
# Motor Application and Installation Data

BMAID

CentriPro
a xylem brand

# INDEX



## 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.

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.

Coolant Leakage — during storage or shipment, it is common for some coolant/fluid to leak from the motors, this should not be a concern. The filtered check valve will refill the motor upon submergence in a well. If leakage appears extraordinary or you are concerned, please call the nearest factory customer service number found on the back cover of this manual for checking instructions.

## 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.

## 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 15° 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 back pressure (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.

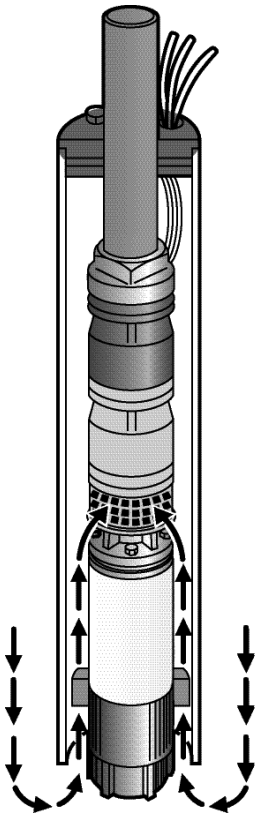
Control boxes should be shaded from direct sunlight in areas where temperatures exceed 90° F as excessive heat may shorten capacitor life. It is advisable to paint the enclosure white if outside in very hot, sunny climates.

## MOTOR COOLING, TEMPERATURE AND TIME RATINGS

All 4 inch CentriPro motors may be operated continuously in water up to 86º F. Optimum service life will be attained by maintaining a minimum 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 95º F (35º 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 77º F (25º C) water with .5'/sec velocity past the motor.

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*

## PUMP COOLING AND LUBRICATION

In addition to motor cooling, another reason to maintain minimum flow rates is pump lubrication. All manufacturers', either on curves or in selection charts, show minimum flows. This insures that rotating pump parts are properly lubricated to prolong service life and reduce friction. A dead headed pump will super heat water very quickly, and hot water has no lubricity.

## MINIMUM FLOW RATES FOR PROPER MOTOR COOLING

| Well or Sleeve Diameter (inches) | 3.75" Diameter 4" CP or FE Motor .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.

# CROSS REFERENCE

## CONTROL BOX CROSS REFERENCE

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

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

# 1ST Generation 2008 - 2011

## 2-WIRE MOTOR DATA See next page for 2nd generation data

### TWO WIRE PSC, SINGLE PHASE 4" MOTORS - ELECTRICAL DATA, 60 HERTZ, 3450 RPM

| Type | Motor Order No. | | HP | KW | Volts | SF | Full Load | | Service Factor | | Locked Rotor Amps | Winding Resistance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Centri-Pro | Red Jacket | | | | | Amps | Watts | Amps | Watts | | |
| 2-Wire (PSC) | M05421 | 50C201 | 0.5 | 0.37 | 115 | 1.6 | 7.4 | 845 | 9.5 | 1088 | 36.4 | 1.3-1.8 |
| | M05422 | 50C211 | 0.5 | 0.37 | 230 | 1.6 | 3.7 | 834 | 4.7 | 1073 | 19.5 | 4.5-5.2 |
| | M07422 | 75C211 | 0.75 | 0.55 | 230 | 1.5 | 5.0 | 1130 | 6.4 | 1459 | 24.8 | 3.0-4.8 |
| | M10422 | 100C211 | 1.0 | 0.75 | 230 | 1.4 | 7.9 | 1679 | 9.1 | 1990 | 21.7 | 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, SINGLE PHASE 4" MOTORS - ENGINEERING DATA

| Type | Motor Order Number | | HP | Volts | Efficiency % | | Power Factor % | | Thrust Rating | KVA Code | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | CentriPro | Red Jacket | | | F.L. | S.F. | F.L. | S.F. | | Gen 1 | Gen 2 |
| 2-Wire (PSC) | M05421 | 50C201 | 0.5 | 115 | 49 | 61 | 99 | 99 | 700 # | K | H |
| | M05422 | 50C211 | 0.5 | 230 | 50 | 62 | 97 | 99 | | K | J |
| | M07422 | 75C211 | 0.75 | 230 | 55 | 65 | 97 | 99 | | J | F |
| | M10422 | 100C211 | 1.0 | 230 | 58 | 65 | 94 | 96 | | F | F |
| | M15422 | 150C211 | 1.5 | 230 | 59 | 64 | 99 | 99 | | H | H |

### 2-WIRE AND 3-WIRE - FUSE AND CIRCUIT BREAKER AMPS (1st and 2nd Generation)

| Type | Motor Order Number | | HP | Fuse or Circuit Breaker Amps | | | |
|---|---|---|---|---|---|---|---|
| | | | | Standard Fuse | | Dual Element Time Delay – Gen 1 & 2 | Circuit Breaker Gen 1 & 2 |
| | CentriPro | Red Jacket | | Gen 1 | Gen 2 | | |
| 2-Wire (PSC) | M05421 | 50C201 | 0.5 | 25 | 25 | 15 | 20 |
| | M05422 | 50C211 | 0.5 | 15 | 15 | 10 | 10 |
| | M07422 | 75C211 | 0.75 | 20 | 15 | 10 | 15 |
| | M10422 | 100C211 | 1.0 | 25 | 20 | 15 | 20 |
| | M15422 | 150C211 | 1.5 | 30 | 30 | 15 | 25 |
| 3-Wire QD (CSIR) | M05411 | 50C301 | 0.5 | 30 | | 20 | 30 |
| | M05412 | 50C311 | 0.5 | 15 | | 10 | 15 |
| | M07412 | 75C311 | 0.75 | 20 | | 10 | 20 |
| | M10412 | 100C311 | 1.0 | 25 | | 15 | 25 |
| 3-Wire CSCR | M05412 | 50C311 | 0.5 | 15 | | 10 | 10 |
| | M07412 | 75C311 | 0.75 | 20 | | 10 | 15 |
| | M10412 | 100C311 | 1.0 | 20 | | 10 | 15 |
| | M15412 | 150C311 | 1.5 | 30 | | 15 | 25 |
| | M20412 | 200C311 | 2.0 | 30 | | 20 | 25 |
| | M30412 | 300C311 | 3.0 | 45 | | 25 | 40 |
| | M50412 | 500C311 | 5.0 | 70 | | 40 | 60 |

# Generation II

## 2-WIRE MOTORS Identified by a - 01 Nameplate Order No. Suffix

As part of Faradyne Motors' continual improvement process we are pleased to introduce the 2 Wire Generation II motors in April 2011. Our pump model numbers and motor order number will not change. The Motor Nameplate will have a new Faradyne part number and the Goulds part number on the Motor Nameplate will have a - 01 suffix, example M05422 will be M05422 - 01, only on the Motor Nameplate not in our catalog or price book.

The self-stick, Mylar motor data stickers we pack with 2 wire motors and complete pumps will be updated with the new electrical data so that installers will know which motor is installed in the well should service work ever be necessary. Note that the motor data is only needed to troubleshoot a motor in the well, i.e. resistance and amperage ratings or when installing a variable speed drive system to set the overloads.

### GENERATION II – 2-WIRE, 4" SINGLE PHASE ELECTRICAL DATA, 60 HERTZ, 3450 RPM

| | | | | | | | Full Load | | Service Factor | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | Motor Order No. | | HP | KW | Volts | SF | Amps | Watts | Amps | Watts | Locked Rotor Amps | Winding Resistance | KVA Code |
| | Goulds Pumps | Red Jacket | | | | | | | | | | | |
| 2-Wire (PSC) | M05421 | 50C201 | 0.5 | 0.37 | 115 | 1.6 | 7.9 | 910 | 9.8 | 1120 | 28 | 1.4-2.0 | H |
| | M05422 | 50C211 | 0.5 | 0.37 | 230 | 1.6 | 4.0 | 845 | 4.7 | 1050 | 16 | 6.1-7.2 | J |
| | M07422 | 75C211 | 0.75 | 0.55 | 230 | 1.5 | 5.0 | 1130 | 6.2 | 1400 | 18 | 5.9-6.9 | F |
| | M10422 | 100C211 | 1.0 | 0.75 | 230 | 1.4 | 6.7 | 1500 | 8.1 | 1800 | 24 | 4.2-5.2 | F |
| | M15422 | 150C211 | 1.5 | 1.1 | 230 | 1.3 | 9.0 | 2000 | 10.4 | 2350 | 43 | 1.8-2.4 | H |

### GENERATION II – 2-WIRE, 4" SINGLE PHASE ENGINEERING DATA

| | | | | | | Efficiency % | | Power Factor % | | Length | | Weight | | Thrust Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | Motor Order Number | | HP | KW | Volts | F.L. | S.F. | F.L. | S.F. | Inches | mm | lb. | kg. | |
| | Goulds | Red Jacket | | | | | | | | | | | | |
| 2-Wire (PSC) | M05421 | 50C201 | 0.5 | 0.37 | 115 | 42% | 54% | 99% | 99% | 10.5 | 267 | 18 | 8.2 | 700 |
| | M05422 | 50C211 | 0.5 | 0.37 | 230 | 45% | 59% | 92% | 97% | 10.5 | 267 | 18 | 8.2 | |
| | M07422 | 75C211 | 0.75 | 0.55 | 230 | 51% | 61% | 98% | 98% | 11.9 | 302 | 22 | 9.7 | |
| | M10422 | 100C211 | 1.0 | 0.75 | 230 | 50% | 59% | 98% | 98% | 12.5 | 318 | 24 | 10.5 | |
| | M15422 | 150C211 | 1.5 | 1.1 | 230 | 57% | 63% | 98% | 99% | 14.2 | 361 | 28 | 12.4 | |

### GENERATION II, 2-WIRE MOTORS, RECOMMENDED LEAD LENGTHS

**Released for Sale in November/December 2011**

| CentriPro Motor Lead Lengths - 2 Wire Motors, 1Ø, 4" Motors Based on Service Factor Amps, 30º C Ambient and 5% Voltage Drop | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Motor Rating | | | | | 60º C and 75º C Insulation - AWG Copper Wire Size | | | | | | | | | | |
| Volts | HP | kW | FLA | SFA | 14 | 12 | 10 | 8 | 6 | 4 | 2 | 1/0 | 2/0 | 3/0 | 4/0 |
| 115 | 1/2 | 0.37 | 7.9 | 9.8 | 112 | 178 | 284 | 449 | 699 | 1114 | 1769 | 2814 | 3550 | 4481 | 5646 |
| 230 | 1/2 | 0.37 | 4.0 | 4.7 | 466 | 742 | 1183 | 1874 | 2915 | 4648 | 7379 | 11733 | | | |
| 230 | 3/4 | 0.55 | 5.0 | 6.2 | 353 | 562 | 897 | 1420 | 2210 | 3523 | 5594 | 8895 | 11222 | | |
| 230 | 1 | 0.75 | 6.7 | 8.1 | 271 | 430 | 686 | 1087 | 1692 | 2697 | 4281 | 6808 | 8590 | 10843 | |
| 230 | 1 1/2 | 1.1 | 9.0 | 10.4 | 211 | 335 | 535 | 847 | 1318 | 2100 | 3335 | 5303 | 6690 | 8445 | |

# 3-WIRE MOTOR DATA

### THREE WIRE, SINGLE PHASE 4" MOTORS - ELECTRICAL DATA, 60 HERTZ, 3450 RPM

| | Motor Order No. | | | | | | Full Load | | Service Factor | | Locked Rotor Amps | Winding Resistance | | Required Control Box |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | Centri-Pro | Red Jacket | HP | KW | Volts | SF | Amps | Watts | Amps | Watts | | Main (B-Y) | Start (R-Y) | |
| 3-Wire with Q.D. Cap. Start Box | M05411 | 50C301 | 0.5 | 0.37 | 115 | 1.6 | Y – 11.0<br>B – 11.0<br>R – 0 | 733 | Y – 12.6<br>B – 12.6<br>R – 0 | 1021 | 49.6 | .9-1.6 | 5.7-7.0 | CB05411 |
| | M05412 | 50C311 | 0.5 | 0.37 | 230 | 1.6 | Y – 5.5<br>B – 5.5<br>R – 0 | 745 | Y – 6.3<br>B – 6.3<br>R – 0 | 1033 | 22.3 | 4.2-4.9 | 17.4-18.7 | CB05412 |
| | M07412 | 75C311 | 0.75 | 0.55 | | 1.5 | Y – 7.2<br>B – 7.2<br>R – 0 | 1014 | Y – 8.3<br>B – 8.3<br>R – 0 | 1381 | 32.0 | 2.6-3.6 | 11.8-13.0 | CB07412 |
| | M10412 | 100C311 | 1.0 | 0.75 | | 1.4 | Y – 8.4<br>B – 8.4<br>R – 0 | 1267 | Y – 9.7<br>B – 9.7<br>R – 0 | 1672 | 41.2 | 2.2-3.2 | 11.3-12.3 | CB10412 |
| 3-Wire with CSCR (CR) or Mag-netic Con-tactor (MC) Con-trol Box | M05412 | 50C311 | 0.5 | 0.37 | | 1.6 | Y – 4.1<br>B – 4.1<br>R – 2.2 | 720 | Y – 4.9<br>B – 4.4<br>R – 2.1 | 955 | 22.3 | 4.2-4.9 | 17.4-18.7 | CB05412CR |
| | M07412 | 75C311 | 0.75 | 0.55 | | 1.5 | Y – 5.1<br>B – 5.0<br>R – 3.2 | 1000 | Y – 6.3<br>B – 5.6<br>R – 3.1 | 1300 | 32.0 | 2.6-3.6 | 11.8-13.0 | CB07412CR |
| | M10412 | 100C311 | 1.0 | 0.75 | | 1.4 | Y – 6.1<br>B – 5.7<br>R – 3.3 | 1205 | Y – 7.2<br>B – 6.3<br>R – 3.3 | 1530 | 41.2 | 2.2-3.2 | 11.3-12.3 | CB10412CR |
| | M15412 | 150C311 | 1.5 | 1.1 | | 1.3 | Y – 9.7<br>B – 9.5<br>R – 1.4 | 1693 | Y – 11.1<br>B – 11.0<br>R – 1.3 | 2187 | 47.8 | 1.6-2.3 | 7.9-8.7 | CB15412CR or CB15412MC |
| | M20412 | 200C311 | 2.0 | 1.5 | | 1.25 | Y – 9.9<br>B – 9.1<br>R – 2.6 | 2170 | Y – 12.2<br>B – 11.7<br>R – 2.6 | 2660 | 49.4 | 1.6-2.2 | 10.8-12.0 | CB20412CR or CB20412MC |
| | M30412 | 300C311 | 3.0 | 2.2 | | 1.15 | Y – 14.3<br>B – 12.0<br>R – 5.7 | 3170 | Y – 16.5<br>B – 13.9<br>R – 5.6 | 3620 | 76.4 | 1.1-1.4 | 2.0-2.5 | CB30412CR or CB30412MC |
| | M50412 | 500C311 | 5.0 | 3.7 | | 1.15 | Y – 24.0<br>B – 19.1<br>R – 10.2 | 5300 | Y – 27.0<br>B – 22.0<br>R – 10.0 | 6030 | 101.0 | .62-.76 | 1.36-1.66 | CB50412CR or CB50412MC |

### THREE WIRE, SINGLE PHASE 4" MOTORS - ENGINEERING DATA

| | | | | | Efficiency % | | Power Factor % | | Thrust Rating | KVA Code |
|---|---|---|---|---|---|---|---|---|---|---|
| Type | Motor Order Number | | HP | Volts | F.L. | S.F. | F.L. | S.F. | | |
| | CentriPro | Red Jacket | | | | | | | | |
| 3-Wire | M05411 | 50C301 | 0.5 | 115 | 51 | 59 | 54 | 69 | 700 # | N |
| | M05412 | 50C311 | 0.5 | 230 | 50 | 58 | 58 | 71 | | M |
| | M07412 | 75C311 | 0.75 | | 55 | 61 | 61 | 72 | | L |
| | M10412 | 100C311 | 1.0 | | 59 | 62 | 66 | 75 | | L |
| | M15412 | 150C311 | 1.5 | | 66 | 67 | 80 | 86 | | J |
| | M20412 | 200C311 | 2 | | 68 | 69 | 96 | 95 | 900 # | G |
| | M30412 | 300C311 | 3 | | 72 | 72 | 96 | 97 | | G |
| | M50412 | 500C311 | 5 | | 71 | 71 | 97 | 98 | 1500 # | E |

### 2-WIRE 1Ø MOTOR WIRE SIZING CHART (Generation 1)

| CentriPro Motor Lead Lengths - 2 Wire Motors, 1Ø, 4" Motors<br>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 |

### GENERATION II, 2-WIRE MOTORS, RECOMMENDED LEAD LENGTHS

**Released for Sale in November/December 2011**

| CentriPro Motor Lead Lengths - 2 Wire Motors, 1Ø, 4" Motors<br>Based on Service Factor Amps, 30º C Ambient and 5% Voltage Drop | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Motor Rating | | | | | 60º C and 75º C Insulation - AWG Copper Wire Size | | | | | | | | | | |
| Volts | HP | kW | FLA | SFA | 14 | 12 | 10 | 8 | 6 | 4 | 2 | 1/0 | 2/0 | 3/0 | 4/0 |
| 115 | 1/2 | 0.37 | 7.9 | 9.8 | 112 | 178 | 284 | 449 | 699 | 1114 | 1769 | 2814 | 3550 | 4481 | 5646 |
| 230 | 1/2 | 0.37 | 4.0 | 4.7 | 466 | 742 | 1183 | 1874 | 2915 | 4648 | 7379 | 11733 | | | |
| 230 | 3/4 | 0.55 | 5.0 | 6.2 | 353 | 562 | 897 | 1420 | 2210 | 3523 | 5594 | 8895 | 11222 | | |
| 230 | 1 | 0.75 | 6.7 | 8.1 | 271 | 430 | 686 | 1087 | 1692 | 2697 | 4281 | 6808 | 8590 | 10843 | |
| 230 | 1 1/2 | 1.1 | 9.0 | 10.4 | 211 | 335 | 535 | 847 | 1318 | 2100 | 3335 | 5303 | 6690 | 8445 | |

