AIM MANUAL

60 Hz SUBMERSIBLE SYSTEMS

APPLICATION | INSTALLATION | MAINTENANCE

2026 EDITION

Franklin Electric

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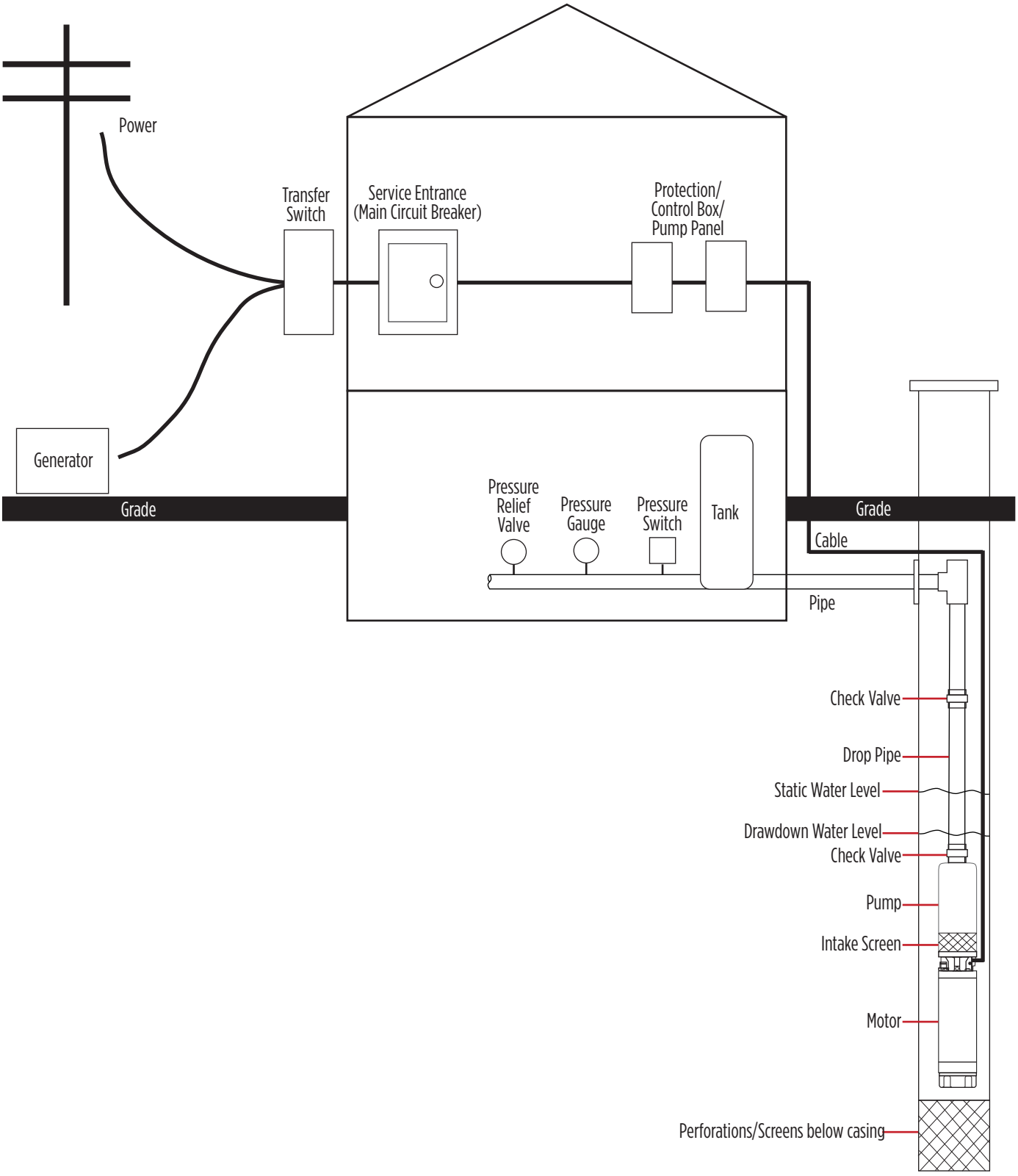
Basic Water System Components



SAFETY INSTRUCTIONS

Hazard Messages

This manual includes safety precautions and other important information in the following formats:

⚠ DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate personal injury.

NOTICE

Indicates a potentially hazardous situation which, if not avoided could result in damage to equipment or other property.

IMPORTANT: Identifies information that controls correct assembly and operation of the product.

NOTE: Identifies helpful or clarifying information.


This symbol alerts the user to the presence of dangerous voltage inside the product that might cause harm or electrical shock.


This symbol alerts the user to the presence of hot surfaces that might cause fire or personal injury

Before Getting Started

This equipment should be installed and serviced by technically qualified personnel who are familiar with the correct selection and use of appropriate tools, equipment, and procedures. Failure to comply with national and local electrical and plumbing codes and within Franklin Electric recommendations may result in electrical shock or fire hazard, unsatisfactory performance, or equipment failure.

Read and follow instructions in this and other product specific manuals carefully to avoid injury and property damage. Do not disassemble or repair unit unless described in the manual.

Failure to follow installation or operation procedures and all applicable codes may result in the following hazards:

⚠ WARNING


High voltages capable of causing severe injury or death by electrical shock are present in this unit.

- To reduce risk of electrical shock, disconnect power before working on or around the system. More than one disconnect switch may be required to de-energize the equipment before servicing.
- Some controls can hold lethal voltage after power has been disconnected. Allow 5 minutes for dangerous internal voltage to discharge before removing covers or working with internal components.
- Make sure the ground terminal is connected to the motor, control enclosures, metal plumbing, and other metal near the motor or cable using wire no smaller than motor cable wires.

⚠ CAUTION


Risk of bodily injury, electric shock, or property damage.

- This equipment must not be used by children or persons with reduced physical, sensory or mental abilities, or lacking in experience and expertise, unless supervised or instructed. Children may not use the equipment, nor may they play with the unit or in the immediate vicinity.
- Operation of this equipment requires detailed installation and operation instructions provided in the owner's manual for use with each product. Read entire owner's manual before starting installation and operation. End User should receive and retain manual for future use.
- Keep safety labels clean and in good condition.

MOTOR APPLICATION

Storage

- Franklin Electric submersible motors are a water-lubricated design. The solution is non-toxic, water based.
- Best storage practices include:
  - Removing the motor from wells carefully during freezing conditions to prevent damage.
  - *Avoiding repeated freezing and thawing to prevent loss of fill solution.

Storage Temperature	Motor Condition	Storage Time Limit
Below -40 °F (-40 °C)	Freezing damage	Do not store at temperature
-40 °F to 26 °F (-40 °C to -3 °C)	Partial freezing of fill solution*	1 year
27 °F to 100 °F (-3 °C to 38 °C)	Good	2 years
100 °F to 130 °F (38 °C to 54 °C)	Heat damage possible	1 year
More than 130 °F (54 °C)	Heat damage	Do not store at temperature

NOTE: There may be an interchange of fill solution with well water during operation. Loss of a few drops of liquid does not damage the motor because an excess amount is provided. The filter/check valve also allows lost liquid to be replaced by filtered well water upon installation. If there has been a considerable amount of leakage, consult the factory for checking procedures.

  - Refer to the table for storage temperature range recommendations.

Control Box, Pumptec Products, and Panel Environment

Franklin Electric control boxes, Pumptec products, and three-phase panels meet UL requirements for NEMA Type 3R enclosures.

- Install within temperatures of 14 °F (-10 °C) to 122 °F (50 °C).

  IMPORTANT: Operating control boxes below 14 °F can cause reduced starting torque and loss of overload protection.

- Never mount in direct sunlight or high temperature locations.
- Use a ventilated enclosure, painted white to reflect heat, for outdoor, higher temperature locations.
- Do not install in a damp well pit or other humid locations to avoid corrosion and component failure.
- Mount control boxes with voltage relays in a vertical upright position only.

Frequency of Starts

IMPORTANT: Excessive cycling reduces the life of control components and cause motor spline damage, bearing damage, or motor overheating.

- Keep the average number of starts per day within the recommended numbers for best system life.
- Select the pump size, tank size, and other controls to keep the starts per day as low as possible.
- Run motors a minimum of one minute to dissipate heat build up from starting current.
- Keep at least 15 minutes between starts or starting attempts for 6-inch and larger encapsulated motors without RVS or VFDs.

Motor Type	Motor Rating		Maximum Starts per 24 Hr Period	
	HP	KW	Single-Phase	Three-Phase
Encapsulated	Up to 0.75	Up to 0.55	300	
	1 - 5.5	0.75 - 4	100	300
	7.5 - 30	5.5 - 22	50	100*
	40 - 200	30 - 150	-	100
Rewindable	75 - 540	55 - 400	-	120

NOTE: *7.5 through 30 hp three-phase encapsulated motors can be started up to 200 times per 24-hour period when used with a properly configured Reduced Voltage Starter (RVS) or Variable Frequency Drive (VFD).

Mounting Position

- FE submersible motors are designed primarily to operate in the vertical, shaft-up position.
- During acceleration, the pump thrust increases as its output head increases.

  NOTE: In cases where the pump head stays below its normal operating range during start-up and full speed condition, the pump may create upward thrust on the motor upthrust bearing. This is an acceptable operation for short periods at each start, but running continuously this way will cause excessive wear on the upthrust bearing.

- With the restrictions listed below, motors are also suitable for operation in positions from shaft-up to shaft-horizontal. As the mounting position becomes closer to horizontal, the probability of shortened thrust bearing life increases. For normal motor life expectancy with motor positions other than shaft-up:
  1. Minimize the frequency of starts to fewer than 10 per 24 hour period.
  2. Ensure 6- and 8-inch motors have a minimum of 20 minutes between starts or starting attempts.

     IMPORTANT: Do not use in systems than can run for short periods at full speed without thrust toward the motor.

  3. Raise shaft end 15 degrees from horizontal.

Transformer Capacity

- Adequately size distribution transformers to satisfy the kVA requirements of the submersible motor.
  - When transformers are too small to supply the load, voltage to the motor decreases.
  - Other loads would add directly to the kVA sizing requirements of the transformer bank.
- The following table references the motor horsepower rating, phase, and the smallest transformer required for open or closed three-phase systems.

  NOTE: While not recommended, open wye or delta systems require larger transformers because only two transformers are used. Refer to "Current Unbalance" on page 18.

Motor Rating		Total Effective kVA Required	Smallest kVA Rating (each transformer)	
HP	KW		Open Wye or Delta 2–Transformers	Closed Wye or 3–Transformers
1.5	1.1	3	2	1
2	1.5	4	2	1.5
3	2.2	5	3	2
5	3.7	7.5	5	3
7.5	5.5	10	7.5	5
10	7.5	15	10	5
15	11	20	15	7.5
20	15	25	15	10
25	18.5	30	20	10
30	22	40	25	15
40	30	50	30	20
50	37	60	35	20
60	45	75	40	25
75	55	90	50	30
100	75	120	65	40
125	93	150	85	50
150	110	175	100	60
175	130	200	115	70
200	150	230	130	75
250	185	300	175	100
300	220	340	200	115

Motor Rating		Total Effective kVA Required	Smallest kVA Rating (each transformer)	
HP	KW		Open Wye or Delta 2–Transformers	Closed Wye or 3–Transformers
335	250	370	215	125
400	300	430	250	145
470	350	520	300	175
540	400	600	350	200

NOTE: Standard kVA ratings are shown. If the power company allows transformer loading higher than standard, higher loading values may be used to meet total effective kVA required, as long as correct voltage and balance are maintained.

Engine Driven Generators

- Engine driven generators can be externally or internally regulated. Most are externally regulated. They use an external voltage regulator that senses the output voltage. As the voltage dips at motor start-up, the regulator increases the output voltage of the generator.
- Generators must be sized to deliver at least 65% of the motor's rated nameplate voltage during starting to ensure adequate starting torque.
- Motor speed varies with generator frequency (Hz).
  - Due to pump affinity laws, a pump running at 1 to 2 Hz below motor nameplate frequency design will not meet its performance curve.
  - A pump running at 1 to 2 Hz above may trip overloads.

Generator Operation

⚠ WARNING

High voltages capable of causing severe injury or death by electrical shock are present in this unit.

- To prevent accidental electrocution, automatic or manual transfer switches must be used any time a generator is used as standby or back up on power lines. Contact power company for use and approval.

⚠ CAUTION

Risk of bodily injury, electric shock, or property damage.

- Do not use a Reduced Voltage Starter with a minimum sized generator. Both items drop the output voltage and combing these items causes the potential for severe motor damage and failure due to low voltage.

- Always start the generator before turning on the motor and always turn off the motor before shutting down the generator.
- The motor thrust bearing may be damaged if the generator is allowed to coast down with the motor running or if it runs out of fuel.
- Follow the generator manufacturer's recommendations to de-rate at higher elevations or use natural gas.

  NOTE: Using the minimum rating or sized generator acts as a soft start to the motor. No additional voltage reduction is allowed.

Generator Minimum Rating

2-wire Motors

Motor Rating		2-wire motors	
HP	KW	KW	kVA
1/3	0.25	2.25	2.85
1/2	0.37	3	3.75
3/4	0.55	4.5	5.7
1	0.75	6	7.5
1.5	1.1	7.5	9.375

3-wire or 3-phase Motors

Motor Rating		3-wire motors	
HP	KW	KW	kVA
1/3	0.25	1.5	1.9
1/2	0.37	2	2.5
3/4	0.55	3	3.8
1	0.75	4	5.0
1.5	1.1	5	6.25
2	1.5	7.5	9.4
3	2.2	10	12.5
5	3.7	15	18.75
7.5	5.5	20	25.0
10	7.5	30	37.5
15	11	40	50
20	15	60	75
25	18.5	75	94
30	22	100	125
40	30	100	125

Motor Rating		3-wire motors	
HP	KW	KW	kVA
50	37	150	188
60	45	175	220
75	55	250	313
100	75	300	375
125	93	370	469
150	110	450	563
175	130	525	656
200	150	600	750
250	185	750	950
300	220	900	1125
335	250	1000	1250
400	300	1200	1500
470	350	1410	1760
540	400	1620	2025

Effects of Torque

- While starting a submersible pump, ensure the pump, delivery pipe, and other parts of the support system can handle the torque developed by the motor. Most pumps rotate in the direction that causes unscrewing torque on right-handed threaded pipe or pump stages.
- Ensure all parts of the pump support system can repeatedly withstand the maximum torque without loosening or breaking. Unscrewing joints will break electrical cable and may cause loss of the pump-motor unit.
- To safely withstand maximum unscrewing torques with a minimum safety factor of 1.5, tighten all threaded joints to at least 10 lb-ft per motor horsepower. If necessary, such as shallower settings, tack weld or weld a strap across the pipe joints on high horsepower pumps.

Torque Required Examples

Motor Rating		Minimum Safe Torque-Load (lb-ft)
HP	KW	
1 & Less	0.75 & Less	10
20	15	200
75	55	750
200	150	2000
300	220	3000
540	400	5400

Check Valve Use

Check valves hold pressure in the system when the pump stops.

- Always use at least one positive-sealing check valve in submersible pump installations.
- If the pump does not have a built-in check valve, install a line check valve in the discharge line within 25 feet of the pump and below the drawdown level of the water supply.
- For Franklin pumps with built-in check valves with settings deeper than 200 feet, install additional check valves per the manufacturer's recommendations.
- Do not use more than the recommended number of check valves.
- Never use swing type check valves with submersible motors/pumps.
- Internal pump check valves or spring-loaded check valves close quickly and help eliminate water hammer.

NOTE: To diagnose and correct check valve related conditions, refer to "Check Valve Troubleshooting" on page 27.

Drawdown Seals

- These are often used to increase well production to prevent water level drop in a low water well.
- Required motor operating temperatures are based on surrounding pressures equal to or greater than atmospheric pressure.

NOTE: Do not use drawdown seals because they can create a pressure surrounding the motor that is lower than atmospheric pressure.

Well Applications

FE submersible motors are designed to operate with a cooling flow of water over and around the full length of the motor. The conditions requiring a flow inducer sleeve are:

- The pump installation does not provide the required cooling flow. Refer to "Required Cooling Flow" on page 8.
- Well diameter is too large to meet required cooling flow. Refer to "Minimum GPM required for motor cooling in water up to 86 °F (30 °C)" on page 9.
- Pump is in an open body of water.
- Pump is in a rock well or below the well casing.
- The well is "top-feeding" (cascading).
- Pump is set in or below screens or perforations.

Water Temperature and Flow

- FE standard submersible motors, except Hi-Temp designs, are designed to operate at a maximum service factor horsepower in water up to 86 °F (30 °C).
  - For example, a 4-inch 5 HP motor in a 6-inch sleeve would need to deliver a minimum 13 GPM to achieve the 0.25 ft/s flow rate.
  - Refer to "Minimum GPM required for motor cooling in water up to 86 °F (30 °C)" on page 9 for various well diameters and motor sizes.
- If a standard motor is operated in water over 86 °F (30 °C) and under 122 °F (50 °C), increase water flow past the motor to maintain safe motor operating temperatures. For temperatures greater than 122 °F (50 °C) to 140 °F (60 °C) increased water flow and horsepower de-rating is required per the tables in "Hot Water Applications (4-inch Standard Motors)" on page 10.

  NOTE: 4-inch motors 2 HP & smaller do not have a required minimum flow, except that it must be greater than zero.

Required Cooling Flow

Use this formula to calculate flow velocity past motor.

NOTE: Flow should not exceed 10 feet per second.

$$fps = \frac{gpm \times 0.409}{ID^2 - OD^2}$$

fps = feet per second

gpm = gallons per minute

ID = internal diameter (in inches) of casing or sleeve

OD = outside diameter (in inches) of the motor

0.409 is a constant used because of the various units of measurement (inches, feet, meters, etc.)

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

Casing or Sleeve ID Inches (mm)	Cooling Flow by Motor Type GPM (LPM)				
	4-inch (3-10 hp) 0.25 ft (7.62 cm) per sec	6-inch 5–60 hp encapsulated 6-inch < 40 hp Magforce 0.50 ft (15.24 cm) per sec	6-inch MagForce ≥ 40 hp 1.6 ft (48.76 cm) per sec	8-inch encapsulated 0.50 ft (15.24 cm) per sec	8-inch MagForce 1.5 ft (45.72 cm) per sec
4 (102)	1.2 (4.5)	-	-	-	-
5 (127)	7 (25.3)	-	-	-	-
6 (152)	13 (51)	8 (30)	25 (95)	-	-
7 (178)	21 (81)	24 (90)	76 (287)	-	-
8 (203)	31 (116)	42 (159)	135 (510)	6 (22)	17 (65)
10 (254)	53 (199)	86 (326)	275 (1043)	50 (188)	149 (565)
12(305)	79 (301)	140 (529)	448 (1694)	104 (392)	311 (1176)
14 (356)	111 (421)	203 (770)	651 (2464)	167 (633)	501 (1898)
16 (406)	148 (560)	277 (1048)	886 (3353)	240 (910)	721 (2731)

Flow Inducer Sleeve

If the flow rate is less than specified in "Minimum GPM required for motor cooling in water up to 86 °F (30 °C)" on page 9, use a flow inducer sleeve. A flow sleeve is always required in an open body of water.

1. Worm gear clamps
2. Intake
3. Flow inducer sleeve

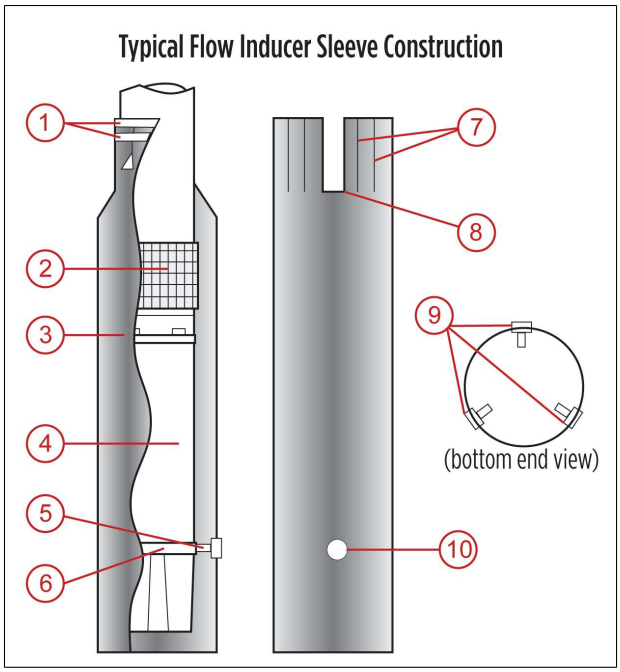
   NOTE: Ensure flow sleeve covers the entire motor.

4. Submersible Motor
5. Centering bolt

   NOTE: Locate centering bolts on the motor casting. Do not put on stator shell.

6. Motor casting
7. Saw cuts
8. Notch out (for cable guards)
9. Lock nuts (inside sleeve)
10. Centering bolt hole

    NOTE: Three centering bolt holes are recommended.



Head Loss

- Head loss is the loss of pump performance and output due to friction inside a pipe, well casing, or flow sleeve.
- If the water velocity moving past the motor is less than 10 feet per second, head loss is typically not a problem.
- Refer to "Minimum GPM required for motor cooling in water up to 86 °F (30 °C)" on page 9 .

Hot Water Applications (4-inch Standard Motors)

Franklin Electric offers a line of Hi-Temp motors which are designed to operate in water with various temperatures up to 194 °F (90 °C) without increased flow. A standard 4-inch motor may be used in hot water applications where the water temperature does not exceed 130 °F (55 °C) by meeting the following conditions:

- Increase the minimum flow rate to 3 ft/s. Use a flow sleeve if necessary.
- When selecting the motor to drive a pump in over 122 °F (50 °C) water, de-rate the motor horsepower per the **4-inch Motors 1/3–5 hp** table.

GPM Required for 3 ft per Second Flow Rate

Casting or Sleeve ID		4-inch motor	
Inches	mm	GPM	LPM
4	102	15	57
5	127	80	303
6	152	106	606

4-inch Motors 1/3–5 hp

Water Temperature		Approximate Allowable % of Maximum Nameplate Amps
°F	°C	
122	50	100%
130	55	90%
140	60	80%

Equipment Grounding

⚠ WARNING

Contact with hazardous voltage could result in death or serious injury.

- Serious or fatal electrical shock may result from failure to connect the motor, control enclosures, metal plumbing, and all other metal near the motor or cable to the power supply ground terminal using wire no smaller than motor cable wires.

Safety is the primary purpose of grounding the metal drop pipe and/or metal well casing in an installation. Grounding limits the voltage between nonelectrical (exposed metal) parts of the system and ground, thus minimizing dangerous shock hazards.

- Use wire at least the size of the motor cable wires to provide adequate current-carrying capability for any ground fault that might occur. Use this wire to provide a low resistance path to ground, ensuring that the current to ground will be large enough to trip any over-current device designed to detect faults (such as a ground fault circuit interrupter [GFCI]).
- Normally, the ground wire to the motor provides the primary path back to the power supply ground for any ground fault. However, there are conditions where the ground wire connection can become compromised. For example, when the water in the well is abnormally corrosive or aggressive, a grounded metal drop pipe or casing becomes the primary path to ground.
- When an installation has abnormally corrosive water and the drop pipe or casing is plastic, use a GFCI with a 10 mA set-point. In this case, route the motor ground wire through the current-sensing device along with the motor power leads. Wired this way, the GFCI will trip only when a ground fault has occurred and the motor ground wire is no longer functional.

IMPORTANT: Installations that use plastic drop pipes and/or casings require dedicated equipment grounding the conductor from the electrical panel ground to the submersible motor to ensure the water column itself does not become the conductive path to ground.

Grounding Control Boxes and Panels

⚠ WARNING

High voltages capable of causing severe injury or death by electrical shock are present in this unit.

- Failure to ground the control frame can result in a serious or fatal electrical shock hazard.

- Always connect the control box or panel-grounding terminal to supply ground per the National Electrical Code (NEC) requirements.
- If the circuit has no grounding conductor and no metal conduit from the box to supply panel, use a wire at least as large as line conductors. Connect this wire from the grounding terminal to the electrical supply ground, per NEC requirements.

Single-Phase Motors

2-Wire Motor Solid State Controls

⚠ CAUTION

Risk of bodily injury, electric shock, or property damage.

- Restarting the motor within 5 seconds after power is removed may cause the motor overload to trip.

