class 14 Starter*
							Amps	Watts	Amps	Watts		
6M309	30	22	575	3	6" x 6"	1.15	31.7	27040	35.8	31070	235	GSHE
6M404	40	30	460				53.0	35530	60.0	41100	340	HSKC
6M409	40	30	575				41.3	35640	47.1	41200	272	HSJE
66M504	50	37	460				70.0	45210	79.0	52380	465	HSKC
66M509	50	37	575				55.4	45310	62.6	52480	372	HSKE
86M504	50	37	460		8" x 6"		65.0	44360	73.0	51000	435	HSKC
86M509	50	37	575									HSKE
86M604	60	45	460				80.0	52850	90.0	60900	510	ISLC
86M609	60	45	575									ISLE
8M754	75	55	460		8" x 8"		96.0	65900	109.0	76100	650	ISLC
8M759	75	55	575									ISLE
8M1004	100	75	460				127.0	87600	145.0	101300	795	NA
8M1009	100	75	575									NA
8M1254	125	90	460				160.0	110800	180.0	126000	980	NA
8M1259	125	90	575									NA
8M1504	150	110	460				195.0	130700	220.0	152000	1060	NA
8M1509	150	110	575									NA
10M2004	200	150	460		10 "x 10"		235.0	171100	270.0	198600	1260	NA
10M2009	200	150	575									

* Furnas Class 14 NEMA Starter with ESP100 Adjustable Overloads and phase loss protection. Overloads were selected based on SF Amps as submersible pumps use the available motor service factor.

* Available Coil Voltages and their 4th character code are:

A = 120/240 E = 575 ex. CSBA has a 120/240V Coil

C = 240/480 G = 240

D = 200/208 H = 480

DATA NOT YET AVAILABLE

5-30 HP, 3 Phase 230 and 460 Motors have adjustable voltage feature, change voltage plugs to convert from 230V to 460V operation. Spare Change Plug Order No's are: PLUG-230V or PLUG-460V

NOTE: The selection of Furnas "K" type ambient compensated heaters (overloads) is determined based on the Class of starter being used. Class 16 DP starters use Furnas overload heater relay Tables 393, 395 and 398. Obsolete Class 15 and Innova starters use different tables and therefore different heaters.

6" SINGLE PHASE MOTORS

Motor Order No.	HP	kW	Volts	Phase	F.L. Efficiency %	KVA Code	Resistance - Ohms		
							R - Y	B - Y	R - B
6M051	5	3.7	230	1	74.8	G	2.172	0.512	2.627
6M071	7.5	5.5			72.9	F	1.401	0.400	1.774
6M101	10	7.5			73.6	E	1.052	0.316	1.310
6M151	15	11			73.7	D	0.678	0.230	0.850

6-10" THREE PHASE MOTORS

Motor Order No.	HP	kW	Volts	Phase	F.L. Efficiency %	KVA Code	Line - Line Resistance	Time Delay Fuse	
								Standard	Dual Element
6M058	5	3.7	200	3	75.9	K			
6M052	5	3.7	230		76.8	K	0.806	45	20
6M054	5	3.7	460		76.8	K	3.050	25	10
6M059	5	3.7	575		76.9	K			
6M078	7.5	5.5	200		77.9	J			
6M072	7.5	5.5	230		78.5	J	0.651	70	30
6M074	7.5	5.5	460		78.5	J	2.430	35	15
6M079	7.5	5.5	575		79.1	J			
6M108	10	7.5	200		79.7	K			
6M102	10	7.5	230		79.3	K	0.448	90	40
6M104	10	7.5	460		79.3	K	1.619	45	20
6M109	10	7.5	575		81.1	K			
6M158	15	11	200		81.7	K			
6M152	15	11	230		81.7	K	0.312	150	60
6M154	15	11	460		81.7	K	1.074	70	30
6M159	15	11	575		80.8	K			
6M208	20	15	200		82.7	J			
6M202	20	15	230		83.2	J	0.258	175	70
6M204	20	15	460		83.2	J	0.861	90	35
6M209	20	15	575		83.3	J			
6M258	25	18.5	200		82.0	K			
6M252	25	18.5	230		83.0	K	0.210	225	90
6M254	25	18.5	460		83.0	K	0.666	110	45
6M259	25	18.5	575		83.1	K			
6M308	30	22	200		82.9	J			
6M302	30	22	230		82.5	K	0.166	250	100

6-10" THREE PHASE MOTORS *(continued)*

Motor Order No.	HP	kW	Volts	Phase	F.L. Efficiency %	KVA Code	Line - Line Resistance	Time Delay Fuse	
								Standard	Dual Element
6M304	30	22	460	3	82.5	K	0.554	125	50
6M309	30	22	575		82.8	J			
6M404	40	30	460		84.0	H	0.446	175	70
6M409	40	30	575		83.7	H			
66M504	50	37	460		82.5	J	0.388	225	90
66M509	50	37	575		82.3	J			
86M504	50	37	460		84.1	H	0.331	200	90
86M509	50	37	575		84.1	H			
86M604	60	45	460		84.7	H	0.278	250	110
86M609	60	45	575		84.7	H			
8M754	75	55	460		84.9	H	0.218	300	125
8M759	75	55	575		84.9	H			
8M1004	100	75	460		85.2	H	0.164	400	175
8M1009	100	75	575		85.2	H			
8M1254	125	90	460		84.2	G	0.132	500	225
8M1259	125	90	575		84.2	G			
8M1504	150	110	460		85.6	G	0.115	600	250
8M1509	150	110	575		85.6	G			
10M2004	200	150	460		87.2	F	0.0929	800	350
10M2009	200	150	575		87.2	F			

DATA NOT YET AVAILABLE

3-WIRE AND 2-WIRE 1Ø MOTOR WIRE SIZING CHART

Motor Lead Lengths - CentriPro 2 Wire Motors - Based on Service Factor Amps, 30º C Ambient and 5% Voltage Drop														
Motor Rating				60º C & 75º C Insulation - AWG Copper Wire Size										
Volts	HP	kW	SFA	14	12	10	8	6	4	2	1/0	2/0	3/0	4/0
115	½	0.37	9.5	115	183	293	463	721	1150	1825	2902	3662	4623	5824
230	½	0.37	4.7	466	742	1183	1874	2915	4648	7379	11733	14803	18688	23544
230	¾	0.55	6.4	342	545	869	1376	2141	3413	5419	8617	10871	13724	17290
230	1	0.75	9.1	241	383	611	968	1506	2400	3811	6060	7646	9652	12160
230	1½	1.1	11.0	199	317	505	801	1246	1986	3153	5013	6325	7985	10060

Motor Lead Lengths - CentriPro 3 Wire Motors (CSIR) - Based on Service Factor Amps, 30º C Ambient and 5% Voltage Drop														
Motor Rating				60º C & 75º C Insulation - AWG Copper Wire Size										
Volts	HP	kW	SFA	14	12	10	8	6	4	2	1/0	2/0	3/0	4/0
115	½	0.37	12.6	87	138	221	349	544	867	1376	2188	2761	3485	4391
230	½	0.37	6.3	348	553	883	1398	2175	3467	5505	8753	11044	13942	17564
230	¾	0.55	8.3	264	420	670	1061	1651	2632	4178	6644	8383	10582	13332
230	1	0.75	9.7	226	359	573	908	1413	2252	3575	5685	7173	9055	11408
230	1½	1.1	11.1	197	314	501	793	1234	1968	3124	4968	6268	7913	9969

Tables based on values from NEC, Tables 310.16 and 310.17 and NEC, Chapter 9, Table 8 Conductor Properties.

NOTE: Motors and control boxes are designed to operate on 230V systems. Systems with low line voltage, between 200 – 207 volts require the next larger cable size than shown in the 230V charts. If using a 3-wire motor with control box on a low voltage application switch to a 208V start relay. The 208V start relay order numbers are found on control box repair part charts in this manual.

Another option is to use a boost transformer to increase voltage.

The 2-wire sizing chart above is only for use with PSC type, 2-wire motors.

Temperature Conversions:

20º C = 68º F,
30º C = 86º F,
60º C = 140º F,
75º C = 167º F,
90º C = 194º F

THIS PAGE RESERVED FOR 4" THREE PHASE MOTOR WIRING CHARTS

DATA FOR ½ – 7.5 HP CENTRIPRO MOTORS NOT YET AVAILABLE.

Use for CentriPro 6-10" Motors

75° C CABLE, 60 HZ (SERVICE ENTRANCE TO MOTOR) MAXIMUM LENGTH IN FEET

Motor Rating		75° C Insulation - AWG Copper Wire Size														
Volts	HP	14	12	10	8	6	4	2	1	1/0	2/0	3/0	4/0	250	350	500
230V 60 Hz. Single Phase	5	0	100	170	260	430	680	1060	1330	1660	2070	2560	3190			
	7.5	0	0	**120**	200	310	490	760	940	1150	1420	1740	2120			
	10	0	0	0	**140**	220	340	520	660	810	1020	1250	1540			
	15	0	0	0	0	**140**	**230**	370	450	560	700	870	1080			
200V 60 Hz. Three Phase 3 Lead	5															
	7.5															
	10															
	15															
	20															
	25															
	30															
230V 60 Hz. Three Phase 3 Lead	5	**140**	230	370	590	920	1430	2190	2690	3290	4030	4850	5870	6650	8460	
	7.5	0	**150**	250	410	640	1010	1540	1900	2310	2840	3400	4120	4660	5910	7440
	10	0	0	**180**	300	470	740	1140	1410	1720	2110	2550	3090	3510	4500	5710
	15	0	0	0	**200**	320	510	790	970	1180	1450	1760	2120	2410	3080	3900
	20	0	0	0	**150**	**240**	390	600	750	920	1130	1370	1670	1900	2440	3100
	25	0	0	0	0	**190**	310	490	600	730	900	1100	1330	1510	1950	2480
	30	0	0	0	0	0	**250**	390	490	590	730	890	1080	1230	1580	2030
460V 60 Hz. Three Phase 3 Lead	5	590	950	1500	2360	3700	5750									
	7.5	410	670	1060	1670	2610	4060	6200	7610							
	10	300	480	770	1220	1910	2980	4580	5630	6900						
	15	0	**330**	530	840	1320	2070	3160	3890	4760	5840	7040				
	20	0	0	400	640	1020	1600	2460	3020	3710	4560	5500				
	25	0	0	**320**	520	810	1280	1960	2410	2960	3640	4400	5350			
	30	0	0	0	**410**	650	1030	1570	1950	2390	2940	3560	4330	4940		
	40	0	0	0	**320**	**500**	790	1220	1500	1840	2270	2730	3320	3760		
	50	0	0	0	0	**390**	**610**	940	1170	1430	1750	2110	2560	2910	3700	4690
	60	0	0	0	0	0	**540**	830	1020	1250	1540	1860	2250	2550	3260	4120
	75	0	0	0	0	0	**430**	**660**	820	1000	1230	1480	1810	2050	2640	3360
	100	0	0	0	0	0	0	**490**	**610**	**750**	930	1120	1360	1540	1990	2520
	125	0	0	0	0	0	0	0	0	**620**	**770**	**920**	1040	1270	1620	2040
	150	0	0	0	0	0	0	0	0	0	**620**	**750**	**910**	1040	1330	1680
	200	0	0	0	0	0	0	0	0	0	0	**610**	**740**	**840**	1070	1370