### 3-WIRE 1Ø MOTOR WIRE SIZING CHART

| CentriPro Motor Lead Lengths - 3 Wire Motors, 1Ø, 4" Motors<br>Based on Service Factor Amps, 30º C Ambient and 5% Voltage Drop | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Motor Rating | | | | | 60º C & 75º C Insulation - AWG Copper Wire Size | | | | | | | | | | | | |
| HP | Volts | kW | FLA | SFA | 14 | 12 | 10 | 8 | 6 | 4 | 3 | 2 | 1 | 1/0 | 2/0 | 3/0 | 4/0 |
| ½ | 115 | 0.37 | 11 | 12.6 | 87 | 138 | 221 | 349 | 544 | 867 | 1090 | 1376 | 1734 | 2188 | 2761 | 3485 | 4391 |
| ½ | | 0.37 | 5.5 | 6.3 | 348 | 553 | 883 | 1398 | 2175 | 3467 | 4359 | 5505 | 6935 | 8753 | 11044 | 13942 | 17564 |
| ¾ | | 0.55 | 7.2 | 8.3 | 264 | 420 | 670 | 1061 | 1651 | 2632 | 3309 | 4178 | 5264 | 6644 | 8383 | 10582 | 13332 |
| 1 | | 0.75 | 8.4 | 9.7 | 226 | 359 | 573 | 908 | 1413 | 2252 | 2831 | 3575 | 4504 | 5685 | 7173 | 9055 | 11408 |
| 1½ | 230 | 1.1 | 9.7 | 11.1 | 197 | 314 | 501 | 793 | 1234 | 1968 | 2474 | 3124 | 3936 | 4968 | 6268 | 7913 | 9969 |
| 2 | | 1.5 | 9.9 | 12.2 | 180 | 286 | 456 | 722 | 1123 | 1790 | 2251 | 2843 | 3581 | 4520 | 5703 | 7199 | 9070 |
| 3 | | 2.2 | 14.3 | 16.5 | 133 | 211 | 337 | 534 | 830 | 1324 | 1664 | 2102 | 2648 | 3342 | 4217 | 5323 | 6706 |
| 5 | | 3.7 | 24 | 27 | | | 206 | 326 | 507 | 809 | 1017 | 1284 | 1618 | 2042 | 2577 | 3253 | |

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

## USING TWO DIFFERENT CABLE SIZES

Customers sometimes desire to use two or more wire sizes on a pump installation. This is acceptable as long as the maximum cable length ratings are not exceeded. The data below describes how to safely accomplish the task. The cable lengths in the wire sizing charts represent 100% of the allowable length for each wire size. Never use more than 100% of any length shown in the table.

The Three-Wire, Single Phase Motor Wire Chart will be used in this example. See page 8.

**Installation Data:**

- 2 HP, 230V, 1Ø, 3-Wire Motor
- 150 Ft of #12 wire buried between the home (service entrance) and the well
- Pump is set at 340 feet
- Total wire length is 490 feet

**Refer to 3-Wire Motor Lead Length Chart**

- Select row for 2 HP, 230V, 1Ph Motor
- Maximum wire lengths are:
  - o #12 - 286'
  - o #10 - 456'
  - o # 8 - 722'
- Allowable Drop Cannot Exceed 100% of Any Length or Combination of Lengths

***The existing 150 feet of #12 underground wire uses 150'/286' = 52.4% of the allowable length. 100% - 52.4% = 47.6% of another wire available to use. Which wire will use ≤ 47.6% of its allowable length to run 340'.***

***340'/456' = 74.5% of #10 - 74.5% + 52.4% = 126.9% - over 100% is not allowable***

***340'/722' = 47.1% of #8 - 47.1% + 52.4% = 99.5% which is allowable***

***On this application we can use 150' of #12 with 340' of #8.***

The formula is: $\frac{\text{Actual Length 1}}{\text{Maximum Allowed}} + \frac{\text{Actual length 2}}{\text{Maximum Allowed}} \leq 1 \text{ or } \leq 100\%$

Using this formula it is possible to size wire using 2 or more different wire sizes.

# THREE PHASE, 4", MOTOR DATA

## ELECTRICAL DATA, 60 HERTZ, 3450 RPM, 4" MOTORS

| | | | | | | Full Load | | Service Factor | | Locked Rotor Amps | Line - Line Resistance |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CentriPro # | Red Jacket # | HP | kW | Volts | SF | Amps | Watts | Amps | Watts | | |
| M05430 | 50C323 | **0.5** | 0.37 | **200** | 1.6 | 2.9 | 600 | 3.4 | 870 | 22 | 4.1 - 5.2 |
| M07430 | 75C323 | **0.75** | 0.55 | | 1.5 | 3.8 | 812 | 4.5 | 1140 | 32 | 2.6-3.0 |
| M10430 | 100C323 | **1** | 0.75 | | 1.4 | 4.6 | 1150 | 5.5 | 1500 | 29 | 3.4-3.9 |
| M15430 | 150C323 | **1.5** | 1.1 | | 1.3 | 6.3 | 1560 | 7.2 | 1950 | 40 | 1.9-2.5 |
| M20430 | 200C323 | **2** | 1.5 | | 1.25 | 7.5 | 2015 | 8.8 | 2490 | 51 | 1.4-2.0 |
| M30430 | 300C323 | **3** | 2.2 | | 1.15 | 10.9 | 2890 | 12.0 | 3290 | 71 | 0.9-1.3 |
| M50430 | 500C323 | **5** | 3.7 | | 1.15 | 18.3 | 4850 | 20.2 | 5515 | 113 | 0.4-0.8 |
| M75430 | 750C323 | **7.5** | 5.5 | | 1.15 | 27.0 | 7600 | 30.0 | 8800 | 165 | 0.5-0.6 |
| M05432 | 50C313 | **0.5** | 0.37 | **230** | 1.6 | 2.4 | 610 | 2.9 | 880 | 17.3 | 5.7 - 7.2 |
| M07432 | 75C313 | **0.75** | 0.55 | | 1.5 | 3.3 | 850 | 3.9 | 1185 | 27 | 3.3 - 4.3 |
| M10432 | 100C313 | **1** | 0.75 | | 1.4 | 4.0 | 1090 | 4.7 | 1450 | 26.1 | 4.1-5.1 |
| M15432 | 150C313 | **1.5** | 1.1 | | 1.3 | 5.2 | 1490 | 6.1 | 1930 | 32.4 | 2.8-3.4 |
| M20432 | 200C313 | **2** | 1.5 | | 1.25 | 6.5 | 1990 | 7.6 | 2450 | 44 | 1.8-2.4 |
| M30432 | 300C313 | **3** | 2.2 | | 1.15 | 9.2 | 2880 | 10.1 | 3280 | 58.9 | 1.3-1.7 |
| M50432 | 500C313 | **5** | 3.7 | | 1.15 | 15.7 | 4925 | 17.5 | 5650 | 93 | .85-1.25 |
| M75432 | 750C313 | **7.5** | 5.5 | | 1.15 | 24 | 7480 | 26.4 | 8570 | 140 | .55-.85 |
| M05434 | 50C353 | **0.5** | 0.37 | **460** | 1.6 | 1.3 | 610 | 1.5 | 875 | 9 | 23.6 - 26.1 |
| M07434 | 75C353 | **0.75** | 0.55 | | 1.5 | 1.7 | 820 | 2.0 | 1140 | 14 | 14.4 - 16.2 |
| M10434 | 100C353 | **1** | 0.75 | | 1.4 | 2.2 | 1145 | 2.5 | 1505 | 13 | 17.8 - 18.8 |
| M15434 | 150C353 | **1.5** | 1.1 | | 1.3 | 2.8 | 1560 | 3.2 | 1980 | 16.3 | 12.3 - 13.1 |
| M20434 | 200C353 | **2** | 1.5 | | 1.25 | 3.3 | 2018 | 3.8 | 2470 | 23 | 8.0 - 8.67 |
| M30434 | 300C353 | **3** | 2.2 | | 1.15 | 4.8 | 2920 | 5.3 | 3320 | 30 | 5.9-6.5 |
| M50434 | 500C353 | **5** | 3.7 | | 1.15 | 7.6 | 4810 | 8.5 | 5530 | 48 | 3.58-4.00 |
| M75434 | 750C353 | **7.5** | 5.5 | | 1.15 | 12.2 | 7400 | 13.5 | 8560 | 87 | 1.9-2.3 |
| M100434 | 1000C353 | **10** | 7.5 | | 1.15 | 15.6 | 9600 | 17.2 | 11000 | 110 | 1.8-2.2 |
| M15437 | 150C363 | **1.5** | 1.1 | **575** | 1.3 | 2.0 | 1520 | 2.4 | 1950 | 11.5 | 19.8-20.6 |
| M20437 | 200C363 | **2** | 1.5 | | 1.25 | 2.7 | 1610 | 3.3 | 2400 | 21 | 9.4-9.7 |
| M30437 | 300C363 | **3** | 2.2 | | 1.15 | 3.7 | 2850 | 4.1 | 3240 | 21.1 | 9.4-9.7 |
| M50437 | 500C363 | **5** | 3.7 | | 1.15 | 7.0 | 5080 | 7.6 | 5750 | 55 | 3.6-4.2 |
| M75437 | 750C363 | **7.5** | 5.5 | | 1.15 | 9.1 | 7260 | 10.0 | 8310 | 55 | 3.6-4.2 |

## THREE-PHASE, 4" MOTOR, LENGTHS AND WEIGHTS

| HP | Volts | Length | | Weight | |
|---|---|---|---|---|---|
| | | In. | MM | Lb. | Kg. |
| .5 | 200<br>230<br>460 | 10.0 | 254 | 19 | 8.6 |
| .75 | | 10.8 | 275 | 22 | 9.7 |
| 1 | | 11.7 | 297 | 23 | 10.4 |
| 1.5 | | 11.7 | 297 | 23 | 10.4 |
| 2 | | 13.8 | 351 | 28 | 12.7 |
| 3 | | 15.3 | 389 | 32 | 14.5 |
| 5 | | 21.7 | 550 | 55 | 24.9 |
| 7.5 | | 27.7 | 703 | 70 | 31.8 |
| 10 | | 30.7 | 780 | 78 | 35.4 |
| 1.5 | 575 | 11.7 | 297 | 23 | 10.4 |
| 2 | | 15.3 | 389 | 32 | 14.5 |
| 3 | | 15.3 | 389 | 32 | 14.5 |
| 5 | | 27.7 | 703 | 70 | 31.8 |
| 7.5 | | 27.7 | 703 | 70 | 31.8 |

# THREE PHASE, 4", MOTOR DATA

## EFFICIENCY, THRUST RATING, FUSE/CIRCUIT BREAKER, KVA CODES

| Motor Order No. | | HP | Volts | Efficiency % | | Thrust Rating | KVA Code | Standard Fuse | | DE-TD Fuse | | Circuit Breaker | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Centri-Pro | Red Jacket | | | F.L. | S.F. | | | Meets NEC based FLA | Max. Value based SFA | Meets NEC based FLA | Max. Value based SFA | Meets NEC based FLA | Max. Value based SFA |
| M05430 | 50C323 | **0.5** | **200** | 62 | 68 | 700 # | R | 10 | 15 | 6 | 10 | 10 | 15 |
| M07430 | 75C323 | **0.75** | | 69 | 74 | | R | 15 | 20 | 10 | 15 | 10 | 20 |
| M10430 | 100C323 | **1** | | 66 | 70 | | M | 15 | 20 | 10 | 10 | 10 | 15 |
| M15430 | 150C323 | **1.5** | | 72 | 74 | | L | 20 | 25 | 10 | 15 | 15 | 20 |
| M20430 | 200C323 | **2** | | 74 | 75 | 900 # | K | 25 | 30 | 15 | 20 | 20 | 25 |
| M30430 | 300C323 | **3** | | 77 | 77 | | K | 35 | 40 | 20 | 25 | 30 | 35 |
| M50430 | 500C323 | **5** | | 76 | 76 | 1500 # | J | 60 | 70 | 35 | 40 | 50 | 60 |
| M75430 | 750C323 | **7.5** | | 74 | 74 | | J | 80 | 90 | 50 | 60 | 70 | 80 |
| M05432 | 50C313 | **0.5** | **230** | 61 | 68 | 700 # | R | 6 | 10 | 6 | 6 | 6 | 10 |
| M07432 | 75C313 | **0.75** | | 66 | 71 | | R | 6 | 15 | 6 | 10 | 6 | 10 |
| M10432 | 100C313 | **1** | | 69 | 72 | | M | 10 | 15 | 6 | 10 | 10 | 15 |
| M15432 | 150C313 | **1.5** | | 75 | 76 | | K | 15 | 20 | 10 | 15 | 15 | 15 |
| M20432 | 200C313 | **2** | | 75 | 75 | 900 # | K | 15 | 25 | 15 | 15 | 20 | 20 |
| M30432 | 300C313 | **3** | | 77 | 77 | | J | 25 | 35 | 15 | 20 | 25 | 30 |
| M50432 | 500C313 | **5** | | 76 | 76 | 1500 # | J | 45 | 60 | 30 | 35 | 40 | 45 |
| M75432 | 750C313 | **7.5** | | 75 | 75 | | J | 70 | 80 | 45 | 50 | 60 | 70 |
| M05434 | 50C353 | **0.5** | **460** | 61 | 68 | 700 # | R | 3 | 6 | 3 | 3 | 3 | 6 |
| M07434 | 75C353 | **0.75** | | 69 | 73 | | R | 3 | 10 | 6 | 6 | 3 | 6 |
| M10434 | 100C353 | **1** | | 65 | 69 | | M | 6 | 10 | 3 | 6 | 6 | 10 |
| M15434 | 150C353 | **1.5** | | 72 | 73 | | K | 10 | 10 | 6 | 6 | 6 | 10 |
| M20434 | 200C353 | **2** | | 74 | 75 | 900 # | L | 15 | 15 | 6 | 10 | 10 | 10 |
| M30434 | 300C353 | **3** | | 76 | 77 | | J | 15 | 20 | 10 | 10 | 15 | 15 |
| M50434 | 500C353 | **5** | | 77 | 77 | 1500 # | J | 25 | 30 | 15 | 20 | 20 | 20 |
| M75434 | 750C353 | **7.5** | | 76 | 76 | | L | 40 | 50 | 25 | 30 | 35 | 40 |
| M100434 | 1000C353 | **10** | | 79 | 80 | | K | 45 | 60 | 25 | 35 | 35 | 45 |
| M15437 | 150C363 | **1.5** | **575** | 73 | 74 | 700 # | J | 6 | 10 | 3 | 6 | 6 | 10 |
| M20437 | 200C363 | **2** | | 78 | 78 | 900 # | M | 10 | 10 | 6 | 6 | 10 | 10 |
| M30437 | 300C363 | **3** | | 78 | 78 | | J | 10 | 15 | 10 | 10 | 10 | 15 |
| M50437 | 500C363 | **5** | | 74 | 75 | 1500 # | M | 20 | 25 | 15 | 15 | 20 | 20 |
| M75437 | 750C363 | **7.5** | | 77 | 77 | | J | 25 | 35 | 20 | 20 | 25 | 30 |