BIAC Switch Operation

- When power is applied, the bi-metal switch contacts are closed so the triac is conducting and energizes the start winding.
- As rpm increases, the voltage in the sensor coil generates heat in the bi-metal strip.
- The bi-metal strip bends and opens the switch circuit, removing the start winding.
- The motor continues to run on the main winding alone.
- Approximately 5 seconds after power is removed from the motor, the bi-metal strip cools sufficiently to return to its closed position.
- The motor is ready for the next start cycle.

NOTE: If the motor speed drops during operation, the lowered voltage in the sensor coil allows the bi-metal contacts to close and bring the motor back to operating speed.

Rapid Cycling

- The BIAC starting switch will reset within approximately 5 seconds after the motor is stopped. If an attempt is made to restart the motor before the BIAC starting switch has reset, the motor may not start; however, there will be current in the main winding until the overload protector interrupts the circuit. The time for the overload protector to reset is longer than the reset of the BIAC starting switch. Therefore, the BIAC start switch will have closed and the motor will operate.
- A waterlogged tank condition causes rapid cycling. When this condition occurs, the user will be alerted to the problem during the off time (overload reset time) because the pressure will drop drastically. Correct this condition to prevent nuisance tripping of the overload protector.

Bound Pump (Sand-locked)

- When the motor is not free to turn, as with a sandlocked pump, the BIAC switch creates a "reverse impact torque" in the motor in either direction.
- Once the sand is dislodged, the motor will start and operate in the correct direction.

3-Wire Control Boxes

NOTICE

Risk of damage to equipment.

- The control box and motor are two pieces of one assembly. Be certain that the control box and motor hp and voltage match. Since a motor is designed to operate with a control box from the same manufacturer, warranty consideration applies only when a Franklin control box is used with a Franklin motor.

- Single-phase, three-wire submersible motors require the use of control boxes. Operation of motors without control boxes or with incorrect boxes can result in motor failure and voids warranty.
- Control boxes contain starting capacitors, a starting relay, and, in some sizes, overload protectors, running capacitors, and contactors.
- Ratings through 1 hp may use either a Franklin Electric solid state QD or a potential (voltage) type starting relay, while larger ratings use potential relays.

QD Relays (Solid State)

There are two elements in the relay: a reed switch and a triac. The reed switch consists of two tiny rectangular blade-type contacts, which bend under magnetic flux. It is hermetically sealed in glass and is located within a coil that conducts line current.

When power is supplied to the control box:

- The main winding current passing through the coil immediately closes the reed switch contacts.
- The triac turns on, supplying voltage to the start winding.
- The motor starts.
- The QD relay operates, interacting between the triac, reed switch, and motor windings.
- The solid state switch senses motor speed through the changing phase relationship between start winding current and line current.
- As the motor approaches running speed, the phase angle between the start current and the line current becomes nearly in phase.
- The reed switch contacts open.
- The triac turns off, removing voltage from the start winding.
- The motor continues to run on the main winding only.
- The QD relay is ready for the next starting cycle.

Potential (Voltage) Relays

Potential relays have normally closed contacts.

- When power is applied, the start and main motor windings are energized.
- The motor starts.
- The voltage across the start winding is relatively low and not enough to open the contacts of the relay.
- As the motor accelerates, the increasing voltage across the start winding (and the relay coil) opens the relay contacts.
- The starting circuit opens.
- The motor continues to run on the main winding alone, or the main plus run capacitor circuit.

After the motor is started the relay contacts remain open.

Auxiliary Running Capacitors

A submersible pump system itself is normally not a source of problem noise. However, sometimes the system tolerances come together to create an audible noise. Adding run capacitors is one way to eliminate system noise.

1. Connect added capacitors across "Red" and "Black" control box terminals in parallel with any existing running capacitors.
2. Mount the additional capacitor(s) in an auxiliary box.

NOTE: Although motor amps decrease when auxiliary run capacitance is added, the load on the motor does not. If a motor is overloaded with normal capacitance, it will still be overloaded with auxiliary run capacitance, even though motor amps may be within nameplate values.

Auxiliary Capacitor Sizing

NOTE: This table includes maximum SF amps normally in each lead with the auxiliary capacitor.

Motor Rating		Normal Running Capacitor(s) Microfarad (MFD)	Auxiliary Running Capacitors for Noise Reduction				Maximum Amps with Run Capacitor		
HP	Volts		MFD	Min. Volts	Part Number	Qty	Yellow	Black	Red
1/2	115	0	60 *	370	155327101	2	8.4	7.0	4.0
1/2	230	0	15 *	370	155328101	1	4.2	3.5	2.0
3/4	230	0	20 *	370	155328103	1	5.8	5.0	2.5
1	230	0	25 *	370	155328101 155328102	1	7.1	5.6	3.4
1.5	230	15	15	370	155328101	1	9.3	7.5	4.4
2	230	20	10	370	155328102	1	11.2	9.2	3.8
3	230	45	-	-	-	1	17.0	12.6	6.0
5	230	80	-	-	-	1	27.5	19.1	10.8
7.5	230	45	45	370	155327101 155328101	1	37.0	32.0	11.3
10	230	70	30	370	155327101	1	49.0	42.0	13.0
15	230	135	-	-	-	1	75.0	62.5	16.9

IMPORTANT: *Do not add running capacitors to 1/3 through 1 hp control boxes that use solid state switches or QD relays. Adding capacitors will cause switch failure. If the control box is converted to use a voltage relay, the specified running capacitance can be added.

Buck-Boost Transformers

- When the available power supply voltage is not within the proper range, a buck-boost transformer is often used to adjust voltage to match the motor.
- The most common application with submersible motors is boosting a 208V supply to use a standard 230V single-phase submersible motor and control.
- While tables giving a wide range of voltage boost or buck are published by transformer manufacturers, the following table shows Franklin's recommendations. The values given below are based on boosting the voltage 10% and show the minimum kVA needed as well as the common transformer kVA available.

Buck-Boost Transformer Sizing

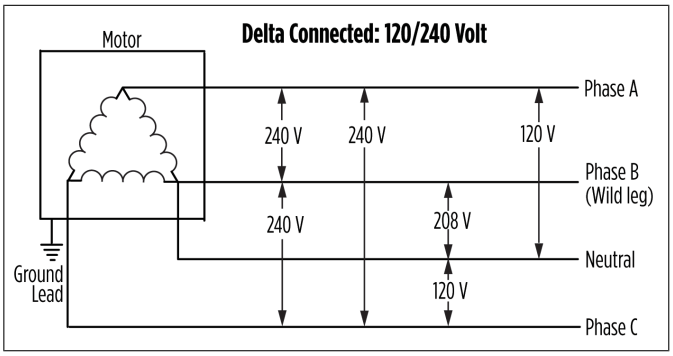
kVA	Motor HP										
	1/3	1/2	3/4	1	1.5	2	3	5	7.5	10	15
Load kVA	1.02	1.36	1.84	2.21	2.65	3.04	3.91	6.33	9.66	11.70	16.60
Minimum XFMR kVA	0.11	0.14	0.19	0.22	0.27	0.31	0.40	0.64	0.97	1.20	1.70
Standard XFMR kVA	0.25	0.25	0.25	0.25	0.50	0.50	0.50	0.75	1.00	1.50	2.00

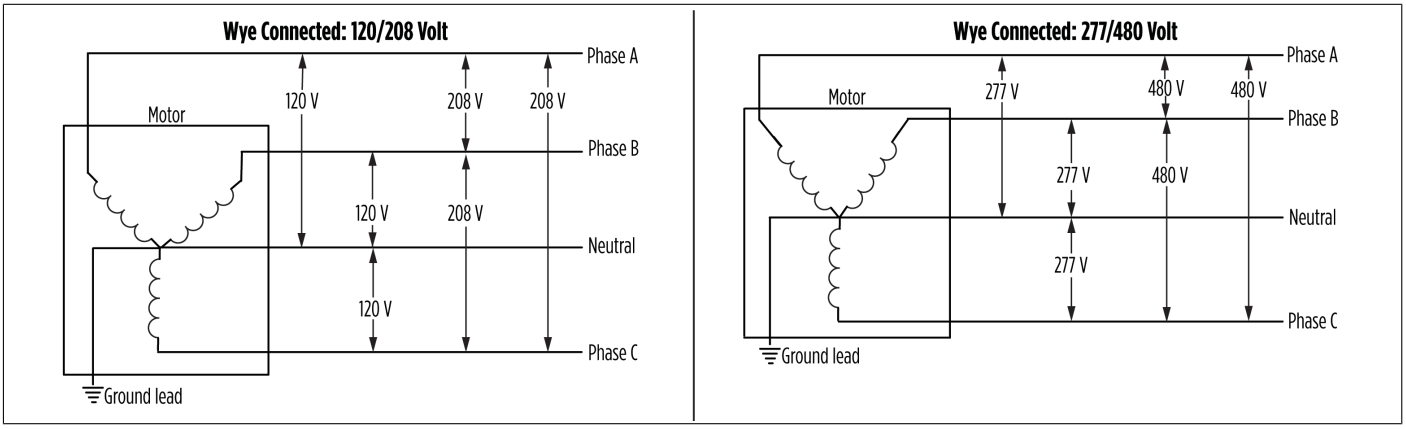
NOTE: Buck-Boost transformers are power transformers, not control transformers. They may also be used to lower voltage when the available power supply voltage is too high.

Three-Phase Motors

Power Connections and Transformers

- When connecting transformers, utility companies have many different options, such as open or closed wye, open or closed delta, center tap and corner grounded delta. Three transformer closed systems are recommended.
- Even if the supply appears to be full three-phase power, voltage measurements can vary depending on the transformer's internal connections.
- The figures are examples of line-to-line and line-to-ground voltages.





Power Factor Correction

- In some installations, power supply limitations require an increase to the power factor of a submersible motor.
- The table below lists the capacitive kVAR required to increase the power factor of large Franklin Electric three-phase submersible motors to the approximate values shown at maximum input loading.
- Connect capacitors on the line side of the overload relay or overload protection will be lost.

kVAR Required

Motor		kVAR		
HP	KW	0.90 PF	0.95 PF	1.00 PF
5	3.7	1.2	2.1	4.0
7.5	5.5	1.7	3.1	6.0
10	7.5	1.5	3.3	7.0
15	11	2.2	4.7	10.0
20	15	1.7	5.0	12.0
25	18.5	2.1	6.2	15.0
30	22	2.5	7.4	18.0
40	30	4.5	11.0	24.0
50	37	7.1	15.0	32.0
60	45	8.4	18.0	38.0
75	55	6.3	18.0	43.0

Motor		kVAR		
HP	KW	0.90 PF	0.95 PF	1.00 PF
100	75	11.0	27.0	60.0
125	93	17.0	36.0	77.0
150	110	20.0	42.0	90.0
175	130	9.6	36.0	93.0
200	150	16.0	46.0	110.0
250	185	15.4	48.8	133.2
300	220	25.2	67.1	172.8
335	250	39.3	84.8	199.7
400	300	8.5	61.0	193.6
470	350	20.1	83.9	244.8
540	400	33.9	107.3	292.7

NOTE: Values listed are total required (not per phase).

Phase Converters

Many different types of phase converters are available. Each generates three-phase power from a single-phase power line.

In all phase converters, the voltage balance is critical to current balance. Although some phase converters may be well-balanced at one point on the system-operating curve, submersible pumping systems often operate at differing points on the curve as water levels and operating pressures fluctuate. Other converters may be well-balanced at varying loads, but their output may vary widely with fluctuations in the input voltage.

Follow these established guidelines for submersible installations with a phase converter:

1. Limit pump loading to rated horsepower. Do not load into motor service factor.
2. Maintain at least 3 ft/s flow past the motor. Use a flow sleeve when necessary.
3. Use time delay fuses or circuit breakers in pump panel. Standard fuses or circuit breakers do not provide secondary motor protection.
4. Do not use SubMonitor Connect with electronic solid state or electro mechanical phase converters.
5. Do not allow current unbalance to exceed 10%.

Reduced Voltage Starters (RVS)

⚠ CAUTION

Risk of bodily injury, electric shock, or property damage.

- Do not use a Reduced Voltage Starter with a minimum sized generator. Both items drop the output voltage and combining these items causes the potential for severe motor damage and equipment failure due to low voltage.

All Franklin Electric three-phase submersible motors are suitable for full-voltage starting. Under this condition the motor speed goes from zero to full speed within a half second or less. The motor current goes from zero to locked rotor amps, then drops to running amps at full speed. This may dim lights, cause momentary voltage dips to other electrical equipment, and shock power distribution transformers.

Use a RVS:

- When the power company requires one to limit voltage drop.
- To reduce motor starting torque thus reducing the stress on shafts, couplings, and discharge piping.
- To slow the rapid acceleration of the water on start-up to help control upthrust and water hammer.

If the maximum recommended cable length is used, an RVS may not be required. In this case, there is a 5% voltage drop in the cable at running amps. This causes about 20% reduction in starting current and about 36% reduction in starting torque compared to having rated voltage at the motor.

Three-Lead Motors: Use an autotransformer or solid-state RVS to soft-start standard three-phase motors.

When using autotransformer starters, supply the motor with at least 55% of rated voltage to ensure adequate starting torque. Most autotransformer starters have 65% and 80% taps. Setting the taps on these starters depends on the percentage of the maximum allowable cable length used in the system.

- If the cable length is less than 50% of maximum allowable, use either the 65% or the 80% taps.
- If the cable length is more than 50% of maximum allowable, use the 80% tap.

Six-Lead Motors: Wye-Delta starters are used with six-lead Wye-Delta motors. All Franklin Electric 6–inch and 8–inch three-phase motors are available in six-lead Wye-Delta construction. Consult the factory for details and availability. Do not use part winding starters because they are not compatible with Franklin Electric submersible motors.

Do not use Wye-Delta starters of the open-transition type that momentarily interrupt power during the starting cycle. Instead use closed-transition starters which do not interrupt power during the start cycle.

An RVS has settings for acceleration ramp time that are typically preset to 30 seconds. Adjust them so the motor is at full voltage within three seconds maximum to prevent excessive radial and thrust bearing wear.

If using SubMonitor or SubMonitor-Plus, set the acceleration time to two seconds maximum because of the 3 second reaction time of the SubMonitor or SubMonitor-Plus.

Solid-state starters (soft starts) may not be compatible with SubMonitor/SubMonitor-Plus. However, in some cases a bypass contactor has been used. Consult the factory for details.

During shutdown, remove the power to allow the pump/motor to coast down. Stopping the motor by ramping down the voltage is possible, but should be limited to three (3) seconds maximum.

Overload Protection of Three-Phase Submersible Motors

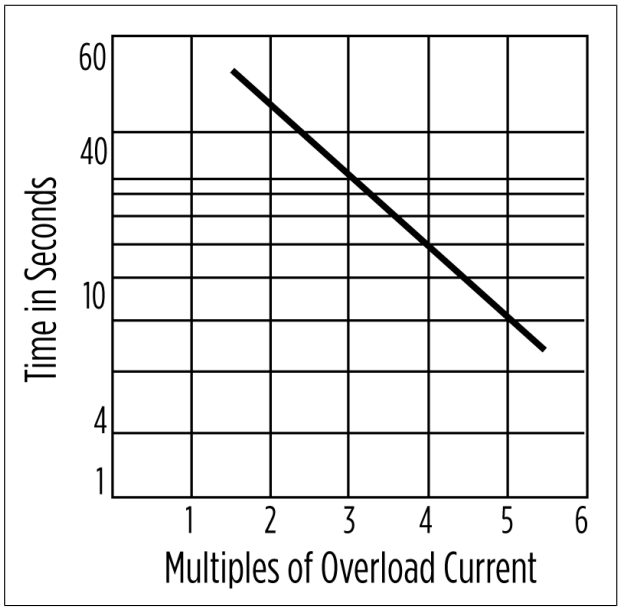
NOTE: Class 10 protection required.

Special overload protection is required for submersible motors. To provide sufficient protection against overloading and locked rotor conditions, ensure the relay meets the following characteristics:

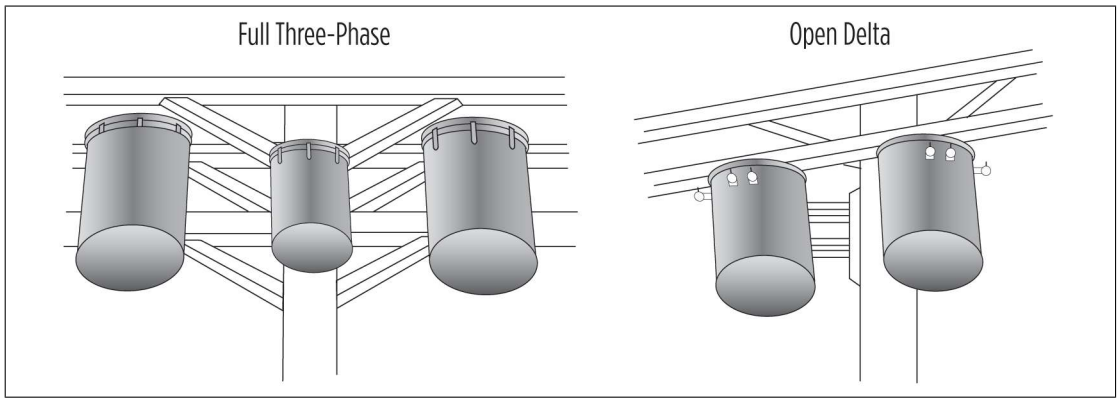
- Trips within 10 seconds or less at 600% of set current
- Ultimately trips at 125% of set current
- Protects against single phasing
- Temperature compensates to avoid nuisance tripping.

Make sure the trip points meet with the relay at 14 °F (-10 °C) room ambient and 122 °F (50 °C) temperatures.

Obtain specific overload information directly from the manufacturer's catalog. This information is available from a Time/Current curve as shown.



Three-Phase Power Unbalance



- Use a full three-phase supply for all three-phase motors, consisting of 3 individual transformers or 1 three-phase transformer.
- Open delta or wye connections that use only two transformers are more likely to cause problems, such as poor performance, overload tripping, or early motor failure due to current unbalance.
- Ensure transformer ratings are no smaller than listed in "Transformer Capacity" on page 5 for supply power to the motor alone.

Motor Rotation

1. Establish correct motor rotation by running the motor in both directions.

   NOTE: Normal rotation is counterclockwise (CCW) viewing the shaft end. The rotation that gives the most water flow is typically the correct rotation.

2. Change rotation by interchanging any two of the three motor leads.

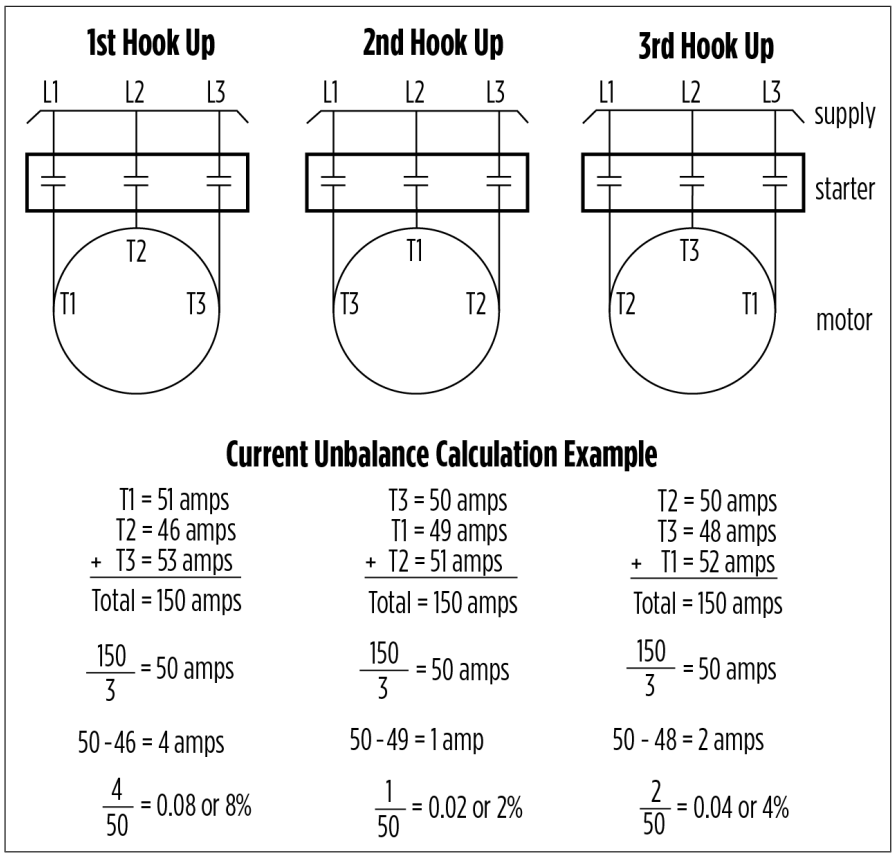
CCW Rotation Lead Phase Designation

- Phase 1 or "A" - Black, T1, or U1
- Phase 2 or "B" - Yellow, T2, or V1
- Phase 3 or "C" - Red, T3, or W1

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

Current Unbalance

1. After correct rotation has been established, check the current in each of the three motor leads and calculate the current unbalance:
    a. Add the three line amps values together.
    b. Sum ÷ 3 = average current
    c. Pick the amp value that is furthest from the average current (either high or low).
    d. Average — this amp value (furthest from average)
    e. Difference ÷ average = Result
    f. Result x 100 = percent of unbalance.
    - If the current unbalance is 2% or less, leave the leads as connected.
2. If the current unbalance is more than 2%, roll the motor leads across the starter in the same direction to prevent motor reversal.
3. Correct any unbalance that exceeds 5% max amp load or 10% rated input load.
    - If the unbalance cannot be corrected by rolling leads, locate and correct the source of the unbalance.
    - 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 side" of the system.
    - 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. Consider a damaged cable, leaking splice, poor connection, or faulty motor winding.



Three-Phase Motor Lead Identification

⚠ WARNING

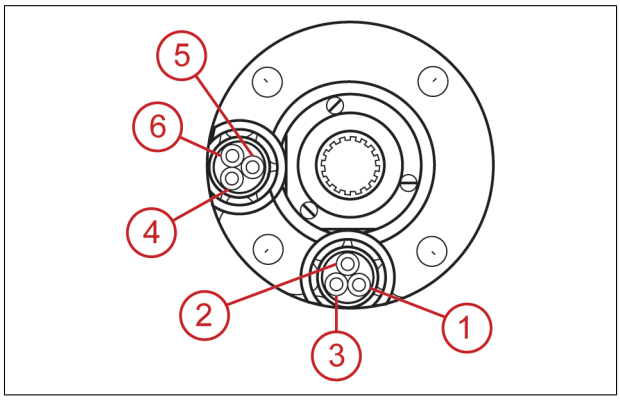
Risk of severe injury or death.

- When installing 6-lead motors extra care must be used to ensure lead identification at the surface. Leads must be marked and connected per diagram. Motor leads are not connected red to red, yellow to yellow, etc.

90° Lead Spacing

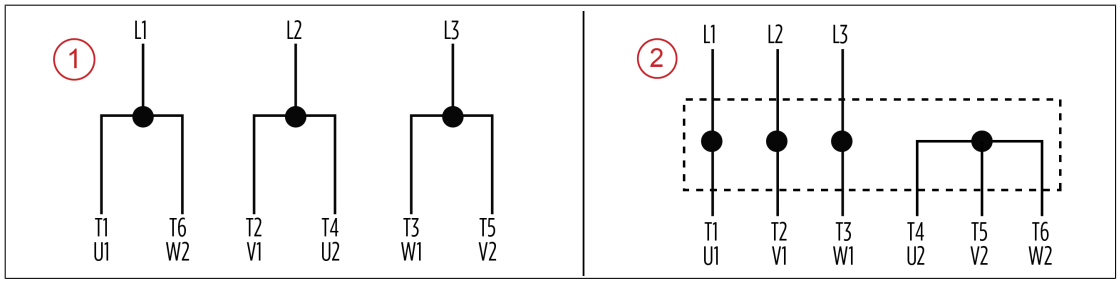
1. T1-U1 (BLK)*
2. T2-V1 (YEL)*
3. T3-W1 (RED)*
4. T4-U2 (BLK)
5. T5-V2 (YEL)
6. T6-W2 (RED)

NOTE: *Only leads T1-T3 are provided in 3-lead DOL and MagForce motors.



Six-Lead Motors Line Connections

NOTE: Each motor lead is numbered with two markers, one near each end. To reverse rotation, interchange any two line connections.



1. Connections for across-the-line starting, running, and any reduced voltage starting except WYE-DELTA type starters
2. WYE-DELTA starters connect the motor as shown during starting, then change to the running connection shown in number 1.

Variable Frequency Drive Submersible Motor Requirements

⚠ WARNING

Contact with hazardous voltage could result in death or serious injury.