Use for CentriPro 6-10" Motors

60° C CABLE, 60 HZ (SERVICE ENTRANCE TO MOTOR) MAXIMUM LENGTH IN FEET

Motor Rating		60° C Insulation - AWG Copper Wire Size														
Volts	**HP**	**14**	**12**	**10**	**8**	**6**	**4**	**2**	**1**	**1/0**	**2/0**	**3/0**	**4/0**	**250**	**350**	**500**
230V	5	0	0	**170**	260	430	680	1060	1330	1660	2070	2560				
60 Hz.	7.5	0	0	0	**200**	310	490	760	940	1150	1420	1740				
Single	10	0	0	0	0	**220**	340	520	660	810	1020	1250	1540			
Phase	15	0	0	0	0	0	**230**	370	450	560	700	870	1080			
	5	**140**	230	370	590	920	1430	2190	2690	3290	4030	4850	5870	6650	8460	
230V	7.5	0	**150**	250	410	640	1010	1540	1900	2310	2840	3400	4120	4660	5910	7440
60 Hz.	10	0	0	**180**	300	470	740	1140	1410	1720	2110	2550	3090	3510	4500	5710
Three	15	0	0	0	**200**	320	510	790	970	1180	1450	1760	2120	2410	3080	3900
Phase	20	0	0	0	0	**240**	390	600	750	920	1130	1370	1670	1900	2440	3100
3 Lead	25	0	0	0	0	0	**310**	490	600	730	900	1100	1330	1510	1950	2480
	30	0	0	0	0	0	**250**	**390**	490	590	730	890	1080	1230	1580	2030
	5	590	950	1500	2360	3700	5750									
	7.5	410	670	1060	1670	2610	4060	6200	7610							
	10	300	480	770	1220	1910	2980	4580	5630	6900						
	15	0	**330**	530	840	1320	2070	3160	3890	4760	5840	7040				
	20	0	0	**400**	640	1020	1600	2460	3020	3710	4560	5500				
460V	25	0	0	0	**520**	810	1280	1960	2410	2960	3640	4400	5350			
60 Hz.	30	0	0	0	**410**	650	1030	1570	1950	2390	2940	3560	4330	4940		
Three	40	0	0	0	0	**500**	790	1220	1500	1840	2270	2730	3320	3760		
Phase	50	0	0	0	0	0	**610**	940	1170	1430	1750	2110	2560	2910	3700	4690
3 Lead	60	0	0	0	0	0	**540**	**830**	1020	1250	1540	1860	2250	2550	3260	4120
	75	0	0	0	0	0	0	**660**	**820**	1000	1230	1480	1810	2050	2640	3360
	100	0	0	0	0	0	0	0	**610**	**750**	**930**	1120	1360	1540	1990	2520
	125	0	0	0	0	0	0	0	0	0	**770**	**920**	**1040**	1270	1620	2040
	150	0	0	0	0	0	0	0	0	0	0	**750**	**910**	**1040**	1330	1680
	200	0	0	0	0	0	0	0	0	0	0	0	0	**840**	**1070**	1370

Lengths NOT IN BOLD TYPE meet the U.S. N.E.C. ampacity for either individual conductors or jacketed 60° C cable.

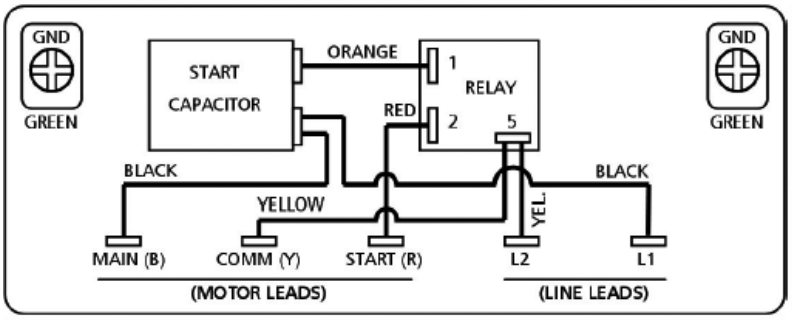
Lengths **IN BOLD TYPE** meet the National Electric Code ampacity only for individual conductor 60° C cable, in free air or water. If other cable is used, the National Electric Code as well as the local codes should be observed.

NOTE: 60° C cable is no longer the industry standard and may not be readily available. See 75° C Cable Chart, as it is now very common and available.

1Ø THREE-WIRE CONTROL BOX WIRING CHARTS

Quick Disconnect ½ – 1 HP

WIRING DIAGRAM



CHECK OUT DATA

Motor		Standard Circuit Breaker	Winding Resistance (Ohms)		Relay (Ohms)	Dimensions (in)
HP	Volts		Main (BLK/YL)	Start (RD/YL)		
½	115	30	1.0 – 1.5	4.0 – 5.5	3900	W 4.9" D 3.0" H 8.5"
½	230	15	4.0 – 5.5	16.5 – 20.5	5600	
¾	230	20	3.0 – 4.0	11.0 – 13.5	5600	
1	230	25	2.0 – 3.0	10.0 – 12.5	5600	

NOTE: Resistance of drop cable must be added to above values when checking pump in the well.

"K" REPAIR PARTS FOR QUICK DISCONNECT STYLE CONTROL BOXES*

Order Number	Old Order Number	HP	Volts	Capacitor Order Number	Start Capacitor Mfd	Capacitor Voltage	Capacitor Quantity	Start Relay Order No.	Supplier Number
CB05411 (G)	00043 (GP)	.5	115	9K450	250 - 300	125	1	9K457	RVA7AA (6L) (or KL)
CB05412 (G)	00044 (GP)	.5	230	9K448	59 - 71	220	1	9K462	RVA2AL (6L) (or KL)
CB07412 (G)	00054 (GP)	.75	230	9K449	86 - 103	220	1		
CB10412 (G)	00064 (GP)	1	230	9K447	105 - 126	220	1		
Special 208 V Relay for .5 - 1 HP operating on 200 or 208 volt power supplies Order No. 9K461.									

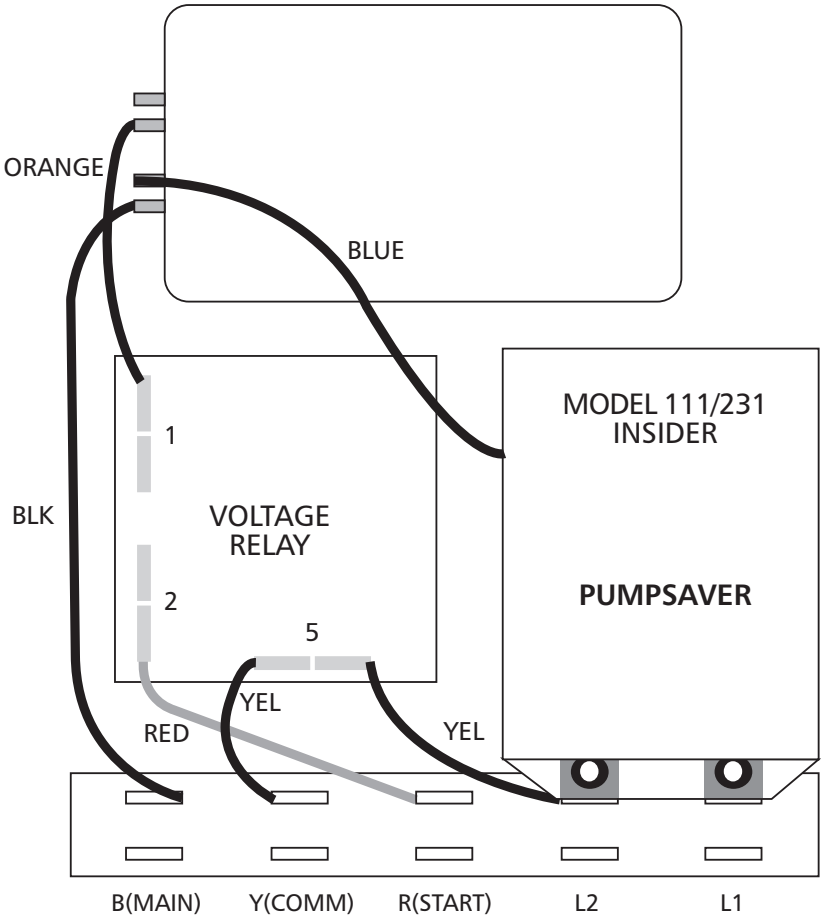
* Repair parts will work in new voltage relay control boxes as well as in control boxes shown in Old Order No. column above.

Prices for "K" parts are in our Repair Part Price Book, PRP, available from the Literature Distribution Center at phone (315) 255-3378, fax (315) 253-7408 or email, wtdldc@itt.com.

CENTRIPRO™ QUICK DISCONNECT WITH PUMPSAVER INSIDER

CONNECTIONS:

1. Remove the cover from the front of the 3-wire CentriPro control box.
2. Remove the yellow wire from the terminal strip at L2.
3. Remove the black wire connecting L1 and the capacitor completely from the box.
4. Press the PumpSaver® onto the L1 and L2 terminals.
5. Reconnect the yellow wire to L2 on the PumpSaver.
6. Connect the blue wire attached to the PumpSaver to the dual-lug terminal (with the black wire) of the capacitor.



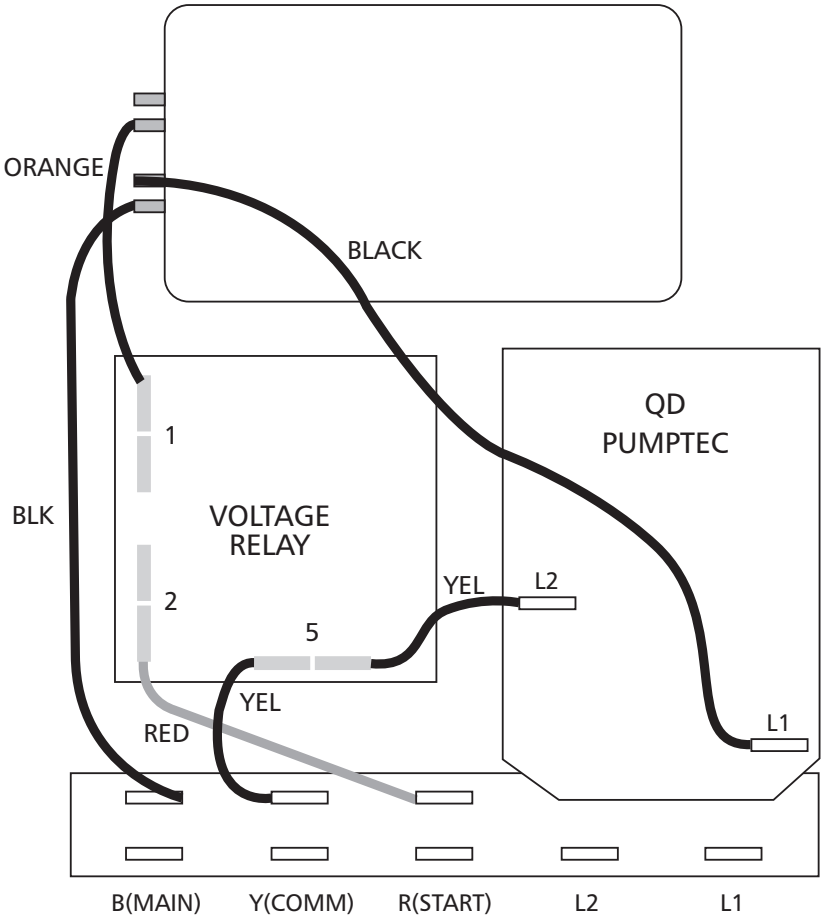
CENTRIPRO CONTROL BOX WITH INSIDER INSTALLED

CENTRIPRO™ QUICK DISCONNECT WITH QD PUMPTEC

CONNECTIONS:

1. Remove the cover from the front of the 3-wire CentriPro control box.
2. Remove the yellow wire from the terminal strip at L2.
3. Remove the black wire connecting L1 and the capacitor from L1.
4. Press the QD Pumptec onto the L1 and L2 terminals.
5. Reconnect the yellow wire to L2 on the QD Pumptec.
6. Connect the black wire from the capacitor to L1 on the QD Pumptec.