### 3Ø 4" CENTRIPRO MOTOR WIRE CHART

| Motor Lead Lengths – 3-Phase Motors – Based on Service Factor Amps, 30° C Ambient and 5% Voltage Drop | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Motor Rating | | | | | 60° C and 75° C Insulation - AWG Copper Wire Size | | | | | | | | | | |
| Volts | HP | kW | FLA | SFA | 14 | 12 | 10 | 8 | 6 | 4 | 2 | 1/0 | 2/0 | 3/0 | 4/0 |
| 200 | .5 | .37 | 3.8 | 2.9 | 657 | 1045 | 1667 | 2641 | 4109 | | | | | | |
| | .75 | .55 | 3.8 | 4.5 | 423 | 674 | 1074 | 1702 | 2648 | | | | | | |
| | 1 | .75 | 4.6 | 5.5 | 346 | 551 | 879 | 1392 | 2166 | 3454 | | | | | |
| | 1.5 | 1.1 | 6.3 | 7.2 | 265 | 421 | 672 | 1064 | 1655 | 2638 | | | | | |
| | 2 | 1.5 | 7.5 | 8.8 | 217 | 344 | 549 | 870 | 1354 | 2158 | 3427 | 5449 | | | |
| | 3 | 2.2 | 10.9 | 12.0 | 159 | 253 | 403 | 638 | 993 | 1583 | 2513 | 3996 | | | |
| | 5 | 3.7 | 18.3 | 20.2 | 94 | 150 | 239 | 379 | 590 | 940 | 1493 | 2374 | 2995 | 3781 | 4764 |
| | 7.5 | 5.5 | 27.0 | 30.0 | 64 | 101 | 161 | 255 | 397 | 633 | 1005 | 1598 | 2017 | 2546 | 3207 |
| 230 | .5 | .37 | 2.4 | 2.9 | 756 | 1202 | 1917 | 3037 | 4725 | 7532 | | | | | |
| | .75 | .55 | 3.3 | 3.9 | 562 | 894 | 1426 | 2258 | 3513 | 5601 | 8892 | | | | |
| | 1 | .75 | 4 | 4.7 | 466 | 742 | 1183 | 1874 | 2915 | 4648 | 7379 | | | | |
| | 1.5 | 1.1 | 5.2 | 6.1 | 359 | 571 | 912 | 1444 | 2246 | 3581 | 5685 | 9040 | | | |
| | 2 | 1.5 | 6.5 | 7.6 | 288 | 459 | 732 | 1159 | 1803 | 2874 | 4563 | 7256 | 9155 | | |
| | 3 | 2.2 | 9.2 | 10.1 | 217 | 345 | 551 | 872 | 1357 | 2163 | 3434 | 5460 | 6889 | 8696 | 10956 |
| | 5 | 3.7 | 15.7 | 17.5 | | | 318 | 503 | 783 | 1248 | 1982 | 3151 | 3976 | 5019 | 6323 |
| | 7.5 | 5.5 | 24 | 26.4 | | | | 334 | 519 | 827 | 1314 | 2089 | 2635 | 3327 | 4192 |
| 460 | .5 | .37 | 1.3 | 1.5 | 2922 | 4648 | 7414 | | | | | | | | |
| | .75 | .55 | 1.7 | 2.0 | 2191 | 3486 | 5560 | 8806 | | | | | | | |
| | 1 | .75 | 2.2 | 2.5 | 1753 | 2789 | 4448 | 7045 | | | | | | | |
| | 1.5 | 1.1 | 2.8 | 3.2 | 1370 | 2179 | 3475 | 5504 | | | | | | | |
| | 2 | 1.5 | 3.3 | 3.8 | 1153 | 1835 | 2926 | 4635 | 7212 | | | | | | |
| | 3 | 2.2 | 4.8 | 5.3 | 827 | 1315 | 2098 | 3323 | 5171 | | | | | | |
| | 5 | 3.7 | 7.6 | 8.5 | 516 | 820 | 1308 | 2072 | 3224 | 5140 | | | | | |
| | 7.5 | 5.5 | 12.2 | 13.5 | 325 | 516 | 824 | 1305 | 2030 | 3236 | 5138 | | | | |
| | 10 | 7.5 | 15.6 | 17.2 | 255 | 405 | 647 | 1024 | 1593 | 2540 | 4033 | | | | |
| 575 | 1.5 | 1.1 | 2.0 | 2.4 | 2283 | 3631 | 5792 | | | | | | | | |
| | 2 | 1.5 | 2.7 | 3.3 | 1660 | 2641 | 4212 | 6671 | | | | | | | |
| | 3 | 2.2 | 3.7 | 4.1 | 1336 | 2126 | 3390 | 5370 | | | | | | | |
| | 5 | 3.7 | 7.0 | 7.6 | 721 | 1147 | 1829 | 2897 | 4507 | | | | | | |
| | 7.5 | 5.5 | 9.1 | 10.0 | 548 | 871 | 1390 | 2202 | 3426 | | | | | | |

## 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.① |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Amps | Watts | Amps | Watts | | |
| 6M051 | 5 | 3.7 | 230 | 1 | 6" x 6" | 1.15 | 24 | 4987 | 27.5 | 5735 | 124 | CB05MC (3R) |
| 6M071 | 7.5 | 5.5 | | | | | 36 | 7675 | 41 | 8950 | 167 | CB07MC (3R) |
| 6M101 | 10 | 7.5 | | | | | 50 | 10135 | 58 | 11830 | 202 | CB10MC (3R) |
| 6M151 | 15 | 11 | | | | | 72 | 15180 | 85 | 18050 | 275 | CB15MC (3R) |

① NEMA 3R control boxes will be replacing the current models.

## 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 | 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 | | | | 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 | CSDC |
| 6M078 | 7.5 | 5.5 | 200 | | | | 25.4 | 7180 | 28.5 | 8230 | 158 | DSFD |
| 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 |
| 6M108 | 10 | 7.5 | 200 | | | | 33.3 | 9360 | 37.2 | 10700 | 236 | ESFD |
| 6M102 | 10 | 7.5 | 230 | | | | 29.0 | 9407 | 33.0 | 10730 | 208 | ESFC |
| 6M104 | 10 | 7.5 | 460 | | | | 14.5 | 9407 | 16.5 | 10730 | 104 | DSEC |
| 6M158 | 15 | 11 | 200 | | | | 47.4 | 13700 | 53.5 | 15710 | 347 | GSJD |
| 6M152 | 15 | 11 | 230 | 3 | 6" x 6" | 1.15 | 42.0 | 13700 | 46.0 | 15800 | 320 | FSHC |
| 6M154 | 15 | 11 | 460 | | | | 21.0 | 13700 | 23.0 | 15800 | 160 | ESFC |
| 6M208 | 20 | 15 | 200 | | | | 61.2 | 18040 | 69.5 | 20820 | 431 | HSKD |
| 6M202 | 20 | 15 | 230 | | | | 54.0 | 17930 | 60.0 | 20650 | 392 | GSJC |
| 6M204 | 20 | 15 | 460 | | | | 27.0 | 17930 | 30.0 | 20650 | 196 | FSHC |
| 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 |
| 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 | GSJC |
| 6M404 | 40 | 30 | 460 | | 6" x 6" | | 53.0 | 35530 | 60.0 | 41100 | 340 | HSKC |
| 66M504 | 50 | 37 | 460 | | | | 70.0 | 45210 | 79.0 | 52380 | 465 | HSKC |
| 86M504 | 50 | 37 | 460 | | 8" x 6" | | 65.0 | 44360 | 73.0 | 51000 | 435 | HSKC |
| 86M604 | 60 | 45 | 460 | | | | 80.0 | 52850 | 90.0 | 60900 | 510 | JTMC |
| 8M754 | 75 | 55 | 460 | 3 | | 1.15 | 96.0 | 65900 | 109.0 | 76100 | 650 | JTMC |
| 8M1004 | 100 | 75 | 460 | | 8" x 8" | | 127.0 | 87600 | 145.0 | 101300 | 795 | JTMC |
| 8M1254 | 125 | 90 | 460 | | | | 160.0 | 110800 | 180.0 | 126000 | 980 | NA |
| 8M1504 | 150 | 110 | 460 | | | | 195.0 | 130700 | 220.0 | 152000 | 1060 | NA |
| 10M2004 | 200 | 150 | 460 | | 10 "x 10" | | 235.0 | 171100 | 270.0 | 198600 | 1260 | NA |

* Furnas Class 14 NEMA Starter with ESP200 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

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.

## 6-10" 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 | 0.618 | 50 | 25 |
| 6M052 | 5 | 3.7 | 230 | | 76.8 | K | 0.806 | 45 | 20 |
| 6M054 | 5 | 3.7 | 460 | | 76.8 | K | 3.050 | 25 | 10 |
| 6M078 | 7.5 | 5.5 | 200 | | 77.9 | J | 0.504 | 80 | 40 |
| 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 |
| 6M108 | 10 | 7.5 | 200 | | 79.7 | K | 0.315 | 100 | 50 |
| 6M102 | 10 | 7.5 | 230 | | 79.3 | K | 0.448 | 90 | 40 |
| 6M104 | 10 | 7.5 | 460 | | 79.3 | K | 1.619 | 45 | 20 |
| 6M158 | 15 | 11 | 200 | | 81.7 | K | 0.213 | 175 | 70 |
| 6M152 | 15 | 11 | 230 | | 81.7 | K | 0.312 | 150 | 60 |
| 6M154 | 15 | 11 | 460 | | 81.7 | K | 1.074 | 70 | 30 |
| 6M208 | 20 | 15 | 200 | | 82.7 | J | 0.189 | 200 | 90 |
| 6M202 | 20 | 15 | 230 | | 83.2 | J | 0.258 | 175 | 70 |
| 6M204 | 20 | 15 | 460 | | 83.2 | J | 0.861 | 90 | 35 |
| 6M258 | 25 | 18.5 | 200 | | 82.0 | K | 0.146 | 250 | 110 |
| 6M252 | 25 | 18.5 | 230 | | 83.0 | K | 0.210 | 225 | 90 |
| 6M254 | 25 | 18.5 | 460 | | 83.0 | K | 0.666 | 110 | 45 |
| 6M308 | 30 | 22 | 200 | | 82.9 | J | 0.119 | 300 | 125 |
| 6M302 | 30 | 22 | 230 | | 82.5 | K | 0.166 | 250 | 100 |
| 6M304 | 30 | 22 | 460 | | 82.5 | K | 0.554 | 125 | 50 |
| 6M404 | 40 | 30 | 460 | | 84.0 | H | 0.446 | 175 | 70 |
| 66M504 | 50 | 37 | 460 | | 82.5 | J | 0.388 | 225 | 90 |
| 86M504 | 50 | 37 | 460 | | 84.1 | H | 0.331 | 200 | 90 |
| 86M604 | 60 | 45 | 460 | | 84.7 | H | 0.278 | 250 | 110 |
| 8M754 | 75 | 55 | 460 | | 84.9 | H | 0.218 | 300 | 125 |
| 8M1004 | 100 | 75 | 460 | | 85.2 | H | 0.164 | 400 | 175 |
| 8M1254 | 125 | 90 | 460 | | 84.2 | G | 0.132 | 500 | 225 |
| 8M1504 | 150 | 110 | 460 | | 85.6 | G | 0.115 | 600 | 250 |
| 10M2004 | 200 | 150 | 460 | | 87.2 | F | 0.0929 | 800 | 350 |

# Use for CentriPro 6-10" Motors

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

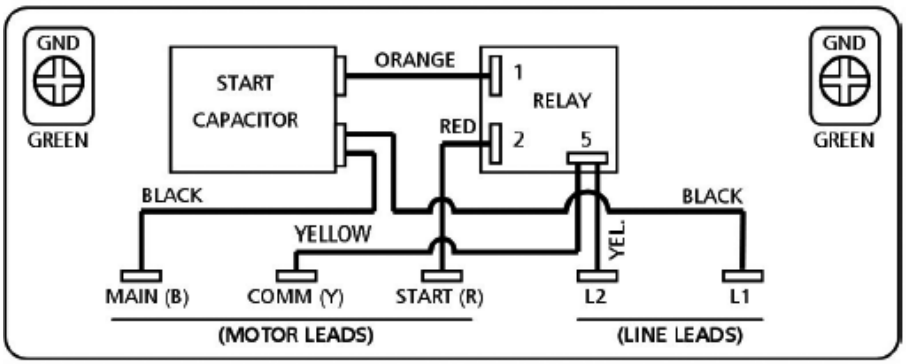
| Motor Rating | | 75° C Insulation - AWG Copper Wire Size | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volts** | **HP** | **14** | **12** | **10** | **8** | **6** | **4** | **2** | **1** | **1/0** | **2/0** | **3/0** | **4/0** | **250** | **350** | **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 | | | |
| 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 |

Lengths **IN BOLD TYPE** meet the National Electric Code ampacity only for individual conductor 75° 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:** Since 60° C cable is no longer the industry standard and is not readily available, we have removed the chart.

# 1Ø THREE-WIRE CONTROL BOX WIRING CHARTS
## Quick Disconnect ½ – 1 HP

### WIRING DIAGRAM




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

| Order Number | HP | Volts | Capacitor Order Number | Start Capacitor Mfd | Capacitor Voltage / Quantity | Start Relay Order No. | Standard Circuit Breaker | Relay (Ohms) #2-#5 |
|---|---|---|---|---|---|---|---|---|
| CB05411 | .5 | 115 | 9K450 | 250 - 300 | 125 / 1 | ① 9K457<br>② 9K566 | 30 | 700 – 1800 |
| CB05412 | .5 | 230 | 9K448 | 59 - 71 | 250 / 1 | ① 9K462<br>② 9K567 | 15 | 4500 – 7000 |
| CB07412 | .75 | 230 | 9K449 | 86 - 103 | 250 / 1 | | 20 | |
| CB10412 | 1 | 230 | 9K447 | 105 - 126 | 250 / 1 | | 25 | |

① First Design - Up to June 2009 - Relay tab on bottom, capacitor held by bracket and screw. See pictures below. 208 V use 9K461 relay.

② Current Design - Starting June 2009 - Relay tab on top and Ducati capacitors, all held by one screw. See pictures below. The relays are designed for operation in a specific orientation, therefore there are two different numbers now. 208 V use 9K568 relay.