- There is a potential shock hazard from contact with and/or touching the insulated cables connected to the variable frequency drive output anytime the motor has energy applied.

- Franklin Electric's three-phase, encapsulated submersible motors can be used with variable frequency drives (VFDs) when applied within the guidelines below.
- Size the VFD for all three-phase, encapsulated submersible motors based on the motor's nameplate maximum amps, not horsepower. Ensure the continuous rated amps of the VFD are equal to or greater than the motor's nameplate maximum amps or the warranty will be void.
- Franklin Electric's single-phase encapsulated submersible motors can only be used with the appropriate Franklin Electric constant pressure controller.

VFD Generator Sizing

Use this formula to find the minimum sized, three-phase generator for Franklin X-Drives:

Watts = **Maximum** VFD Amp Rating x 1.5 x 1.732 x Motor Nameplate Voltage

Maximum VFD Amps = nameplate max of the VFD unit.
(This value will typically be higher than the motor max amps)

1.5 (or 150%) = an industry value to provide tolerance for different generator manufacturers and designs.

1.732 = square root of 3 (For 1-phase generators, delete this value).

Nameplate volts = voltage rating of the motor, not the power source (IE. 460v, not 480v).

VFD Output Filter Requirement

NOTICE

Risk of damage to equipment.

- An incoming power supply or line-side filter for the drive does not replace the need for additional output filters.

For suggestions on dV/dt and sine wave filters:

Motor Voltage Rating (VAC)	Motor Cable Length (ft)	Recommended Output Filter	Recommended VFD Carrier Frequency (kHz)
<380	<50	None	2
	>800–1000	dV/dt[1]	2 - 2.5
	>1000	sine wave[2]	> 4
380–575	<50	None	2
	50–800	dV/dt[1]	2–2.5
	>800	sine wave[2]	>4

NOTE:

1. MagForce 4-Pole motors with fundamental frequency up to 120 Hz will require dV/dt filter current de-rating.
2. VFD Operating Frequencies greater than 75 Hz may need de-rating depending on filter manufacturer.
3. More than 99% of the drives applied on water well submersible motors meet the requirements to have an output filter.
4. An output filter may be necessary for the motor to be considered for warranty.

Filtering Guidelines

- For non-Franklin Electric drives, use filters recommended by the drive manufacturer.
- The Franklin Electric SubDrive systems already have the required additional output filtering installed.
- For other Franklin Electric VFD products, follow the filter requirements as recommended in the product manuals.

VFD Filter Sizing

Be sure to have the following information when ordering a filter:

- VFD model
- Carrier frequency setting
- Motor nameplate voltage
- Motor nameplate max amps
- Cable length from the drive output terminals to the motor
- Motor operating frequency or hertz

Filter & Reactor Types

- For submersible applications, typical installations use either a reactor, dV/dt filter, or sine wave filter. While a sine wave filter is generally best, it is not always required.
- A resistor-inductor-capacitor (RLC) filter has both a high pass filter and a low pass filter section. These filters are considered the best practice, but a low pass reactor filter is also acceptable in some cases
- PWM (Pulse Width Modulated) dV/dt value is either the rate at which voltage is changing with time or how fast the voltage is accelerating.
  - This information is supplied by the drive manufacturer or the manufacturer's drive specification sheet.
  - The dV/dt value cannot be measured with typical field equipment, even when using a true-RMS voltage/amperage multi-meter.

Input Current & Motor Overload Protection

- Set motor input current at the system's typical operating current when running at nameplate rated voltage and frequency (Hz).
- Set motor overload protection to trip at 115% of the system's typical operating current.
- Check that motor overload protection trips equal to or faster than NEMA Class 10 motor overload curve requirements. Refer to "Overload Protection of Three-Phase Submersible Motors" on page 16.

Motor Maximum Load Limits

- Make sure the system never operates above the motor nameplate maximum amps.
- On 50 Hz motors, nameplate full load amps are maximum amps since they have a 1.0 service factor.

Motor Operating Hertz, Cooling Requirements, and Underload Settings

- For three-phase induction submersible motors with large VFD installations, limit the operation to 60 Hz max. Operating at greater than 60 Hz requires special system design considerations.
- Check that the motor never exceeds maximum nameplate amps.
- Ensure the motor never operates below 30 Hz. This is the minimum speed required to provide correct bearing lubrication.
- Make sure the motor's operating speed always operates so the minimum water flow requirements of 0.5 ft/sec for 6–inch and 8–inch motors and 0.25 ft/sec for 4-inch motors is supplied.
- Select the motor underload protection trip point so minimum flow requirements are always met.

VFD Frequency of Starts

- Keep the starts per day within the recommended numbers shown in "Frequency of Starts" on page 4 to provide the best system life.
- Large three-phase submersible motors can be started more frequently because in-rush current is typically reduced when used with a properly configured VFD.
- In all cases a maximum of 200 starts per 24 hour period is recommended.

Starting and Stopping Ramp Settings

- The motor must reach or pass the 30 Hz operating speed within 1 second of the motor being energized. If this does not occur, the motor bearings will be damaged and the motor life reduced.
- The best stopping method is to turn power off followed by a natural coast to stop.
- A controlled stop from 30 Hz to 0 Hz is allowed if the time does not exceed 1 second.

Drive Carrier Frequency

Some drives have a selectable carrier frequency range between 2k and 12k Hz. The higher the carrier frequency setting, the more losses the drive will have which causes heat in the drive; the lower the carrier wave frequency setting, the rougher/poorer the shape of the power curve.

Application Function Setting

If the VFD doesn't have a setting for submersible pump, use a centrifugal pump or propeller fan setting. Centrifugal pumps and fans have similar load characteristics.

VFD Pressure Tank Sizing

- VFD systems only need a small pressure tank to maintain constant pressure, although a larger tank may be used. For proper tank sizing, refer to the VFD manufacturer.
- For generic tank sizing, size the tank volume to be 10 to 20% of the pumps output rating at 60Hz. For example, a system capable of 100 GPM = 10 to 20 gallon tank by volume minimum.

NEMA MG1 Above Ground Motor Standard Comments

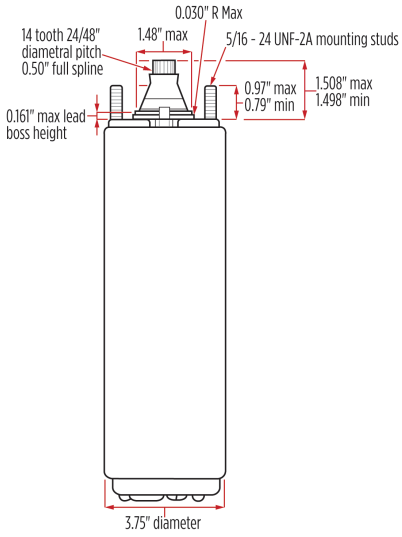
Franklin Electric encapsulated submersible motors are not declared inverter duty motors by NEMA MG1 standards because part 31 does not include a section covering encapsulated winding designs. However, these motors can be used with VFDs without warranty concerns so long as Franklin Electric guidelines are followed.

INSTALLATION

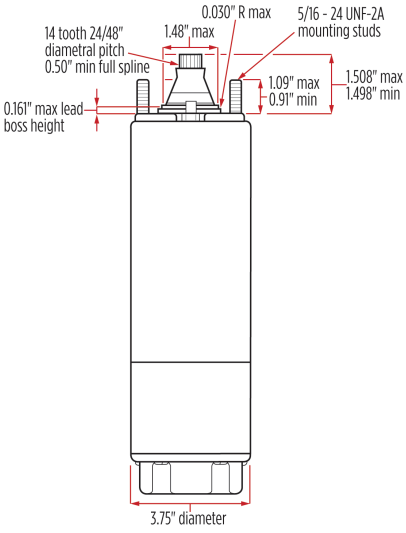
Submersible Motor Dimensions for a Standard Water Well

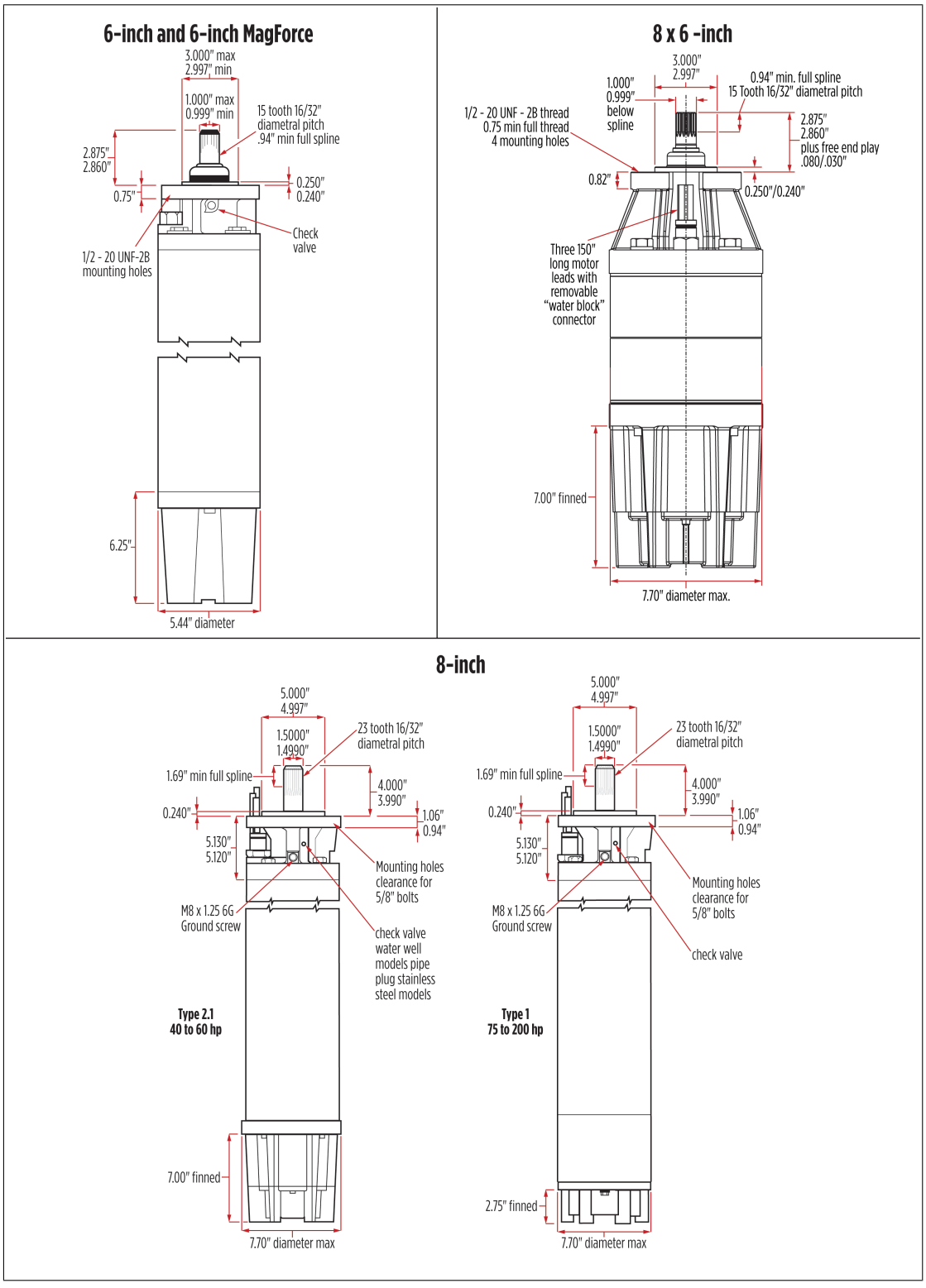
NOTE: Visit franklinwater.com or refer to the catalog for motor lengths and shipping weights.

4-inch Super Stainless and 4-inch 1.5-3 HP MagForce



4-inch High Thrust and 4-inch 5-10 HP MagForce




6-inch and 6-inch MagForce
3.000" max
2.997" min
1.000" max
0.999" min
15 tooth 16/32"
diametral pitch
.94" min full spline
2.875"
2.860"
0.75"
0.250"
0.240"
Check
valve
1/2 - 20 UNF-2B
mounting holes
6.25"
5.44" diameter
8 x 6 -inch
3.000"
2.997"
1.000"
0.999"
below
spline
0.94" min. full spline
15 Tooth 16/32" diametral pitch
1/2 - 20 UNF - 2B thread
0.75 min full thread
4 mounting holes
2.875"
2.860"
plus free end play
.080/.030"
0.82"
0.250"/0.240"
Three 150"
long motor
leads with
removable
"water block"
connector
7.00" finned
7.70" diameter max.
8-inch
5.000"
4.997"
1.5000"
1.4990"
23 tooth 16/32"
diametral pitch
1.69" min full spline
4.000"
3.990"
0.240"
1.06"
0.94"
5.130"
5.120"
Mounting holes
clearance for
5/8" bolts
M8 x 1.25 6G
Ground screw
check valve
water well
models pipe
plug stainless
steel models
Type 2.1
40 to 60 hp
7.00" finned
7.70" diameter max
5.000"
4.997"
1.5000"
1.4990"
23 tooth 16/32"
diametral pitch
1.69" min full spline
4.000"
3.990"
0.240"
1.06"
0.94"
5.130"
5.120"
Mounting holes
clearance for
5/8" bolts
M8 x 1.25 6G
Ground screw
check valve
Type 1
75 to 200 hp
2.75" finned
7.70" diameter max

Submersible Leads and Cables

⚠ CAUTION

Risk of bodily injury, electric shock, or property damage.

- Lead assemblies on submersible motors are suitable only for use in water and may overheat and cause failure if operated in air.

The motor leads are smaller than specified in this manual's cable tables because:

- The leads are considered a part of the motor. They connect the large supply wire and the motor winding. The motor leads are short with virtually no voltage drop across the lead.
- The lead assemblies operate under water, while at least part of the supply cable must operate in air. Lead assemblies running under water operate cooler.

Lead Connector Jam Nut Torque

- Jam nut tightening torques recommended for field assembly are shown. Rubber compression set within the first few hours after assembly may reduce the jam nut torque. This is normal, but does not indicate reduced seal effectiveness. Retighten if original torque was questionable.
- Apply increasing torque to the screws equally in a crisscross pattern until the torque is reached.
- Always use a new motor lead during necessary reassembly as the rubber sets and possible damage may prevent proper resealing of the old lead.
- All motors returned for warranty consideration must have the lead returned with the motor.

Motor Type	Torque	
	ft-lb	Nm
4-inch with jam nut	15 - 20	20 - 27
4-inch with 2 screw clamp plate	2.9 - 3.8	4.0 - 5.1
6-inch	40 - 50	54 - 68
8-inch with 1-3/16" to 1-5/8" jam nut	50 - 60	68 - 81
8-inch with 4 screw clamp plate*	80 - 90	9.0 - 10.2

NOTE: *Does not apply to 8-inch MagForce motors.

NOTE: 8-inch MagForce, 10-inch, and 12-inch motor leads are not field replaceable.

Pump to Motor Coupling Assembly

- Assemble coupling with non-toxic FDA approved waterproof grease such as Mobile FM222, Texaco CYGNUS2661, or approved equivalent. This prevents abrasives from entering the spline area and prolongs spline life.
- After assembling the motor to the pump, in a crisscross pattern torque mounting fasteners according to the table to the right.

Pump and Motor Type (inches)	Torque	
	lb-ft	Nm
4	10	14
6	50	68
8	120	163
10	170	230
12	220	300

Shaft Height and Free End Play

Motor Type	Normal Shaft Height		Dimension Shaft Height inches (mm)		Free End Play inches (mm)	
	inches	mm	Min	Max	Min	Max
4-inch	1.5	38.1	1.498 (38.05)	1.508 (38.30)	0.010 (0.25)	0.045 (1.14)
6-inch	2.875	73.0	2.860 (72.64)	2.875 (73.02)	0.030 (0.76)	0.050 (1.27)
8-inch Type 1	4	101.6	3.990 (101.35)	4.000 (101.60)	0.008 (0.20)	0.032 (0.81)
8-inch Type 2.1					0.030 (0.76)	0.080 (2.03)

NOTE: If the height, measured from the pump-mounting surface of the motor, is low and/or end play exceeds the limit, replace the motor thrust bearing that is possibly damaged.

MOTOR MAINTENANCE

System Troubleshooting

Condition	Possible Cause	Checking Procedures	Corrective Action
Motor does not start	No power or incorrect voltage	Check voltage at line terminals. The voltage must be ± 10% of rated voltage.	Contact power company if voltage is incorrect.
	Fuses blown or circuit breakers tripped	Check fuses for recommended size and check for loose, dirty or corroded connections in fuse receptacle. Check for tripped circuit breakers.	Replace with proper fuse or reset circuit breakers.
	Damaged pressure switch	Check voltage at contact points. Improper contact of switch points can cause voltage less than line voltage.	Replace pressure switch or clean points.
	Control box malfunction	For detailed procedure, see "Single-Phase Motors & Controls" on page 30.	Repair or replace.
	Damaged wiring	Check for loose or corroded connections or defective wiring.	Correct faulty wiring or connections.
	Bound pump	Check for misalignment between pump and motor or a sand bound pump. Amp readings will be 3 to 6 times higher than normal until the overload trips.	Pull pump and correct problem. Run new installation until the water clears.
	Damaged cable or motor	For detailed procedure, see "Preliminary Tests" on page 28.	Repair or replace.
Motor starts too often	Pressure switch	Check setting on pressure switch and examine for defects.	Reset limit or replace switch.
	Check valve stuck open	Damaged or defective check valve will not hold pressure.	Replace if defective.
	Waterlogged tank	Check air charge.	Clean or replace.
	Leak in system	Check system for leaks.	Replace damaged pipes or repair leaks.
Motor Runs Continuously	Pressure switch	Check switch for welded contacts. Check switch adjustments.	Clean contacts, replace switch, or adjust setting.
	Low water level in well	Pump may exceed well capacity. Shut off pump, wait for well to recover. Check static and drawdown level from well head.	Throttle pump output or reset pump to lower level. Do not lower if sand may clog pump.
	Leak in system	Check system for leaks.	Replace damaged pipes or repair leaks.
	Worn pump	Symptoms of worn pump are similar to those of drop pipe leak or low water level in well. Reduce pressure switch setting, if pump shuts off worn parts may be the fault.	Pull pump and replace worn parts.
	Loose coupling or broken motor shaft	Check for loose coupling or damaged shaft.	Replace worn or damaged parts.
	Pump screen blocked	Check for clogged intake screen.	Clean screen and reset pump depth.
	Check valve stuck closed	Check operation of check valve.	Replace if defective.
	Control box malfunction	See "Single-Phase Motors & Controls" on page 30 for single-phase.	Repair or replace.
Motor runs but overload protector trips	Incorrect voltage	Using voltmeter, check the line terminals. Voltage must be within ± 10% of rated voltage.	Contact power company if voltage is incorrect.
	Overheated protectors	Direct sunlight or other heat source can raise control box temperature causing protectors to trip. The box must not be hot to touch.	Shade box, provide ventilation or move box away from source.
	Damaged control box	For detailed procedures, see "Single-Phase Motors & Controls" on page 30.	Repair or replace.
	Damaged motor or cable	For detailed procedures, see "Preliminary Tests" on page 28.	Repair or replace.
	Worn pump or motor	Check running current, see motor specifications tables in "Motor, Cable, & Fuse/Circuit Breaker Reference" on page 39.	Replace pump and/or motor.

Check Valve Troubleshooting

Condition	Definition	Resulting Problems	Possible Cause	Corrective Action
Backspin	The water in the drop pipe and the water in the system flows down the discharge pipe when the motor stops.	• Excessive force is placed across the pump-motor assembly • The pump rotates in a reverse direction • Impeller damage, motor or pump shaft breakage, excessive bearing wear, etc.	• No check valve • Failed check valve	• Install a positive sealing check valve. • Never start the motor while it is back-spinning.
Upthrust	The unit starts under a zero head condition causing an uplifting or upthrust on the impeller-shaft assembly in the pump. This upward movement carries across the pump-motor coupling and creates an upthrust condition in the motor.	• Premature failure of the pump and motor	• No check valve • Leaking check valve • Drilled check valve	• Install a positive sealing check valve.
Water Hammer	• On the next pump start, water moving at very high velocity fills the void and strikes the closed check valve and the stationary water in the pipe above it, causing a hydraulic shock. • Water hammer can often be heard or felt.	• Split pipes • Broken joints • Pump/motor damage	• A swing type check valve is used, causing a slower reaction time • The lowest check valve is more than 30 feet above the standing (lowest static) water level. • A lower check valve leaks, and the above check valve holds, creating a vacuum in the discharge piping	• Shut down the system, and contact the pump installer to correct the problem.
Variable Flow Conditions	Most standard spring-loaded check valves are not designed for the variable flow conditions that occur in a VFD controlled pump.	• Premature wear • Noisy conditions that transfer through the system piping	• The check valve is not VFD compatible	• Use only check valves that are specifically designed for variable flow conditions, typically marked as “VFD compatible”.

Preliminary Tests

Complete these tests before removing the motor from the well or other location for all sizes and phases.

NOTE:

- Check Line-to-Line voltage (Nameplate +/-10%)
- Check amperage on all motor wires (See "Motor, Cable, & Fuse/Circuit Breaker Reference" on page 39)
- Check Line-to-Ground insulation resistance
- Check Line-to-Line winding resistance

Insulation Resistance

1. Open master breaker and disconnect all leads from control box or pressure switch to avoid electric shock hazard and damage to the meter.

   NOTE: For QD-type controls, remove lid.

2. Use a megohmmeter set to 500V (1000V maximum).

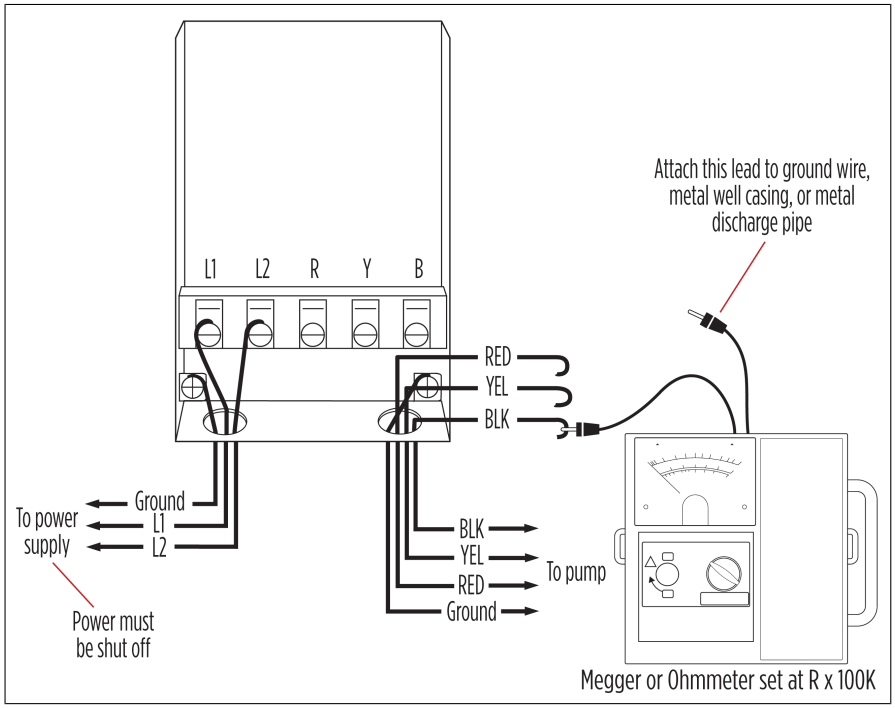
   - If using an ohmmeter, set to R X 100k. Zero the meter.

3. Connect one meter lead to any one of the motor leads and the other lead to the ground wire, metal drop pipe, or metal well casing.

   - If the drop pipe is plastic, connect the meter lead to ground.

4. Check if the ohms value is normal ("Insulation Resistance Readings" on page 28).

   - If it is normal, the motor is not grounded and the cable insulation is not damaged.
   - If it is below normal, either the windings are grounded or the cable insulation is damaged. Check that the cable insulation at the well seal is not being pinched.