NOTE: The QD Pumptec and Pumptec will only work with Franklin Electric 4" motors.

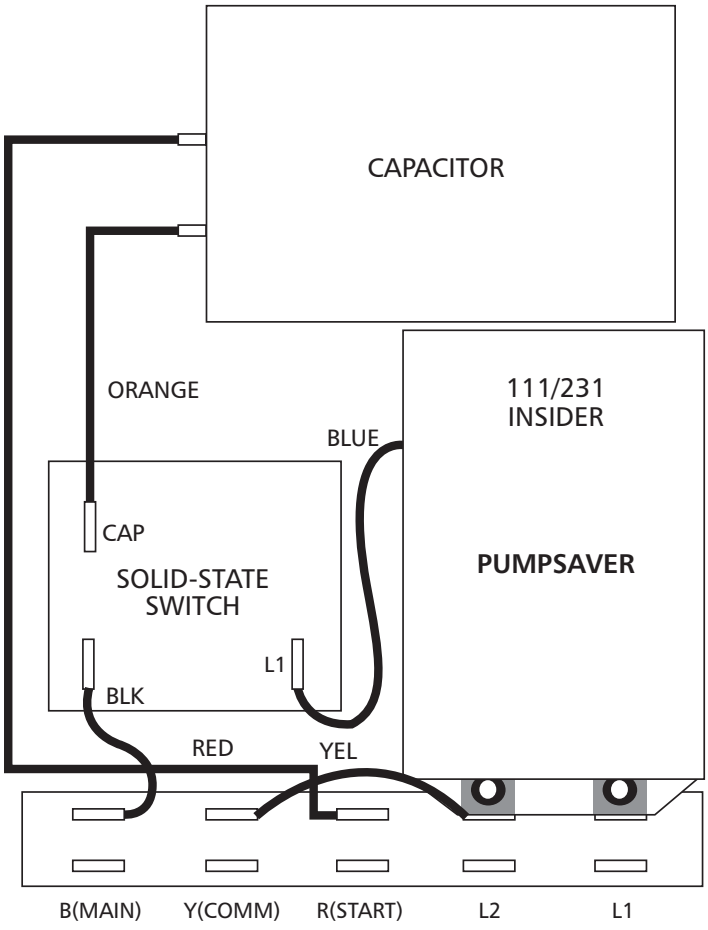


CENTRIPRO CONTROL BOX WITH PUMPTEC INSTALLED

FRANKLIN™ Q-D WITH PUMPSAVER INSIDER

CONNECTIONS:

1. Remove blue wire from terminal strip and solid state switch (blue relay) and discard.
2. Remove yellow jumper wire from terminal L2.
3. Install Insider by aligning tabs with upper L2 and L1 tabs and pushing onto tabs.
4. Connect yellow wire onto L2 terminal on Insider.
5. Connect blue wire attached to Insider to L1 on solid state switch (blue relay).



FRANKLIN CONTROL BOX WITH INSIDER INSTALLED

CSCR 1Ø CONTROL BOXES
CAPACITOR START - CAPACITOR RUN

FOR USE WITH 3 WIRE, 1Ø, 4" CENTRIPRO MOTORS AND 4" (6", 5 HP) FRANKLIN ELECTRIC MOTORS

Control Box Order Number	HP	KW	Volts	May Replace GP #	May Replace RJ #	May Replace FE #	Standard Circuit Breaker	Standard Fuse	Dual Element Time Delay Fuse	Enclosure Dimensions W x D x H (in)	Shipping Wt. (lbs)
CB05412CR (G)	0.5	.37	230	①	50F311CB S50N1CB, A50N1CB	2824055015①	15	20	10	8.1 x 5.9 x 9.3	7
CB07412CR (G)	.75	.55	230	①	75F311CB S75N1CB, A75N1CB	2824075015①	20	25	15	8.1 x 5.9 x 9.3	7
CB10412CR (G)	1	.75	230	①	S100F311CB S100N1CB, A100N1CB	2824085015①	25	30	20	8.1 x 5.9 x 9.3	7
CB15412CR (G)	1.5	1.1	230	00074	150F311CB S150N1CB, A150N1CB	282 3008 110	30	35	20	8.1 x 5.9 x 9.3	7
CB20412CR (G)	2	1.5	230	00084	200F311CB S200N1CB, AS200T1CB	282 3018 110	25	30	20	8.1 x 5.9 x 9.3	7
CB30412CR (G)	3	2.2	230	00094	300F311CB S300N1CB	282 3028 110	40	45	30	8.1 x 5.9 x 9.3	7
CB50412CR (G)	5	3.7	230	00104	500F311CB S500N1CB	282 1138 110	60	80	45	8.1 x 5.9 x 9.3	8

"K" REPAIR PARTS

Control Box Order Number	HP	Volts	Old Control Box Order Number	Capacitor Repair Part Number	Capacitor Mfd.	Capacitor Type	Capacitor Voltage	Capacitor Quantity	Overload Order Number ②	Start Relay Order Number	Supplier Number
CB05412CR (G)	.5	230	①	9K465	43-53	Start	220	1	NA	9K458	RVA2ALKL
				9K466	15	Run	370	1			
CB07412CR (G)	.75	230	①	9K448	59-71	Start	220	1	N/A	9K458	RVA2ALKL
				9K467	23	Run	370	1			
CB10412CR (G)	1	230	①	9K449	86-103	Start	220	1	N/A	9K458	RVA2ALKL
				9K467	23	Run	370	1			
CB15412CR (G)	1.5	230	00074	9K447	105-126	Start	220	1	9K471	9K458	RVA2ALKL
				9K452	10	Run	370	1			
CB20412CR (G)	2	230	00084	9K447	105-126	Start	220	1	9K481	9K458	RVA2ALKL
				9K451	20	Run	370	1			
CB30412CR (G)	3	230	00094	9K453	208-250	Start	220	1	9K482	9K458	RVA2ALKL
				9K454	45	Run	370	1			
CB50412CR (G)	5	230	00104	9K455	270-324	Start	330	1	9K483	9K459	RVAH2ALKL
				9K456	40	Run	370	2			

① New ½ – 1 HP CSCR control box is now in a larger enclosure, it is not in a quick disconnect style enclosure.

② Overloads for 2, 3 and 5 HP CSCR boxes are sold prewired and soldered as an assembly. No field soldering or wiring required.

MAGNETIC CONTACTOR (MC) CONTROL BOXES

FOR USE WITH 3 WIRE, 1Ø, 4" CENTRIPRO MOTORS AND 4" (6", 5 HP) FRANKLIN ELECTRIC MOTORS

Control Box Order Number	HP	KW	Volts	Replaces GP #	Replaces RJ #	Replaces FE #	Standard Circuit Breaker	Standard Fuse	Dual Element Time Delay Fuse	Enclosure Dimensions W x D x H (in)	Shipping Wt. (lbs)
CB15412MC (G)	1.5	1.1	230	No Equal	No Equal	No Equal	30	35	20	8.1 x 5.9 x 9.3	8
CB20412MC (G)	2	1.5	230	00084MC	No Equal	2823018310	25	30	20		
CB30412MC (G)	3	2.2	230	00094MC	S300N1CBC	2823028310	40	45	30		
CB50412MC (G)	5	3.7	230	00104MC	S500N1CBC	2821139310	60	80	45	11 x 6 x 14	15

"K" REPAIR PARTS

Control Box Order Number	HP	KW	Volts	Capacitor Repair Part Number	Capacitor Type	Capacitor Mfd.	Capacitor Voltage	Capacitor Quantity	Contactor Order Number	Overload Order Number	Start Relay Order Number	Supplier Relay Number
CB15412MC (G)	1.5	1.1	230	9K447	Start	105-126	220	1	9K485	9K493	9K458	RVA2ALKL
				9K452	Run	10	370	1				
CB20412MC (G)	2	1.5		9K447	Start	105-126	220	1		9K480 (S)		
				9K451	Run	20	370	1		9K472 (M)		
CB30412MC (G)	3	2.2		9K453	Start	208-250	220	1		9K473 (S)		
				9K454	Run	45	370	1		9K474 (M)		
CB50412MC (G)	5	3.7		9K455	Start	270-324	330	1	9K486	9K475 (S)	9K459	RVAH2ALKL
				9K456	Run	40	370	2		9K476 (M)		

Repair parts above are compatible with and replace parts in old Goulds Pumps or Franklin Electric control boxes.

CSCR AND MC CONTROL BOX CHECK OUT

CHECKING PROCEDURE: BE SURE POWER IS TURNED OFF.

A. OVERLOAD (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.

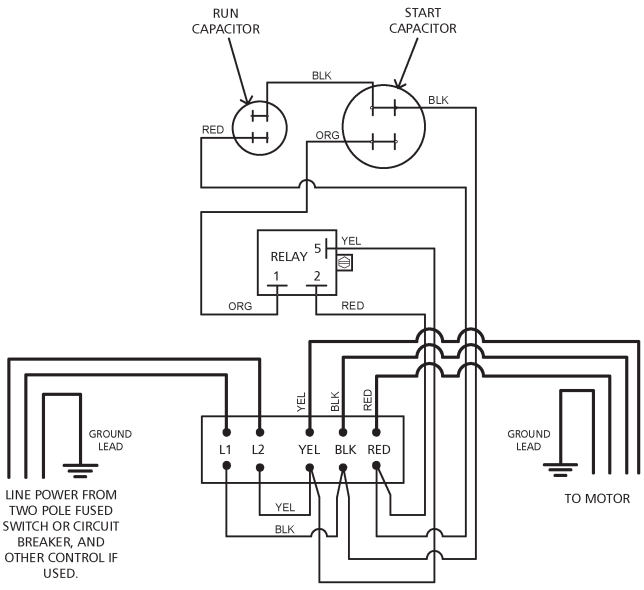
B. CAPACITOR (DISCONNECT ONE LEAD FROM EACH CAPACITOR PRIOR TO CHECKING.)
1. OHMMETER SETTING: (R X 1000).
2. TERMINAL CONNECTIONS: INDIVIDUAL CAPACITOR TERMINALS.
3. OHMMETER READING: POINTER SHOULD SWING TOWARD ZERO THEN DRIFT BACK TOWARD INFINITY.

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.

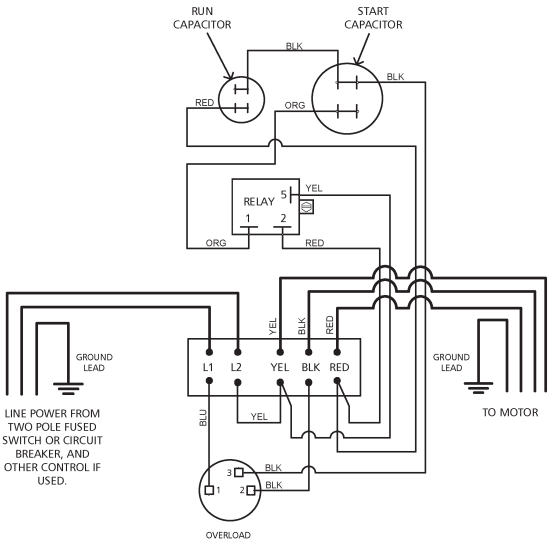
E. MAGNETIC CONTACTOR ONLY (DISCONNECT 1 COIL LEAD)
1. OHMMETER SETTING: (R X 100).
2. CHECK COIL RESISTANCE: 180-1400 OHMS.
3. REMOVE CONTACT COVER AND INSPECT CONTACTS.