**First Design**

**Tab Down ①**

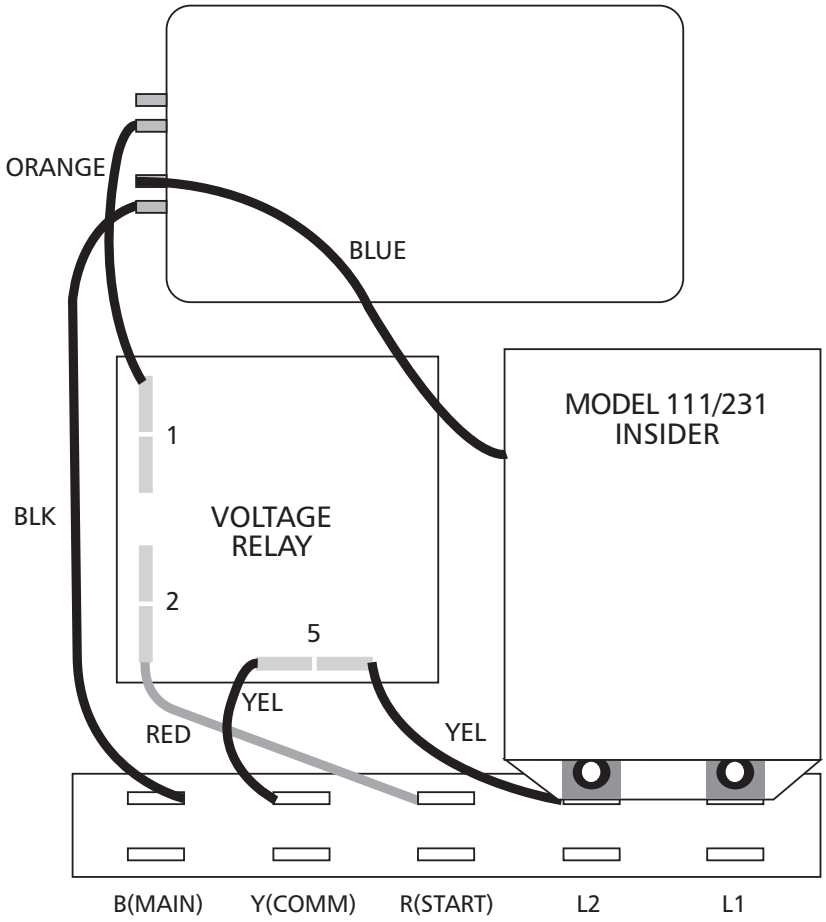
**Current Design**

**Tab Up ②**

## 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.

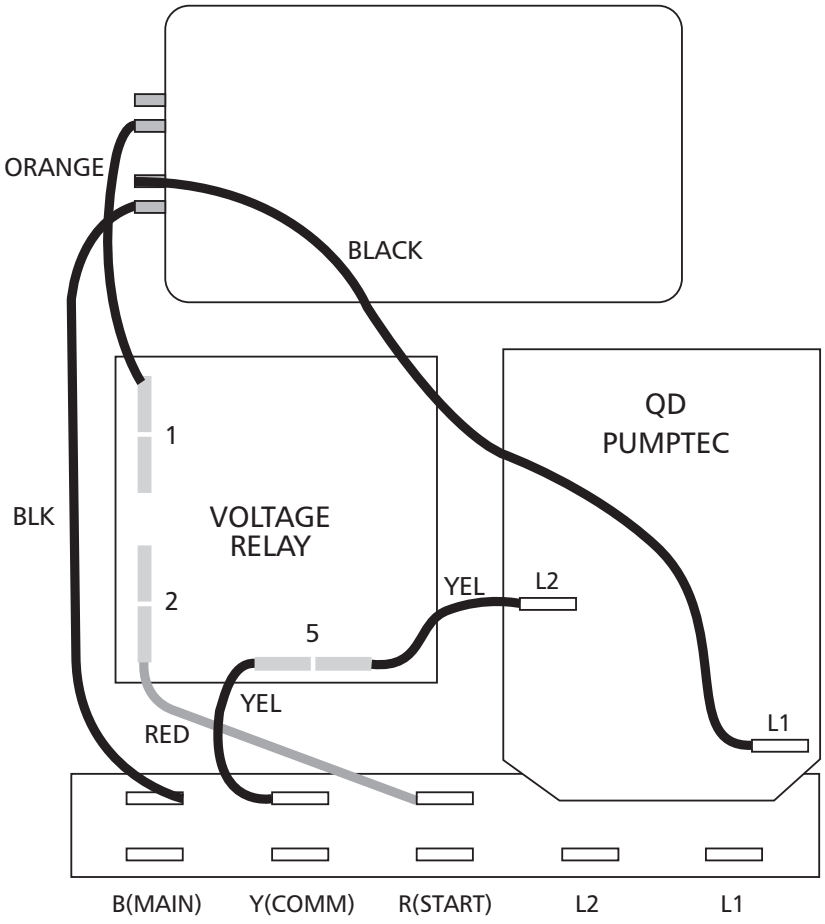



**CENTRIPRO CONTROL BOX WITH INSIDER INSTALLED**

## 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.

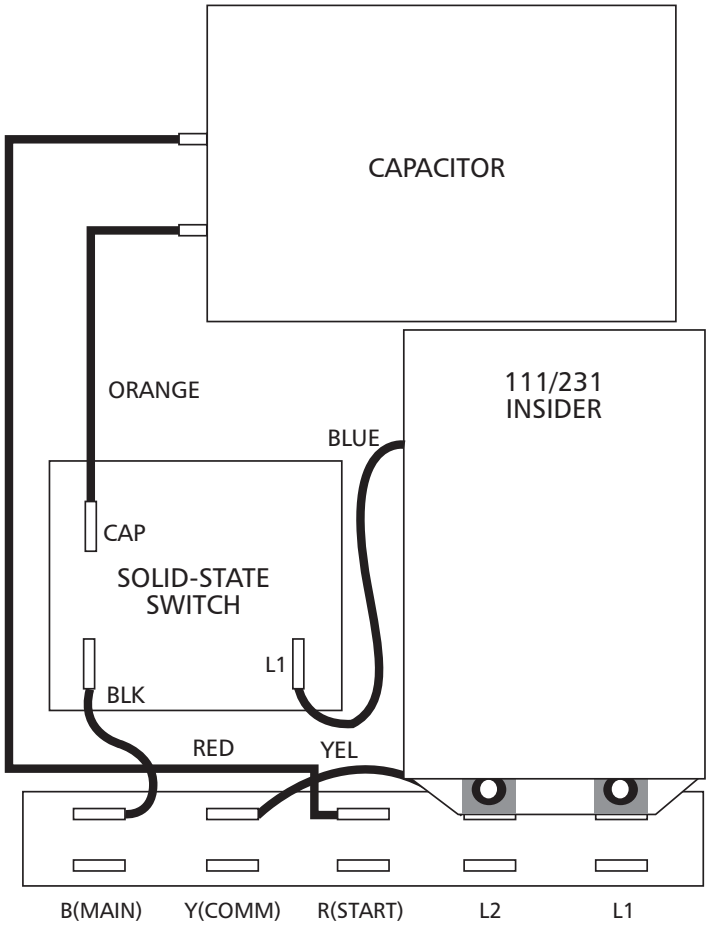



**CENTRIPRO CONTROL BOX WITH PUMPTEC INSTALLED**

# 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 | 0.5 | .37 | 230 | ① | 50F311CB S50N1CB, A50N1CB | 2824055015① | 15 | 20 | 10 | 8.1 x 5.9 x 9.3 | 7 |
| CB07412CR | .75 | .55 | 230 | ① | 75F311CB S75N1CB, A75N1CB | 2824075015① | 20 | 25 | 15 | 8.1 x 5.9 x 9.3 | 7 |
| CB10412CR | 1 | .75 | 230 | ① | S100F311CB S100N1CB, A100N1CB | 2824085015① | 25 | 30 | 20 | 8.1 x 5.9 x 9.3 | 7 |
| CB15412CR | 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 | 2 | 1.5 | 230 | 00084 | 200F311CB S200N1CB, AS200T1CB | 282 3018 110 | 25 | 30 | 20 | 8.1 x 5.9 x 9.3 | 7 |
| CB30412CR | 3 | 2.2 | 230 | 00094 | 300F311CB S300N1CB | 282 3028 110 | 40 | 45 | 30 | 8.1 x 5.9 x 9.3 | 7 |
| CB50412CR | 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| CB05412CR | .5 | 230 | ① | 9K465 | 43-53 | Start | 250 | 1 | NA | 9K458 |
| | | | | 9K466 | 15 | Run | 370 | | | |
| CB07412CR | .75 | 230 | ① | 9K448 | 59-71 | Start | 250 | 1 | N/A | 9K458 |
| | | | | 9K467 | 23 | Run | 370 | | | |
| CB10412CR | 1 | 230 | ① | 9K449 | 86-103 | Start | 250 | 1 | N/A | 9K458 |
| | | | | 9K467 | 23 | Run | 370 | | | |
| CB15412CR | 1.5 | 230 | 00074 | 9K447 | 105-126 | Start | 250 | 1 | 9K471 | 9K458 |
| | | | | 9K452 | 10 | Run | 370 | | | |
| CB20412CR | 2 | 230 | 00084 | 9K447 | 105-126 | Start | 250 | 1 | 9K481 | 9K458 |
| | | | | 9K451 | 20 | Run | 370 | | | |
| CB30412CR | 3 | 230 | 00094 | 9K453 | 208-250 | Start | 250 | 1 | 9K482 | 9K459 |
| | | | | 9K454 | 45 | Run | 370 | | | |
| CB50412CR | 5 | 230 | 00104 | 9K455 | 270-324 | Start | 330 | 1 | 9K483 | |
| | | | | 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.

Order Number 9K479 for 200/208 Volt Start Relay.

# 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 | 1.5 | 1.1 | 230 | No Equal | No Equal | No Equal | 30 | 35 | 20 | 8.1 x 5.9 x 9.3 | 8 |
| CB20412MC | 2 | 1.5 | 230 | 00084MC | No Equal | 2823018310 | 25 | 30 | 20 | | |
| CB30412MC | 3 | 2.2 | 230 | 00094MC | S300N1CBC | 2823028310 | 40 | 45 | 30 | | |
| CB50412MC | 5 | 3.7 | 230 | 00104MC | S500N1CBC | 2821139310 | 60 | 80 | 45 | 11 x 6.7 x 12.5 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CB15412MC | 1.5 | 1.1 | 230 | 9K447 | Start | 105-126 | 250 | 1 | 9K485 | 9K493 | 9K458 |
| | | | | 9K452 | Run | 10 | 370 | | | | |
| CB20412MC | 2 | 1.5 | | 9K447 | Start | 105-126 | 250 | | | 9K480 (S) | |
| | | | | 9K451 | Run | 20 | 370 | | | 9K472 (M) | |
| CB30412MC | 3 | 2.2 | | 9K453 | Start | 208-250 | 250 | | | 9K473 (S) | 9K459 |
| | | | | 9K454 | Run | 45 | 370 | | | 9K474 (M) | |
| CB50412MC | 5 | 3.7 | | 9K455 | Start | 270-324 | 330 | 1 | 9K486 | 9K475 (S) | |
| | | | | 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.

Order Number 9K479 for 200/208 Volt Start Relay.

## 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.

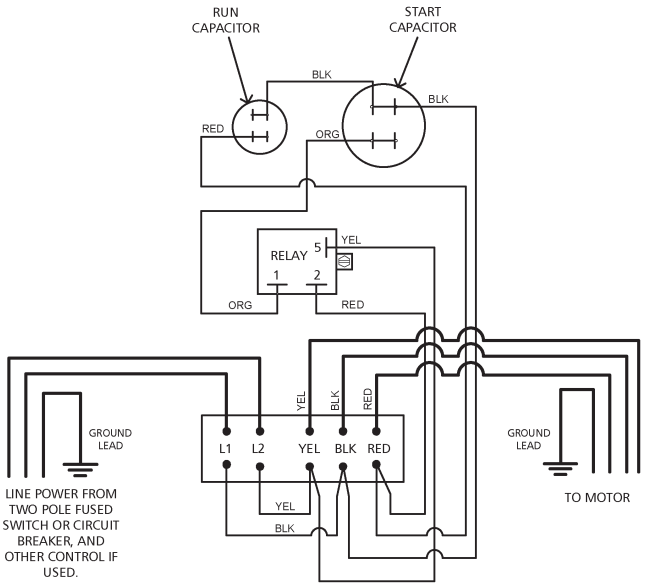
**B.** CAPACITOR (DISCONNECT ONE LEAD FROM EACH CAPACITOR PRIOR TO CHECKING.)
1. OHMMETER SETTING: (R X 1000).
2. TERMINAL CONNECTIONS: INDIVIDUAL CAPACITOR TERMINALS.
3. OHMMETER READING: POINTER SHOULD SWING TOWARD ZERO THEN DRIFT BACK TOWARD INFINITY.

**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.

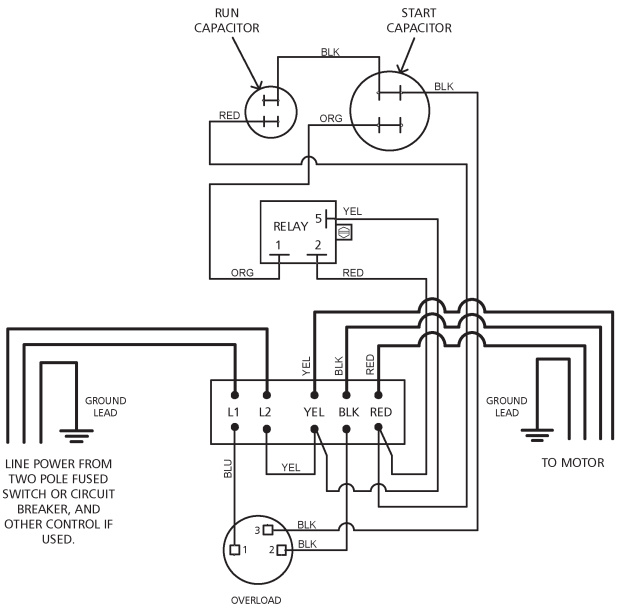
**E.** MAGNETIC CONTACTOR ONLY (DISCONNECT 1 COIL LEAD)
1. OHMMETER SETTING: (R X 100).
2. CHECK COIL RESISTANCE: 180-1400 OHMS.
3. REMOVE CONTACT COVER AND INSPECT CONTACTS.

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

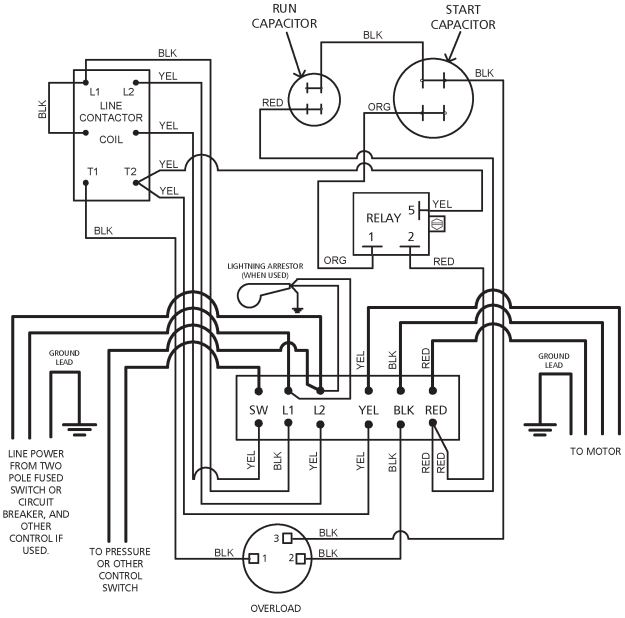


# 1Ø CONTROL BOX WIRING DIAGRAMS

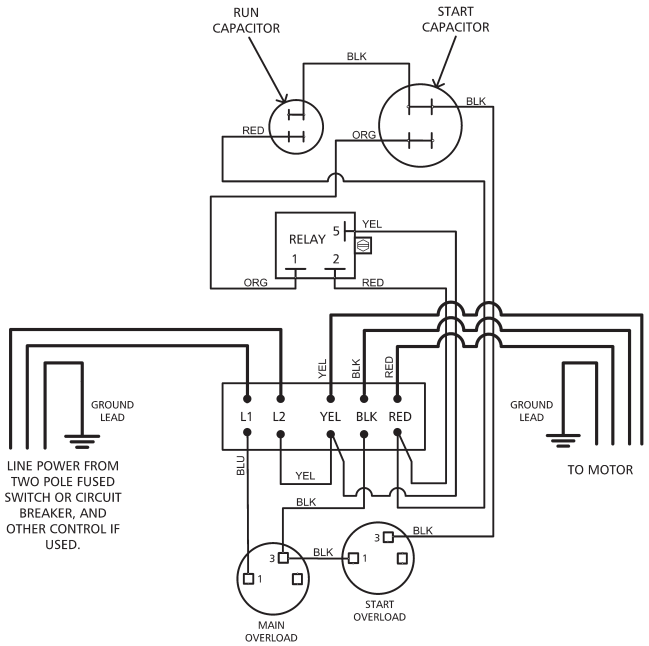
## 1½ HP STANDARD



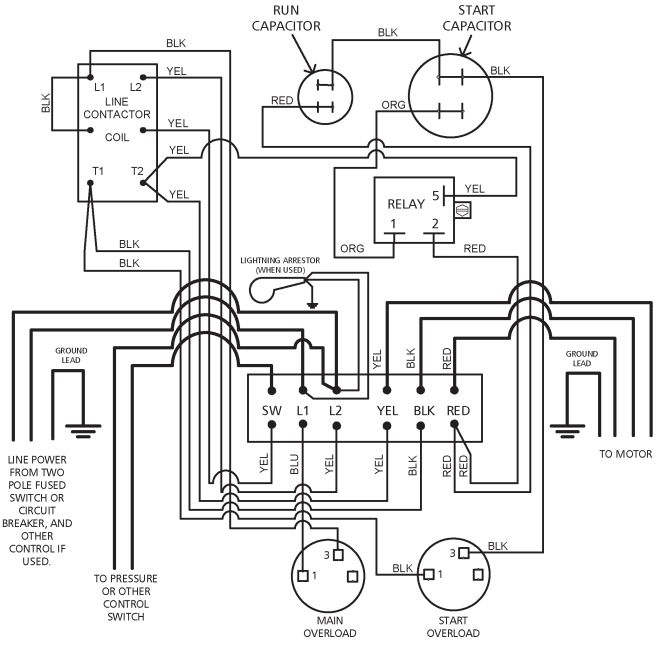

## 1½ HP WITH MAGNETIC CONTACTOR




## 2 HP STANDARD

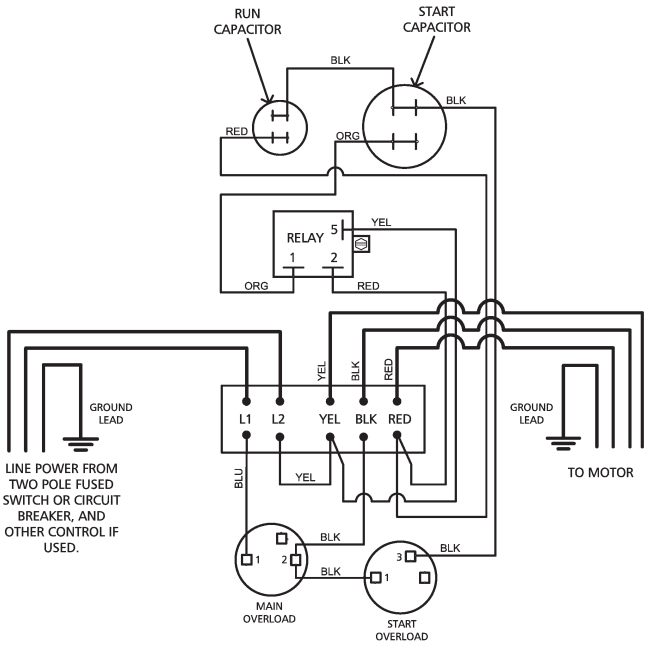



## 2 HP WITH MAGNETIC CONTACTOR

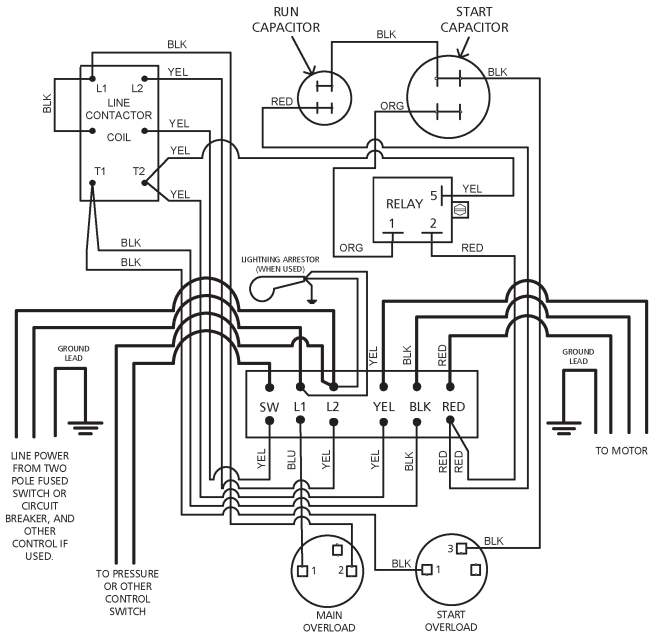


# 1Ø CONTROL BOX WIRING DIAGRAMS

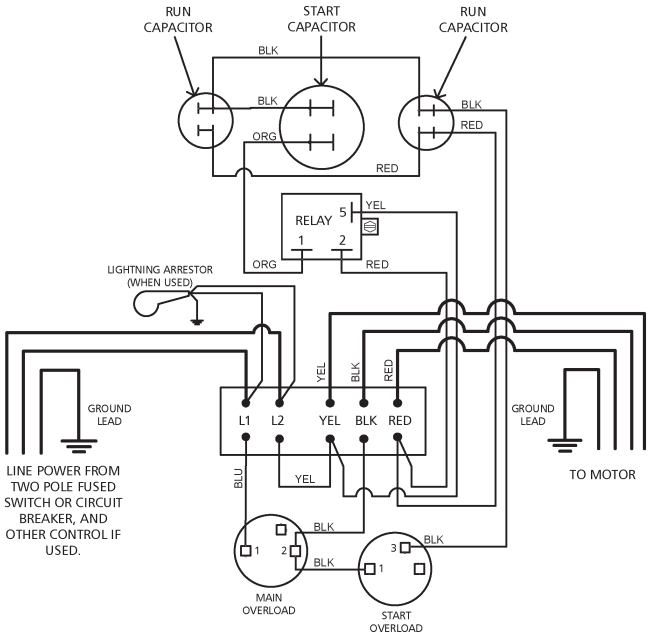
## 3 HP STANDARD



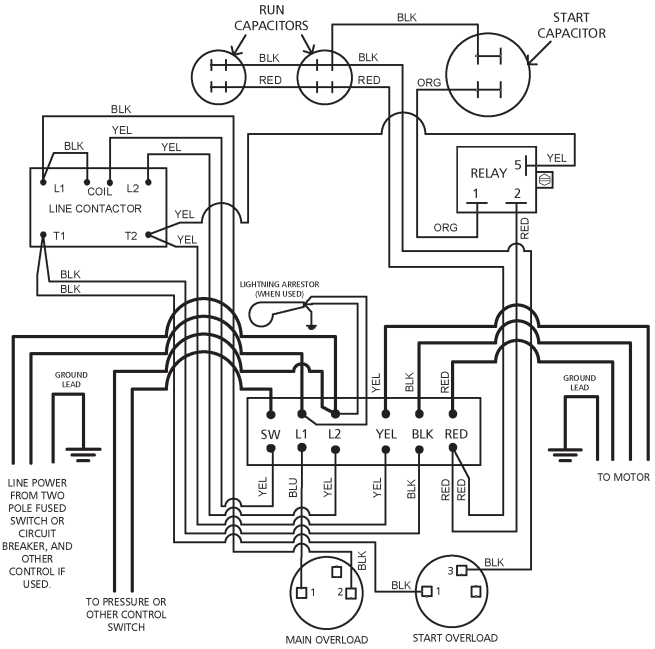

## 3 HP WITH MAGNETIC CONTACTOR




## 5 HP STANDARD




## 5 HP WITH MAGNETIC CONTACTOR



## PUMP 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<br>a. Incorrect control box<br>b. Incorrect or faulty electrical connections<br>c. Faulty thermal protector<br>d. Low voltage<br>e. Ambient temperature of control box/ starter too high<br>f. Pump bound by foreign matter<br>g. Inadequate submergence | 1. Allow motor to cool, thermal protector will automatically reset<br>a – e. Have a qualified electrician inspect and repair, as required<br>f. Pull pump, clean, adjust set depth as required<br>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<br>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 |

# AQUAVAR SOLO DATA

## CONTROLLER, BREAKER, GENERATOR SIZING

| Motor | | Controller Model ② | | | | Circuit Breaker ③ | Generator ④ (VA) |
|---|---|---|---|---|---|---|---|
| HP | Voltage ① | 1AS15 | 3AS20 | 3AS30 | 3AS50 | | |
| ½ | 230 | | | | | 15 | 2200 |
| | 200 | | | | | | |
| ¾ | 230 | | | | | | 2900 |
| | 200 | | | | | | |
| 1 | 230 | | | | | | 3500 |
| | 200 | | | | | | |
| 1½ | 230 | | | | | 20 | 4400 |
| | 200 | | | | | | |
| 2 | 230 | | | | | 30 | 6100 |
| | 200 | | | | | | |
| 3 | 230 | | | | | | 8100 |
| | 200 | | | | | | |
| | | | | | | 40 | |
| 5 | 230 | | | | | 50 | 13300 |
| | 200 | | | | | | |

① Supply voltage must be 196 VAC – 265 VAC.