Insulation Resistance Readings

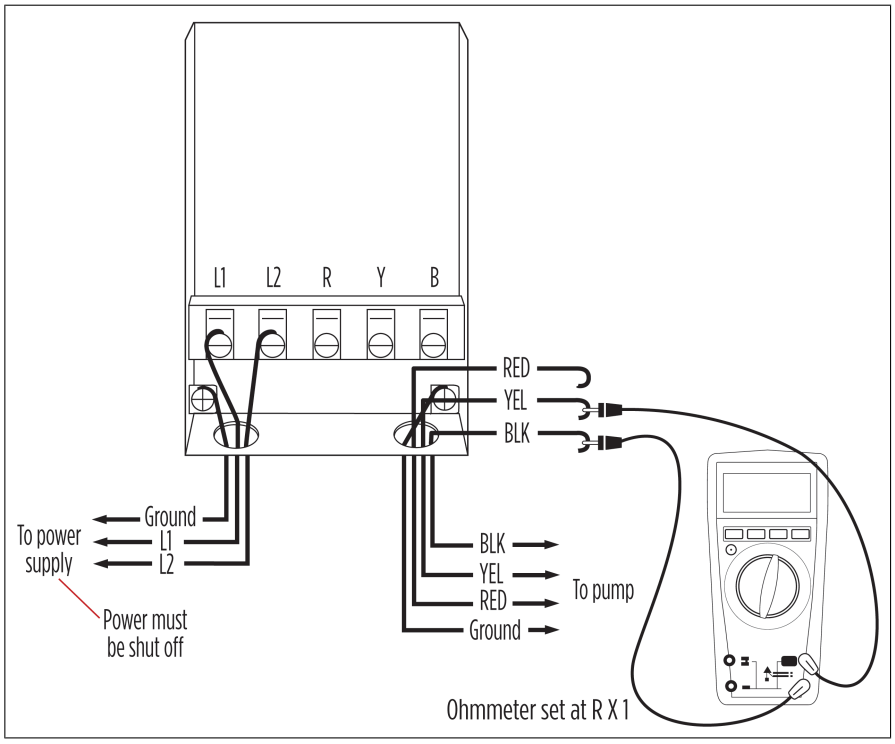
- Insulation resistance varies little with rating. Motors of all hp, voltage, and phase rating have similar values of insulation resistance.
- This table is based on readings taken with a megohmmeter with a 500 VDC output.
- It is less effective to use an Ohmmeter for this test as it may provide inaccurate results.

Condition of motor & leads	In well?	Megohm Value	Ohms Value
A new motor (without drop cable)	No	200.0 or more	200,000,000 or more
A used motor which can be reinstalled in well	No	10.0 or more	10,000,000 or more
*New motor	Yes	2.0 or more	2,000,000 or more
*Motor in good condition	Yes	0.50 - 2.0	500,000 - 2,000,000
*Insulation damage(locate and repair)	Yes	Less than 0.50	Less than 500,000

NOTE: *Readings are for drop cable plus motor

Winding Resistance

1. Open master breaker and disconnect all leads from control box or pressure switch (QD type control, remove lid) to avoid electric shock hazard and damage to the meter.
2. Use a multi-meter set to 20 ohms or an ohmmeter set to R X 1 for values under 10 ohms.
   - Use next scale up for values over 10 ohms.
   - Zero the meter.
3. On 3-wire motors, measure the resistance of yellow to black (main winding) and yellow to red (start winding) at the control box.
4. On 2-wire motors, measure the resistance from line-to-line.
5. For three-phase motors, measure the resistance line-to-line for all three combinations.
6. Check ohms values.



- If all ohms values are normal (see "Motor, Cable, & Fuse/Circuit Breaker Reference" on page 39), the motor windings are neither shorted nor open and the cable colors are correct.
- If any one value is less than normal, the motor is shorted.
- 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.
- If some ohms values are greater than normal and some less on single-phase motors, the leads are mixed. Refer to "Cable Identification" on page 30 to verify cable colors.

Resistance of Drop Cable (ohms)

- The values in the table to the right are for two copper conductors per 100 feet of wire at 50 °F . If aluminum conductor drop cable is used, the resistance will be higher.
- To determine the actual resistance of the aluminum drop cable, divide the ohm readings from this table by 0.61. This table shows total resistance of cable from control to motor and back.

NOTE: The winding resistance measured at the motor should fall within the values specified in the motor spec tables in "Motor, Cable, & Fuse/Circuit Breaker Reference" on page 39. When measured through the drop cable, subtract the resistance of the drop cable from the ohmmeter readings to get the winding resistance of the motor.

AWG or MCM Wire Size (Copper)	Resistance per 100 ft of distance (ohms)
14	0.544
12	0.338
10	0.214
8	0.135
6	0.082
4	0.052
3	0.041
2	0.032
1	0.026
1/0	0.021
2/0	0.017
3/0	0.013
4/0	0.010
250	0.0088
300	0.0073
350	0.0063
400	0.0056
500	0.0044
600	0.0037
700	0.0032

Single-Phase Motors & Controls

Cable Identification

NOTE: For single-phase, 3-wire units.

1. If the colors on the individual drop cables cannot be found, using an ohmmeter measure:
   - Cable 1 to Cable 2; Cable 2 to Cable 3; Cable 3 to Cable 1
2. Find the highest resistance reading.
   - The motor lead that is not used during the highest cable to cable resistance test result is the yellow lead.
3. Use the yellow lead and each of the other two leads to get two readings:
   - Highest is the red lead. Lowest is the black lead.

Example Results:

- The lead not used in the highest reading (6 ohms) was Cable 3, making it the yellow lead.
- The yellow lead's highest reading was 4 ohms. The other cable in this reading was Cable 1, making it the red lead.
- The yellow lead's lowest reading was 2 ohms. The other cable in this reading was Cable 2,
  making it the black lead.

Cables	Ohmmeter Reading	Results
Cable 1 to Cable 2	6 ohms	Cable 3 - Yellow
Cable 2 to Cable 3	2 ohms	Cable 2 - Black
Cable 3 to Cable 1	4 ohms	Cable 1 - Red

Control Box Checks

⚠ WARNING

Contact with hazardous voltage could result in death or serious injury.

- Power must be on for these tests. Do not touch any live parts.

IMPORTANT: Keep in mind the component tests in this manual are not conclusive. For example, a capacitor may test good (not open, not shorted) but may have lost some of its capacitance and no longer be able to perform its function.

Voltage Measurements

1. Ensure the motor is not running.
2. Measure voltage at L1 and L2 of pressure switch or line contactor.
   - Ensure the voltage reading is ± 10% of motor rating.
3. Turn the motor on until it is running normally.
4. Measure voltage at load side of pressure switch or line contactor with pump running.
   - Ensure the voltage reading remains the same except for slight dip on starting. Loose connections, bad contacts, ground faults, or inadequate power supply can cause excessive voltage drop.
   - Either low voltage or ground faults cause relay chatter.

Current (Amp) Measurements

Measure current on all motor leads.

- For the amp reading, refer to "4-inch/1-Phase/Encapsulated without "G" suffix/3450 RPM" on page 39 and "6-inch/1-Phase/3-Lead/Encapsulated/3450 RPM" on page 44.
  - Ensure current in red lead is momentarily high and then drops within one second to those values. This verifies relay or solid state relay operation.
  - Check current in black and yellow leads does not exceed those values.
- Relay or switch failures cause red lead current to remain high and overload tripping.
- Open run capacitor(s) cause amps to be higher than normal in the black and yellow motor leads and lower than normal in the red motor lead.
- A bound pump causes locked rotor amps and overloading tripping.
- Pump running at shut-off, worn pump, or stripped splines may cause low amps.
- Failed start capacitor or open switch/relay are indicated if the red lead current is not momentarily high at starting.

Ohmmeter Tests

- The tests below are not conclusive. For example, a capacitor may test good (not open, not shorted) but may have lost some of its capacitance and no longer be able to perform its function.
- Perform these tests with the power off.

QD, Solid State Control Box

Part	Test	Meter Setting	Connections	Correct Motor Reading
Start Capacitor and Run Capacitor (CRC)	Terminals	R x 1,000	Capacitor terminals	Pointer should swing toward zero, then back to infinity.
Q.D. (Blue) Relay	Triac	R x 1,000	Cap and B terminal	Infinity for all models
	Coil	R x 1	L1 and B	Zero ohms for all models.
Potential (Voltage) Relay	Coil	R x 1,000	#2 & #5	For 115 Volt Boxes: 0.7-1.8 (700 to 1,800 ohms). For 230 Volt Boxes: 4.5-7.0 (4,500 to 7,000 ohms).
	Contact	R x 1	#1 & #2	Zero for all models.

Integral Horsepower Control Box

Part	Test	Meter Setting	Connections	Correct Motor Reading
Overloads	Push reset buttons to make sure contacts are closed	R x 1	Overload terminals	Less than 0.5 ohms
Capacitor	Disconnect leads from one side of each capacitor before checking	R x 1,000	Capacitor terminals	Pointer should swing toward zero, then drift back to infinity, except for capacitors with resistors which will drift back to 15,000 ohms.
Potential (Voltage) Relay	Coil Test	R x 1,000	#2 & #5	4.5-7.0 (4,500 to 7,000 ohms) for all models
	Contact Test	R x 1	#1 & #2	Zero ohms for all models
Contactor	Coil Test	R x 100	Coil terminals	1.8-14.0 (180 to 1,400 ohms)
	Manually close the contacts	R X 1	L1 & T1 or L2 & T2	Zero ohms

Ordering Information

QD Control Box Parts

HP	Volts	Control Box Model Number	QD (Blue) Relay	Start Capacitor			Run Capacitor		
				Order Number	MFD	Volts	Order Number	MFD	Volts
1/3	115	280 102 4915	223 415 905	275 464 125	159-191	110	—	—	—
	230	280 103 4915	223 415 901	275 464 126	43-53	220	—	—	—
1/2	115	280 104 4915	223 415 906	275 464 201	250-300	125	—	—	—
	230	280 105 4915	223 415 902	275 464 105	59-71	220	—	—	—
		282 405 5015 (CRC)	223 415 912	275 464 126	43-53		156 362 101	15	370
3/4	230	280 107 4915	223 415 903	275 464 118	86-103	220	—	—	—
		282 407 5015 (CRC)	223 415 913	275 464 105	59-71		156 362 102	23	370
1	230	280 108 4915	223 415 904	275 464 113	105-126	220	—	—	—
		282 408 5015 (CRC)	223 415 914	275 464 118	86-103		156 362 102	23	370

NOTE: Control boxes with QD Relays are designed to operate on 230V systems. For 208V systems or where line voltage is between 200V and 210V, use the next larger cable size or a boost transformer.

QD Capacitor Replacement Kits

Capacitor Number	Kit
275 464 105	305 207 905
275 464 113	305 207 913
275 464 118	305 207 918
275 464 125	305 207 925

Capacitor Number	Kit
275 464 126	305 207 926
275 464 201	305 207 951
156 362 101	305 203 907
156 362 102	305 203 908

NOTE: Voltage relays kits for 115 volts (305 102 901) and 230 volts (305 102 902) will replace current, voltage, or QD relays, and solid state switches.

Integral Horsepower Control Box Parts

Motor Size (inches)	Motor Rating (HP)	Control Box[1] Model No.	Capacitors				Part Number		
			Part No.[2]	MFD.	Volts	QTY	Overload[2]	Relay[3]	Contactor[2]
4	1 - 1.5	282 300 8110 Standard	275 464 113 S	105-126	220	1	275 411 107	155 031 102	—
			155 328 102 R	10	370				
		282 300 8110 Standard (See Note 3)	275 464 113 S	105-126	220		275 411 114 S		
			155 328 101 R	15	370		275 411 113 M		
		282 300 8310 Deluxe (See Note 3)	275 464 113 S	105-126	220		275 411 114 S		155325102
			155 328 101 R	15	370		275 411 113 M		
	2	282 301 8110 Standard	275 464 113 S	105-126	220		275 411 117 S	155 031 102	—
			155 328 103 R	20	370		275 411 113 M		
		282 301 8310 Deluxe	275 464 113 S	105-126	220		275 411 117 S	155 031 102	155 325 102 L
			155 328 103 R	20	370		275 411 113 M		
	3	282 302 8110 Standard	275 463 123 S	208-250	220		275 411 118 S	155 031 102	—
			155 327 109 R	45	370		275 411 115 M		
		282 302 8310 Deluxe	275 463 123 S	208-250	220		275 411 118 S	155 031 102	155 325 102 L
			155 327 109 R	45	370		275 411 115 M		
4 & 6	5	282 113 8110 Standard	275 468 118 S	216-259	330	1	275 411 119 S	155 031 601	—
			155 327 114 R	40	370	2	275 406 102 M		
		282 113 9310 Deluxe	275 468 118 S	216-259	330	1	275 411 119 S	155 031 601	155 326 101 L
			155 327 114 R	40	370	2	275 406 102 M		
6	7.5	282 201 9210 Standard	275 468 119 S	270-324	330	1	275 411 102 S	155 031 601	—
			275 468 117 S	130-154					
			155 327 109 R	45	370		275 406 122 M		
		282 201 9310 Deluxe	275 468 119 S	270-324	330	1	275 411 102 S	155 031 601	155 326 102 L
			275 468 117 S	130-154					
			155 327 109 R	45	370		275 406 121 M		
	10	282 202 9210 Standard	275 468 119 S	270-324	330	1	275 406 103 S	155 031 601	—
			275 468 120 S	350-420					
			155 327 102 R	35	370	2	155 409 101 M		
		282 202 9230 Standard	275 468 119 S	270-324	330	2	275 406 103 S		—
			155 327 102 R	35	370		155 409 101 M		
		282 202 9310 Deluxe	275 468 119 S	270-324	330	1	275 406 103 S	155 031 601	155 326 102 L
			275 468 120 S	350-420					
			155 327 102 R	35	370	2	155 409 101 M		
		282 202 9330 Deluxe	275 468 119 S	270-324	330	2	275 406 103 S		155 326 102 L
			155 327 102 R	35	370	2	155 409 101 M		
	15	282 203 9310 Deluxe	275 468 120 S	350-420	330	2	275 406 103 S	155 031 601	155 429 101 L
			155 327 109 R	45	370	3	155 409 102 M		
		282 203 9330 Deluxe	275 468 119 S	270-324	330	2	275 406 103 S		
			155 327 109 R	45	370	3	155 409 102 M		
		282 203 9621 X-Large (obsolete)	275 468 119 S	270-324	330	2	275 406 103 S	155 031 601 (2 required)	155 429 101 L
			155 327 109 R	45	370	3	155 409 102 M		

NOTE:

1. Surge arrestors 150 814 902 are suitable for all control boxes.
2. S = Start, M = Main, L = Line, R = Run, Deluxe = Control box with line contactor.
3. Control box model 282 300 8110 with date code 11C19 (March 2011) and newer. These models contain 15 MFD run capacitor and both start and run overloads. This box is designed for use with any Franklin 1.5 hp motor.
4. For 208V systems or where line voltage is between 200V and 210V, a low voltage relay is required. On 3 hp and smaller control boxes use relay part 155 031 103 in place of 155 031 102 and use the next larger cable size than specified in the 230V table. On 5 hp and larger use relay 155 031 602 in place of 155 031 601 and next larger wire. Boost transformers are an alternative to special relays and cable. Refer to "Buck-Boost Transformers" on page 13.

Integral HP Capacitor Replacement Kits

Capacitor Number	Kit
275 463 120	305 206 920
275 463 122	305 206 922
275 463 123	305 206 923
275 464 113	305 207 913
275 464 137	305 207 937
275 468 117	305 208 917
275 468 118	305 208 918
275 468 119	305 208 919

Capacitor Number	Kit
275 468 120	305 208 920
155 327 101	305 203 901
155 327 102	305 203 902
155 327 109	305 203 909
155 327 114	305 203 914
155 328 101	305 204 901
155 328 102	305 204 902
155 328 103	305 204 903

Integral HP Overload Replacement Kits

Overload Number	Kit
275 406 102	305 214 902
275 406 103	305 214 903
275 406 121	305 214 921
275 406 122	305 214 922
275 411 102	305 215 902
275 411 107	305 215 907

Overload Number	Kit
275 411 108	305 215 908
275 411 113	305 215 913
275 411 114	305 215 914
275 411 115	305 215 915
275 411 117	305 215 917
275 411 118	305 215 918
275 411 119	305 215 919

Integral HP Voltage Relay Replacement Kits

Relay Number	Description	Kit
155 031 102	230V Standard Duty	305 213 902
155 031 103	208V Standard Duty	305 213 903

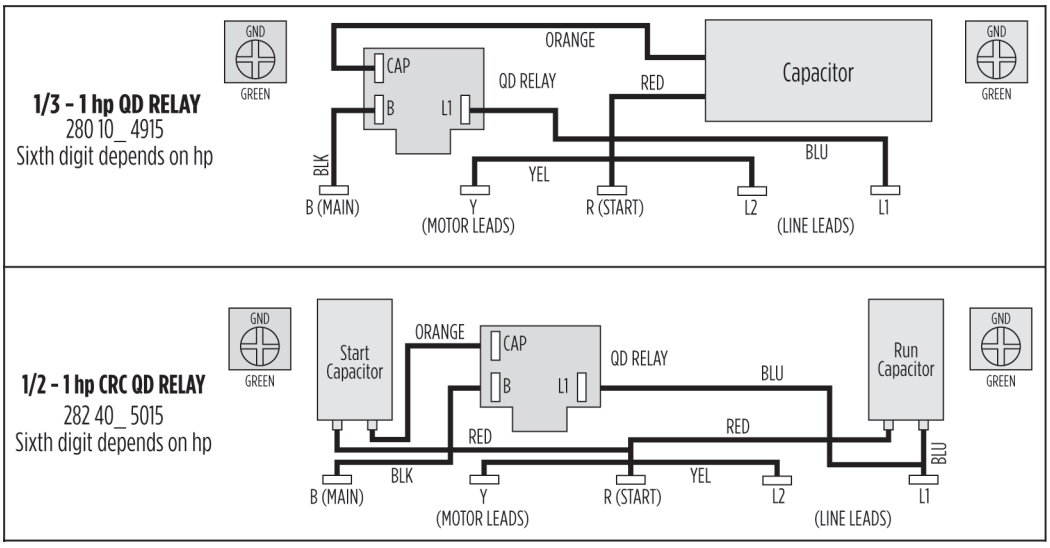
Relay Number	Description	Kit
155 031 601	230V Heavy Duty	305 213 961
155 031 602	208V Heavy Duty	305 213 962

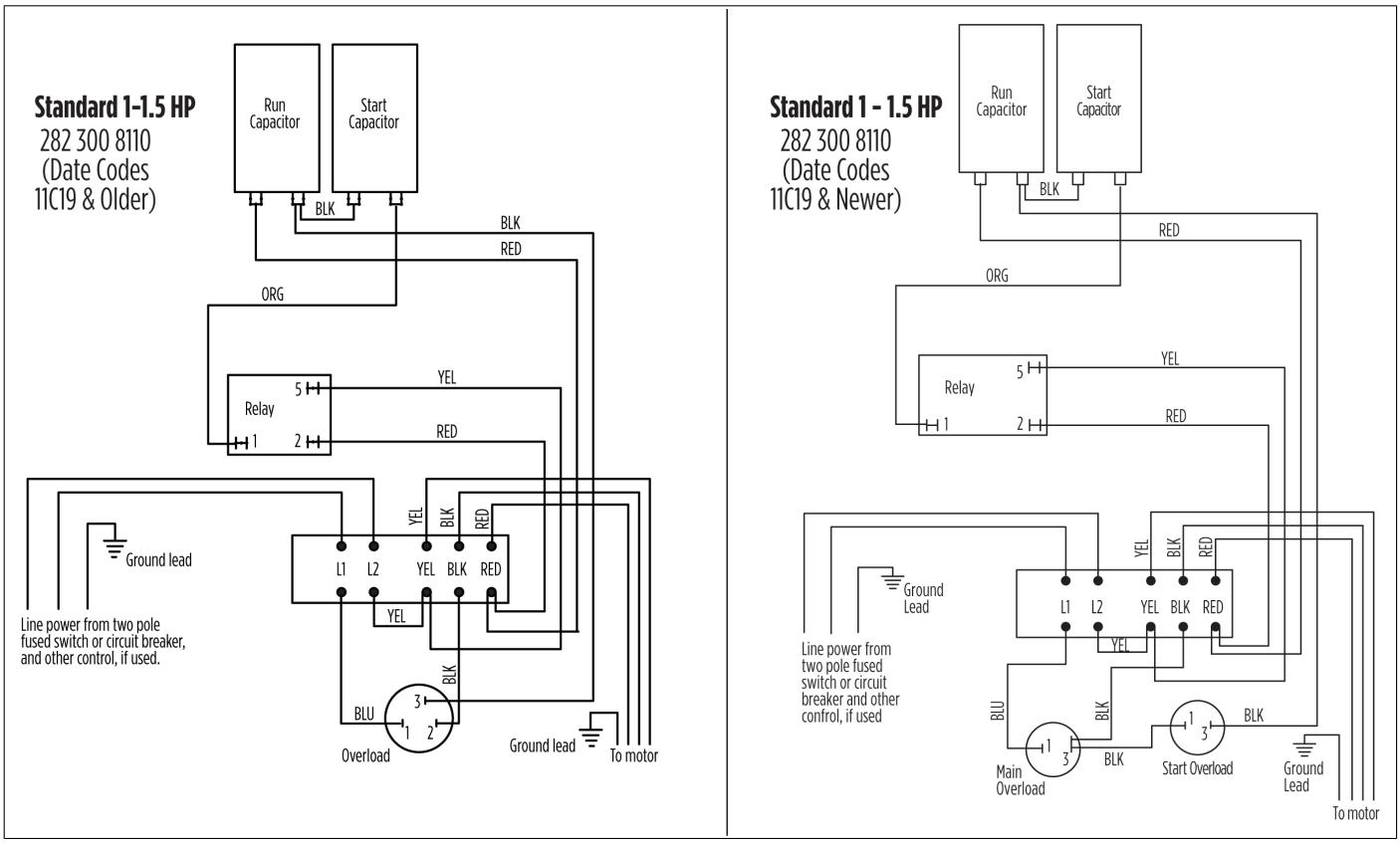
Integral HP Contactor Replacement Kits

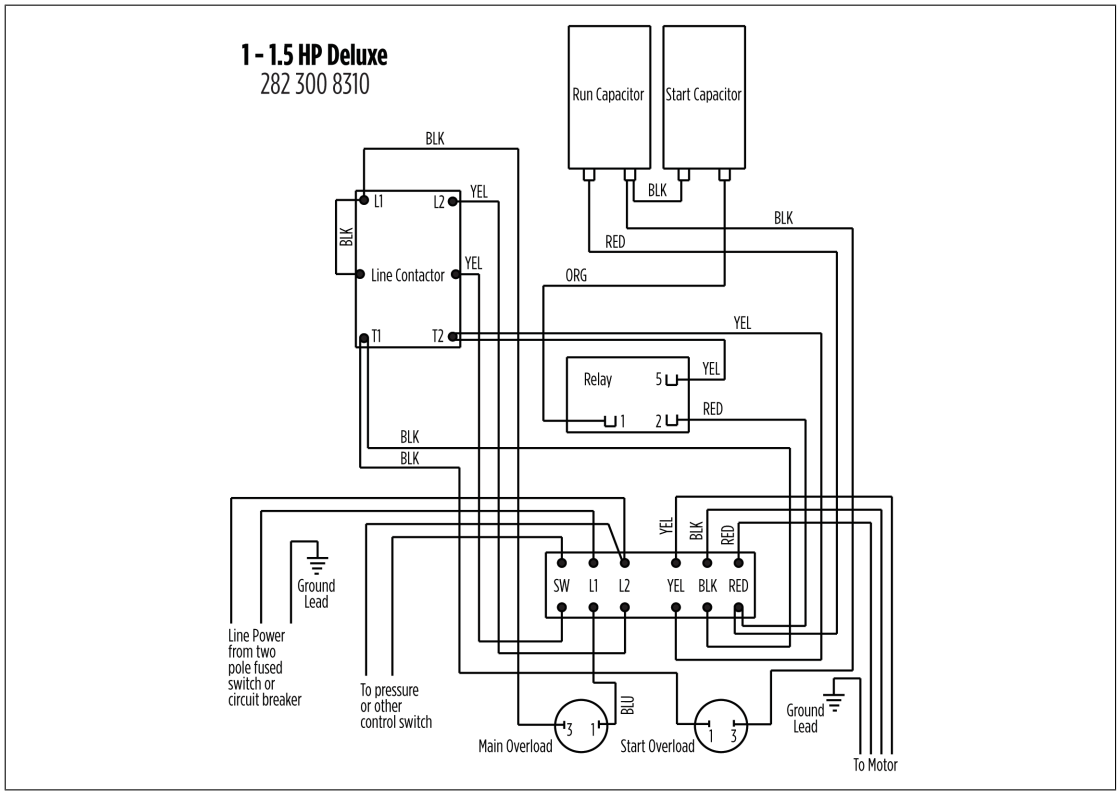
Contactor	Kit
155 325 102	305 226 902
155 326 101	305 347 903