½, ¾ & 1 HP – 1Ø CSCR CONTROL BOX WIRING DIAGRAMS

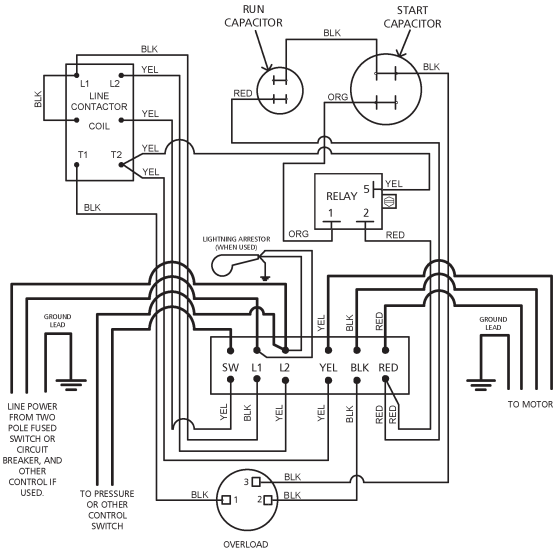


1Ø CONTROL BOX WIRING DIAGRAMS

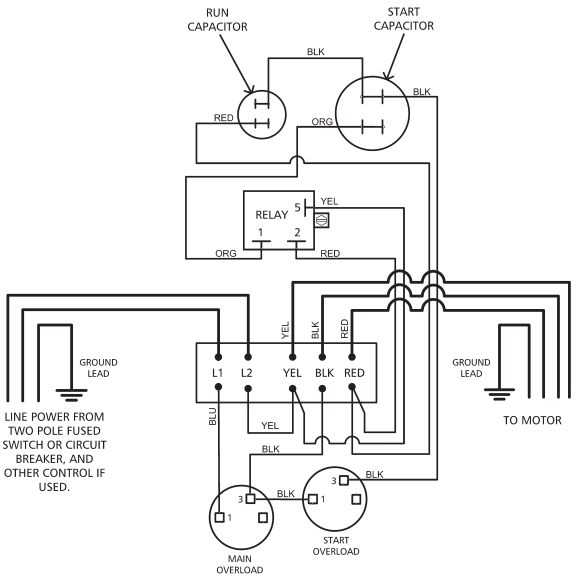
1½ HP STANDARD



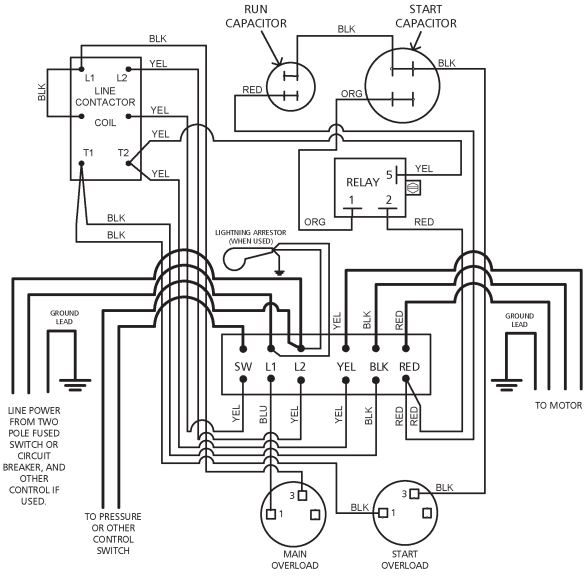
1½ HP WITH MAGNETIC CONTACTOR



2 HP STANDARD

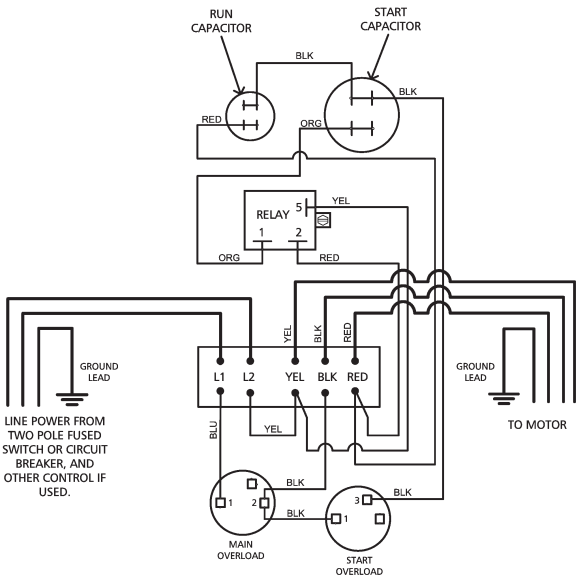


2 HP WITH MAGNETIC CONTACTOR

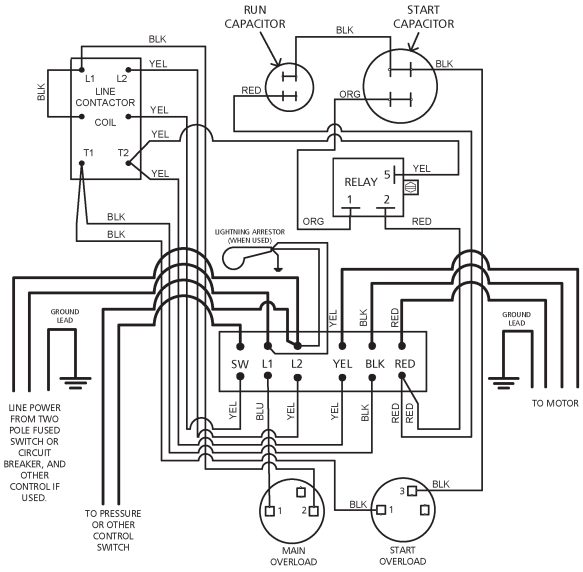


1Ø CONTROL BOX WIRING DIAGRAMS

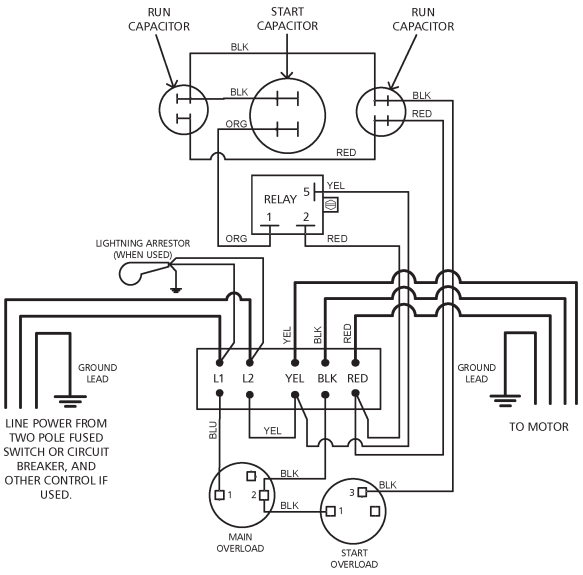
3 HP STANDARD



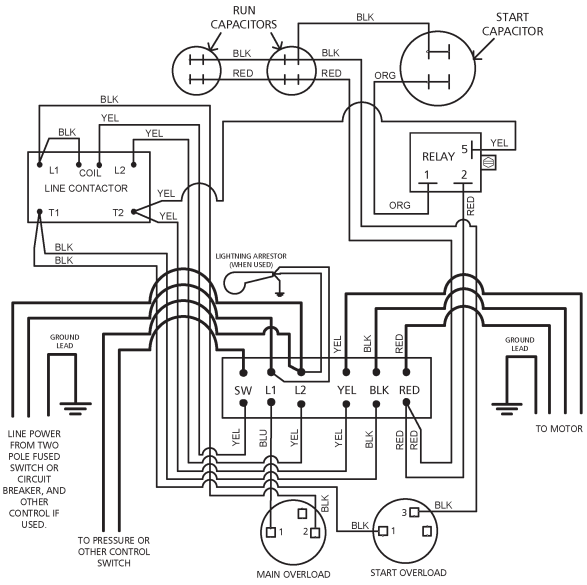
3 HP WITH MAGNETIC CONTACTOR



5 HP STANDARD



5 HP WITH MAGNETIC CONTACTOR



TROUBLESHOOTING

DISCONNECT AND LOCKOUT ELECTRICAL POWER BEFORE ATTEMPTING ANY SERVICE. FAILURE TO DO SO CAN CAUSE SHOCK, BURNS OR DEATH.

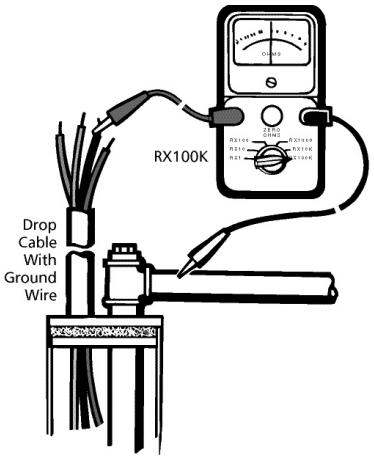
Symptom	Probable Cause	Recommended Action
PUMP MOTOR NOT RUNNING	1. Motor thermal protector tripped a. Incorrect control box b. Incorrect or faulty electrical connections c. Faulty thermal protector d. Low voltage e. Ambient temperature of control box/starter too high f. Pump bound by foreign matter g. Inadequate submergence	1. Allow motor to cool, thermal protector will automatically reset a – e. Have a qualified electrician inspect and repair, as required f. Pull pump, clean, adjust set depth as required g. Confirm adequate unit submergence in pumpage
	2. Open circuit breaker or blown fuse	2. Have a qualified electrician inspect and repair, as required
	3. Power source inadequate for load	3. Check supply or generator capacity
	4. Power cable insulation damage 5. Faulty power cable splice	4 – 5. Have a qualified electrician inspect and repair, as required
LITTLE OR NO LIQUID DELIVERED BY PUMP	1. Faulty or incorrectly installed check valve	1. Inspect check valve, repair as required
	2. Pump air bound	2. Successively start and stop pump until flow is delivered
	3. Lift too high for pump	3. Review unit performance, check with dealer
	4. Pump bound by foreign matter	4. Pull pump, clean, adjust set depth as required
	5. Pump not fully submerged	5. Check well recovery, lower pump if possible
	6. Well contains excessive amounts of air or gases	6. If successive starts and stops does not remedy, well contains excessive air or gases
	7. Excessive pump wear	7. Pull pump and repair as required
	8. Incorrect motor rotation – three phase only.	8. Reverse any two motor electrical leads

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 or control box 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.



Megger…

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.

TABLE 1 – 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

MOTOR WINDING RESISTANCE CHECKOUT

Measuring Winding Resistance

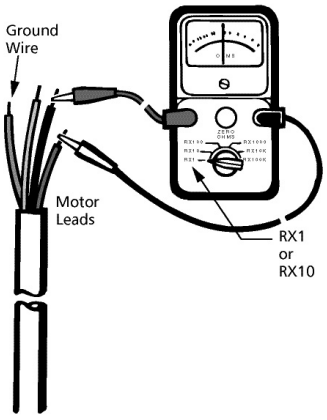
1. Set the scale lever to R x 1 for values under 10 ohms. For values over 10 ohms, set the scale lever to R x 10. Zero balance the ohmmeter as described earlier on page 11.