② Shaded areas indicate which controller models can be used with which motors. Lighter shading indicates combinations where controller will limit peak performance to 85% of catalog value for pump/motor.

③ Circuit Breaker or Dual Element Time Delay Fuse Size (Amps) protecting branch circuit supplying controller.

④ Minimum size of single phase 240 V generator required.

## WIRE SIZING – MAXIMUM CABLE LENGTHS IN FEET TO LIMIT VOLTAGE DROP TO 5% FOR 230 V SYSTEMS ⑤

### Service Entrance to Controller

| Controller Input | Motor HP | Copper Wire Size 75ºC Insulation Exposed to a Maximum of 50ºC (122ºF) Ambient Temperature ⑥ | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 14 | 12 | 10 | 8 | 6 | 4 | 3 | 2 | 1 | 1/0 | 2/0 | 3/0 | 4/0 | 250 | 300 | 350 | 400 | 500 |
| 230V 1 PH | ½ | 366 | 583 | 925 | 1336 | 2107 | 3345 | 4175 | 5267 | 6637 | 8364 | | | | | | | | |
| | ¾ | 279 | 445 | 706 | 1020 | 1608 | 2552 | 3186 | 4019 | 5065 | 6383 | 8055 | | | | | | | |
| | 1 | 226 | 360 | 571 | 824 | 1300 | 2064 | 2576 | 3250 | 4095 | 5161 | 6513 | 8201 | | | | | | |
| | 1½ | * | **286** | 455 | 657 | 1036 | 1644 | 2052 | 2589 | 3262 | 4111 | 5188 | 6533 | 8236 | 9710 | | | | |
| | 2 | * | * | 331 | 478 | 754 | 1197 | 1495 | 1886 | 2376 | 2995 | 3779 | 4759 | 5999 | 7073 | 8455 | 9852 | | |
| | 3 | * | * | **246** | 355 | 561 | 890 | 1111 | 1401 | 1766 | 2225 | 2808 | 3536 | 4458 | 5256 | 6283 | 7321 | 8343 | |
| | 5 | * | * | * | **218** | **343** | 545 | 680 | 858 | 1081 | 1363 | 1720 | 2165 | 2730 | 3219 | 3847 | 4483 | 5109 | 6348 |

### Controller to Motor

| Controller Output | Motor HP | Copper Wire Size 75ºC Insulation Exposed to a Maximum of 50ºC (122ºF) Ambient Temperature ⑥ | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 14 | 12 | 10 | 8 | 6 | 4 | 3 | 2 | 1 | 1/0 | 2/0 | 3/0 | 4/0 | 250 | 300 | 350 | 400 | 500 |
| 230V 3 PH | ½ | 905 | 1442 | 2290 | 3306 | 5213 | 8276 | | | | | | | | | | | | |
| | ¾ | 690 | 1100 | 1748 | 2523 | 3978 | 6316 | 7884 | 9945 | | | | | | | | | | |
| | 1 | 558 | 890 | 1413 | 2040 | 3216 | 5106 | 6375 | 8041 | | | | | | | | | | |
| | 1½ | 445 | 709 | 1126 | 1625 | 2562 | 4068 | 5078 | 6406 | 8072 | | | | | | | | | |
| | 2 | 324 | 516 | 820 | 1184 | 1866 | 2963 | 3699 | 4666 | 5879 | 7410 | 9351 | | | | | | | |
| | 3 | 241 | 384 | 609 | 880 | 1387 | 2202 | 2749 | 3467 | 4369 | 5506 | 6949 | 8750 | | | | | | |
| | 5 | * | 235 | 373 | 539 | 849 | 1348 | 1683 | 2123 | 2675 | 3372 | 4255 | 5358 | 6755 | 7964 | 9520 | | | |

⑤ Reduce lengths by 13% for 200 V systems. ⑥ Lengths in bold require 90ºC wire. Shading indicates 40º C maximum ambient. * Wire does not meet the N.E.C. ampacity requirement.

The lengths in each of the Wire Sizing tables represent 100% of the allowable voltage drop when motor is running at full load. When sizing wire, the voltage drop of each wire segment must be included. The total must not exceed 100% of the allowable drop. Take for example a 1.5 HP motor with a distance from Service Entrance to Controller of 100' and 500' between the Controller and Motor.

- Service Entrance to Controller = 100' of 10 AWG (100/455) = 22 % (455' is from the S.E. to Controller chart)
- Controller to Motor = 500' of 12 AWG (500/709) = 71 % (709' is from the Controller to Motor chart)

Total Drop (must be ≤ 100%) 93 %

If the distance from the Controller to Motor was 600' (600/709) = 85% + 22% = 107%, we would need to use #10 wire for that segment, ex. 600/1126 = 53% + 22% (for 100' of #10) = 75% which is acceptable. It is also acceptable to use different wire sizes for the Buried and Well sections of wire.

## AQUAVAR SOLO AND BALANCED FLOW REPAIR PARTS

**(See Ecom website or PRP, Repair Part Price Book, for Current Prices)**

| Order Number | Description |
|---|---|
| 6K210 | Gauge Guard - Transducer Protector |
| 9K518 | 100 PSI Transducer 0.5 – 4.5V |
| 9K519 | 200 PSI Transducer 0.5 – 4.5V |
| 9K520 | 300 PSI Transducer 0.5 – 4.5V |
| 9K523 | 10 Bar Transducer 0.5 – 4.5V (145 PSI) |
| 9K524 | SOLO and Balanced Flow Screw Repair Kit |
| 9K525 | SOLO and Balanced Flow Fan Repair Kit |
| 9K545 | 10' Transducer Cable with Ground and GRN. Clamp |
| 9K546 | 15' Transducer Cable with Ground and GRN. Clamp |
| 9K547 | 25' Transducer Cable with Ground and GRN. Clamp |
| 9K548 | 50' Transducer Cable with Ground and GRN. Clamp |
| 9K549 | 100' Transducer Cable with Ground and GRN. Clamp |
| 9K576 | 150' Transducer Cable with Ground and GRN. Clamp |
| 9K577 | 200' Transducer Cable with Ground and GRN. Clamp |
| 9K550 | AquaBoost UIB |
| 9K552 | Balanced Flow and Aquavar SOLO UIB |
| 9K575 | Balanced Flow and Aquavar SOLO (all sizes) R05 Programmer |
| 9K585 | Water Sensor with Relay Contact |
| 9K589 | Over-Pressure Switch, 60-120 PSI, Balanced Flow or S-Drive |

## SERVICE FACTOR AMPS ALL MOTORS

| HP | 230 Volt | | | | | | | | | 200 Volt | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1Ø 2-Wire | | | 1Ø 3-Wire | | | 3Ø | | | 3Ø | |
| | CentriPro[1] | Franklin | Grundfos | CentriPro | Franklin | Grundfos | CentriPro | Franklin | Grundfos | CentriPro | Franklin |
| ½ | 4.7/4.7 | 6 | 6 | 6.3 | 6 | 6 | N/A | N/A | N/A | N/A | N/A |
| ¾ | 6.4/6.2 | 8 | 8.4 | 8.3 | 8 | 8.4 | 3.9 | 3.8 | N/A | 4.5 | 4.4 |
| 1 | 9.1/8.1 | 9.8 | 9.8 | 9.7 | 9.8 | 9.8 | 4.7 | 4.7 | N/A | 5.5 | 5.4 |
| 1½ | 11.0/10.4 | 13.1[2] | 13.1[2] | 11.1 | 11.5 | 11.6 | 6.1 | 5.9 | 7.3 | 7.2 | 6.8 |
| 2 | N/A | N/A | N/A | 12.2 | 13.2[2] | 13.2[2] | 7.6 | 8.1 | 8.7 | 8.8 | 9.3 |
| 3 | N/A | N/A | N/A | N/A | N/A | N/A | 10.1 | 10.9 | 12.2 | 12 | 12.5 |
| 5 | N/A | N/A | N/A | N/A | N/A | N/A | 17.5 | 17.8 | 19.8[2] | 20.2[2] | 20.5[2] |

1. CentriPro 2-Wire motors have Generation 1 and Generation 2 amp ratings, see motor nameplate or motor data sticker that was supplied with motor.
2. Amps are higher than controller overload range - use of these motors will current limit and provide reduced performance.

## THREE PHASE MOTOR OPERATION ON VFD'S

**Variable Frequency Drive's (VFD) can be used with the 3 phase CentriPro motor provided the operator meets the following criteria:**

1) Maintain frequencies from 30HZ – 60HZ. Do not operate below 30HZ for more than 1 second. 80 HZ operation can be used.
2) Ensure VFD is a PWM, IGBT, Volts per Hz scalar type and does not produce more than 500 volts dV/dT.
3) Use a load reactor (load filter) of 3% impedance or more on motor lead lengths of 50 wire feet or more. The Balanced Flow product already includes this in all models.
4) Follow all NEC, state, local or provincial electrical codes for Power Conversion Equipment wiring and installation.
5) Provide appropriate dedicated short circuit protection. Properly sized fuses or breaker disconnects.
6) Size wire according to NEC, state, local or provincial codes OR refer to manufacturers recommendation for wiring sizing.
7) Ensure proper flow around motor.
8) Maintain proper grounding of the motor back to drive and service entrance. Common ground throughout system!

**The following are some installation issues we have seen on returned Balanced Flow controllers which factory re-testing has shown to operate perfectly:**

| Symptom | Cause |
|---|---|
| • Cycling, won't turn off, poor pressure control | Incorrect tank pre-charge pressure |
| • Cycling and wide pressure swings | Larger than recommended tank |
| • Poor performance | Motor running backwards |

***Performance Improvement Suggestions:***

- Installing a spring check valve on the pump side of the tank can reduce time to standby when flow stops.
- Poor pressure control can be caused by a clogged sensor. Not an issue for sensors 4/09 and later.
- Updating controllers built prior to 4/09 with latest Software, UIB and Sensor will improve reliability and performance.
- Updating software in controllers built after 4/09 may improve performance.
- Many generators produce voltages that exceed the 264VAC max rating of the controller. Test the generator output voltage when no load is connected. If the voltage exceeds 264VAC, do not use it with the BF controller!

## AQUAVAR SOLO (formerly known as Balanced Flow) TROUBLESHOOTING

Section 3 Installer Pre-Start Selections is used to indicate system status i.e. running, stopped, or faulted. When faulted, the status light will be red. The error code is the number of quick flashes followed by a 1 second pause. The number of flashes can be any number from 2 to 9. The error code will be repeated until cleared. Some errors will clear themselves with time. Others must be cleared manually by turning the power off for 1 minute. The following table describes the various errors that can occur.

### FAULT BLINK CODES

| NO LIGHT | | |
|---|---|---|
| **Flashes** | **Controller Status** | **Description** |
| None | Low/No Input Voltage | Check the input voltage to the controller. Measure the voltage between L1 and L2 using an AC Voltmeter. This voltage should be greater than 190Vac. |
| None | Controller is in Program Mode | Check the position of the "RUN/PRG Jumper". The "RUN/PRG Jumper" is located in the upper left hand corner of the controller. Refer to Figure 3.<br>Placing this jumper in "PRG" mode (Program Mode) allows the user to update the controller's software through the the controller's software. When this jumper is in "RUN" mode (Run Mode), the controller will operate normally.<br>If the controller is powered while in Program Mode, the status indicator will not turn on.<br>To return the controller to Run Mode turn the power off to the controller and wait 5 minutes. Then move the "RUN/PRG Jumper" to "RUN". Apply power to the controller. The controller is now in Run Mode. |
| **GREEN LIGHT CODES** | | |
| **Flashes** | **Controller Status** | **Description** |
| Constant | Standby/Low Voltage | Constant Green Light indicates the pump is off. The system is in Standby mode when there is no flow in the system and the pressure setting has been reached. The system is in a Low Voltage condition when the line input voltage drops below 190VAC. |
| Blinking | Pump Running | Flashing Green Light indicates the pump is running. |
| **RED LIGHT CODES** | | |
| **Flashes** | **Controller Status**<br>**Controller Action** | **Fault Description**<br>This information is to be used by professional installers or qualified personnel only. |
| Constant | Controller Error<br>To clear the fault, turn off power to the controller, wait 1 minute, turn on power to the controller. If fault persists contact installer. | Internal controller fault. Replace controller. |

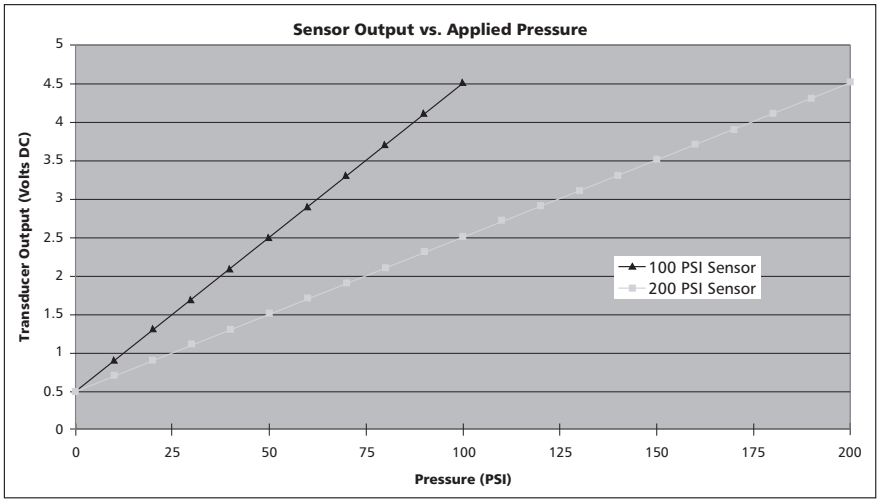
## AQUAVAR SOLO (formerly known as Balanced Flow) TROUBLESHOOTING

### FAULT BLINK CODES *(continued)*

| RED LIGHT CODES | | |
|---|---|---|
| **Flashes** | **Controller Status** | **Description** |
| 2 Blinks | Dry Well<br>The controller will automatically restart according to the chart shown on the right. If fault persists contact installer. | This fault can be caused by:<br>• Water supply level in well falls below suction inlet of pump.<br>• Plugged suction screen.<br>• Restriction in pipe between pump and pressure sensor.<br>• Air bound pump – see "Purging System"<br>• Incorrect setting of "MAXIMUM SPEED" switch. Be sure to set the "MAXIMUM SPEED" switch to 80 Hz when using mismatched pumps (water ends) and motors.<br>• Incorrect setting of "MOTOR OVERLOAD SETTING (SFA)" switch. Ensure the Motor Overload Setting (SFA) Switch is not set higher than the Service Factor Amps (SFA) listed on the motor nameplate.<br>• Need for Dry Well Power Calibration. Perform Dry Well Power Calibration as described in ADVANCED SETTINGS section.<br>**In systems where the motor operates at less than Service Factor Amps the controller may show a false "dry well" fault. See Dry Well Sensitivity Section.**<br>If problems persists, please verify supply capacity.<br>The controller will automatically restart according to the chart below.<br>**Dry Well Fault Reset table:**<br>**Fault 1** (Start Point) - resets after 1 minute<br>**Fault 2** - resets after 10 minutes<br>**Fault 3** - resets after 20 minutes<br>**Fault 4** - resets after 30 minutes<br>**Fault 5** - resets after 60 minutes and every 60 minutes thereafter<br>Dry well can be reset by pressing both pushbuttons at the same time or by turning off the power. A fixed, 1 minute, restart time is also available. See ADVANCED SETTINGS section. |
| 3 Blinks | Sensor Fault<br>The controller will not run if the signal from the sensor is disconnected or out of tolerance. The controller will automatically restart when the signal is within tolerance. If fault persists contact installer. | This fault can be caused by:<br>• Disconnected sensor. Disconnect sensor from sensor cable connector and reconnect to ensure a good connection.<br>• Disconnected sensor cable lead inside the controller. Check for loose wires where the sensor cable connects to the circuit board by tugging on each wire.<br>• Broken wire in the sensor cable.<br>• Miswired sensor cable. Check that the wires are connected to the correct terminals on the sensor connector. The correct location of the wires is indicated on the circuit board. B=Black, R=Red, W=White.<br>• Failed sensor. With the sensor cable connected to the circuit board, measure the DC voltage between the black and white wires of the sensor cable at the sensor connector. The voltage measured should be between 0.5Vdc and 4.5Vdc depending on the system pressure, see chart below.<br>• A vacuum on the sensor (transducer) of 17" Hg or more will cause a sensor fault, eliminate the vacuum. |