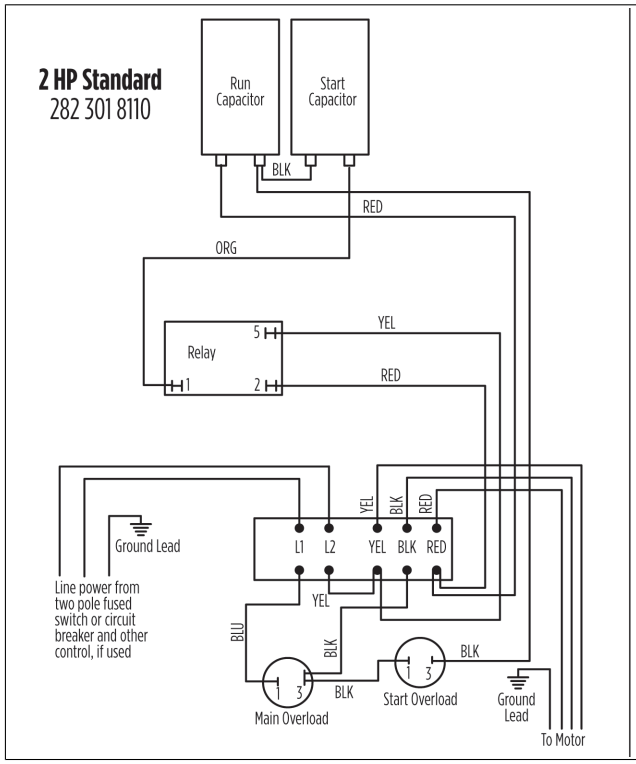
Contactor	Kit
155 326 102	305 347 902
155 429 101	305 347 901

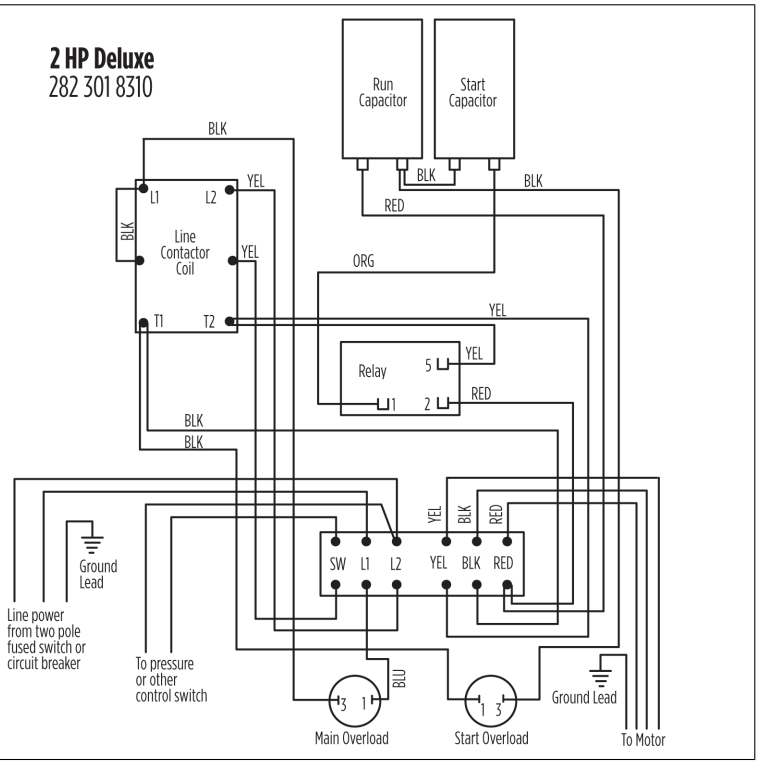
Control Box Wiring Diagrams

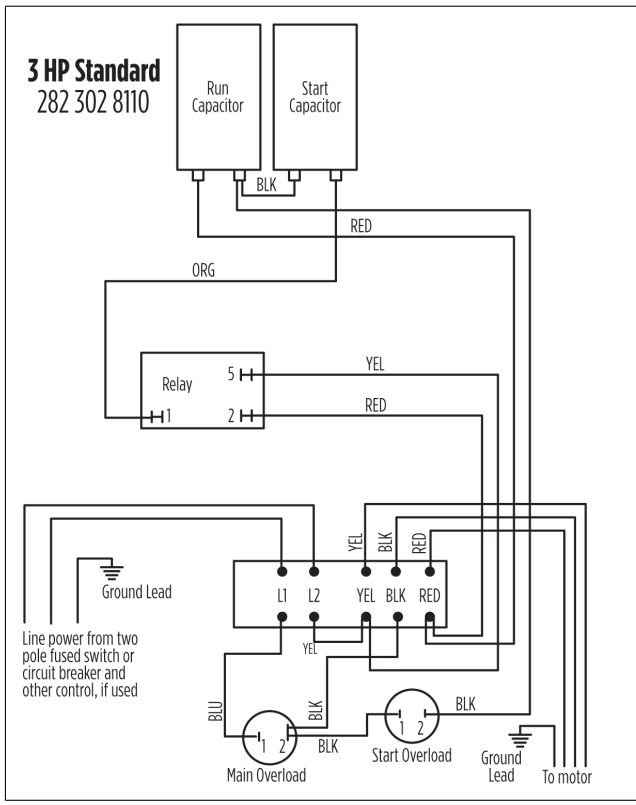


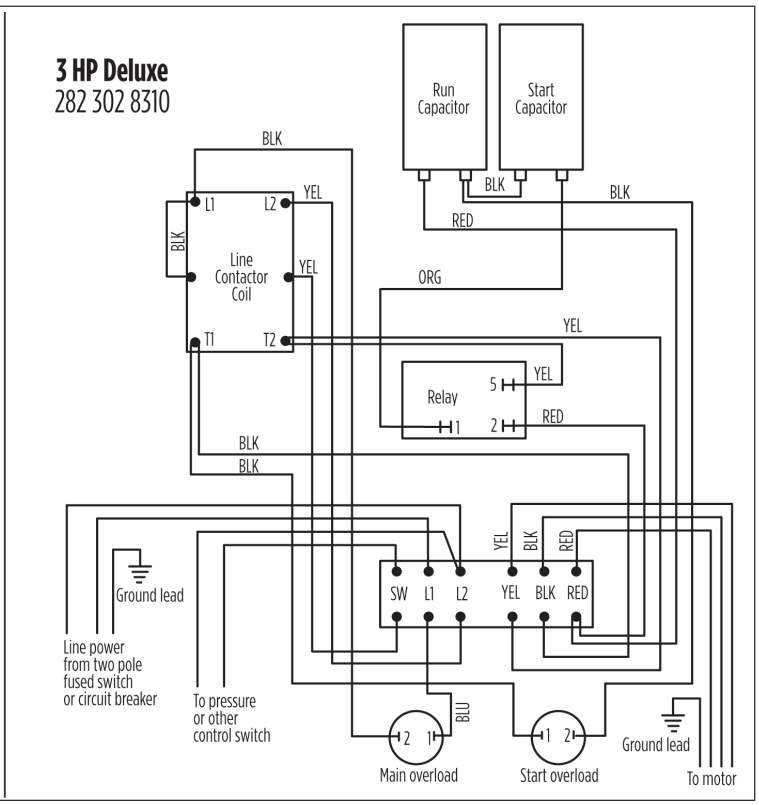

Standard 1-1.5 HP
282 300 8110
(Date Codes
11C19 & Older)
Run Capacitor
Start Capacitor
BLK
BLK
RED
ORG
Relay
5
1
2
YEL
RED
YEL
BLK
RED
L1
L2
YEL
BLK
RED
Ground lead
Line power from two pole fused switch or circuit breaker, and other control, if used.
YEL
BLK
BLU
3
1
2
Overload
Ground lead
To motor
Standard 1 - 1.5 HP
282 300 8110
(Date Codes
11C19 & Newer)
Run Capacitor
Start Capacitor
BLK
RED
ORG
Relay
5
1
2
YEL
RED
YEL
BLK
RED
L1
L2
YEL
BLK
RED
Ground Lead
Line power from two pole fused switch or circuit breaker and other confrol, if used
YEL
BLU
BLK
BLK
1
3
Main Overload
1
3
Start Overload
BLK
Ground Lead
To motor


1 - 1.5 HP Deluxe
282 300 8310
Run Capacitor
Start Capacitor
BLK
BLK
BLK
RED
L1
L2
YEL
BLK
Line Contactor
YEL
ORG
T1
T2
YEL
Relay
5
1
2
YEL
RED
BLK
BLK
YEL
BLK
RED
SW
L1
L2
YEL
BLK
RED
Ground Lead
Line Power from two pole fused switch or circuit breaker
To pressure or other control switch
BLU
3
1
Main Overload
1
3
Start Overload
Ground Lead
To Motor

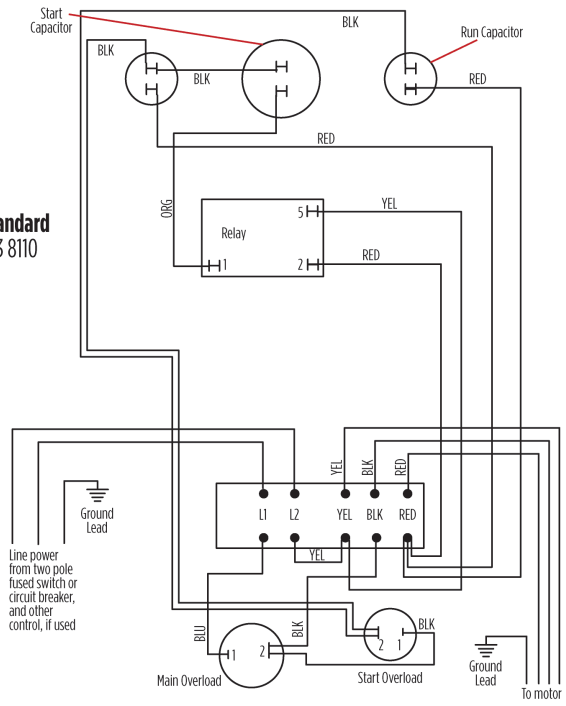

2 HP Standard
282 301 8110
Run Capacitor
Start Capacitor
BLK
RED
ORG
Relay
5
1
2
YEL
RED
Ground Lead
Line power from two pole fused switch or circuit breaker and other control, if used
L1
L2
YEL
BLK
RED
BLU
Main Overload
Start Overload
Ground Lead
To Motor


2 HP Deluxe
282 301 8310
Run Capacitor
Start Capacitor
BLK
YEL
L1
L2
Line Contactor Coil
T1
T2
RED
ORG
Relay
5
1
2
SW
Ground Lead
Line power from two pole fused switch or circuit breaker
To pressure or other control switch
BLU
Main Overload
Start Overload
To Motor

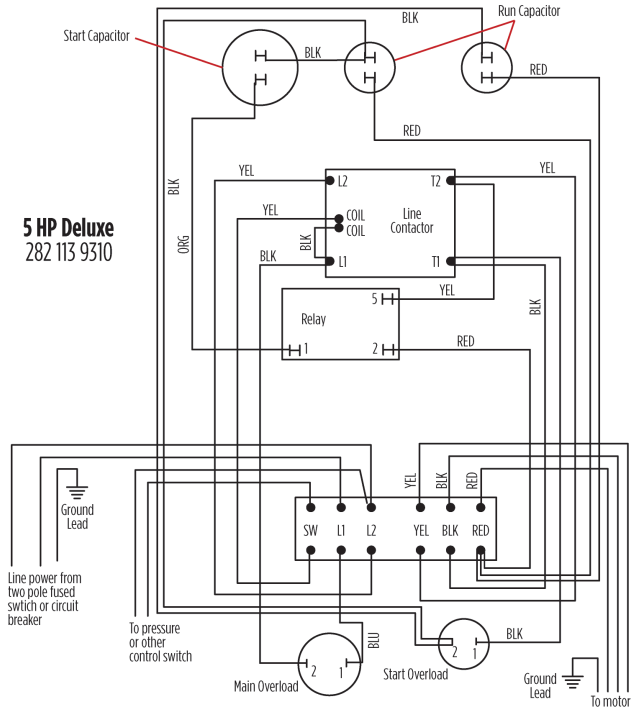

3 HP Standard
282 302 8110
Run Capacitor
Start Capacitor
BLK
RED
ORG
Relay
5
1
2
YEL
Ground Lead
Line power from two pole fused switch or circuit breaker and other control, if used
L1
L2
BLU
Main Overload
Start Overload
Ground Lead
To motor


3 HP Deluxe
282 302 8310
Run Capacitor
Start Capacitor
BLK
YEL
L1
L2
Line Contactor Coil
T1
T2
RED
ORG
Relay
5
1
2
SW
Ground lead
Line power from two pole fused switch or circuit breaker
To pressure or other control switch
BLU
Main overload
Start overload
To motor

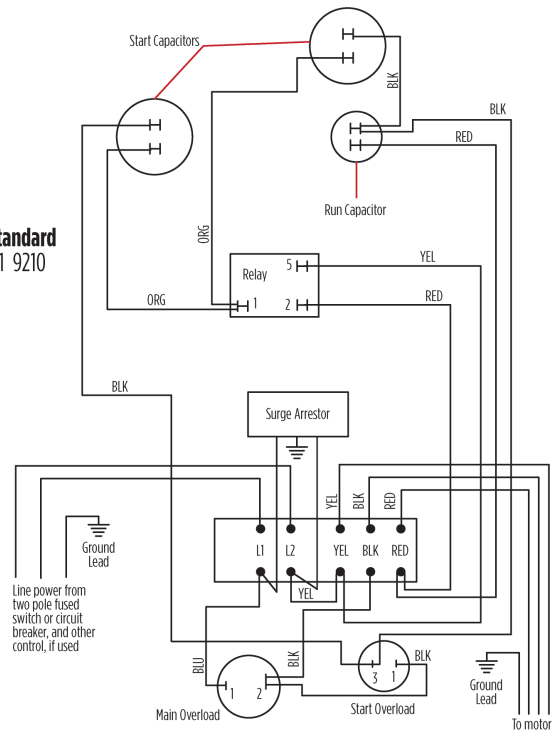
5 HP Standard
282 113 8110



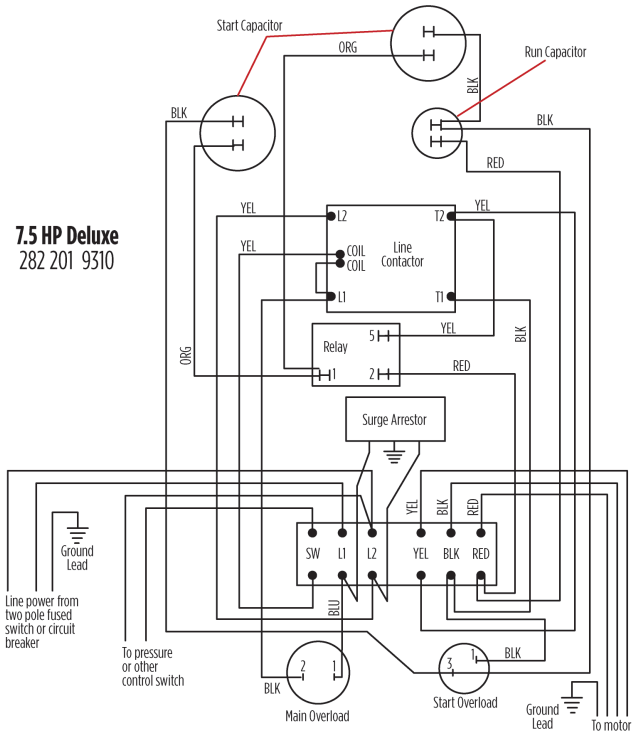
5 HP Deluxe
282 113 9310

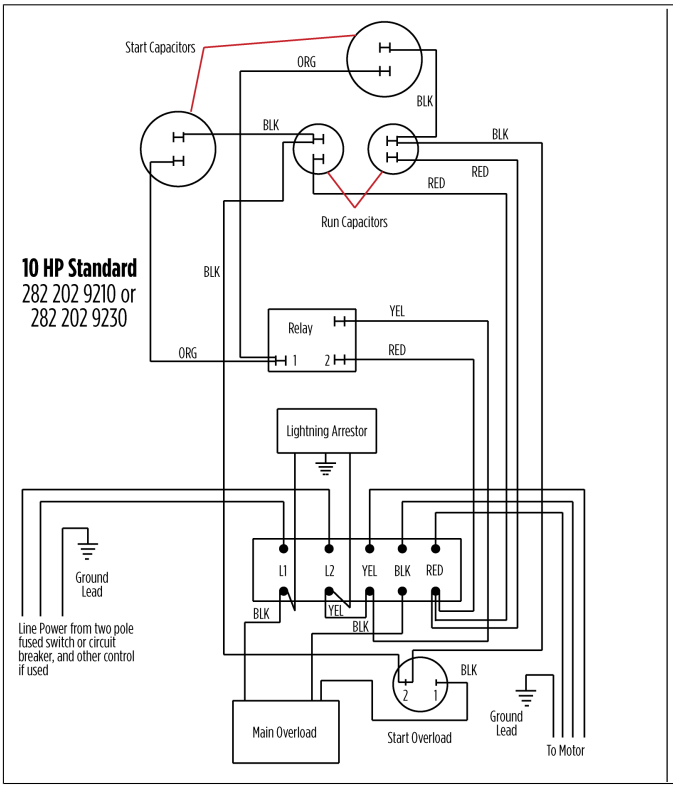


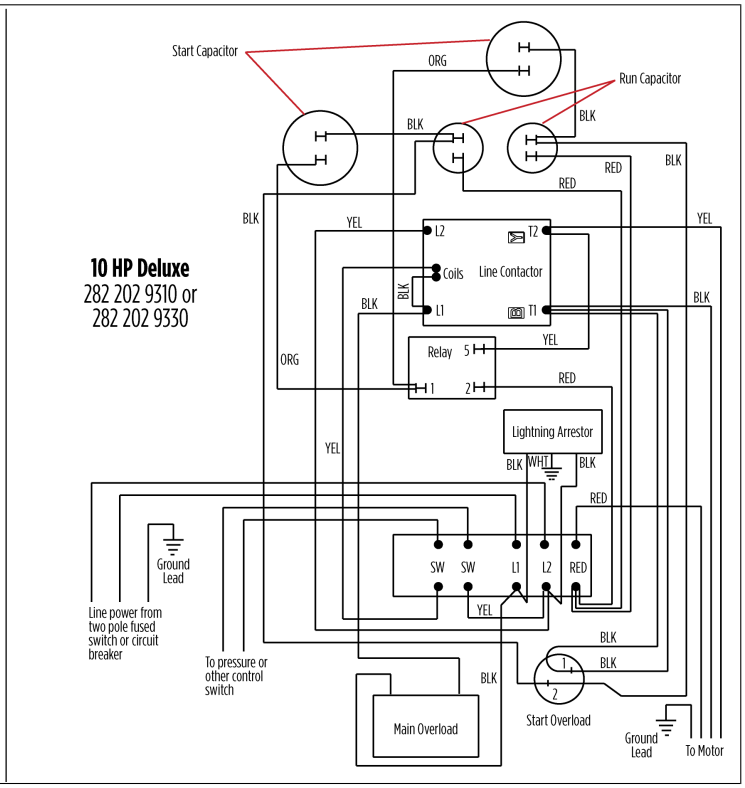
7.5 HP Standard
282 201 9210

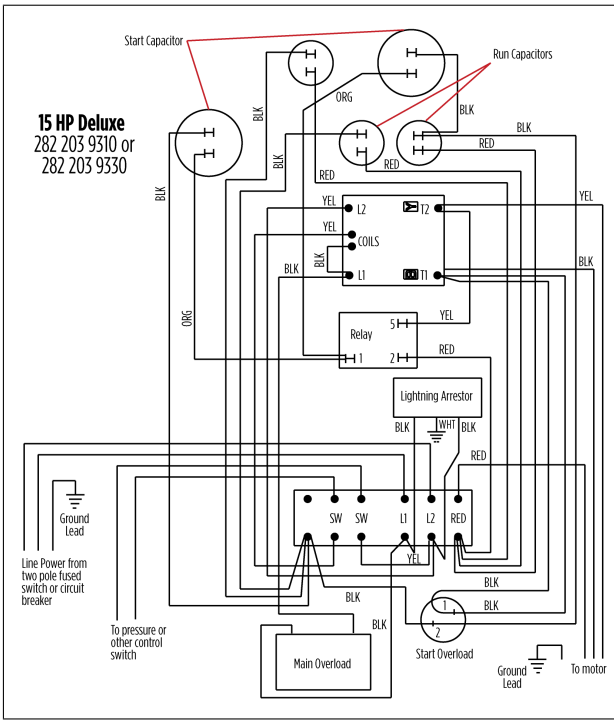


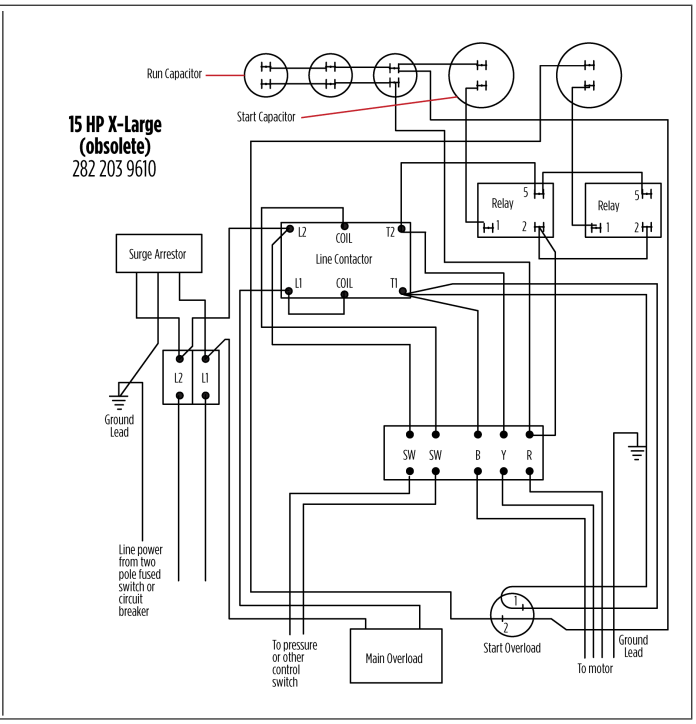
7.5 HP Deluxe
282 201 9310




10 HP Standard
282 202 9210 or
282 202 9230
Start Capacitors
Run Capacitors
Relay
Lightning Arrestor
L1
L2
YEL
BLK
RED
Ground Lead
Line Power from two pole fused switch or circuit breaker, and other control if used
Main Overload
Start Overload
To Motor


10 HP Deluxe
282 202 9310 or
282 202 9330
Start Capacitor
Run Capacitor
Coils
Line Contactor
Relay
Lightning Arrestor
SW
Ground Lead
Line power from two pole fused switch or circuit breaker
To pressure or other control switch
Main Overload
Start Overload
To Motor


15 HP Deluxe
282 203 9310 or
282 203 9330
Start Capacitor
Run Capacitors
COILS
Relay
Lightning Arrestor
Ground Lead
Line Power from two pole fused switch or circuit breaker
To pressure or other control switch
Main Overload
Start Overload
To motor


15 HP X-Large
(obsolete)
282 203 9610
Run Capacitor
Start Capacitor
Surge Arrestor
Relay
Line Contactor
Ground Lead
Line power from two pole fused switch or circuit breaker
To pressure or other control switch
Main Overload
Start Overload
To motor

MOTOR, CABLE, & FUSE/CIRCUIT BREAKER REFERENCE

Motor Specifications

- The following tables provide detailed information on Franklin submersible motors.
- Individual motor performance curves can also be found online using FE Select.
- Keep the following in mind for the tables:
  - Performance is typical, not guaranteed, at specified voltages and specified capacitor values. Performance at voltage ratings not shown is similar, except amps vary inversely with voltage.
  - Where applicable:
    - M: Main winding = yellow to black
    - S: Start winding = yellow to red
    - Y: Yellow lead = line amps
    - B: Black lead = main winding amps
    - R: Red lead = start or auxiliary winding amps