   ⚠ CAUTION **Open master breaker and disconnect all leads from control box to pressure switch (Q-D type control, remove lid) to avoid damage to meter or electric shock hazard.**

2. Connect the ohmmeter leads as shown below.

TABLE 2 – Cable Resistance – Copper

Cable Size	DC Resistance of Cable per 100 Foot Length Ohms per Pair of Leads
14	.544
12	.338
10	.214
8	.135
6	.082
4	.052
2	.032



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.

See motor data pages for motor resistance ratings.

RULE OF THUMB

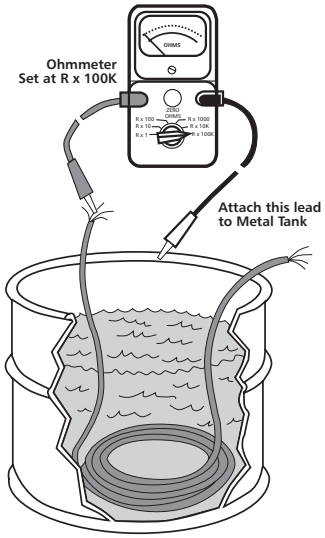
Add resistance of drop cable when checking pump in well. See Table 2 above.

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 to 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 to (∞) (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 or replaced.

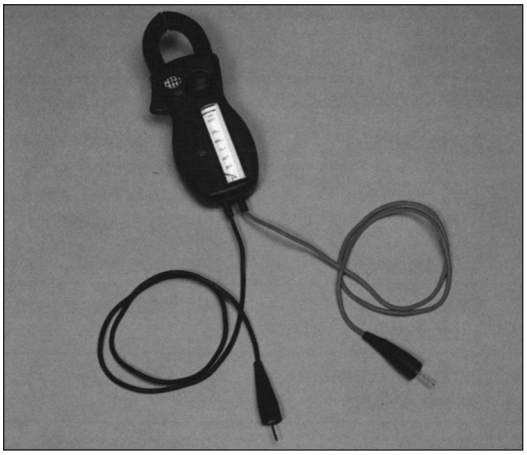
Checking Cable and Splice Test



What It Means –

1. If all ohm values are normal, the motor windings are neither shorted nor open, and the cable colors are correct.
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.
4. If some ohm values are greater than normal and some less, the leads are mixed.

AMPROBE INSTRUCTIONS

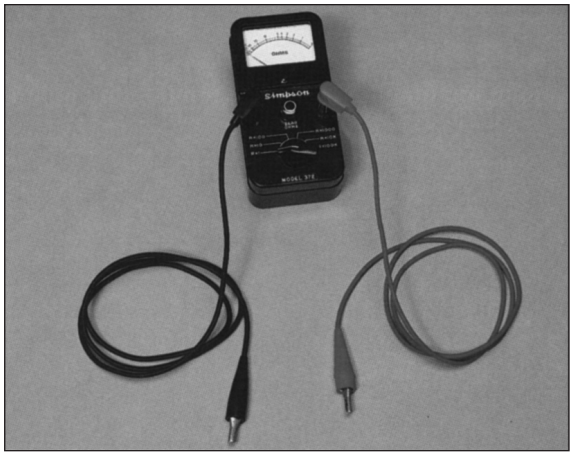


The Amprobe is a multi-range, combination ammeter and voltmeter.

Voltmeter Scales:	150 VOLTS	600 VOLTS
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.

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:

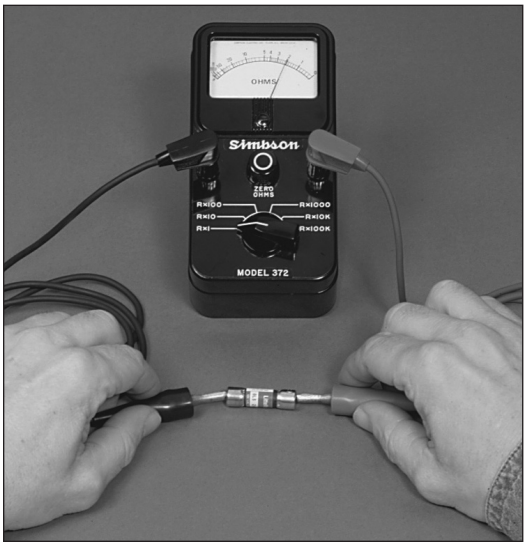
RX_1	=	R x 1
RX_{10}	=	R x 10
RX_{100}	=	R x 100
RX_{1000}	=	R x 1,000
RX_{10K}	=	R x 10,000
RX_{100K}	=	R x 100,000

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.**

⚠ CAUTION **Use Ohmmeter only with POWER OFF.**

FUSE CHECKOUT



1. Set R x 1.

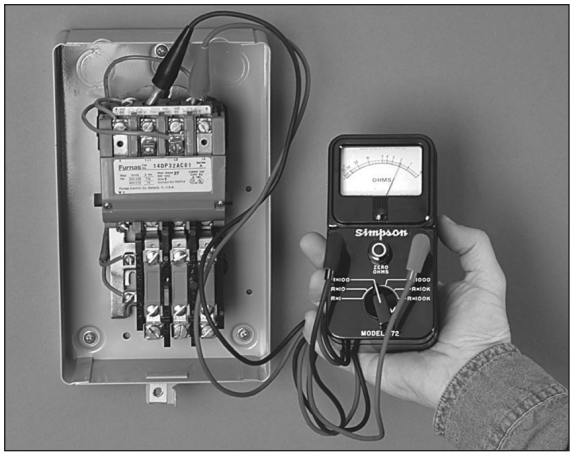
2. Connect leads as shown.

3. Reading: Should register zero.

What It Means –

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

3 PHASE STARTER 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, Approximately 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.

3 PHASE STARTER VOLTAGE CHECKOUT

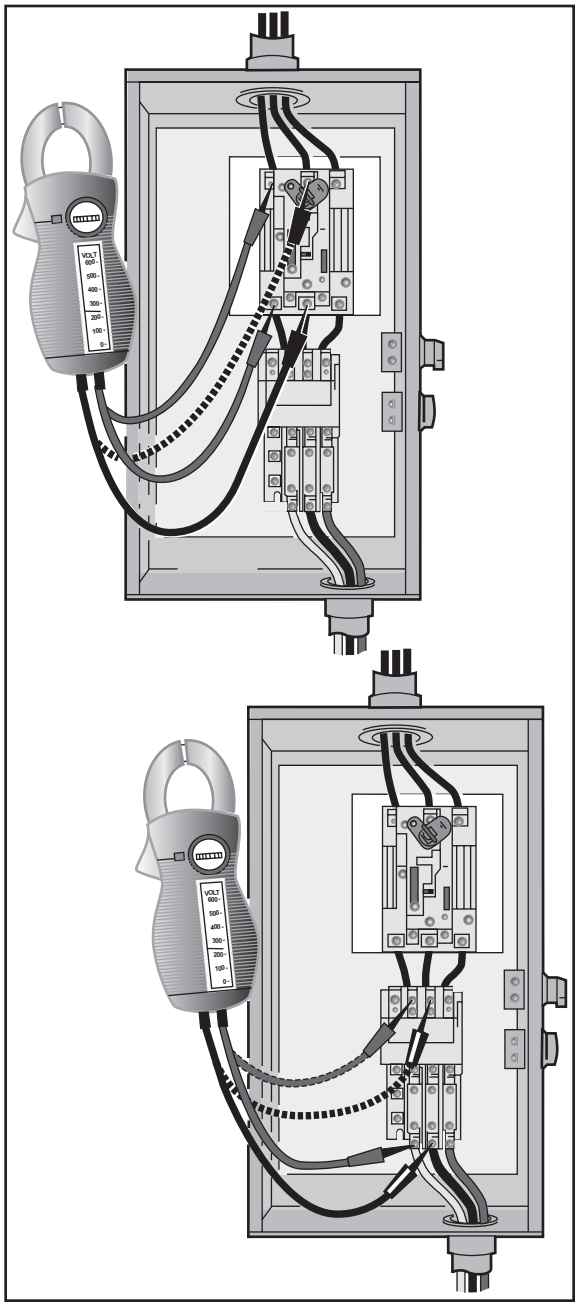
Checking Voltage at Fused Disconnect and Magnetic Starter

⚠ 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	
	Minimum	Maximum
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.

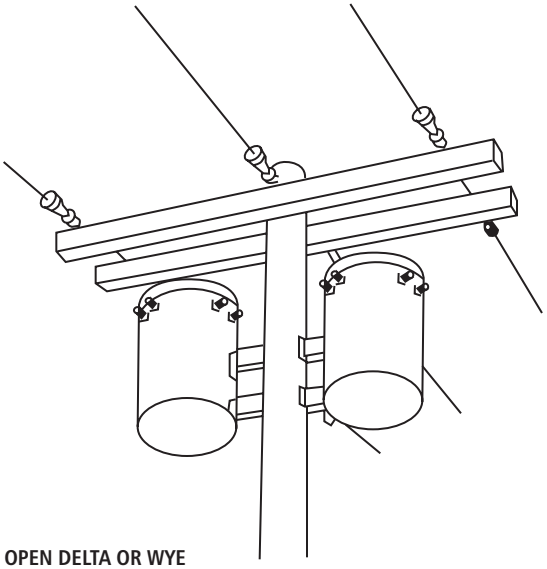
TRANSFORMER SIZES

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.

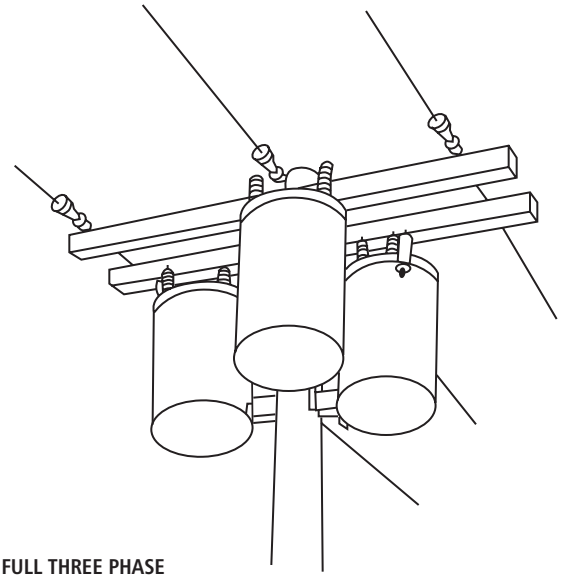
Transformer ratings should be no smaller than listed in the table for supply power to the motor alone.

TRANSFORMER CAPACITY REQUIRED FOR SUBMERSIBLE MOTORS

Submersible 3ø Motor HP Rating	Total Effective KVA Required	Smallest KVA Rating – Each Transformer	
		Open WYE DELTA 2 Transformers	WYE or DELTA 3 Transformers
1½	3	2	1
2	4	2	1½
3	5	3	2
5	7½	5	3
7½	10	7½	5
10	15	10	5
15	20	15	7½
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



OPEN DELTA OR WYE



FULL THREE PHASE

THREE PHASE POWER UNBALANCE

A full three phase supply is recommended for all three phase motors, consisting of three individual transformers or one three phase transformer. So-called "open" delta or wye connections using only two transformers can be used, but are more likely to cause problems, such as poor performance overload tripping or early motor failure due to current unbalance.

Transformer ratings should be no smaller than listed on Transformer Size Chart on previous page.

Checking and correcting rotation and current unbalance

1. Establish correct motor rotation by running in both directions. Change rotation by exchanging any two of the three motor leads. The rotation that gives the most water flow is always the correct rotation.
2. After correct rotation has been established, check the current in each of the three motor leads and calculate the current unbalance as explained in 3 below.

   If the current unbalance is 2% or less, leave the leads as connected.