## AQUAVAR SOLO (formerly known as Balanced Flow) TROUBLESHOOTING

### FAULT BLINK CODES *(continued)*

| RED LIGHT CODES | | |
|---|---|---|
| **Flashes** | **Controller Status** | **Description** |
| 3 Blinks | Sensor Fault *(continued)* |   |
| 4 Blinks | Over Current<br>The controller will try to restart the motor three times before displaying this fault. To clear the fault, turn off power to the controller, wait 1 minute, turn on power to the controller. If fault persists contact installer. | This fault can be caused by:<br>• Installing a 1Ø motor - system requires a 3Ø, 200 or 230 V motor.<br>• Mechanical binding from debris in pump.<br>• Electrical failure of the motor.<br>• Incorrect setting of "MOTOR OVERLOAD SETTING (SFA)" switch. A false "bound pump" error will be displayed if the switch is set too low.<br>• Pump wire insulation breaking down. Check insulation with megger.<br>Verify the error by turning power to controller off for 1 minute and then on. Pump/Motor must be checked if fault persists. |
| 5 Blinks | Short Circuit<br>If this fault is detected while the pump is running, the controller will attempt to restart three times before displaying this fault. To clear the fault, turn off power to the controller, wait 1 minute, turn on power to the controller. If fault persists contact installer. | This fault can be caused by:<br>• Electrical failure of the motor.<br>• Electrical failure of wiring between controller and motor.<br>Verify the error by turning power to controller off for 1 minute and then on. If error persists, motor and wiring between controller and motor must be checked. Turn power off for 1 minute. Remove the three motor wires from the terminal block. Check wiring and motor for shorting phase to phase and phase to ground. Refer to motor's manual for information on resistance readings. |

## AQUAVAR SOLO (formerly known as Balanced Flow) TROUBLESHOOTING

### FAULT BLINK CODES *(continued)*

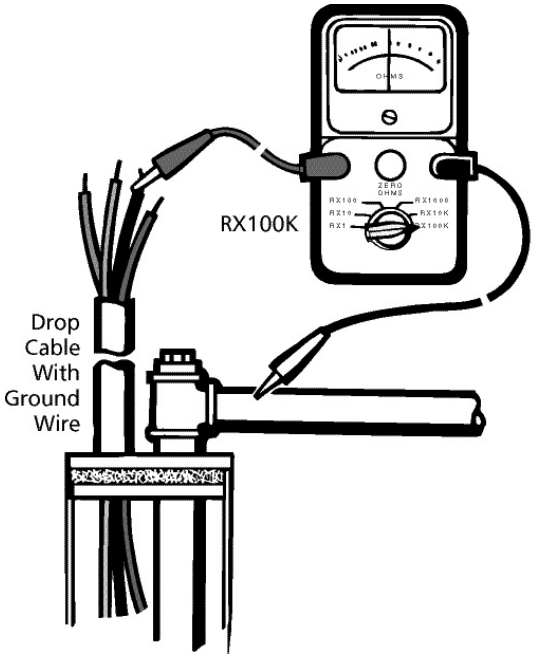
| RED LIGHT CODES | | |
|---|---|---|
| **Flashes** | **Controller Status** | **Description** |
| 6 Blinks | Ground Fault<br>The controller will not restart if displaying this fault. To clear the fault, turn off power to the controller, wait 1 minute, turn on power to the controller. If fault persists contact installer. | **WARNING** **This device does not provide personnel protection against shock. This function is intended for equipment protection only.**<br>This fault can be caused by:<br>• Electrical failure of the motor<br>• Electrical failure of wiring between controller and motor.<br>• Miswiring of motor cable.<br>Verify the error by turning power to controller off for 1 minute and then on. If error persists, motor and wiring between controller and motor must be checked. Turn power off and wait 1 minute. Remove the three motor wires and ground wire from the terminal block. Check wiring and motor for shorting phase to ground using a megohmmeter ("megger"). A reading less than 200K Ohms indicates faulty insulation in the motor cable or motor. Test each to determine fault location. |
| 7 Blinks | Temperature<br>The controller will automatically restart when the temperature reaches an acceptable level. If fault persists contact installer. | This fault can be caused by:<br>• High ambient temperature. The maximum ambient temperature rating is 122ºF (50ºC).<br>• Low ambient temperature. The minimum ambient temperature rating is -4ºF (-20ºC).<br>Check for a fan failure. The fan will turn on when the temperature inside the controller reaches 140ºF (60ºC). The fan will turn on for 1 second each time the controller starts the motor. If the fan never turns on, check fan connections and replace as needed. Ensure that the external fan intake filter is not blocked or clogged. It can be removed for cleaning and replacements are available. |
| 8 Blinks | Open Lead<br>The controller will not restart if displaying this fault. To clear the fault, turn off power to the controller, wait 1 minute, turn on power to the controller. If fault persists contact installer. | This fault can be caused by:<br>• Disconnected or broken wire between the controller and motor.<br>Verify the error by turning power to controller off for 1 minute and then on. If error persists, motor and wiring between controller and motor must be checked. Turn power off for 5 minutes. Remove the three motor wires from the terminal block. Using an ohmmeter, measure the resistance from phase to phase. A disconnected or broken wire will be indicated by a high resistance reading (20 ohms or higher). |
| 9 Blinks | Low Pressure Cut-Off<br>The controller will not restart if displaying this fault. To clear the fault, turn off power to the controller, wait 1 minute, turn on power to the controller. If fault persists contact installer. | This fault can be caused by:<br>• Pressure 20 PSI below set point for 30 seconds. May be a broken pipe or tripped pressure relief valve. If 20 PSI or more pressure drop for 30 seconds is normal for the system, switch the broken pipe protection off or change system to prevent the pressure drop. |

## 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.**

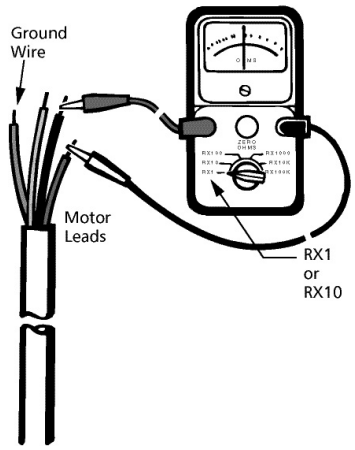
2. Connect the ohmmeter leads as shown below.

**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.*



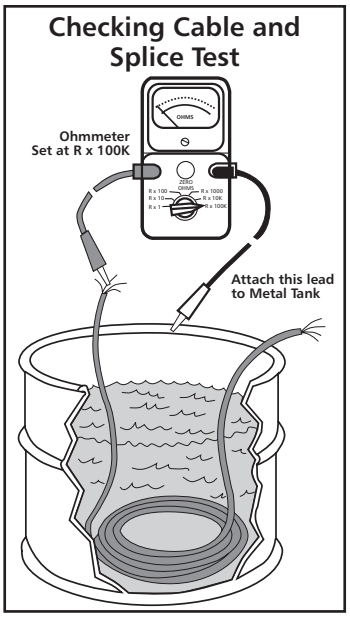

***RULE OF THUMB***

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

## CABLE CHECKOUT

### Checking Cable and Splice

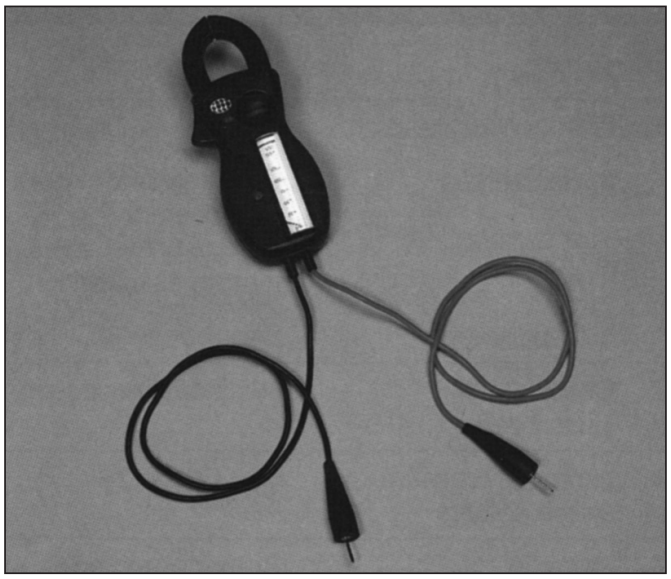
1. Submerge cable and splice in steel barrel of water with both ends out of water.
2. Set ohmmeter selector on RX100K and adjust needle to zero (0) by clipping ohmmeter leads together.
3. After adjusting ohmmeter, clip one ohmmeter lead to barrel and the other to each cable lead individually, as shown.
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.




### 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

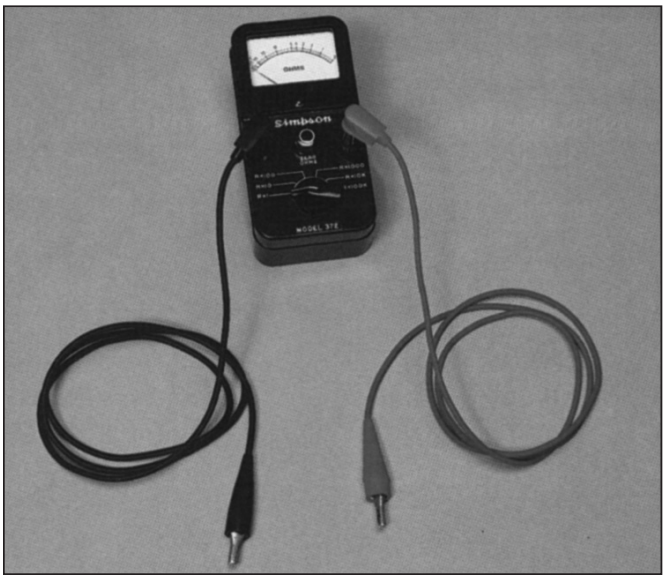


The Amprobe is a multi-range, combination ammeter and voltmeter.

| | | |
|---|---|---|
| **Voltmeter Scales:** | 150 VOLTS | 600 VOLTS |
| **Ammeter Scales:** | 5 AMPS<br>15 AMPS | 40 AMPS<br>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:

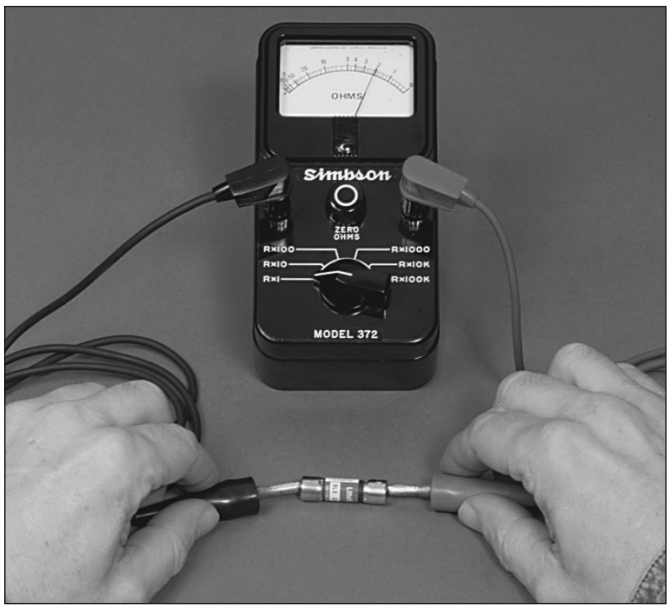
| | | |
|---|---|---|
| $\mathbf{RX_1}$ | = | R x 1 |
| $\mathbf{RX_{10}}$ | = | R x 10 |
| $\mathbf{RX_{100}}$ | = | R x 100 |
| $\mathbf{RX_{1000}}$ | = | R x 1,000 |
| $\mathbf{RX_{10K}}$ | = | R x 10,000 |
| $\mathbf{RX_{100K}}$ | = | R x 100,000 |

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

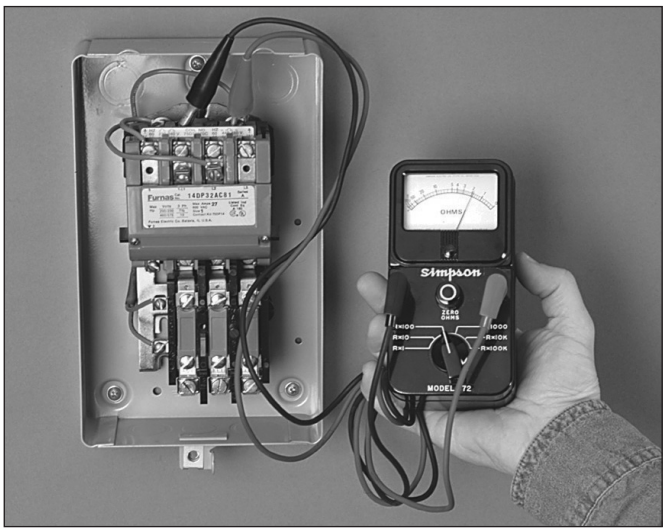



1. Set R x 1.
2. Connect leads as shown.
3. Reading: Should register zero.

**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 1,000.
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

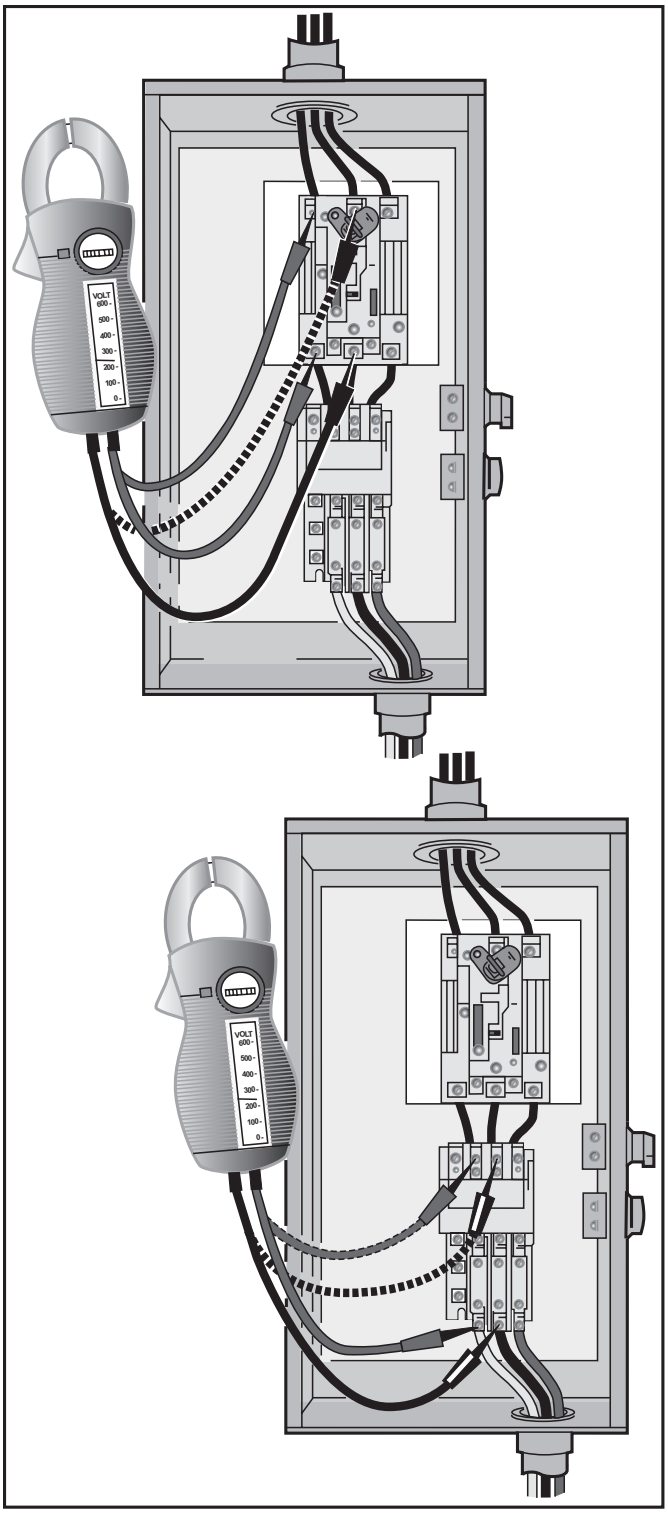
### Checking Voltage at Fused Disconnect and Magnetic Starter

**⚠ 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.

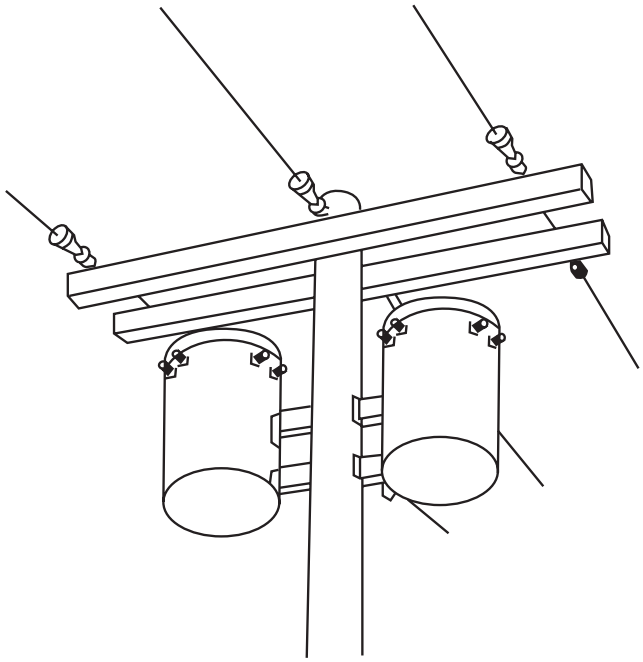
## TRANSFORMER SIZES

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.