4-inch Motor Specifications

4-inch/1-Phase/Encapsulated without "G" suffix/3450 RPM

e.g. 2445040117

Type	Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Res. in ohms	Efficiency %		Power Factor %		Locked Rotor Amps	KVA Code
		HP	KW	Volts	SF	Amps	Watts	Amps	Watts	M=Main Res. S=Start Res.	SF	FL	SF	FL		
2-Wire	244504	1/2	0.37	115	1.6	10.0	670	12.0	960	1.0 - 1.3	62	56	73	58	64.4	R
	244505	1/2	0.37	230	1.6	5.0	670	6.0	960	4.2 - 5.2	62	56	73	58	32.2	R
	244507	3/4	0.55		1.5	6.8	940	8.0	1310	3.0 - 3.6	64	59	74	62	40.7	N
	244508	1	0.75		1.4	8.2	1210	10.4	1600	2.2 - 2.7	65	62	74	63	48.7	N
	244309	1.5	1.1		1.3	10.6	1710	13.1	2280	1.5 - 2.1	64	63	83	76	66.2	M
3-Wire	214504	1/2	0.37	115	1.6	Y10.0 B10.0 R0	670	Y12.0 B12.0 R0	960	M1.0-1.3 S4.1-5.1	62	56	73	58	50.5	M
	214505	1/2	0.37	230	1.6	Y5.0 B5.0 R0	670	Y6.0 B6.0 R0	960	M4.2-5.2 S16.7-20.5	62	56	73	58	23	M
	214507	3/4	0.55		1.5	Y6.8 B6.8 R0	940	Y8.0 B8.0 R0	1310	M3.0-3.6 S10.7-13.1	64	59	74	62	34.2	M
	214508	1	0.75		1.4	Y8.2 B8.2 R0	1210	10.4 10.4 R0	1600	M2.2-2.7 S9.9-12.1	65	62	74	63	41.8	L
3-Wire w/CRC CB	214505	1/2	0.37	230	1.6	Y3.2 B3.7 R2.0	655	Y4.3 B4.0 R2.0	890	M4.2-5.2 S16.7-20.5	67	57	90	81	23	M
	214507	3/4	0.55		1.5	Y4.4 B5.0 R3.2	925	Y5.7 B5.2 R3.1	1220	M3.0-3.6 S10.7-13.1	69	60	92	84	34.2	M
	214508	1	0.75		1.4	Y5.6 B5.7 R3.4	1160	Y8.1 B6.2 R3.3	1490	M2.2-2.7 S9.9-12.1	70	64	92	86	41.8	L

Type	Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Res. in ohms	Efficiency %		Power Factor %		Locked Rotor Amps	KVA Code
		HP	KW	Volts	SF	Amps	Watts	Amps	Watts	M=Main Res. S=Start Res.	SF	FL	SF	FL		
3-Wire	214508 w/1- 1.5 CB	1	0.75	230	1.4	Y6.6 B6.6 R1.3	1130	Y8.0 B7.9 R1.3	1500	M2.2-2.7 S9.9-12.1	70	66	82	72	43	L
	224300	1.5	1.1		1.3	Y10.0 B9.9 R1.3	1620	Y11.5 B11.0 R1.3	2080	M1.7-2.1 S7.5-9.2	70	69	85	79	51.4	J
	224301	2	1.5		1.25	Y10.0 B9.3 R2.6	2025	Y13.2 B11.9 R2.6	2555	M1.8-2.3 S5.5-7.2	73	74	95	94	53.1	G
	224302	3	2.2		1.15	Y14.0 B11.2 R6.1	3000	Y17.0 B12.6 R6.0	3400	M1.1-1.4 S4.0-4.8	75	75	99	99	83.4	H
	224303	5	3.7		1.15	Y23.0 B15.9 R11.0	4830	Y27.5 B19.1 R10.8	5500	M.71-.82 S1.8-2.2	78	77	100	100	129	G

4-inch/1-Phase/Encapsulated with "G" suffix/3450 RPM

e.g. 2445040117G

NOTE: For all model numbers with "7" as its fourth digit, even if ending with "G," consult "4-inch/1-Phase/Encapsulated 700 series/3450 RPM" on page 41.

Type	Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Res. in ohms	Efficiency %		Power Factor %		Locked Rotor Amps	KVA Code
		HP	KW	Volts	SF	Amps	Watts	Amps	Watts	M=Main Res. S=Start Res.	SF	FL	SF	FL		
2-Wire	244504	1/2	0.37	115	1.6	10.0	660	12.0	1000	1.1-1.5	60	56	78	64	58.8	P
	244505	1/2	0.37	230	1.6	5.0	660	6.0	1000	4.7-5.8	60	56	78	64	28.5	P
	244507	3/4	0.55	230	1.5	6.8	925	8.0	1350	3.3-4.1	62	60	79	68	36.9	N
	244508	1	0.75	230	1.4	8.2	1215	10.4	1630	2.4-3.0	64	62	77	67	47.6	M
	244309	1.5	1.1	230	1.3	10.3	1690	13.1	2170	1.8-2.2	67	66	81	75	62.0	L
3-Wire	214504	1/2	0.37	115	1.6	Y10.0 B10.0 R0	660	Y12.0 B12.0 R0	1000	M1.1-1.5 S4.3-5.3	60	56	78	64	44.1	M
	214505	1/2	0.37	230	1.6	Y5.0 B5.0 R0	660	Y6.0 B6.0 R0	1000	M4.7-5.8 S17.5-21.5	60	56	78	64	20.6	M
	214507	3/4	0.55	230	1.5	Y6.8 B6.8 R0	925	Y8.0 B8.0 R0	1350	M3.3-4.1 S11.2-13.8	62	60	79	68	29.7	L
	214508	1	0.75	230	1.4	Y8.2 B8.2 R0	1215	Y10.4 B10.4 R0	1630	M2.4-3.0 S10.2-12.6	64	62	77	67	35.9	K
3-Wire w/CRC CB	214505	1/2	0.37	230	1.6	Y3.2 B3.7 R2.0	620	Y4.3 B4.0 R2.0	860	M4.7-5.8 S17.5-21.5	69	60	97	93	20.6	M
	214507	3/4	0.55	230	1.5	Y4.4 B5.0 R3.2	885	Y5.7 B5.2 R3.1	1185	M3.3-4.1 S11.2-13.8	71	63	99	98	29.7	L
	214508	1	0.75	230	1.4	Y5.6 B5.7 R3.4	1135	Y8.1 B6.2 R3.3	1455	M2.4-3.0 S10.2-12.6	72	66	96	93	35.9	K

Type	Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Res. in ohms	Efficiency %		Power Factor %		Locked Rotor Amps	KVA Code
		HP	KW	Volts	SF	Amps	Watts	Amps	Watts	M=Main Res. S=Start Res.	SF	FL	SF	FL		
3-Wire	214508 w/ 1- 1.5 CB	1	0.75	230	1.4	Y6.6 B6.6 R2.0	1150	Y8.0 B7.4 R1.9	1460	M2.4-3.0 S10.2-12.6	71	65	89	85	41.7	L
	224300	1.5	1.1	230	1.3	Y10.0 B9.3 R1.9	1540	Y11.5 B10.8 R1.9	1980	M1.9-2.4 S6.8-8.3	73	73	90	87	49.0	J
	224301	2	1.5	230	1.25	Y10.0 B8.8 R2.6	1985	Y13.2 B12.0 R2.5	2535	M1.8-2.3 S5.6-6.9	74	75	96	95	51.0	G
	224302	3	2.2	230	1.15	Y12.8 B8.7 R6.1	2930	Y17.0 B13.2 R5.8	3350	M1.2-1.5 S3.2-3.9	77	76	98	98	84.0	H
	224303	5	3.7	230	1.15	Y20.5 B13.5 R10.5	4740	Y27.5 B21.0 R10.0	5440	M.81-1.00 S1.8-2.3	79	78	100	100	126	G

4-inch/1-Phase/Encapsulated 700 series/3450 RPM

e.g. 2247022504G, any model number with "7" as its fourth digit.

Type	Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Res. in ohms	Efficiency %		Power Factor %		Locked Rotor Amps	KVA Code
		HP	KW	Volts	SF	Amps	Watts	Amps	Watts	M=Main Res. S=Start Res.	SF	FL	SF	FL		
3-Wire	224702	3	2.2	230	1.15	Y13.3 B10.6 R6.1	2980	Y17.0 B13.9 R5.9	3400	M1.1-1.4 S3.0-3.7	76	75	97	97	77.9	G
	224703	5	3.7			Y21.3 B14.5 R10.5	4860	Y27.5 B21.3 R10.1	5580	M0.78-0.95 S1.8-2.2	77	77	100	100	107	E

4-inch/3-Phase/3-Lead/Encapsulated without "G" suffix/3450 RPM

e.g. 2345114116

Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Resistance (Ohms)	Efficiency %		Locked Rotor Amps	kVA Code
	HP	KW	Volts	SF	Amps	Watts	Amps	Watts		SF	FL		
234904	1/2	0.37	48	1.6	10.3	590	13.3	870	0.34-0.43	68	63	67.3	N
234501			200		2.8	585	3.4	860	6.6-8.4	70	64	17.5	
234511			230		2.4		2.9		9.5-10.9			15.2	
234541			380		1.4		2.1		23.2-28.6			9.2	
234521			460		1.2		1.5		38.4-44.1			7.6	
234531			575		1.0		1.2		58.0-71.0			6.1	
234902	3/4	0.55	100	1.5	6.9	775	8.6	1105	0.77-0.94	76	72	58.0	M
234502			200		3.6	810	4.4	1150	4.6-5.9	73	69	24.6	N
234512			230		3.1		3.8		6.8-7.8			21.4	
234542			380		1.9		2.5		16.6-20.3			13.0	
234522			460		1.6		1.9		27.2-30.9			10.7	
234532			575		1.3		1.6		41.5-50.7			8.6	
234503	1	0.75	200	1.4	4.5	1070	5.4	1440	3.8-4.5	72	70	30.9	M
234513			230		3.9		4.7		4.9-5.6			26.9	
234543			380		2.3		2.8		12.2-14.9			16.3	
234523			460		2.0		2.4		19.9-23.0			13.5	
234533			575		1.6		1.9		30.1-36.7			10.8	

Motor Specifications

Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Resistance (Ohms)	Efficiency %		Locked Rotor Amps	kVA Code
	HP	KW	Volts	SF	Amps	Watts	Amps	Watts		SF	FL		
234504	1.5	1.1	200	1.3	5.8	1460	6.8	1890	2.5-3.0	76	76	38.2	K
234514			230		5.0		5.9		3.2-4.0			33.2	
234544			380		3.0		3.6		8.5-10.4			20.1	
234524			460		2.5		3.1		13.0-16.0			16.6	
234534			575		2.0		2.4		20.3-25.0			13.3	
234305	2.0	1.5	200	1.25	7.7	1960	9.3	2430	1.8-2.4	76	76	50.3	K
234315			230		6.7		8.1		2.3-3.0			45.0	
234345			380		4.1		4.9		6.6-8.2			26.6	
234325			460		3.4		4.1		9.2-12.0			22.5	
234335			575		2.7		3.2		14.6-18.7			17.8	
234306	3.0	2.2	200	1.15	10.9	2920	12.5	3360	1.3-1.7	77	77	69.5	K
234316			230		9.5		10.9		1.8-2.2			60.3	
234346			380		5.8		6.6		4.7-6.0			37.5	
234326			460		4.8		5.5		7.2-8.8			31.0	
234336			575		3.8		4.4		11.4-13.9			25.1	
234307	5	3.7	200	1.15	18.3	4800	20.5	5500	0.68-0.83	78	78	116	K
234317			230		15.9		17.8		0.91-1.1			102	
234347			380		9.6		10.8		2.6-3.2			60.2	
234327			460		8.0		8.9		3.6-4.4			53.7	
234337			575		6.4		7.1		5.6-6.9			41.8	
234308	7.5	5.5	200	1.15	26.5	7150	30.5	8200	0.45-0.53	78	78	117	K
234318			230		23.0		26.4		0.60-0.73			152	
234348			380		13.9		16.0		1.6-2.0			92.7	
234328			460		11.5		13.2		2.3-2.8			83.8	
234338			575		9.2		10.6		3.6-4.5			64.6	
234549	10	7.5	380	1.15	19.3	10000	21.0	11400	1.2-1.6	75	75	140	L
234595			460		15.9		17.3		1.8-2.3			116	
234598			575		12.5		13.6		2.8-3.5			92.8	
234646	15	11	380	1.15	27.6	14600	31.2	16800	0.86-1.1	77	76	178	J
234626			460		22.8		25.8		1.2-1.5			147	
234636			575		18.2		20.7		1.9-2.4			118	

4-inch/3-Phase/3-Lead/Encapsulated with "G" suffix/3450 RPM

e.g. 2345114116G

NOTE: For all model numbers with "7" as its fourth digit, even if ending with "G," consult "4-inch/Three-Phase/3-Lead/Encapsulated Motor Specs 700 series/3450 RPM" on page 57.

Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Resistance (Ohms)	Efficiency %		Locked Rotor Amps	kVA Code
	HP	KW	Volts	SF	Amps	Watts	Amps	Watts		SF	FL		
234501	1/2	0.37	200	1.6	2.8	580	3.4	865	7.7-9.4	69	64	16.0	N
234511			230		2.4		2.9		9.8-12.0			13.9	
234541			380		1.4		2.1		26.1-31.9			8.4	
234521			460		1.2		1.5		39.5-48.2			7.0	
234531			575		1.0		1.2		56.0-68.4			5.6	
234502	3/4	0.55	200	1.5	3.6	820	4.4	1180	5.4-6.7	71	68	22.4	M
234512			230		3.1		3.8		7.0-8.6			19.5	
234542			380		1.9		2.5		18.5-22.6			11.8	
234522			460		1.6		1.9		28.4-34.7			9.7	
234532			575		1.3		1.6		44.0-53.8			7.8	

Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Resistance (Ohms)	Efficiency %		Locked Rotor Amps	kVA Code
	HP	KW	Volts	SF	Amps	Watts	Amps	Watts		SF	FL		
234503	1	0.75	200	1.4	4.5	1060	5.4	1440	3.9-4.8	72	70	28.8	M
234513			230		3.9		4.7		5.1-6.3			25.0	
234543			380		2.3		2.8		13.5-16.5			15.1	
234523			460		2.0		2.4		20.7-25.3			12.5	
234533			575		1.6		1.9		32.6-39.9			10.0	
234504	1.5	1.1	200	1.3	5.8	1475	6.8	1915	2.8-3.4	76	76	34.8	K
234514			230		5.0		5.9		3.6-4.4			30.5	
234544			380		3.0		3.6		9.5-11.7			18.3	
234524			460		2.5		3.1		14.4-17.6			15.1	
234534			575		2.0		2.4		22.7-27.8			12.2	
234305	2.0	1.5	200	1.25	7.7	1935	9.3	2410	2.0-2.5	77	77	46.3	K
234315			230		6.7		8.1		2.6-3.2			40.1	
234345			380		4.1		4.9		7.6-9.3			25.3	
234325			460		3.4		4.1		10.4-12.7			20.9	
234335			575		2.7		3.2		16.4-20.0			16.4	
234306	3.0	2.2	200	1.15	10.9	2870	12.5	3310	1.4-1.7	78	78	65.2	J
234316			230		9.5		10.9		1.8-2.2			57.0	
234346			380		5.8		6.6		5.3-6.5			33.0	
234326			460		4.8		5.5		7.3-8.9			27.3	
234336			575		3.8		4.4		11.5-14.1			21.9	
234307	5.0	3.7	200	1.15	16.1	4710	18.8	5410	0.81-1.0	79	79	123	K
234317			230		14.2		16.4		1.0-1.3			111	
234347			380		8.6		9.9		2.9-3.6			67.1	
234327			460		7.1		8.2		4.2-5.1			55.4	
234337			575		5.7		6.6		6.2-7.6			45.9	L
234308	7.5	5.5	200	1.15	24	7000	28.2	8020	0.50-0.61	80	80	193	K
234318			230		21		24.6		0.67-0.82			171	L
234348			380		12.7		14.9		1.9-2.3			104	
234328			460		10.5		12.3		2.7-3.3			87.9	
234338			575		8.2		9.8		4.1-5.0	81	81	71.0	
234549	10	7.5	380	1.15	16.1	9200	18.6	10620	1.5-1.9	81	81	127	K
234595			460		13.3		15.4		2.2-2.7			105	
234598			575		10.7		12.4		3.5-4.3			81.6	

4-inch/3-Phase/3-Lead/Encapsulated 700 series/3450 RPM

e.g. 2347170630G, any model number with “7” as its fourth digit

Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Resistance (Ohms)	Efficiency %		Locked Rotor Amps	kVA Code
	HP	KW	Volts	SF	Amps	Watts	Amps	Watts		SF	FL		
234707	5	3.7	200	1.15	17.4	4870	19.8	5580	0.78-0.95	77	76	111	J
234717			230		15.4		17.4		1.0-1.3			98.5	K
234747			380		9.1	4820	10.4	5530	2.8-3.5	78	77	58.5	J
234727			460		7.5		8.6		4.1-5.0			48.3	J
234737			575		6.1		6.9		6.0-7.3			42.0	K
234708	7.5	5.5	200	1.15	26.8	7190	30.0	8220	0.45-0.56	78	78	193	K
234718			230		21.8	7130	24.8	8190	0.65-0.80			171	L
234748			380		13.2	7100	15.0	8140	1.8-2.2	79	79	104	
234728			460		10.9		12.4		2.6-3.2			87.9	
234738			575		8.9	7035	10.1	8065	3.8-4.7	80		71.0	
234749	10	7.5	380	1.15	17.1	9455	19.7	10925	1.5-1.8	78	79	127	K
234729			460		14.5	9375	16.5	10780	1.9-2.4	79		105	
234739			575		11.5	9550	13.2	11000	3.4-4.1	78	78	81.6	

4-inch/3-Phase/3-Lead/Encapsulated MagForce/3600 RPM

Motor Model Prefix	Rating				Maximum S.F. Load		Winding Resistance (Ohms)	Efficiency %
	HP	KW	Volts	SF	Amps	Watts		SF
234055	1.5	1.1	230	1.3	4.8	1700	2.9-3.5	85
234052	2	1.5	230	1.25	6.4	2160	1.8-2.3	86
	3	2.2		1.15	8.1	2955		87
234054	5	3.7	230	1.15	13.9	4750	0.65-0.79	90
234064	5	3.7	460	1.15	6.9	4750	2.6-3.2	90
234056	7.5	5.5	230	1.15	19.8	7105	0.44-0.54	90
	10	7.5			26.0	9460		
234066	7.5	5.5	460	1.15	9.9	7105	1.8-2.2	90
	10	7.5			13.0	9460		

6-inch Motor Specifications

6-inch/1-Phase/3-Lead/Encapsulated/3450 RPM

NOTE: *Control Boxes date coded 01M and older have 60 MFD run capacitors and the current values on a 6-inch motor will be Y23.0 @ FL -Y27.5 @ Max Load.

- B18.2; B23.2; R8.0; R7.8

Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Res. in ohms	Efficiency %		Power Factor %		Locked Rotor Amps	kVA Code
	HP	KW	Volts	SF	Amps	Watts	Amps	Watts	M=Main Res. S=Start Res.	SF	FL	SF	FL		
*226110	5	3.7	230	1.15	Y23.0 B14.3 R10.8	4910	Y27.5 B17.4 R10.5	5570	M0.55-0.68 S1.3-1.7	77	76	100	99	99	E
226111	7.5	5.5	230	1.15	Y36.5 B34.4 R5.5	7300	Y42.1 B40.5 R5.4	8800	M0.36-0.50 S0.88-1.1	73	74	91	90	165	F
226112	10	7.5	230	1.15	Y44.0 B39.5 R9.3	9800	Y51.0 B47.5 R8.9	11300	M.27-.33 S0.80-0.99	76	77	96	96	204	E
226113	15	11	230	1.15	Y62.0 B52.0 R17.5	13900	Y75.0 B62.5 R16.9	16200	M0.17-0.22 S0.68-0.93	79	80	97	98	303	E

6-inch/3-Phase/3-Lead/Encapsulated/3450 PRM

NOTE: Model numbers are for 3-lead motors. 6-lead motors with different model numbers have the same running performance, but when Wye connected for starting draw 33% of the values shown. 6-lead individual phase resistance = table X 1.5.

Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Resistance (Ohms)	Efficiency %		Locked Rotor Amps	kVA Code
	HP	KW	Volts	SF	Amps	Watts	Amps	Watts		SF	FL		
236650	5	3.7	200	1.15	17.5	4700	20.0	5400	0.77-0.93	79	79	99	H
236600			230		15		17.6		1.0-1.2			86	
236660			380		9.1		10.7		2.6-3.2			52	
236610			460		7.5		8.8		3.9-4.8			43	
236620			575		6		7.1		6.3-7.7			34	
236310			230		15		17.6		1.0-1.2			86	
			460		7.5		8.8		3.9-4.8			43	
236651	7.5	5.5	200	1.15	25.1	7000	28.3	8000	0.43-0.53	80	80	150	H
236601			230		21.8		24.6		0.64-0.78			130	
236661			380		13.4		15		1.6-2.1			79	
236611			460		10.9		12.3		2.4-2.9			65	
236621			575		8.7		9.8		3.7-4.6			52	
236311			230		21.8		24.6		0.64-0.78			130	
			460		10.9		12.3		2.4-2.9			65	
236652	10	7.5	200	1.15	32.7	9400	37	10800	0.37-0.45	79	79	198	H
236602			230		28.4		32.2		0.47-0.57			172	
236662			380		17.6		19.6		1.2-1.5			104	
236612			460		14.2		16.1		1.9-2.4			86	
236622			575		11.4		12.9		3.0-3.7			69	
236312			230		28.4		32.2		0.47-0.57			172	
			460		14.2		16.1		1.9-2.4			86	
236653	15	11	200	1.15	47.8	13700	54.4	15800	0.24-0.29	81	81	306	H
236603			230		41.6		47.4		0.28-0.35			266	
236663			380		25.8		28.9		0.77-0.95			161	
236613			460		20.8		23.7		1.1-1.4			133	
236623			575		16.6		19		1.8-2.3			106	
236313			230		41.6		47.4		0.28-0.35			266	
			460		20.8		23.7		1.1-1.4			133	
236654	20	15	200	1.15	61.9	18100	69.7	20900	0.16-0.20	82	82	416	J
236604			230		53.8		60.6		0.22-0.26			362	
236664			380		33.0		37.3		0.55-0.68			219	
236614			460		26.9		30.3		0.8-1.0			181	
236624			575		21.5		24.2		1.3-1.6			145	
236314			230		53.8		60.6		0.22-0.26			362	
			460		26.9		30.3		0.8-1.0			181	
236655	25	18.5	200	1.15	77.1	22500	87.9	25700	0.12-0.15	83	83	552	J
236605			230		67.0		76.4		0.15-0.19			480	
236665			380		41.0		46.0		0.46-0.56			291	
236615			460		33.5		38.2		0.63-0.77			240	
236625			575		26.8		30.0		1.0-1.3			192	
236315			230		67.0		76.4		0.15-0.19			480	
			460		33.5		38.2		0.63-0.77			240	

Motor Specifications

Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Resistance (Ohms)	Efficiency %		Locked Rotor Amps	kVA Code
	HP	KW	Volts	SF	Amps	Watts	Amps	Watts		SF	FL		
236656	30	22	200	1.15	90.9	26900	104	31100	0.09-0.11	83	83	653	J
236606			230		79.0		90.4		0.14-0.17			568	
236666			380		48.8		55.4		0.35-0.43			317	
236616			460		39.5		45.2		0.52-0.64			284	H
236626			575		31.6		36.2		0.78-0.95			227	J
236316			230		79.0		90.4		0.14-0.17			568	J
			460		39.5		45.2		0.52-0.64			284	H
236667	40	30	380	1.15	66.5	35600	74.6	41400	0.26-0.33	83	83	481	J
236617			460		54.9		62.9		0.34-0.42			397	
236627			575		42.8		49.6		0.52-0.64			318	H
236668	50	37	380	1.15	83.5	45100	95	52200	0.21-0.25	82	83	501	H
236618			460		67.7		77		0.25-0.32			414	
236628			575		54.2		61.6		0.40-0.49			331	
276668			380		82.4		94.5		0.21-0.25			501	
276618			460		68.1		78.1		0.25-0.32			414	
276628			575		54.5		62.5		0.40-0.49			331	
276029	60/50	45/37	380	1.15	98.1	53500	111.8	61700	0.15-0.18	84	84	627	H
276009			460		81.0		92.3		0.22-0.27			518	
276059			575		64.8		73.9		0.35-0.39			414	
236669	60	45	380	1.15	98.7	53500	111	61700	0.15-0.18	84	84	627	H
236619			460		80.5		91		0.22-0.27			518	
236629			575		64.4		72.8		0.35-0.39			414	
276669			380		98.1		111.8		0.15-0.18			627	
276619			460		81.0		92.3		0.22-0.27			518	
276629			575		64.8		73.9		0.35-0.39			414	

6-inch/3-Phase/3-Lead/Encapsulated Hi-Temp (90 °C)/3450 RPM

NOTE: Model numbers are for 3-lead motors. 6-lead motors with different model numbers have the same running performance, but when Wye connected for starting draw 33% of the values shown. 6-lead individual phase resistance = table X 1.5.

Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Resistance (Ohms)	Efficiency %		Locked Rotor Amps	kVA Code
	HP	KW	Volts	SF	Amps	Watts	Amps	Watts		SF	FL		
276650	5	3.7	200	1.15	17.2	5200	19.8	5800	0.53-0.65	73	72	124	K
276600			230		15.0		17.2		0.68-0.84			108	
276660			380		9.1		10.4		2.0-2.4			66	
276610			460		7.5		8.6		2.8-3.4			54	
276620			575		6.0		6.9		4.7-5.7			43	
276651	7.5	5.5	200	1.15	24.8	7400	28.3	8400	0.30-0.37	77	76	193	K
276601			230		21.6		24.6		0.41-0.50			168	
276661			380		13.1		14.9		1.1-1.4			102	
276611			460		10.8		12.3		1.7-2.0			84	
276621			575		8.6		9.9		2.6-3.2			67	
276652	10	7.5	200	1.15	32.0	9400	36.3	10700	0.21-0.26	80	79	274	L
276602			230		27.8		31.6		0.28-0.35			238	
276662			380		16.8		19.2		0.80-0.98			144	
276612			460		13.9		15.8		1.2-1.4			119	
276622			575		11.1		12.7		1.8-2.2			95	

Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Resistance (Ohms)	Efficiency %		Locked Rotor Amps	kVA Code
	HP	KW	Volts	SF	Amps	Watts	Amps	Watts		SF	FL		
276653	15	11	200	1.15	48.5	14000	54.5	15900	0.15-0.19	81	80	407	L
276603			230		42.2		47.4		0.19-0.24			354	
276663			380		25.5		28.7		0.52-0.65			214	
276613			460		21.1		23.7		0.78-0.96			177	
276623			575		16.9		19.0		1.2-1.4			142	
276654	20	15	200	1.15	64.9	18600	73.6	21300	0.10-0.12	80	80	481	K
276604			230		56.4		64.0		0.14-0.18			418	
276664			380		34.1		38.8		0.41-0.51			253	
276614			460		28.2		32.0		0.58-0.72			209	
276624			575		22.6		25.6		0.93-1.15			167	
276655	25	18.5	200	1.15	80	22600	90.6	25800	0.09-0.11	83	82	665	L
276605			230		69.6		78.8		0.11-0.14			578	
276665			380		42.1		47.7		0.27-0.34			350	
276615			460		34.8		39.4		0.41-0.51			289	
276625			575		27.8		31.6		0.70-0.86			231	
276656	30	22	200	1.15	95.0	28000	108.6	31900	0.07-0.09	81	80	736	K
276606			230		82.6		94.4		0.09-0.12			640	
276666			380		50.0		57.2		0.23-0.29			387	
276616			460		41.3		47.2		0.34-0.42			320	
276626			575		33.0		37.8		0.52-0.65			256	
276667	40	30	380	1.15	67.2	35900	76.0	42400	0.18-0.23	84	83	545	L
276617			460		55.4		62.8		0.23-0.29			450	
276627			575		45.2		50.2		0.34-0.43			360	

6-inch/3-Phase/6-Lead/Encapsulated/3450 RPM

Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Resistance (Ohms)	Efficiency %		Locked Rotor Amps	kVA Code
	HP	KW	Volts	SF	Amps	Watts	Amps	Watts		SF	FL		
236767	40	30	200	1.15	127	35600	142	41400	0.064-0.078	83	83	913	J
236727			230		110		124		0.090-0.110			794	
236768	50	37	200	1.15	159	45100	181	52200	0.050-0.062	82	83	952	H
236728			230		138		157		0.067-0.081			828	
236729	60	45	230	1.15	163	54400	184	62700	0.057-0.070	82	82	1036	H

6-inch/3-Phase/3-Lead/Encapsulated MagForce/3600 RPM

Motor Model Prefix	Rating				Maximum Load		Winding Resistance (Ohms)	Efficiency %
	HP	KW	Volts	SF	Amps	Watts		SF
236080	7.5	5.5	460	1.15	11.6	7305	0.76-0.94	88
	10	7.5			14.2	9545		90
	15	11			20.5	14160		
236084	20	15	460	1.15	28.9	18835	0.30-0.37	91
	25	18.5			34.6	23380		
	30	22			41.0	28000		92
236086	40	30	460	1.15	56.5	37270	0.17-0.22	92
	50	37			69.2	46490		
	60	45			80.0	55970		

8-inch Motor Specifications

8-inch/3-Phase/3-Lead/Encapsulated/3525 RPM

NOTE: Model numbers are for 3-lead motors. 6-lead motors with different model numbers have the same running performance, but when Wye connected for starting draw 33% of the values shown. 6-lead individual phase resistance = table X 1.5.

Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Resistance (Ohms)	Efficiency %		Locked Rotor Amps	kVA Code
	HP	KW	Volts	SF	Amps	KW	Amps	KW		SF	FL		
239660	40	30	380	1.15	64	35	72	40	0.16-0.20	86	86	479	J
239600			460		53		60		0.24-0.30			396	
239000			460		53		63		0.24 -0.30			396	
239610			575		42		48		0.39-0.49			317	
239661	50	37	380	1.15	79	43	88	49	0.12-0.16	87	87	656	K
239601			460		64		73		0.18-0.22			542	
239001			460		64		76		0.18 -0.22			542	
239611			575		51		59		0.28-0.34			434	
239662	60	45	380	1.15	92	52	104	60	0.09-0.11	88	87	797	K
239602			460		76		86		0.14-0.17			658	
239002			460		76		91		0.14-0.17			658	
239612			575		61		69		0.22-0.28			526	
239663	75	55	380	1.15	114	64	130	73.5	0.06-0.09	88	88	1046	L
239603			460		94		107		0.10-0.13			864	
239613			575		76		86		0.16-0.21			691	
239664	100	75	380	1.15	153	85	172	97.5	0.05-0.06	89	89	1466	L
239604			460		132		148		0.07-0.09			1211	
239614			575		101		114		0.11-0.13			969	
239165	125	93	380	1.15	202	109	228	125	0.03-0.04	87	86	1596	K
239105			460		167		188		0.05-0.07			1318	
239115			575		134		151		0.08-0.11			1054	
239166	150	110	380	1.15	235	128	266	146	0.02-0.03	88	87	1961	K
239106			460		194		219		0.04-0.05			1620	
239116			575		164		182		0.06-0.08			1296	
239167	175	130	380	1.15	265	150	302	173	0.02-0.04	88	88	1991	J
239107			460		219		249		0.04-0.05			1645	
239117			575		175		200		0.06-0.08			1316	
239168	200	150	380	1.15	298	169	342	194	0.02-0.03	88	88	2270	J
239108			460		246		282		0.03-0.05			1875	
239118			575		197		226		0.05-0.07			1500	

8-inch/3-Phase/3-Lead/Encapsulated Hi-Temp (75 °C)/3525 RPM

NOTE: Model numbers are for 3-lead motors. 6-lead motors with different model numbers have the same running performance, but when Wye connected for starting draw 33% of the values shown. 6-lead individual phase resistance = table X 1.5.

Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Resistance (Ohms)	Efficiency %		Locked Rotor Amps	kVA Code
	HP	KW	Volts	SF	Amps	KW	Amps	KW		SF	FL		
279160	40	30	380	1.15	69.9	38	78.7	43	0.11-0.14	79	78	616	M
279100			460		57.5		65.0		0.16-0.19			509	
279110			575		46.0		52.0		0.25-0.31			407	
279161	50	37	380	1.15	84.3	47	95.4	53	0.07-0.09	81	80	832	M
279101			460		69.6		78.8		0.11-0.14			687	
279111			575		55.7		63.0		0.18-0.22			550	

Motor Model Prefix	Rating				Full Load		Maximum S.F. Load		Winding Resistance (Ohms)	Efficiency %		Locked Rotor Amps	kVA Code
	HP	KW	Volts	SF	Amps	KW	Amps	KW		SF	FL		
279162	60	45	380	1.15	98.4	55	112	62	0.06-0.07	83	82	1081	N
279102			460		81.3		92.1		0.09-0.11			893	
279112			575		65.0		73.7		0.13-0.16			715	
279163	75	56	380	1.15	125	68	141	77	0.05-0.06	83	82	1175	L
279103			460		100		114		0.07-0.09			922	
279113			575		80		92		0.11-0.14			738	
279164	100	75	380	1.15	159	88	181	100	0.04-0.05	86	85	1508	M
279104			460		131		149		0.05-0.07			1246	
279114			575		105		119		0.08-0.10			997	
279165	125	93	380	1.15	195	109	223	125	0.03-0.04	86	85	1793	L
279105			460		161		184		0.04-0.06			1481	
279115			575		129		148		0.07-0.09			1185	
279166	150	110	380	1.15	235	133	269	151	0.02-0.03	85	84	2012	K
279106			460		194		222		0.03-0.05			1662	
279116			575		155		178		0.05-0.07			1330	

8-inch/3-Phase/3-Lead/Rewindable MagForce/3600 RPM

Motor Model Prefix	Rating				Maximum S.F. Load		Winding Resistance (Ohms)	Efficiency %
	HP	KW	Volts	SF	Amps	KW		SF
263014	60	45	460	1.15	73	55.3	0.13-0.17	93
	75	55			91	68.9		
	100	75			124	92.3		
263016	100	75	460	1.15	127	92.8	0.09-0.12	92
	125	93			160	117		
263018	125	93	460	1.15	150	114	0.07-0.10	94
	150	110			182	137		93
	175	130			216	161		

Cable Selection

- Lengths shown in shaded cells meet the NEC ampacity requirements only for individual conductors.
- Unshaded cells in the following tables meet the NEC ampacity requirements for either individual conductors or jacketed 75 °C cable and can be in conduit or directly buried. Flat molded and web/ribbon cable are considered jacketed cable. If any other cable is used, observe the NEC and local codes.

  NOTE: Contact Franklin Electric or see the online AIM App for 60 °C and 90 °C cable charts.

- Total cable length refers to the cable between the power supply and the motor. Cable lengths shown in the following tables allow for a 5% voltage drop when running at maximum nameplate amperes. Multiply the 5% voltage drop length by 0.6 to get the 3% voltage drop maximum cable length.
- To ensure reliable contactor operation for single-phase systems using a control box with line contactor, the portion of the total cable length between the power supply and single-phase control box should not exceed 25% of the total allowable maximum. Single-phase control boxes without line contactors can be connected at any point in the total cable length.
- Values found in the following tables are based on copper wire. If aluminum wire is used, it must be two sizes larger than copper wire, and oxidation inhibitors must be used on connections.
  EXAMPLE: If #12 copper wire is called for, #10 aluminum wire would be required.

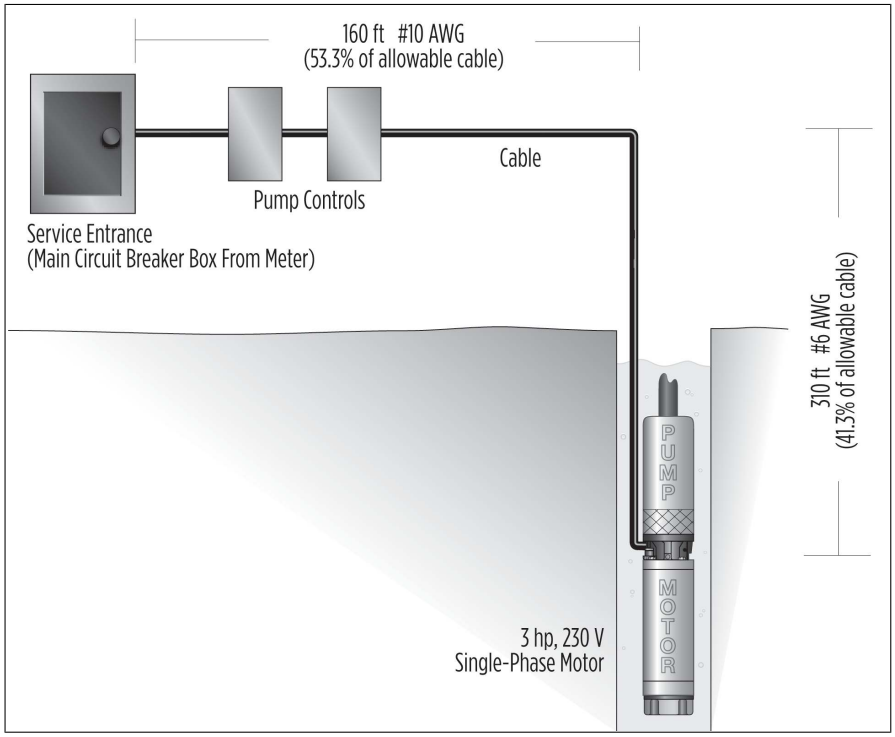
Cable Size Combinations

Depending on the installation, different combinations of cable can be used.

EXAMPLE: In a replacement/upgrade installation, the well already has 160 feet of buried #10 AWG copper wire installed cable between the service entrance and the wellhead.

A new 3 hp, 230V, single-phase motor is being installed at 310 feet to replace a smaller motor.

NOTE: The below cable length specifications come from the cable selection tables included in this section.



- A 3 hp motor can use up to 300 feet of #10 AWG cable.
  - Using the formula, 160 feet (actual length) ÷ 300 feet (max allowed) = 0.533.
  - 0.533 x 100 = 53.3% of the allowable voltage drop or loss, between the service entrance and the motor, occurs in this wire.
  - 46.7% (1.00 - 0.533 = 0.467) of wire size is left to use in the remaining 310 feet "down hole" wire run.
- #8 AWG copper wire can use up to 470 feet.
  - Using the formula, 310 feet (actual length) ÷ 470 feet (max allowed) = 0.660
  - 0.533 + 0.660 = 1.193
  - This is greater than 1.00 and will not meet NEC voltage drop requirements.
- #6 AWG copper wire can use up to 750 feet.
  - Using the formula, 310 feet (actual length) ÷ 750 feet (max allowed) = 0.413
  - 0.533 + 0.413 = 0.946.
  - This is less than 1.00 and will meet NEC voltage drop requirements.

Cable Sizing Formula

$$\frac{\text{Actual Length}}{\text{Max Allowed}} + \frac{\text{Actual Length}}{\text{Max Allowed}} = 1.00$$

NOTE: This works for two or more combinations of wire and it does not matter which size wire comes first in the installation.

4-inch Motor Cable Selection

4-inch/1-Phase/2-Lead and 3-Lead/75 °C Cable

Motor Rating			AWG Copper Wire Size												
Volts	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000
115	1/2	0.37	100	160	250	390	620	960	1190	1460	1780	2160	2630	3140	3770
230	1/2	0.37	400	650	1020	1610	2510	3880	4810	5880	7170	8720	-	-	-
	3/4	0.55	300	480	760	1200	1870	2890	3580	4370	5330	6470	7870	9380	-
	1	0.75	250	400	630	990	1540	2380	2960	3610	4410	5360	6520	7780	9350
	1.5	1.1	190	310	480	770	1200	1870	2320	2850	3500	4280	5240	6300	7620
	2	1.5	150	250	390	620	970	1530	1910	2360	2930	3620	4480	5470	6700
	3	2.2	120	190	300	470	750	1190	1490	1850	2320	2890	3610	4470	5550
	5	3.7	0	110	180	280	450	710	890	1110	1390	1740	2170	2680	3330

4-inch/3-Phase/3-Lead/75 °C Cable

Motor Rating			Maximum Cable Length (ft) Measured from service entrance to motor																	
			AWG Copper Wire Size													MCM Copper Wire Size				
Volts	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
48	1/2	0.37	40	70	110	170	270	420	520	650	790	960	1170	1400	1680	–	–	–	–	–
100	3/4	0.55	150	140	380	580	900	1400	1710	2110	2570	3120	3790	4540	5360	–	–	–	–	–
200	1/2	0.37	710	1140	1800	2840	4420	–	–	–	–	–	–	–	–	–	–	–	–	–
	3/4	0.55	510	810	1280	2030	3160	–	–	–	–	–	–	–	–	–	–	–	–	–
	1	0.75	430	690	1080	1710	2670	4140	5140	–	–	–	–	–	–	–	–	–	–	–
	1.5	1.1	310	500	790	1260	1960	3050	3780	–	–	–	–	–	–	–	–	–	–	–
	2	1.5	240	390	610	970	1520	2360	2940	3610	4430	5420	–	–	–	–	–	–	–	–
	3	2.2	180	290	470	740	1160	1810	2250	2760	3390	4130	–	–	–	–	–	–	–	–
	5	3.7	110	170	280	440	690	1080	1350	1660	2040	2490	3050	3670	4440	5030	–	–	–	–
	7.5	5.5	0	0	200	310	490	770	960	1180	1450	1770	2170	2600	3150	3560	–	–	–	–
230	1/2	0.37	930	1490	2350	3700	5760	8910	–	–	–	–	–	–	–	–	–	–	–	–
	3/4	0.55	670	1080	1700	2580	4190	6490	8060	9860	–	–	–	–	–	–	–	–	–	–
	1	0.75	560	910	1430	2260	3520	5460	6780	8290	–	–	–	–	–	–	–	–	–	–
	1.5	1.1	420	670	1060	1670	2610	4050	5030	6160	7530	9170	–	–	–	–	–	–	–	–
	2	1.5	320	510	810	1280	2010	3130	3890	4770	5860	7170	8780	–	–	–	–	–	–	–
	3	2.2	240	390	620	990	1540	2400	2980	3660	4480	5470	6690	8020	9680	–	–	–	–	–
	5	3.7	140	230	370	590	920	1430	1790	2190	2690	3290	4030	4850	5870	6650	7560	8460	9220	–
	7.5	5.5	0	160	260	420	650	1020	1270	1560	1920	2340	2870	3440	4160	4710	5340	5970	6500	7510
380	1/2	0.37	2690	4290	6730	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	3/4	0.55	2000	3190	5010	7860	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	1	0.75	1620	2580	4060	6390	9980	–	–	–	–	–	–	–	–	–	–	–	–	–
	1.5	1.1	1230	1970	3100	4890	7630	–	–	–	–	–	–	–	–	–	–	–	–	–
	2	1.5	870	1390	2180	3450	5400	8380	–	–	–	–	–	–	–	–	–	–	–	–
	3	2.2	680	1090	1710	2690	4200	6500	8020	9830	–	–	–	–	–	–	–	–	–	–
	5	3.7	400	640	1010	1590	2490	3870	4780	5870	7230	8830	–	–	–	–	–	–	–	–
	7.5	5.5	270	440	690	1090	1710	2640	3260	4000	4930	6010	7290	8780	–	–	–	–	–	–
	10	7.5	200	320	510	800	1250	1930	2380	2910	3570	4330	5230	6260	7390	8280	9340	–	–	–
460	1/2	0.37	3770	6020	9460	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	3/4	0.55	2730	4350	6850	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	1	0.75	2300	3670	5770	9070	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	1.5	1.1	1700	2710	4270	6730	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	2	1.5	1300	2070	3270	5150	8050	–	–	–	–	–	–	–	–	–	–	–	–	–
	3	2.2	1000	1600	2520	3970	6200	–	–	–	–	–	–	–	–	–	–	–	–	–
	5	3.7	590	950	1500	2360	3700	5750	–	–	–	–	–	–	–	–	–	–	–	–
	7.5	5.5	420	680	1070	1690	2640	4100	5100	6260	7680	–	–	–	–	–	–	–	–	–
	10	7.5	310	500	790	1250	1960	3050	3800	4680	5750	7050	–	–	–	–	–	–	–	–
	15	11	0	340	540	850	1340	2090	2600	3200	3930	4810	5900	7110	–	–	–	–	–	–
575	1/2	0.37	5900	9410	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	3/4	0.55	4270	6810	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	1	0.75	3630	5800	9120	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	1.5	1.1	2620	4180	6580	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	2	1.5	2030	3250	5110	8060	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	3	2.2	1580	2530	3980	6270	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	5	3.7	920	1480	2330	3680	5750	–	–	–	–	–	–	–	–	–	–	–	–	–
	7.5	5.5	660	1060	1680	2650	4150	–	–	–	–	–	–	–	–	–	–	–	–	–
	10	7.5	490	780	1240	1950	3060	4770	5940	–	–	–	–	–	–	–	–	–	–	–

4-inch/3-Phase/3-Lead/Encapsulated MagForce 75 °C Cable/3600 RPM

Motor Rating			Maximum Cable Length (ft) Measured from service entrance to motor												
			AWG Copper Wire Size												
Volts	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000
230	1.5	1.1	520	830	1320	2030	3160	4910	6020	7470	9150	–	–	–	–
	2	1.5	390	620	990	1520	2370	3680	4510	5600	6860	8360	–	–	–
	3	2.2	300	490	780	1200	1870	2910	3560	4420	5420	6610	8070	9680	
	5	3.7	180	290	460	700	1100	1700	2090	2600	3180	3880	4740	5680	6800
	7.5	5.5	120	200	320	490	760	1190	1450	1810	2210	2700	3300	3960	4740
	10	7.5	0	150	240	370	580	900	1110	1380	1680	2060	2510	3010	3610
460	5	3.7	720	1160	1840	2820	4400	6830	8370	–	–	–	–	–	–
	7.5	5.5	500	810	1280	1970	3070	4760	5830	7240	8870	–	–	–	–
	10	7.5	380	610	970	1500	2330	3620	4440	5520	6750	8240	–	–	–

6-inch Motor Cable Selection

6-inch/1-Phase/3-Lead/75 °C Cable

Motor Rating			AWG Copper Wire Size												
Volts	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000
230	5	3.7	0	110	180	280	450	710	890	1110	1390	1740	2170	2680	3330
	7.5	5.5	0	0	120	200	310	490	610	750	930	1140	1410	1720	2100
	10	7.5	0	0	0	160	250	390	490	600	750	930	1160	1430	1760
	15	11	0	0	0	0	170	270	340	430	530	660	820	1020	1260

6-inch/3-Phase/3-Lead/75 °C Cable

Motor Rating			Maximum Cable Length (ft) Measured from service entrance to motor																
			AWG Copper Wire Size													MCM Copper Wire Size			
Volts	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	000-0	250	300	350	400	500
200	5	3.7	110	170	280	440	690	1080	1350	1660	2040	2490	3050	3670	4440	5030	–	–	–	–
	7.5	5.5	0	0	200	310	490	770	960	1180	1450	1770	2170	2600	3150	3560	–	–	–	–
	10	7.5	0	0	150	230	370	570	720	880	1090	1330	1640	1970	2390	2720	3100	3480	3800	4420
	15	11	0	0	0	160	250	390	490	600	740	910	1110	1340	1630	1850	2100	2350	2570	2980
	20	15	0	0	0	0	190	300	380	460	570	700	860	1050	1270	1440	1650	1850	2020	2360
	25	18.5	0	0	0	0	0	240	300	370	460	570	700	840	1030	1170	1330	1500	1640	1900
	30	22	0	0	0	0	0	200	250	310	380	470	580	700	850	970	1110	1250	1360	1590
230	5	3.7	140	230	370	590	920	1430	1790	2190	2690	3290	4030	4850	5870	6650	7560	8460	9220	–
	7.5	5.5	0	160	260	420	650	1020	1270	1560	1920	2340	2870	3440	4160	4710	5340	5970	6500	7510
	10	7.5	0	0	190	310	490	760	950	1170	1440	1760	2160	2610	3160	3590	4100	4600	5020	5840
	15	11	0	0	0	210	330	520	650	800	980	1200	1470	1780	2150	2440	2780	3110	3400	3940
	20	15	0	0	0	160	250	400	500	610	760	930	1140	1380	1680	1910	2180	2450	2680	3120
	25	18.5	0	0	0	0	200	320	400	500	610	750	920	1120	1360	1540	1760	1980	2160	2520
	30	22	0	0	0	0	0	260	330	410	510	620	760	930	1130	1280	1470	1650	1800	2110
380	5	3.7	400	640	1010	1590	2490	3870	4780	5870	7230	8830	–	–	–	–	–	–	–	–
	7.5	5.5	270	440	690	1090	1710	2640	3260	4000	4930	6010	7290	8780	–	–	–	–	–	–
	10	7.5	200	320	510	800	1250	1930	2380	2910	3570	4330	5230	6260	7390	8280	9340	–	–	–
	15	11	0	0	370	590	920	1430	1770	2170	2690	3290	4000	4840	5770	6520	7430	8250	8990	–
	20	15	0	0	280	440	700	1090	1350	1670	2060	2530	3090	3760	4500	5110	2840	6510	7120	8190
	25	18.5	0	0	0	360	570	880	1100	1350	1670	2050	2510	3040	3640	4130	4720	5250	5740	6590
	30	22	0	0	0	290	470	730	910	1120	1380	1700	2080	2520	3020	3430	3920	4360	4770	5490
	40	30	0	0	0	0	0	530	660	820	1010	1240	1520	1840	2200	2500	2850	3170	3470	3990
	50	37	0	0	0	0	0	440	540	660	820	1000	1220	1480	1770	2010	2290	2550	2780	3190
	60	45	0	0	0	0	0	370	460	560	690	850	1030	1250	1500	1700	1940	2150	2350	2700