   If the current unbalance is more than 2%, current readings should be checked on each leg using each of the three possible hook-ups. Roll the motor leads across the starter in the same direction to prevent motor reversal.
3. To calculate percent of current unbalance:
   A. Add the three line amp values together.
   B. Divide the sum by three, yielding average current.
   C. Pick the amp value which is furthest from the average current (either high or low).
   D. Determine the difference between this amp value (furthest from average) and the average.
   E. Divide the difference by the average. Multiply the result by 100 to determine percent of unbalance.
4. Current unbalance should not exceed 5% at service factor load or 10% at rated input load. If the unbalance cannot be corrected by rolling leads, the source of the unbalance must be located and corrected. If, on the three possible hookups, the leg farthest from the average stays on the same power lead, most of the unbalance is coming from the power source. However, if the reading farthest from average moves with the same motor lead, the primary source of unbalance is on the "motor side" of the starter. In this instance, consider a damaged cable, leaking splice, poor connection, or faulty motor winding.

Phase designation of leads for CCW rotation viewing shaft end.

To reverse rotation, interchange any two leads.

Phase 1 or "A" – Black Motor Lead or T1

Phase 2 or "B" – Yellow Motor Lead or T2

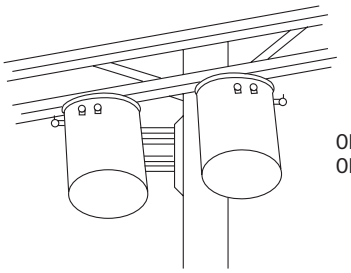
Phase 3 or "C" – Red Motor Lead or T3

Notice: Phase 1, 2 and 3 may not be L1, L2 and L3.

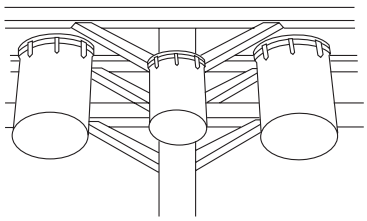
	Hookup 1			Hookup 2			Hookup 3		
	L1	L2	L3	L1	L2	L3	L1	L2	L3
Starter Terminals	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤
	T1	T2	T3	T1	T2	T3	T1	T2	T3
Motor Leads	R	B	Y	Y	R	B	B	Y	R
	T3	T1	T2	T2	T3	T1	T1	T2	T3

Example:

T3-R = 51 amps	T2-Y = 50 amps	T1-B = 50 amps
T1-B = 46 amps	T3-R = 48 amps	T2-Y = 49 amps
T2-Y = 53 amps	T1-B = 52 amps	T3-R = 51 amps
Total = 150 amps	Total = 150 amps	Total = 150 amps
÷ 3 = 50 amps	÷ 3 = 50 amps	÷ 3 = 50 amps
— 46 = 4 amps	— 48 = 2 amps	— 49 = 1 amps
4 ÷ 50 = .08 or 8%	2 ÷ 50 = .04 or 4%	1 ÷ 50 = .02 or 2%



OPEN DELTA OR WYE



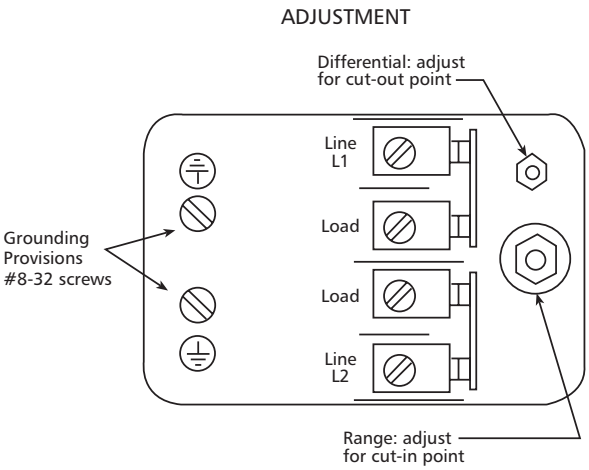
FULL THREE PHASE

SQUARE "D" SWITCHES

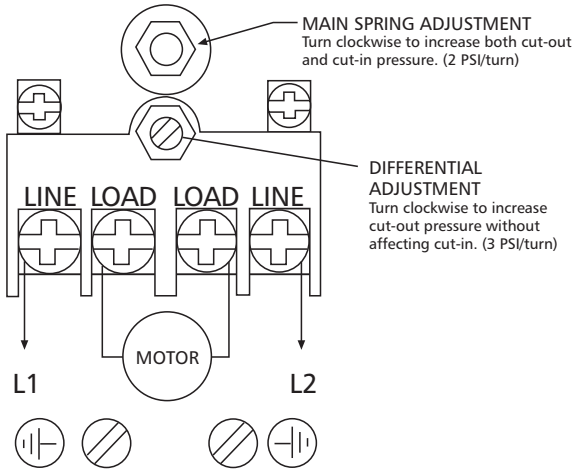
Adjust in proper sequence:

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

CAUTION: TO AVOID DAMAGE, DO NOT EXCEED THE MAXIMUM ALLOWABLE SYSTEM PRESSURE. CHECK SWITCH OPERATION AFTER RESETTING.



FURNAS PRO CONTROL



CLASS 16 FURNAS STARTER

Selection and Nomenclature Chart

1st & 2nd Class	3rd Char Size	4th Char. Coil Code	Coil Voltage	Maximum S.F. Amps	Locked Rotor Amps 200/230V	460V	575V
16	A	A	115/230	25	150	125	100
		F	115				
		D	200				
		G	230				
		H	460				
		C	230/460				
		E	575				
16	B	A	115/230	30	180	150	120
		F	115				
		D	200				
		G	230				
		H	460				
		C	230/460				
		E	575				
16	C	A	115/230	40	240	200	160
		F	115				
		D	200				
		G	230				
		H	460				
		C	230/460				
		E	575				
16	D	A	115/230	50	300	250	200
		F	115				
		D	200				
		G	230				
		H	460				
		C	230/460				
		E	575				

1st & 2nd Class	3rd Char Size	4th Char. Coil Code	Coil Voltage	Maximum S.F. Amps	Locked Rotor Amps 200/230V	460V	575V
16	E	A	115/230	60	360	300	240
		F	115				
		D	200				
		G	230				
		H	460				
		C	230/460				
		E	575				
16	F*	A	115/230	45 - 75 *	450	375	300
		F	115				
		D	200				
		G	230				
		H	460				
		C	230/460				
		E	575				
16	G*	A	115/230	45 - 90 *	540	450	360
		F	115				
		D	200				
		G	230				
		H	460				
		C	230/460				
		E	575				

* 16F and 16G size starters are equipped with ESP100 adjustable overloads and therefore do not require K heaters.

16F starters have an adjustable overload range of 45 - 75 amps

16G starters have an adjustable overload range of 45 - 90 amps

CLASS 16 FURNAS STARTER

Overload Relay Heater Selection Tables

Data Based on Furnas Tables 393 and 398 for Three-Phase Motors

Class 16 DP Model Motor SF Amps		K Heater No.
16A,16B,16C	16D,16E	
1.91	–	K21
2.08	–	K22
2.26	–	K23
2.44	–	K24
2.7	–	K26
2.98	–	K27
3.22	–	K28
3.61	–	K29
3.93	–	K31
4.23	–	K32
4.67	–	K33
5.02	–	K34
5.46	–	K36
6.25	–	K37
6.74	–	K39
7.25	–	K41
8.05	–	K42
8.55	–	K43
9.8	–	K49
10.3	–	K50
12.0	–	K52
12.5	–	K53
13.6	–	K54
14.7	–	K55
15.5	–	K56
16.9	–	K57
17.9	–	K58
19.1	–	K60
22.0	22.5	K61
23.6	24.1	K62
25.2	25.7	K63
27.0	28.0	K64
30.0	31.1	K67
34.0	34.6	K69
37.1	37.8	K70
41.0	41.5	K72
46.0	50.0	K73
49.2	54.0	K74
56.0	57.0	K75
–	60.0	K76
–	66.0	K77
–	73.0	K78
–	80.0	K79

Class 16 DP Model Motor SF Amps		K Heater No.
16F, 16G①	16H, 16I	
50.2	50.1	K72
53.2	53.1	K73
58.0	58.0	K74
62.2	62.1	K75
65.5	65.5	K76
72.0	72.0	K77
80.0	80.0	K78
–	–	K79
85.0	85.0	K83
93.0	93.0	K85
97.5	97.5	K86
104	104	K87
–	114	K88
119	126	K89
–	136	K90
–	150	K92
–	162	K93
–	180	K94
–	190	K96
–	200	K97

Selection tables are used with the motor service factor amps if known, otherwise use motor full load amps multiplied by a factor of 1.15. Select the heater closest to but higher than the SFA (motor trip amps).

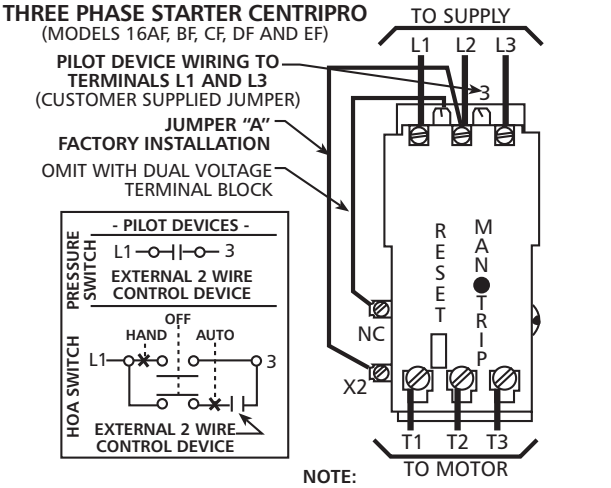
NOTE: These charts are only for Class 16 Definite Purpose, Ambient Compensated Starters (identified by a green reset button) using Quick Trip (class 10) K heaters for Submersible Motors. Other Classes or Brands of Starters require different selection tables, consult the manufacturer for information specific to that brand/class.

Selection example: Motor service factor amps = 9. If using a 16AC starter, select a K49 heater since it is the next higher heater amp rating number above 9 amps.

Starter Size / Max. Amps	
16A / 25	16F / 75
16B / 30	16G / 90
16C / 40	16H / 120
16D / 50	16I / 150
16E / 60	

① Our current 16F and 16G starters are equipped with ESP100 adjustable overloads and do not require heaters. Use this chart only for older starters requiring K heaters.

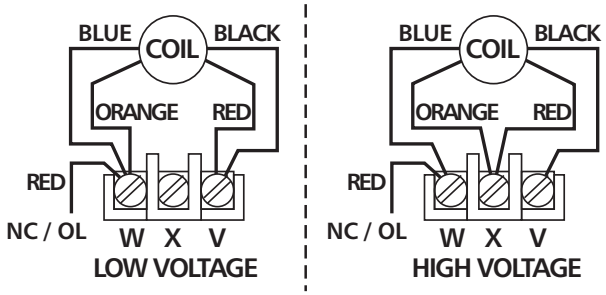
THREE PHASE STARTER CENTRIPRO
(MODELS 16AF, BF, CF, DF AND EF)



NOTE:
FOR SEPARATE CONTROL VOLTAGE SOURCE REMOVE JUMPER "A" IF INSTALLED. CONNECT CONTROL SOURCE TO "L1" ON PILOT DEVICE AND TO "X2" ON OVERLOAD RELAY.

DUAL VOLTAGE, 230/460 "C" COIL WIRING CONNECTIONS

Effective September 2005, 16__C models have this coil wiring terminal strip for simplified coil wiring.