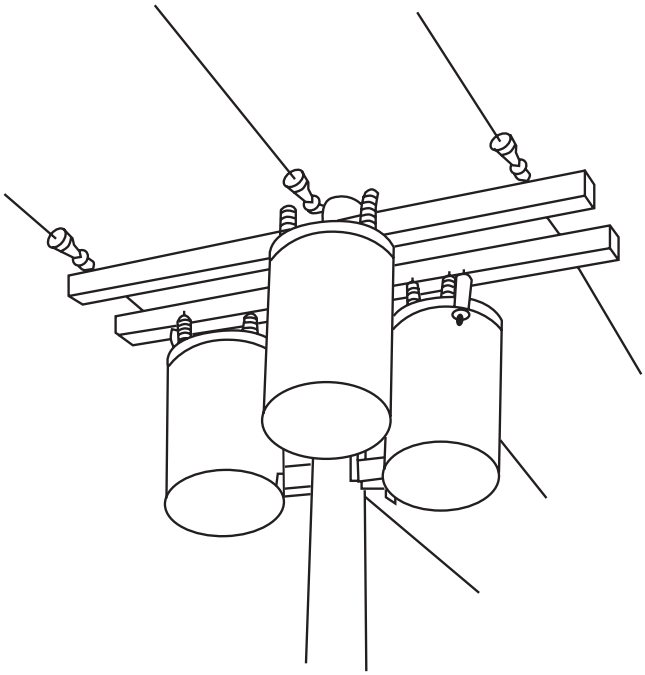
Transformer ratings should be no smaller than listed in the table for supply power to the motor alone.

## 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

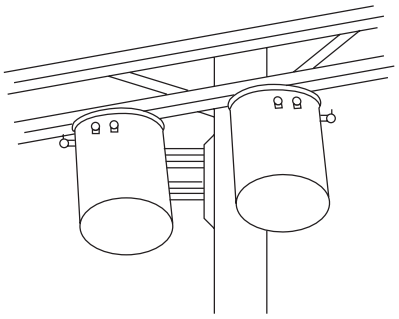
Phase 3 or "C" – Red Motor Lead or T3

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

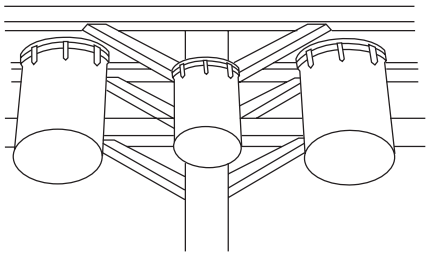
| | Hookup 1 | | | Hookup 2 | | | Hookup 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 |
| Starter Terminals | ⊥ | ⊥ | ⊥ | ⊥ | ⊥ | ⊥ | ⊥ | ⊥ | ⊥ |
| | T1 | T2 | T3 | T1 | T2 | T3 | T1 | T2 | T3 |
| Motor Leads | R | B | Y | Y | R | B | B | Y | R |
|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

## GENERATOR SIZING

***Note: Always consult the generator manufacturer whenever questions arise.***

These sizing charts are recommendations based on motor service factor loading for typical continuous duty generators. If you need to call the generator manufacturer, be prepared to tell them the motor KVA code, the service factor amperage, locked rotor amperage, phase, hertz, motor type, etc. This information can all be found in this manual.

Please note that the 2-wire chart is only for PSC (permanent split capacitor) type, 2-wire motors and should not be used for split-phase, 2-wire motors. If using split-phase, 2-wire motors the generator should be 50% larger than that listed for a 3-wire motor.

You must know which type generator you have before using the charts as the required generator size varies by type. Internally regulated generators are also called self-excited. Externally regulated generators are the most common. In addition to the Kw/KVA rating, the generator frequency (Hertz, typically 60 HZ in USA) is very important when operating pumping equipment because frequency variations affect pump output in direct relation to the pump Affinity Laws. Operating under 60 hertz will reduce flow and head while operating over 60 hertz will increase flow, head, HP and amp draw and could overload the motor.

The generator should always be started before the pump/motor is started and always stop the pump/motor before shutting down the generator. Operating generators at higher elevations or using natural gas a fuel can affect performance, consult the generator manufacturer for their recommendations in these instances.

### GENERATOR RECOMMENDATIONS

| Motor | HP | Externally Regulated | | Internally Regulated | |
|---|---|---|---|---|---|
| | | KW | KVA | KW | KVA |
| | | Minimum Generator Rating | | | |
| PSC Type 2-Wire 1Ø | .5 | 2.5 | 3.1 | 1.75 | 2.2 |
| | .75 | 3.5 | 4.4 | 2.5 | 3.1 |
| | 1 | 5 | 6.3 | 3.2 | 4 |
| | 1.5 | 6 | 7.5 | 4 | 5 |
| 3-Wire 1Ø and 3Ø Motors | .5 | 2 | 2.5 | 1.5 | 1.9 |
| | .75 | 3 | 3.8 | 2 | 2.5 |
| | 1 | 4 | 5 | 2.5 | 3.2 |
| | 1.5 | 5 | 6.3 | 3 | 3.8 |
| | 2 | 7.5 | 9.4 | 4 | 5 |
| | 3 | 10 | 12.5 | 5 | 6.3 |
| | 5 | 15 | 18.8 | 7.5 | 9.4 |
| | 7.5 | 20 | 25 | 10 | 12.5 |
| | 10 | 30 | 37.5 | 15 | 18.8 |
| | 15 | 40 | 50 | 20 | 25 |
| | 20 | 60 | 75 | 25 | 31 |
| | 25 | 75 | 94 | 30 | 37.5 |
| | 30 | 100 | 125 | 40 | 50 |
| | 40 | 100 | 125 | 50 | 62.5 |
| | 50 | 150 | 188 | 60 | 75 |
| | 60 | 175 | 220 | 75 | 94 |
| | 75 | 250 | 313 | 100 | 125 |
| | 100 | 300 | 375 | 150 | 188 |
| | 125 | 375 | 469 | 175 | 219 |
| | 150 | 450 | 563 | 200 | 250 |
| | 175 | 525 | 656 | 250 | 313 |
| | 200 | 600 | 750 | 275 | 344 |

## 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 14 NEMA STARTER SIZING CHART

Order No's shown represent dual voltage, "C", 240/480V Coils

| Order Number | Size | Maximum Motor Horsepower 200-208V | 230V | 460V | 575V | Full Load Amp Range |
|---|---|---|---|---|---|---|
| CSBC | 0 | – | ½ | 11/2 | 2 | .75 - 3.4 |
| CSDC | 0 | 2 | 2 | 5 | 5 | 3 - 12 |
| CSEC | 0 | 3 | 3 | – | – | 5.5 - 22 |
| DSBC | 1 | ½ | ¾ | 1½ | 2 | .75 - 3.4 |
| DSDC | 1 | 2 | 2 | 5 | 5 | 3 - 12 |
| DSEC | 1 | 3 | 3 | 10 | 10 | 5.5 - 22 |
| DSFC | 1 | 7½ | 7½ | – | – | 10 - 40 |
| ESFC | 1¾ | – | – | 15 | 15 | 10 - 40 |
| ESGC | 1¾ | 10 | 10 | – | – | 20 - 40 |
| FSFC | 2 | – | – | 15 | 20 | 10 - 40 |
| FSHC | 2 | 10 | 15 | 25 | 25 | 13 - 52 |
| GSHC | 2½ | – | – | 30 | 30 | 13 - 52 |
| GSJC | 2½ | 15 | 20 | – | – | 13 - 52 |

| Order Number | Size | Maximum Motor Horsepower 200-208V | 230V | 460V | 575V | Full Load Amp Range |
|---|---|---|---|---|---|---|
| HSJC | 3 | – | – | 30 | 40 | 13 - 52 |
| HSKC | 3 | 25 | 30 | 50 | 50 | 25 - 100 |
| ISLC | 3½ | 30 | 40 | 75 | 75 | 50 - 200 |
| JTMC | 4 | 40 | 50 | 100 | 100 | 50 - 200 |

On Class 14 Starters the fourth (4th) character represents the coil voltage, change the Order Number to match the coil voltage to job site voltage.

**Note:** Coils are very voltage sensitive, unmatched supply vs. coil voltage will damage the coil.

A = 120/240 volt coil - ex. CSBA
C = 240/480 volt coil - ex. CSBC
D = 200/208 volt coil - ex. CSBD
E = 575 volt coil - ex. CSBE
G = 240 volt coil - ex. CSBG
H = 480 volt coil - ex. CSBH

Standard lead time for optional coils is 2 weeks.

# 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 |

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

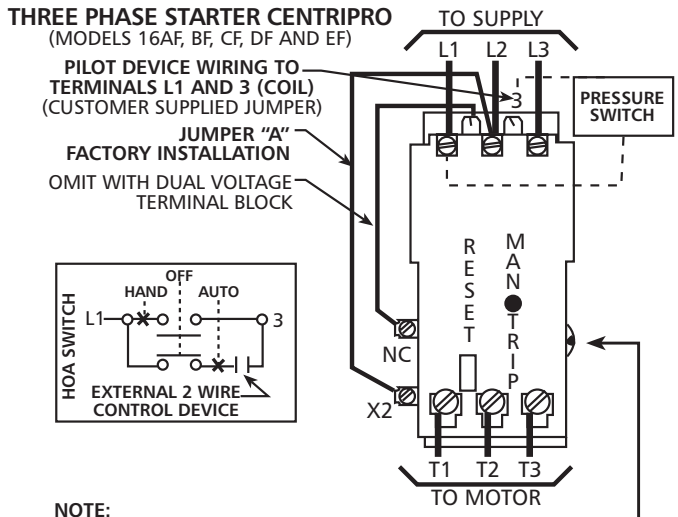
| Class 16 DP Model Motor SF Amps | | K Heater No. |
|---|---|---|
| 16F, 16G① | 16H, 16I | |
| 50.2 | 50.1 | K72 |
| 53.2 | 53.1 | K73 |
| 58.0 | 58.0 | K74 |
| 62.2 | 62.1 | K75 |
| 65.5 | 65.5 | K76 |
| 72.0 | 72.0 | K77 |
| 80.0 | 80.0 | K78 |
| – | – | K79 |
| 85.0 | 85.0 | K83 |
| 93.0 | 93.0 | 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.

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.



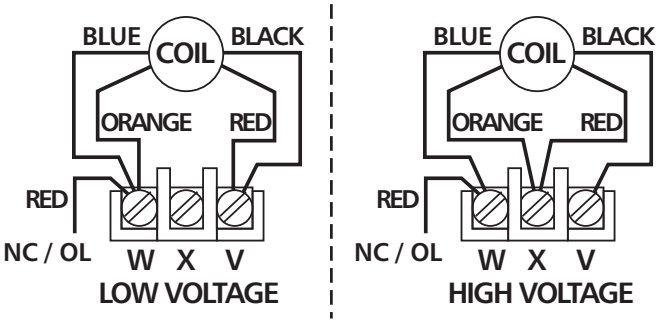

**NOTE:**
FOR SEPARATE CONTROL VOLTAGE SOURCE REMOVE JUMPER "A" IF INSTALLED. CONNECT CONTROL SOURCE TO "L1" ON PILOT DEVICE AND TO "X2" ON OVERLOAD RELAY.

**Dial with V groove:**
Rotate this dial to adjust overload trip setting ±15 %.

**Dial with Tab:**
Auto/Manual reset

### 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 | – | – | – | – |

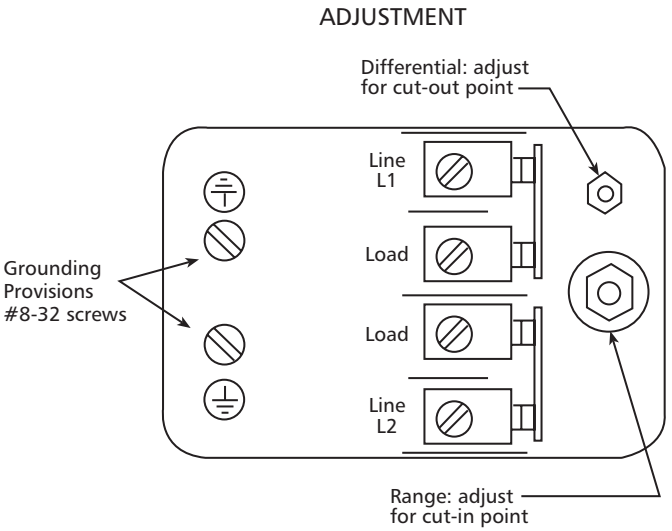
## APPROXIMATE COST OF OPERATING ELECTRIC MOTORS

| 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 |

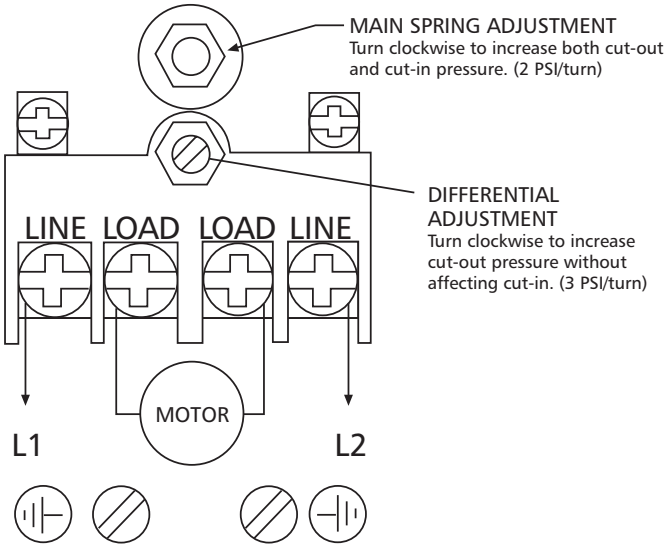
## CENTRIPRO OR SQUARE "D" SWITCHES

**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.




## FURNAS PRO CONTROL




## 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 ($\pi r^2$) (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 |

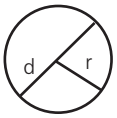
# TERMS AND USABLE FORMULAS

## 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:**<br>**GPM** = Gallons per Minute<br>**8.33** = Pounds of water per gallon<br>**33000** = Ft. Lbs. per minute in one horsepower<br>**Head** = Difference in energy head in feet (field head). |
| **Laboratory BHP** = $\frac{\text{Head x GPM x Sp. Gr.}}{\text{3960 x Eff.}}$<br>**Field BHP** = Laboratory BHP + Shaft Loss<br>**Total BHP** = Field BHP + Thrust Bearing Loss | **Where:**<br>**GPM** = Gallons per Minute<br>**Head** = Lab. Head (including column loss)<br>**Eff.** = Lab. Eff. of Pump Bowls<br>**Shaft Loss** = HP loss due to mechanical friction of lineshaft bearings<br>**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**<br>**Total BHP as determined above** |
| **Overall Plant Efficiency** = $\frac{\text{Water Horsepower}}{\text{Input Horsepower}}$ | **(See (2) below under Misc.)**<br>**Water HP as determined above**<br>**Input HP as determined above** |

**Electrical**

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

**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

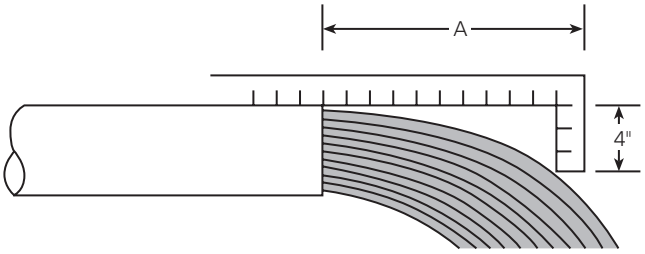
**Discharge Head (in feet of fluid pumped)** = $\frac{\text{Discharge Pressure (psi) x 2.31}}{\text{Sp. Gr. of Fluid Pumped}}$

# DETERMINING FLOW RATES

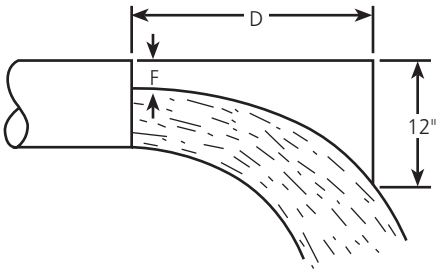
## FULL PIPE FLOW – CALCULATION OF DISCHARGE RATE USING HORIZONTAL OPEN DISCHARGE FORMULA

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).