HEAD AND PRESSURE EQUIVALENTS

1. Feet Head of Water and Equivalent Pressures
To change head in feet to pressure in pounds, multiply by .434

Feet Head	PSI	Feet Head	PSI	Feet Head	PSI	Feet Head	PSI
1	.43	30	12.99	140	60.63	300	129.93
2	.87	40	17.32	150	64.96	325	140.75
3	1.30	50	21.65	160	69.29	350	151.58
4	1.73	60	25.99	170	73.63	400	173.24
5	2.17	70	30.32	180	77.96	500	216.55
6	2.60	80	34.65	190	82.29	600	259.85
7	3.03	90	38.98	200	86.62	700	303.16
8	3.46	100	43.31	225	97.45	800	346.47
9	3.90	110	47.64	250	108.27	900	389.78
10	4.33	120	51.97	275	119.10	1000	433.09
20	8.66	130	56.30	–	–	–	–

2. Pressure and Equivalent Feet Head of Water
To change pounds pressure to feet head, multiply by 2.3

PSI	Feet Head	PSI	Feet Head	PSI	Feet Head	PSI	Feet Head
1	2.31	20	46.18	120	277.07	225	519.51
2	4.62	25	57.72	125	288.62	250	577.24
3	6.93	30	69.27	130	300.16	275	643.03
4	9.24	40	92.36	140	323.25	300	692.69
5	11.54	50	115.45	150	346.34	325	750.41
6	13.85	60	138.54	160	369.43	350	808.13
7	16.16	70	161.63	170	392.52	375	865.89
8	18.47	80	184.72	180	415.61	400	922.58
9	20.78	90	207.81	190	438.90	500	1154.48
10	23.09	100	230.90	200	461.78	1000	2309.00
15	34.63	110	253.98	–	–	–	–

APPROXIMATE COST OF OPERATING ELECTRIC MOTORS

Motor HP	*Average kilowatts input or cost based on 1 cent per kilowatt hour		Motor HP	*Av. kw input or cost per hour based on 1 cent per kw hour
	1 Phase	3 Phase		3 Phase
⅓	.408		20	16.9
½	.535	.520	25	20.8
¾	.760	.768	30	26.0
1	1.00	.960	40	33.2
1½	1.50	1.41	50	41.3
2	2.00	1.82	60	49.5
3	2.95	2.70	75	61.5
5	4.65	4.50	100	81.5
7½	6.90	6.75	125	102
10	9.30	9.00	150	122
			200	162

TERMS AND USABLE FORMULAS

The term "head" by itself is rather misleading. It is commonly taken to mean the difference in elevation between the suction level and the discharge level of the liquid being pumped. Although this is partially correct, it does not include all of the conditions that should be included to give an accurate description.

■ **Friction Head:** The pressure expressed in lbs./sq. in. or feet of liquid needed to overcome the resistance to the flow in the pipe and fittings.

■ **Suction Lift:** Exists when the source of supply is below the center line of the pump.

■ **Suction Head:** Exists when the source of supply is above the center line of the pump.

■ **Static Suction Lift:** The vertical distance from the center line of the pump down to the free level of the liquid source.

■ **Static Suction Head:** The vertical distance from the center line of the pump up to the free level of the liquid source.

■ **Static Discharge Head:** The vertical elevation from the center line of the pump to the point of free discharge.

■ **Dynamic Suction Lift:** Includes static suction lift, friction head loss and velocity head.

■ **Dynamic Suction Head:** Includes static suction head minus friction head minus velocity head.

■ **Dynamic Discharge Head:** Includes static discharge head plus friction head plus velocity head.

■ **Total Dynamic Head:** Includes the dynamic discharge head plus dynamic suction lift or minus dynamic suction head.

■ **Velocity Head:** The head needed to accelerate the liquid. Knowing the velocity of the liquid, the velocity head loss can be calculated by a simple formula Head $= V^2/2g$ in which g is acceleration due to gravity or 32.16 ft./sec. Although the velocity head loss is a factor in figuring the dynamic heads, the value is usually small and in most cases negligible. See table.

BASIC FORMULAS AND SYMBOLS

Formulas

$$GPM = \frac{Lb./Hr.}{500 \times Sp.\ Gr.}$$

$$H = \frac{2.31 \times psi}{Sp.\ Gr.}$$

$$H = \frac{1.134 \times In.\ Hg.}{Sp.\ Gr.}$$

$$H_v = \frac{V^2}{2g} = 0.155\ V^2$$

$$V = \frac{GPM \times 0.321}{A} = \frac{GPM \times 0.409}{(I.D.)^2}$$

$$BHP = \frac{GPM \times H \times Sp.\ Gr.}{3960 \times Eff.}$$

$$Eff. = \frac{GPM \times H \times Sp.\ Gr.}{3960 \times BHP}$$

$$N_S = \frac{N\sqrt{GPM}}{H^{3/4}}$$

$$H = \frac{V^2}{2g}$$

Symbols

GPM = gallons per minute
Lb. = pounds
Hr. = hour
Sp. Gr. = specific gravity
H = head in feet
psi = pounds per square inch
In. Hg. = inches of mercury
h_v = velocity head in feet
V = velocity in feet per second
g = 32.16 ft./sec.^{2} (acceleration of gravity)
A = area in square inches (πr^2) (for a circle or pipe)
ID = inside diameter in inches
BHP = brake horsepower
Eff. = pump efficiency expressed as a decimal
N_S = specific speed
N = speed in revolutions per minute
D = impeller in inches

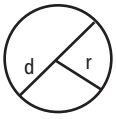
TERMS AND USABLE FORMULAS

BASIC FORMULAS AND SYMBOLS

Temperature conversion

DEG. C = (DEG. F – 32) x .555

DEG. F = (DEG. C x 1.8) + 32



CIRCLE

Area of a Circle

A = area; C = circumference. D = diameter

$A = \pi r^2$; $\pi = 3.14$ r = radius

$C = 2\pi r$

Water Horsepower $= \frac{\text{GPM x 8.33 x Head}}{33000} = \frac{\text{GPM x Head}}{3960}$

Where:
GPM = Gallons per Minute
8.33 = Pounds of water per gallon
33000 = Ft. Lbs. per minute in one horsepower
Head = Difference in energy head in feet (field head).

Laboratory BHP $= \frac{\text{Head x GPM x Sp. Gr.}}{\text{3960 x Eff.}}$

Field BHP = Laboratory BHP + Shaft Loss

Total BHP = Field BHP + Thrust Bearing Loss

Where:
GPM = Gallons per Minute
Head = Lab. Head (including column loss)
Eff. = Lab. Eff. of Pump Bowls
Shaft Loss = HP loss due to mechanical friction of lineshaft bearings
Thrust Bearing Loss = HP Loss in driver thrust bearings (See (1) below under Misc.)

Input Horsepower $= \frac{\text{Total BPH}}{\text{Motor Eff.}}$

Motor Eff. from Motor mfg. (as a decimal)

Field Efficiency $= \frac{\text{Water Horsepower}}{\text{Total BHP}}$

Water HP as determined above
Total BHP as determined above

Overall Plant Efficiency $= \frac{\text{Water Horsepower}}{\text{Input Horsepower}}$

(See (2) below under Misc.)
Water HP as determined above
Input HP as determined above

Electrical

Input Horsepower $= \frac{\text{BHP}}{\text{Mot. Eff.}} = \frac{\text{4.826 x K x M x R}}{\text{T}} = \frac{\text{1.732 x E x I x PF}}{746}$

BHP = Brake Horsepower as determined above
Mot. Eff. = Rated Motor Efficiency
K = Power Company Meter Constant
M = Power Company Meter Multiplier, or Ratio of Current and Potential Transformers connected with meter
R = Revolutions of meter disk
T = Time in Sec. for R
E = Voltage per Leg applied to motor
I = Amperes per Leg applied to motor
PF = Power factor of motor
1.732 = Factor for 3-phase motors. This reduces to 1 for single phase motors

Kilowatt input to Motor = .746 x I.H.P. $= \frac{\text{1.732 x E x I x PF}}{1000}$

KW-Hrs. Per 1000 Gallons of Cold Water Pumped Per Hour $= \frac{\text{HD in ft. x 0.00315}}{\text{Pump Eff. x Mot. Eff.}}$

Miscellaneous

(1) **Thrust Bearing Loss** = .0075 HP per 100 RPM per 1000 lbs. thrust.*
(2) **Overall Plant Efficiency sometimes referred to as "Wire to Water" Efficiency**
***Thrust (in lbs.)** = (thrust constant (k) laboratory head) + (setting in feet x shaft wt. per ft.)
Note: Obtain thrust constant from curve sheets

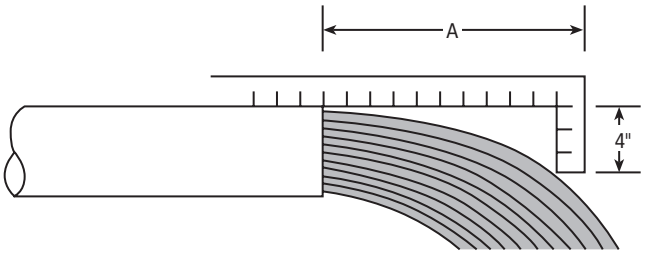
Discharge Head (in feet of fluid pumped) $= \frac{\text{Discharge Pressure (psi) x 2.31}}{\text{Sp. Gr. of Fluid Pumped}}$

DETERMINING FLOW RATES

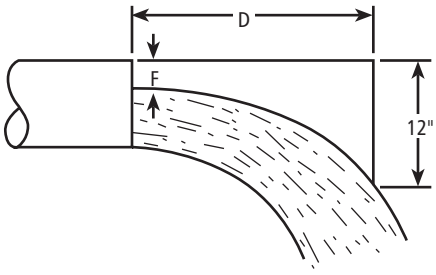
FULL PIPE FLOW – CALCULATION OF DISCHARGE RATE USING HORIZONTAL OPEN DISCHARGE FORMULA

An L-shaped measuring square can be used to estimate flow capacity, using the chart below. As shown in illustration, place 4" side of square so that it hangs down and touches the water. The horizontal distance shown "A" is located in the first column of the chart and you read across to the pipe diameter (ID) to find the gallons per minute discharge rate.

Example: A is 8" from a 4" ID pipe
= a discharge rate of 166 GPM.



PIPE NOT RUNNING FULL – CALCULATION OF DISCHARGE RATE USING AREA FACTOR METHOD



Flow From Horizontal Pipe (Not Full)

Flow (GPM) = A x D x 1.093 x F
A = Area of pipe in square inches
D = Horizontal distance in inches
F = Effective area factor from chart
Area of pipe equals inside Dia.^{2} x 0.7854

Example: Pipe inside diameter = 10 in.
D = 20 in.
F = 2½ in.
A = 10 x 10 x 0.7854 = 78.54 square in.

$$R\ \% = \frac{F}{D} = \frac{2\frac{1}{2}}{10} = 25\ \%$$

F = 0.805
Flow = 78.54 x 20 x 1.039 x 0.805 = 1314 GPM

Ratio F/D = R %	Eff. Area Factor F	Ratio F/D = R %	Eff. Area Factor F
5	0.981	55	0.436
10	0.948	60	0.373
15	0.905	65	0.312
20	0.858	70	0.253
25	0.805	75	0.195
30	0.747	80	0.142
35	0.688	85	0.095
40	0.627	90	0.052
45	0.564	95	0.019
50	0.500	100	0.000

DISCHARGE RATE IN GALLONS PER MINUTE/NOMINAL PIPE SIZE (ID)

Horizontal Dist. (A) Inches	Pipe Diameter											
	1"	1¼"	1½"	2"	2½"	3"	4"	5"	6"	8"	10"	12"
4	5.7	9.8	13.3	22.0	31.3	48.5	83.5					
5	7.1	12.2	16.6	27.5	39.0	61.0	104	163				
6	8.5	14.7	20.0	33.0	47.0	73.0	125	195	285			
7	10.0	17.1	23.2	38.5	55.0	85.0	146	228	334	380		
8	11.3	19.6	26.5	44.0	62.5	97.5	166	260	380	665	1060	
9	12.8	22.0	29.8	49.5	70.0	110	187	293	430	750	1190	1660
10	14.2	24.5	33.2	55.5	78.2	122	208	326	476	830	1330	1850
11	15.6	27.0	36.5	60.5	86.0	134	229	360	525	915	1460	2100
12	17.0	29.0	40.0	66.0	94.0	146	250	390	570	1000	1600	2220
13	18.5	31.5	43.0	71.5	102	158	270	425	620	1080	1730	2400
14	20.0	34.0	46.5	77.0	109	170	292	456	670	1160	1860	2590
15	21.3	36.3	50.0	82.5	117	183	312	490	710	1250	2000	2780
16	22.7	39.0	53.0	88.0	125	196	334	520	760	1330	2120	2960
17		41.5	56.5	93.0	133	207	355	550	810	1410	2260	3140
18			60.0	99.0	144	220	375	590	860	1500	2390	3330
19				110	148	232	395	620	910	1580	2520	3500
20					156	244	415	650	950	1660	2660	3700
21						256	435	685	1000	1750	2800	
22							460	720	1050	1830	2920	
23								750	1100	1910	3060	
24									1140	2000	3200	

DETERMINING WATER LEVEL

Install ⅛" or ¼" tubing long enough to be 10' to 15' below low water level. Measure the tubing length as it is lowered into the well.

Once the tubing is fixed in a stationary position at the top, connect an air line and pressure gauge. Add air to the tubing until the pressure gauge reaches a point that it doesn't read any higher. Take a gauge reading at this point.

A. Depth to water (to be determined).

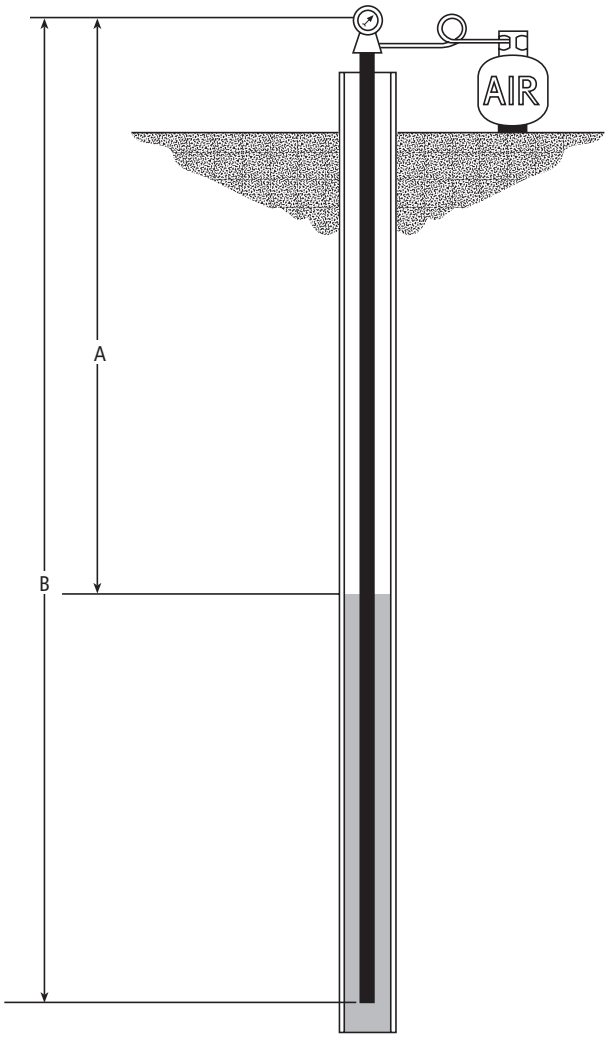
B. Total length of air line (in feet).

C. Water pressure on air tubing. Gauge reads in pounds. Convert to feet by multiplying by 2.31.

Example:
If the air tube is 100' long,
and the gauge reads 20 lbs.

20 lbs. x 2.31 = 46.2 ft.
Length of tube = 100 ft.
minus 46.2 ft. = 53.8 ft.

Depth to water (A) would be 53.8 ft.



STORAGE OF WATER IN VARIOUS SIZES OF WELLS

$\frac{D^2}{24.5}$ = Gals. of Storage per Foot

Where: D = Inside diameter of well casing in inches

Examples:

2" Casing = .16 Gals. per ft. Storage	8" Casing = 2.6 Gals. per ft. Storage
3" Casing = .36 Gals. per ft. Storage	10" Casing = 4.07 Gals. per ft. Storage
4" Casing = .652 Gals. per ft. Storage	12" Casing = 5.87 Gals. per ft. Storage
5" Casing = 1.02 Gals. per ft. Storage	14" Casing = 7.99 Gals. per ft. Storage
6" Casing = 1.4 Gals. per ft. Storage	16" Casing = 10.44 Gals. per ft. Storage

HYDROPRO™ AND CENTRIPRO™ TANK SELECTION

TABLE 1 – TANK MODELS – See your Full Line Catalog Tank Bulletins for a listing of all available models.

Model No.	Total Volume (Gals.)	① Drawdown in Gals. at System Operating Pressure Range of			Max. Drawdown Vol. (Gals.)
		18/40 PSIG	28/50 PSIG	38/60 PSIG	
V6P	2.0	0.8	0.7	0.6	1.2
V15P	4.5	1.8	1.5	1.3	2.7
V25P	8.2	3.3	2.8	2.4	4.5
V45P	13.9	5.6	4.7	4.1	8.4
V45B	13.9	5.6	4.7	4.1	8.4
V45	13.9	5.6	4.7	4.1	8.4
V60B	19.9	8.0	6.8	5.8	12.1
V60	19.9	8.0	6.8	5.8	12.1
V80	25.9	10.4	8.8	7.6	13.9
V80EX	25.9	10.4	8.8	7.6	13.9
V100	31.8	12.8	10.8	9.4	13.8
V100S	31.8	12.8	10.8	9.4	13.8
V140B	45.2	18.2	15.4	13.3	27.3
V140	45.2	18.2	15.4	13.3	27.3
V200B	65.1	26.2	22.1	19.2	39.3
V200	65.1	26.2	22.1	19.2	39.3
V250	83.5	33.6	28.4	25.6	50.8
V260	84.9	34.1	28.9	25.0	44.7
V350	115.9	46.6	39.4	34.1	70.5

Tank Drawdown Pressure Factors Using an "Extra" 2 PSI of Drawdown

Pressure Differential	Factor with extra 2 psi*
18 – 40	.402
28 – 50	.340
38 – 60	.295
48 – 70	.260

To Calculate drawdown capacity multiply: Factor x Tank Volume.

① Drawdown based on a 22 psi differential and Boyle's Law. Temperature, elevation and pressure can all affect drawdown volume.

TABLE 2 – PRESSURE FACTORS

Pump Cut-Out Pressure – PSIG	Pump Cut-In Pressure – PSIG																				
	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115
30	.22																			
35	.30	.20																		
40	.37	.27	.18																	
45	.42	.34	.25	.17																
50	.46	.39	.31	.23	.15															
55	.50	.43	.36	.29	.22	.14														
60	.54	.47	.40	.33	.27	.20	.13													
65		.50	.44	.38	.31	.25	.19	.13												
70		.53	.47	.41	.35	.30	.24	.18	.12											
75			.50	.45	.39	.33	.28	.22	.17	.11										
80			.53	.48	.42	.37	.32	.26	.21	.16	.11									
85				.50	.45	.40	.35	.30	.25	.20	.15	.10								
90				.53	.48	.43	.38	.33	.29	.24	.19	.14	.10							
95					.50	.46	.41	.36	.32	.27	.23	.18	.14	.09						
100					.52	.48	.44	.39	.35	.31	.26	.22	.17	.13	.09					
105						.50	.46	.42	.38	.33	.29	.25	.21	.17	.13	.08				
110						.52	.46	.44	.40	.36	.32	.28	.24	.20	.16	.12				
115							.50	.46	.42	.39	.35	.31	.27	.23	.19	.15	.12	.06		
120							.52	.48	.45	.41	.37	.33	.30	.26	.22	.19	.15	.11		
125								.50	.47	.43	.39	.36	.32	.29	.25	.21	.16	.14	.11	.07

To determine tank drawdown of operating pressure ranges other than those listed in table, use following procedure:
Multiply total tank volume (table 1) by pressure factor (table 4).

Example: Operating range: 35/55
Tank being used: V-200

65.1 = Total volume of tank (table 1)
x .29 Pressure factor (table 4)
18.9 = Drawdown in gallons at 35/55 PSI operating range.

UL AND CSA AGENCY LISTING(S)

Our control boxes, motors, complete pump assemblies and electrical accessories are tested by independent product safety and testing organizations to ensure compliance with the US National Electric Code (NEC) and/or Canadian Standards Association (CSA) standards. Underwriters Laboratories Inc. and CSA are the agencies with whom we contract. They have now agreed to eliminate overlapping efforts through an agreement which allows either to test to the other's standards. This is good for manufacturers and consumers as overlapping independent testing is very expensive. *This agreement does not appear to have been effectively communicated at this time.*

Unfortunately, there is a great deal of misunderstanding associated with the Agency Listings and their marks or logos. By meeting specific safety requirements products can be either UL Listed or UL Recognized. The UL mark in a circle (UL) signifies that a product is UL Listed (approved) for its intended use by Underwriters Laboratories Inc. Radios, televisions, CD players, fans and small appliances are a good example of UL Listed products.

The lesser known and most misinterpreted UL mark is the backwards , signifying a UL Recognized Component. This is used on products that are combined to create a complete assembly, such as submersible motors, which do work only when combined with a matching pump to form a complete assembly. Due to their length and weight only .5 - 1.5 HP submersible pumps are assembled to a motor by manufacturers. These sizes meet shipping company weight and length guidelines and will survive transit. Larger pumps and motors are shipped in separate containers to avoid shipping damage and employee injuries. Since motors are sold as separate components and field assembled to pump ends they can only be tested and sold as Recognized Components. It is for this reason that all our water ends are tagged with warning labels stating they must be mated to a motor of equal or greater HP to avoid overloading the motor. Think of the UL Recognized Component marking as a caution to installers to verify they have correctly matched motors and water ends.

Testing by the Canadian Standards Association is denoted by the CSA logo .

Per their recent agreement UL can test products sold in the USA and/or Canada, conversely, CSA can test products sold in Canada and/or the USA.

Logos and their meanings follow:

- UL Listed for USA 
- UL Listed for Canada (tested by UL to CSA Standards) 
- UL Listed for USA and Canada (tested by UL to UL & CSA Standards) 
- UL Recognized Component for USA 
- UL Recognized Component for Canada (tested by UL to CSA Standards) 
- UL Recognized Component for USA and Canada (tested by UL to UL & CSA Standards) 
- CSA approved for Canada 
- CSA approved for USA (tested by CSA to UL Standards) 
- CSA approved for USA and Canada (tested by CSA to CSA & UL Standards) 

Per the reciprocity agreement between the two agencies, electrical inspectors in both countries should now be honoring either the UL or CSA mark on products approved for their country.

ITT

Residential Water Systems

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