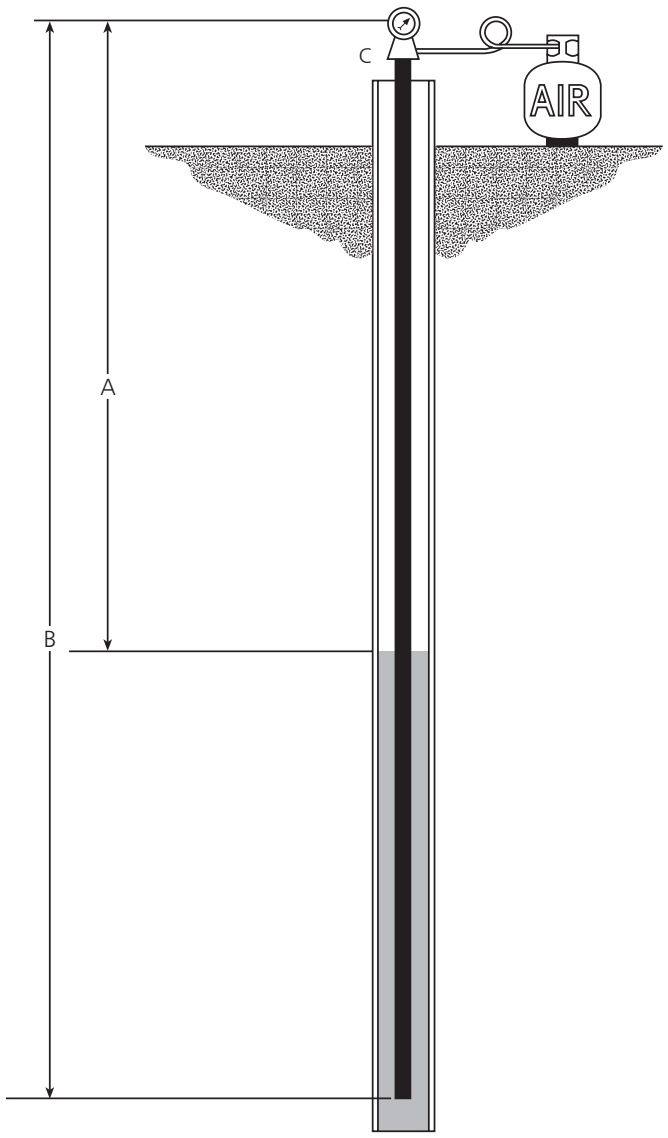
B. Total length of air line (in feet).

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

$\frac{D^2}{24.5}$ = Gallons 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 | | | Maximum Drawdown Volume (Gallons) |
|---|---|---|---|---|---|
| | | 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.

# JET PUMP MOTOR DATA AND ELECTRICAL COMPONENTS

## A.O. SMITH MOTOR DATA

| GP Number | Where Used | A.O. Smith | HP | Volts | Phase | Service Factor | Max. Load Amps | Watts | Circuit Breaker |
|---|---|---|---|---|---|---|---|---|---|
| J04853 | J05, HB705 | C48J2DB11C3HF | ½ | 115/230 | 1 | 1.6 | 10.8/5.4 | 880 | 25/15 |
| J05853 | JL07N, HSJ07, XSH07, HB | C48K2DB11A4HH | ¾ | 115/230 | 1 | 1.5 | 14.8/7.4 | 1280 | 30/15 |
| J06853 | JL10N, HSJ10, SJ10, XSH10, HB | C48L2DB11A4HH | 1 | 115/230 | 1 | 1.4 | 16.2/8.1 | 1440 | 30/20 |
| J07858 | HSJ15, SJ15, HB, XSH15 | C48M2DB11A1HH | 1½ | 115/230 | 1 | 1.3 | 20.0/10.0 | 1866 | 40/20 |
| J08854 | HSJ20, HSC20, XSH20 | K48N2DB11A2HH | 2 | 115/230 | 1 | 1.2 | 22.6/11.3 | 2100 | 25/15 |
| ② J09853 | XSH30, GT30 | C56P2U11A3HH | 3 | 230 | 1 | 1.15 | 17.2 | 3280 | 30 |
| ② J04853L | J5(S), GB | C48A93A06 | ½ | 115/230 | 1 | 1.6 | 10.8/5.4 | 968 | 25/15 |
| ② J05853L | J7(S), GB, GT07, (H)SJ07, HSC07 | C48A94A06 | ¾ | 115/230 | 1 | 1.5 | 14.8/7.4 | 1336 | 30/15 |
| ② J06853L | J10(S), GB, GT10, (H)SJ10, HSC10 | C48A95A06 | 1 | 115/230 | 1 | 1.4 | 16.2/8.1 | 1592 | 30/20 |
| ② J07858L | J15(S), GB, GT15, HSJ15, HSC15 | C48M2DC11A1 | 1½ | 115/230 | 1 | 1.3 | 21.4/10.7 | 1950 | 40/20 |
| ①② J08854L | HSJ20, GB, GT20, HSC20 | K48A34A06 | 2 | 230 | 1 | 1.2 | 12.9 | 2100 | 25 |
| SFJ04853 | JB05 | S48A90A06 | ½ | 115/230 | 1 | 1.6 | 9.4/4.7 | 900 | 20/10 |
| SFJ05853 | JB07 | C48A77A06 | ¾ | 115/230 | 1 | 1.5 | 13.6/6.8 | 1160 | 25/15 |
| SFJ06853 | JB10 | C48A78A06 | 1 | 115/230 | 1 | 1.4 | 15.8/7.9 | 1400 | 30/20 |
| ② SFJ04860 | JRS5, JRD5, JB05 | C48C04A06 | ½ | 115/230 | 1 | 1.6 | 12.6/6.3 | 990 | 25/15 |
| ② SFJ05860 | JRS7, JRD7, JB07 | C48C05A06 | ¾ | 115/230 | 1 | 1.5 | 14.8/7.4 | 1200 | 30/15 |
| ② SFJ06860 | JRS10, JRD10, JB10 | C48C06A06 | 1 | 115/230 | 1 | 1.4 | 16.2/8.1 | 1400 | 30/20 |

① Effective July, 1998, 230 V only. ② Current production motor

## ELECTRICAL COMPONENTS

| GP Motor Model | A.O. Smith Motor Model | Motor Overload with Leads | | | Run Capacitor and MFD | Start Capacitor MFD Rating | Switch⑤ |
|---|---|---|---|---|---|---|---|
| | | ④ Old Number | ③ New Number | T.I. Number | | | |
| J04853 | C48J2DB11C3HF | 614246 71 | | MET38ABN | | 610807 1: 124/148 | 629002 2 |
| J05853 | C48K2DB11A4HH | 614246 20 | | CET63ABN | | 610807 2: 161/192 | 629002 2 |
| J06853 | C48L2DB11A4HH | 614246 9 | | CET52ABN | | 610807 2: 161/192 | 629002 2 |
| J07858 | C48M2DB11A1HH | 614246 79 | | CET38ABM | | 610807 2: 161/192 | 629002 2 |
| J08854 | K48N2DB11A2HH | 611307 29 | | BRT44ABM | 614529 4: 25 | 610807 1: 124/148 | 629002 2 |
| J09853 | _ - 196427-20 | 611106 22 | 611106 36 | BRB2938 | 628318 314: 55 | 610807 11; 36-43 | 629002 2 |
| J04853L | C48A93A06 | 614246 98 | 627121 43 | MET39ABN-CL | | 610807 1:124/148 | 629002 2 |
| J05853L | C48A94A06 | 614246 20 | 627121 38 | CET63ABN | | 610807 2:161/192 | 629002 2 |
| J06853L | C48A95A06 | 614246 9 | 627121 7 | CET52ABN | | 610807 2:161/192 | 629002 2 |
| J07858L | C48C53A06 | | 611123 21 | BRT45ABM | | 610807 7:189/227 | 629002 2 |
| J08854L | K48A34A06 | 616861 10 | 627119 10 | CET31ABN | 623450 8: 30 | 610807 33: 64-77 | 629002 2 |
| SFJ04853 | S48A90A06 | 621863 1 | | MEJ38ABN | | N/A | 3945C91A01 |
| SFJ05853 | C48A77A06 | 621863 4 | | CET55ABN | | 610807 2: 161/192 | 3945C91A01 |
| SFJ06853 | C48A78A06 | 621863 5 | | CET49ABN | | 610807 2: 161/192 | 3945C91A01 |
| SFJ04860 | C48C04A06 | 614246 67 | 627121 48 | MET36ABN | | 610807 2: 161/192 | 629002 2 |
| SFJ05860 | C48C05A06 | 614246 20 | 627121 38 | CET63ABN | | 610807 2: 161/192 | 629002 2 |
| SFJ06860 | C48C06A06 | 614246 9 | 627121 7 | CET52ABN | | 610807 2: 161/192 | 629002 2 |

③ These new overload part numbers are for use with the new plastic terminal board with the quick change voltage plug.

④ Use this suffix if your motor has the old style brown terminal board without quick change voltage plug.

⑤ 629002 2 replaces 614234 1, 2, and 6.

# JET PUMP MOTOR WIRING A.O. SMITH MOTORS

## TERMINAL BOARD AND VOLTAGE CHANGE PLUG

A change has been made to use a new terminal board on the A.O. Smith two compartment motor models. This terminal board is used on both dual voltage and single voltage motors.

### FEATURES

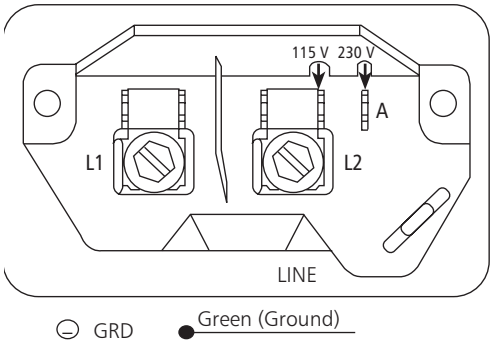
- Voltage Plug: Dual voltage motors use a voltage plug that retains the terminals for the Black and Black Tracer leads. To change voltage, lift the black plug and align the arrow with the desired voltage on terminal board. See Figure 1 for an example of the dual voltage connection diagram.
- Screws with ¼" drive: The terminal screw accepts either a ¼" nut driver or a slotted screw driver.
- Line Wire Connection: The space under the screw will accept #16, #14, #12, #10, or #8 wire. The rib at the bottom edge of the screw allows the wire to be placed straight into the space under the screw. This rib retains the wire under the head of the screw and for #12, #10, or #8 wire it is not necessary to wrap the wire around the screw.
- ½ HP wired 115 V, ¾ HP and up wired 230 V at factory.
- Quick Connect Terminals: Each terminal has provision for ¼" quick connect terminals in addition to the screw.
- Molded Plastic Material: The terminal board is made from an extremely tough white plastic material with L1, L2, and A markings molded into the board.
- Lead Channel: A channel adjacent to the conduit hole directs wiring to the top of the board.
- Governor Guard: An integral backplate prevents leads from entering the area around the governor.
- Ground Guard: To prevent the bare ground wire from touching the "live" L2 terminal, the ground wire must be placed above this guard.

**VOLTAGE CHANGES ARE MADE INSIDE THE MOTOR COVER NOT IN THE PRESSURE SWITCH.**

**WARNING:**
**DISCONNECT POWER SOURCE BEFORE CHECKING. DO NOT MAKE ANY CHANGES WITH POWER ON.**

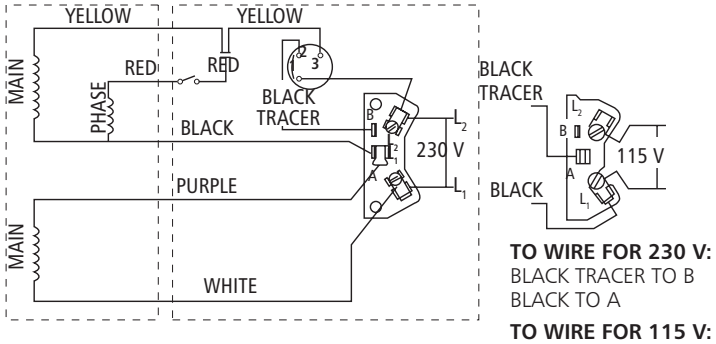
## CAPACITOR START INDUCTION RUN – SINGLE SPEED (NEW STYLE – AFTER APRIL, 1999)

FIGURE 1




Align black plug to 115 V or 230 V arrow.
½ HP wired 115 V, ¾ HP and up wired 230 V at factory.

## CAPACITOR START INDUCTION RUN – SINGLE SPEED (OLD STYLE – UP TO APRIL, 1999)




"Black Tracer" is a black and white wire

**TO WIRE FOR 230 V:**
BLACK TRACER TO B
BLACK TO A

**TO WIRE FOR 115 V:**
BLACK TRACER TO A
BLACK TO $L_1$

# FRICTION LOSS

### SCH 40 – PLASTIC PIPE: FRICTION LOSS (IN FEET OF HEAD) PER 100 FT.

| GPM | GPH | ⅜" | ½" | ¾" | 1" | 1¼" | 1½" | 2" | 2½" | 3" | 4" | 6" | 8" | 10" |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. |
| 1 | 60 | 4.25 | 1.38 | .356 | .11 | | | | | | | | | |
| 2 | 120 | 15.13 | 4.83 | 1.21 | .38 | .10 | | | | | | | | |
| 3 | 180 | 31.97 | 9.96 | 2.51 | .77 | .21 | .10 | | | | | | | |
| 4 | 240 | 54.97 | 17.07 | 4.21 | 1.30 | .35 | .16 | | | | | | | |
| 5 | 300 | 84.41 | 25.76 | 6.33 | 1.92 | .51 | .24 | | | | | | | |
| 6 | 360 | | 36.34 | 8.83 | 2.69 | .71 | .33 | .10 | | | | | | |
| 8 | 480 | | 63.71 | 15.18 | 4.58 | 1.19 | .55 | .17 | | | | | | |
| 10 | 600 | | 97.52 | 25.98 | 6.88 | 1.78 | .83 | .25 | .11 | | | | | |
| 15 | 900 | | | 49.68 | 14.63 | 3.75 | 1.74 | .52 | .22 | | | | | |
| 20 | 1,200 | | | 86.94 | 25.07 | 6.39 | 2.94 | .86 | .36 | .13 | | | | |
| 25 | 1,500 | | | | 38.41 | 9.71 | 4.44 | 1.29 | .54 | .19 | | | | |
| 30 | 1,800 | | | | | 13.62 | 6.26 | 1.81 | .75 | .26 | | | | |
| 35 | 2,100 | | | | | 18.17 | 8.37 | 2.42 | 1.00 | .35 | .09 | | | |
| 40 | 2,400 | | | | | 23.55 | 10.70 | 3.11 | 1.28 | .44 | .12 | | | |
| 45 | 2,700 | | | | | 29.44 | 13.46 | 3.84 | 1.54 | .55 | .15 | | | |
| 50 | 3,000 | | | | | | 16.45 | 4.67 | 1.93 | .66 | .17 | | | |
| 60 | 3,600 | | | | | | 23.48 | 6.60 | 2.71 | .93 | .25 | | | |
| 70 | 4,200 | | | | | | | 8.83 | 3.66 | 1.24 | .33 | | | |
| 80 | 4,800 | | | | | | | 11.43 | 4.67 | 1.58 | .41 | | | |
| 90 | 5,400 | | | | | | | 14.26 | 5.82 | 1.98 | .52 | | | |
| 100 | 6,000 | | | | | | | | 7.11 | 2.42 | .63 | .08 | | |
| 125 | 7,500 | | | | | | | | 10.83 | 3.80 | .95 | .13 | | |
| 150 | 9,000 | | | | | | | | | 5.15 | 1.33 | .18 | | |
| 175 | 10,500 | | | | | | | | | 6.90 | 1.78 | .23 | | |
| 200 | 12,000 | | | | | | | | | 8.90 | 2.27 | .30 | | |
| 250 | 15,000 | | | | | | | | | | 3.36 | .45 | .12 | |
| 300 | 18,000 | | | | | | | | | | 4.85 | .63 | .17 | |
| 350 | 21,000 | | | | | | | | | | 6.53 | .84 | .22 | |
| 400 | 24,000 | | | | | | | | | | | 1.08 | .28 | |
| 500 | 30,000 | | | | | | | | | | | 1.66 | .42 | .14 |
| 550 | 33,000 | | | | | | | | | | | 1.98 | .50 | .16 |
| 600 | 36,000 | | | | | | | | | | | 2.35 | .59 | .19 |
| 700 | 42,000 | | | | | | | | | | | | .79 | .26 |
| 800 | 48,000 | | | | | | | | | | | | 1.02 | .33 |
| 900 | 54,000 | | | | | | | | | | | | 1.27 | .41 |
| 950 | 57,000 | | | | | | | | | | | | | .46 |
| 1000 | 60,000 | | | | | | | | | | | | | .50 |

**NOTE: See page 5 for website addresses for pipe manufacturers – there are many types of new plastic pipe available now.**

## 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.

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 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.

The 4" CentriPro motors are tested by Canadian Standards Association to UL 1004 and 2111 as well as to CSA standards 77 and 100. They carry a logo. This indicates they are CSA Listed for the USA and Canada, i.e., tested by C.S.A. to U.L. and CSA standards.

CentriPro, single-phase, 4" motor control boxes carry a listing.

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

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.

# TECHNICAL ASSISTANCE AND TROUBLESHOOTING
# CUSTOMER SERVICE CONTACT NUMBERS

## Four (4") Inch Motors and Controls

**Seneca Falls, NY**

- Phone: 866-325-4210 — General
- Phone: 866-673-0427 — Technical
- Phone: 866-673-0445 — Controls
- Toll Free Fax: 888-322-5877

**Orlando Distribution Center**

- Phone: 407-829-7808
- Fax: 407-829-7809

**Fresno Distribution Center**

- Phone: 559-265-4730
- Fax: 559-265-4740

**Southaven, MS (was Memphis) Distribution Center**

- Phone: 662-393-5982
- Toll Free Fax: 800-848-9793

**Chicago Customer Service**

- Phone: 847-983-5926
- Fax: 847-983-1766

**Guelph, Ontario, Canada**

- Phone: 519-826-0869
- Fax: 519-826-0874

## Six (6") Inch and Larger Motors

**Lubbock, Texas Turbine Operation**

- Phone: 806-763-7867
- Fax: 800-453-4749

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Let's Solve Water

Xylem Inc.
2881 East Bayard Street Ext.
Seneca Falls, NY 13148
www.xyleminc.com/brands/centripro