Motor Rating			Maximum Cable Length (ft) Measured from service entrance to motor																	
			AWG Copper Wire Size													MCM Copper Wire Size				
Volts	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	000-0	250	300	350	400	500
460	5	3.7	590	950	1500	2360	3700	5750	—	—	—	—	—	—	—	—	—	—	—	—
	7.5	5.5	420	680	1070	1690	2640	4100	5100	6260	7680	—	—	—	—	—	—	—	—	—
	10	7.5	310	500	790	1250	1960	3050	3800	4680	5750	7050	—	—	—	—	—	—	—	—
	15	11	0	340	540	850	1340	2090	2600	3200	3930	4810	5900	7110	—	—	—	—	—	—
	20	15	0	0	410	650	1030	1610	2000	2470	3040	3730	4580	5530	—	—	—	—	—	—
	25	18.5	0	0	330	530	830	1300	1620	1990	2450	3010	3700	4470	5430	—	—	—	—	—
	30	22	0	0	270	430	680	1070	1330	1640	2030	2490	3060	3700	4500	5130	5860	—	—	—
	40	30	0	0	0	320	500	790	980	1210	1490	1830	2250	2710	3290	3730	4250	—	—	—
	50	37	0	0	0	0	410	640	800	980	1210	1480	1810	2190	2650	3010	3420	3830	4180	4850
	60	45	0	0	0	0	0	540	670	830	1020	1250	1540	1850	2240	2540	2890	3240	3540	4100
575	5	3.7	920	1480	2330	3680	5750	—	—	—	—	—	—	—	—	—	—	—	—	—
	7.5	5.5	660	1060	1680	2650	4150	—	—	—	—	—	—	—	—	—	—	—	—	—
	10	7.5	490	780	1240	1950	3060	4770	5940	—	—	—	—	—	—	—	—	—	—	—
	15	11	330	530	850	1340	2090	3260	4060	—	—	—	—	—	—	—	—	—	—	—
	20	15	0	410	650	1030	1610	2520	3140	3860	4760	5830	—	—	—	—	—	—	—	—
	25	18.5	0	0	520	830	1300	2030	2530	3110	3840	4710	—	—	—	—	—	—	—	—
	30	22	0	0	430	680	1070	1670	2080	2560	3160	3880	4770	5780	7030	8000	—	—	—	—
	40	30	0	0	0	500	790	1240	1540	1900	2330	2860	3510	4230	5140	5830	—	—	—	—
	50	37	0	0	0	410	640	1000	1250	1540	1890	2310	2840	3420	4140	4700	5340	5990	6530	7580
	60	45	0	0	0	0	540	850	1060	1300	1600	1960	2400	2890	3500	3970	4520	5070	5530	6410

6-inch/3-Phase/6-Lead/75 °C Cable

Motor Rating			Maximum Cable Length (ft) Measured from service entrance to motor																	
			AWG Copper Wire Size													MCM Copper Wire Size				
Volts	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200	5	3.7	160	250	420	660	1030	1620	2020	2490	3060	3730	4570	5500	6660	7540	—	—	—	—
	7.5	5.5	110	180	300	460	730	1150	1440	1770	2170	2650	3250	3900	4720	5340	—	—	—	—
	10	7.5	80	130	210	340	550	850	1080	1320	1630	1990	2460	2950	3580	4080	4650	5220	5700	6630
	15	11	0	0	140	240	370	580	730	900	1110	1360	1660	2010	2440	2770	3150	3520	3850	4470
	20	15	0	0	120	170	280	450	570	690	850	1050	1290	1570	1900	2160	2470	2770	3030	3540
	25	18.5	0	0	0	140	220	360	450	550	690	850	1050	1260	1540	1750	1990	2250	2460	2850
	30	22	0	0	0	120	180	294	370	460	570	700	870	1050	1270	1450	1660	1870	2040	2380
	40	30	0	0	0	0	130	220	270	330	420	510	630	760	910	1050	1200	1350	1470	1710
	50	37	0	0	0	0	0	180	210	270	330	420	510	610	730	840	960	1080	1170	1360
	60	45	0	0	0	0	0	0	180	220	280	340	420	510	630	720	810	910	990	1150
230	5	3.7	210	340	550	880	1380	2140	2680	3280	4030	4930	6040	7270	8800	9970	—	—	—	—
	7.5	5.5	150	240	390	630	970	1530	1900	2340	2880	3510	4300	5160	6240	7060	8010	8950	9750	—
	10	7.5	110	180	280	460	730	1140	1420	1750	2160	2640	3240	3910	4740	5380	6150	6900	7530	8760
	15	11	0	130	190	310	490	780	970	1200	1470	1800	2200	2670	3220	3660	4170	4660	5100	5910
	20	15	0	0	140	230	370	600	750	910	1140	1390	1710	2070	2520	2860	3270	3670	4020	4680
	25	18.5	0	0	120	190	300	480	600	750	910	1120	1380	1680	2040	2310	2640	2970	3240	3780
	30	22	0	0	0	150	240	390	490	610	760	930	1140	1390	1690	1920	2200	2470	2700	3160
	40	30	0	0	0	0	180	280	360	450	550	670	840	1000	1210	1390	1590	1780	1950	2260
	50	37	0	0	0	0	150	240	280	360	450	550	670	810	970	1120	1270	1420	1560	1810
	60	45	0	0	0	0	0	190	240	300	370	460	570	690	820	940	1080	1210	1320	1530

MOTOR, CABLE, & FUSE/CIRCUIT BREAKER REFERENCE
Cable Selection

Motor Rating			Maximum Cable Length (ft) Measured from service entrance to motor																	
			AWG Copper Wire Size													MCM Copper Wire Size				
Volts	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
380	5	3.7	600	960	1510	2380	3730	5800	7170	8800	—	—	—	—	—	—	—	—	—	—
	7.5	5.5	400	660	1030	1630	2560	3960	4890	6000	7390	9010	—	—	—	—	—	—	—	—
	10	7.5	300	480	760	1200	1870	2890	3570	4360	5350	6490	7840	9390	—	—	—	—	—	—
	15	11	210	340	550	880	1380	2140	2650	3250	4030	4930	6000	7260	8650	9780	—	—	—	—
	20	15	160	260	410	660	1050	1630	2020	2500	3090	3790	4630	5640	6750	7660	4260	9760	—	—
	25	18.5	0	210	330	540	850	1320	1650	2020	2500	3070	3760	4560	5460	6190	7080	7870	8610	9880
	30	22	0	0	270	430	700	1090	1360	1680	2070	2550	3120	3780	4530	5140	5880	6540	7150	8230
	40	30	0	0	210	320	510	790	990	1230	1510	1860	2280	2760	3300	3750	4270	4750	5200	5980
	50	37	0	0	0	250	400	630	810	990	1230	1500	1830	2220	2650	3010	3430	3820	4170	4780
	60	45	0	0	0	0	340	540	660	840	1030	1270	1540	1870	2250	2550	2910	3220	3520	4050
460	5	3.7	880	1420	2250	3540	5550	8620	—	—	—	—	—	—	—	—	—	—	—	—
	7.5	5.5	630	1020	1600	2530	3960	6150	7650	9390	—	—	—	—	—	—	—	—	—	—
	10	7.5	460	750	1180	1870	2940	4570	5700	7020	8620	—	—	—	—	—	—	—	—	—
	15	11	310	510	810	1270	2010	3130	3900	4800	5890	7210	8850	—	—	—	—	—	—	—
	20	15	230	380	610	970	1540	2410	3000	3700	4560	5590	6870	8290	—	—	—	—	—	—
	25	18.5	190	310	490	790	1240	1950	2430	2980	3670	4510	5550	6700	8140	—	—	—	—	—
	30	22	0	250	410	640	1020	1600	1990	2460	3040	3730	4590	5550	6750	7690	8790	—	—	—
	40	30	0	0	300	480	750	1180	1470	1810	2230	2740	3370	4060	4930	5590	6370	—	—	—
	50	37	0	0	250	370	590	960	1200	1470	1810	2220	2710	3280	3970	4510	5130	5740	6270	7270
	60	45	0	0	0	320	500	810	1000	1240	1530	1870	2310	2770	3360	3810	4330	4860	5310	6150
575	5	3.7	1380	2220	3490	5520	8620	—	—	—	—	—	—	—	—	—	—	—	—	—
	7.5	5.5	990	1590	2520	3970	6220	—	—	—	—	—	—	—	—	—	—	—	—	—
	10	7.5	730	1170	1860	2920	4590	7150	8910	—	—	—	—	—	—	—	—	—	—	—
	15	11	490	790	1270	2010	3130	4890	6090	—	—	—	—	—	—	—	—	—	—	—
	20	15	370	610	970	1540	2410	3780	4710	5790	7140	8740	—	—	—	—	—	—	—	—
	25	18.5	300	490	780	1240	1950	3040	3790	4660	5760	7060	—	—	—	—	—	—	—	—
	30	22	240	400	645	1020	1600	2500	3120	3840	4740	5820	7150	8670	—	—	—	—	—	—
	40	30	0	300	480	750	1180	1860	2310	2850	3490	4290	5260	6340	7710	8740	—	—	—	—
	50	37	0	0	380	590	960	1500	1870	2310	2830	3460	4260	5130	6210	7050	8010	8980	9790	—
	60	45	0	0	330	500	790	1270	1590	1950	2400	2940	3600	4330	5250	5950	6780	7600	8290	9610

6-inch/3-Phase/3-Lead/Encapsulated MagForce 75 °C Cable/3600 RPM

Motor Rating			Maximum Cable Length (ft) Measured from service entrance to motor																				
			AWG Copper Wire Size													MCM Copper Wire Size							
Volts	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500	600	700	750	800
460	7.5	5.5	430	690	1090	1680	2620	4060	4980	6180	7570	9230	—	—	—	—	—	—	—	—	—	—	—	—
	10	7.5	350	560	890	1370	2140	3320	4070	5050	6180	7540	9210	—	—	—	—	—	—	—	—	—	—	—
	15	11	240	390	610	950	1480	2290	2820	3500	4280	5220	6380	7650	9150	—	—	—	—	—	—	—	—	—
	20	15	0	270	430	670	1050	1630	2000	2480	3040	3700	4520	5420	6490	7390	8370	9350	—	—	—	—	—	—
	25	18.5	0	0	360	560	870	1360	1670	2070	2530	3090	3780	4530	5420	6170	6990	7810	8480	9790	—	—	—	—
	30	22	0	0	300	470	740	1140	1410	1750	2140	2610	3190	3820	4570	5210	5900	6590	7160	8260	9110	9810	—	—
	40	30	0	0	0	340	530	830	1020	1270	1550	1890	2310	2770	3320	3780	4280	4780	5190	5990	6610	7120	7360	7570
	50	37	0	0	0	0	430	680	830	1030	1260	1540	1890	2260	2710	3080	3490	3900	4240	4890	5390	5810	6010	6180
	60	45	0	0	0	0	0	580	720	890	1090	1330	1630	1960	2340	2670	3020	3380	3670	4230	4660	5030	5200	5340

8-inch Motor Cable Selection

8-inch/3-Phase/3-Lead/75 °C Cable

Motor Rating			Maximum Cable Length (ft) Measured from service entrance to motor																	
			AWG Copper Wire Size													MCM Copper Wire Size				
Volts	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
380	40	30	0	0	0	0	0	530	660	820	1010	1240	1520	1840	2200	2500	2850	3170	3470	3990
	50	37	0	0	0	0	0	440	540	660	820	1000	1220	1480	1770	2010	2290	2550	2780	3190
	60	45	0	0	0	0	0	370	460	560	690	850	1030	1250	1500	1700	1940	2150	2350	2700
	75	55	0	0	0	0	0	0	0	460	570	700	860	1050	1270	1440	1660	1850	2030	2350
	100	75	0	0	0	0	0	0	0	0	420	510	630	760	910	1030	1180	1310	1430	1650
	125	93	0	0	0	0	0	0	0	0	0	0	510	620	740	840	950	1060	1160	1330
	150	110	0	0	0	0	0	0	0	0	0	0	0	520	620	700	790	880	960	1090
	175	130	0	0	0	0	0	0	0	0	0	0	0	0	560	650	750	840	920	1070
	200	150	0	0	0	0	0	0	0	0	0	0	0	0	0	550	630	700	760	880
460	40	30	0	0	0	320	500	790	980	1210	1490	1830	2250	2710	3290	3730	4250	—	—	—
	50	37	0	0	0	0	410	640	800	980	1210	1480	1810	2190	2650	3010	3420	3830	4180	4850
	60	45	0	0	0	0	0	540	670	830	1020	1250	1540	1850	2240	2540	2890	3240	3540	4100
	75	55	0	0	0	0	0	440	550	680	840	1030	1260	1520	1850	2100	2400	2700	2950	3440
	100	75	0	0	0	0	0	0	0	500	620	760	940	1130	1380	1560	1790	2010	2190	2550
	125	93	0	0	0	0	0	0	0	0	0	600	740	890	1000	1220	1390	1560	1700	1960
	150	110	0	0	0	0	0	0	0	0	0	0	630	760	920	1050	1190	1340	1460	1690
	175	130	0	0	0	0	0	0	0	0	0	0	0	670	810	930	1060	1190	1300	1510
	200	150	0	0	0	0	0	0	0	0	0	0	0	590	710	810	920	1030	1130	1310
575	40	30	0	0	0	500	790	1240	1540	1900	2330	2860	3510	4230	5140	5830	—	—	—	—
	50	37	0	0	0	410	640	1000	1250	1540	1890	2310	2840	3420	4140	4700	5340	5990	6530	7580
	60	45	0	0	0	0	540	850	1060	1300	1600	1960	2400	2890	3500	3970	4520	5070	5530	6410
	75	55	0	0	0	0	0	690	860	1060	1310	1600	1970	2380	2890	3290	3750	5220	4610	5370
	100	75	0	0	0	0	0	0	640	790	970	1190	1460	1770	2150	2440	2790	3140	3430	3990
	125	93	0	0	0	0	0	0	0	630	770	950	1160	1400	1690	1920	2180	2440	2650	3070
	150	110	0	0	0	0	0	0	0	0	660	800	990	1190	1440	1630	1860	2080	2270	2640
	175	130	0	0	0	0	0	0	0	0	0	700	870	1050	1270	1450	1650	1860	2030	2360
	200	150	0	0	0	0	0	0	0	0	0	0	760	920	1110	1260	1440	1620	1760	2050

8-inch/3-Phase/6-Lead/75 °C Cable

Motor Rating			Maximum Cable Length (ft) Measured from service entrance to motor																	
			AWG Copper Wire Size													MCM Copper Wire Size				
Volts	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
380	40	30	0	0	210	320	510	790	990	1230	1510	1860	2280	2760	3300	3750	4270	4750	5200	5980
	50	37	0	0	0	250	400	630	810	990	1230	1500	1830	2220	2650	3010	3430	3820	4170	4780
	60	45	0	0	0	0	340	540	660	840	1030	1270	1540	1870	2250	2550	2910	3220	3520	4050
	75	55	0	0	0	0	290	450	550	690	855	1050	1290	1570	1900	2160	2490	2770	3040	3520
	100	75	0	0	0	0	0	340	420	520	640	760	940	1140	1360	1540	1770	1960	2140	2470
	125	93	0	0	0	0	0	0	340	400	490	600	730	930	1110	1260	1420	1590	1740	1990
	150	110	0	0	0	0	0	0	0	350	420	510	620	750	930	1050	1180	1320	1440	1630
	175	130	0	0	0	0	0	0	0	0	360	440	540	660	780	970	1120	1260	1380	1600
	200	150	0	0	0	0	0	0	0	0	0	410	480	580	690	790	940	1050	1140	1320
460	40	30	0	0	300	480	750	1180	1470	1810	2230	2740	3370	4060	4930	5590	6370	—	—	—
	50	37	0	0	250	370	590	960	1200	1470	1810	2220	2710	3280	3970	4510	5130	5740	6270	7270
	60	45	0	0	0	320	500	810	1000	1240	1530	1870	2310	2770	3360	3810	4330	4860	5310	6150
	75	55	0	0	0	0	420	660	810	1020	1260	1540	1890	2280	2770	3150	3600	4050	4420	5160
	100	75	0	0	0	0	310	500	610	760	930	1140	1410	1690	2070	2340	2680	3010	3280	3820
	125	93	0	0	0	0	0	390	470	590	730	880	1110	1330	1500	1830	2080	2340	2550	2940
	150	110	0	0	0	0	0	0	420	510	630	770	950	1140	1380	1570	1790	2000	2180	2530
	175	130	0	0	0	0	0	0	0	450	550	680	830	1000	1220	1390	1580	1780	1950	2270
	200	150	0	0	0	0	0	0	0	0	480	590	730	880	1070	1210	1380	1550	1690	1970
575	40	30	0	300	480	750	1180	1860	2310	2850	3490	4290	5260	6340	7710	8740	—	—	—	—
	50	37	0	0	380	590	960	1500	1870	2310	2830	3460	4260	5130	6210	7050	8010	8980	9790	—
	60	45	0	0	330	500	790	1270	1590	1950	2400	2940	3600	4330	5250	5950	6780	7600	8290	9610
	75	55	0	0	0	420	660	1030	1290	1590	1960	2400	2950	3570	4330	4930	5620	6330	6910	8050
	100	75	0	0	0	0	490	780	960	1180	1450	1780	2190	2650	3220	3660	4180	4710	5140	5980
	125	93	0	0	0	0	0	600	740	920	1150	1420	1740	2100	2530	2880	3270	3660	3970	4600
	150	110	0	0	0	0	0	520	650	800	990	1210	1480	1780	2160	2450	2790	3120	3410	3950
	175	130	0	0	0	0	0	0	570	700	860	1060	1300	1570	1910	2170	2480	2780	3040	3540
	200	150	0	0	0	0	0	0	500	610	760	930	1140	1370	1670	1890	2160	2420	2640	3070

8-inch/3-Phase/3-Lead/Rewindable MagForce 75 °C Cable

Motor Rating			Maximum Cable Length (ft) Measured from service entrance to motor																					
			AWG Copper Wire Size									MCM Copper Wire Size												
Volts	HP	KW	6	4	3	2	1	0	00	000	0000	250	300	350	400	500	600	700	750	800	900	1000	1250	1500
460	60	45	0	640	790	980	1200	1460	1790	2140	2570	2920	3310	3700	4020	4640	5110	5510	5690	5860	6160	6410	6950	7360
	75	55	0	510	630	780	960	1170	1430	1720	2060	2340	2650	2970	3220	3720	4100	4420	4570	4700	4940	5140	5570	5900
	100	75	0	0	0	560	690	840	1030	1230	1470	1680	1900	2120	2310	2660	2940	3170	3270	3360	3540	3680	3990	4230
	125	93	0	0	0	0	540	660	810	980	1170	1330	1510	1690	1830	2110	2330	2510	2600	2670	2810	2920	3170	3350
	150	110	0	0	0	0	0	580	710	860	1030	1170	1320	1480	1610	1860	2050	2210	2280	2350	2470	2570	2780	2950
	175	130	0	0	0	0	0	0	600	720	860	980	1120	1250	1350	1560	1720	1860	1920	1980	2080	2160	2340	2480
575	60	45	650	1000	1230	1530	1880	2290	2800	3350	4010	4570	5180	5780	6280	7250	7990	8610	8900	9150	9620	—	—	—
	75	55	0	800	990	1230	1500	1830	2240	2690	3220	3670	4150	4640	5040	5810	6410	6910	7140	7340	7720	8030	8710	9220
	100	75	0	580	710	880	1080	1310	1610	1930	2310	2620	2970	3320	3610	4160	4590	4950	5110	5260	5530	5750	6240	6610
	125	93	0	0	0	700	850	1040	1270	1530	1830	2080	2360	2640	2860	3300	3640	3930	4060	4170	4390	4560	4950	5240
	150	110	0	0	0	0	750	910	1120	1340	1610	1830	2070	2320	2520	2900	3200	3450	3570	3670	3860	4010	4350	4610
	175	130	0	0	0	0	0	770	940	1130	1350	1540	1750	1950	2120	2450	2700	2910	3000	3090	3250	3380	3670	3880

Motor Fuses/Circuit Breakers

- Fuse and circuit breaker sizes are determined by local, state, and national electric codes.
- Franklin's AIM tables list both the maximum allowable values per the National Electrical Code (NEC) and more conservative breaker/fuse sizes that are typically used in submersible applications. Either size will protect the circuit, but never exceed the maximum NEC value.
- MagForce motors must be used with Variable Frequency Drives. Contact Franklin for further details.

4-inch Motor Fuses/Circuit Breakers

4-inch/1-Phase/Encapsulated/3450 RPM

NOTE: Fuse and beaker sizing is the same for FE standard, "G," and Series "700" motors.

Type	Motor Model Prefix	Rating			Circuit Breaker or Fuse Amps					
					Maximum per NEC			Typical Submersible		
		HP	KW	Volts	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker
2-Wire	244504	1/2	0.37	115	35	20	30	30	15	30
	244505	1/2	0.37	230	20	10	15	15	8	15
	244507	3/4	0.55		25	15	20	20	10	20
	244508	1	0.75		30	20	25	25	11	25
	244309	1.5	1.1		35	20	30	35	15	30
3-Wire	214504	1/2	0.37	115	35	20	30	30	15	30
	214505	1/2	0.37	230	20	10	15	15	8	15
	214507	3/4	0.55		25	15	20	20	10	20
	214508	1	0.75		30	20	25	25	11	25
3-Wire w/ CRC CB	214505	1/2	0.37	230	20	10	15	15	8	15
	214507	3/4	0.55		25	15	20	20	10	20
	214508	1	0.75		30	20	25	25	11	25
3-Wire	214508 w/ 1-1.5 CB	1	0.75	230	30	20	25	25	11	25
	224300	1.5	1.1		35	20	30	30	15	30
	224301	2	1.5		30	20	30	30	15	30
	224302	3	2.2		45	30	40	45	20	40
	224303	5	3.7		80	45	60	70	30	60

NOTE: For further table details, see "Motor Specifications" on page 39.

4-inch/3-Phase/3-Lead/Encapsulated

NOTE: Fuse and breaker sizing are the same for FE standard, G-Series, and 700-Series motors.

Motor Model Prefix	Rating			Circuit Breakers or Fuse Amps (Maximum per NEC)			Circuit Breakers or Fuse Amps (Typical Submersible)		
	HP	KW	Volts	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker
234904	1/2	0.37	48	30	17.5	25	30	12	25
234501			200	10	5	8	10	4	15
234511			230	8	4.5	6	8	4	15
234541			380	5	2.5	4	5	2	15
234521			460	4	2.25	3	4	2	15
234531			575	3	1.8	3	3	1.4	15
234902	3/4	0.55	100	20	12	20	20	8	20
234502			200	15	7	10	12	5	15
234512			230	10	5.6	8	10	5	15
234542			380	6	3.5	5	6	3	15
234522			460	5	2.8	4	5	3	15
234532			575	4	2.5	4	4	1.8	15
234503	1	0.75	200	15	8	15	15	6	15
234513			230	15	7	10	12	6	15
234543			380	8	4.5	8	8	4	15
234523			460	6	3.5	5	6	3	15
234533			575	5	2.8	4	5	2.5	15
234504	1.5	1.1	200	20	12	15	20	8	15
234514			230	15	9	15	15	8	15
234544			380	10	5.6	8	10	4	15
234524			460	8	4.5	8	8	4	15
234534			575	6	3.5	5	6	3	15
234305	2.0	1.5	200	25	15	20	25	11	20
234315			230	25	12	20	25	10	20
234345			380	15	8	15	15	6	15
234325			460	15	6	10	11	5	15
234335			575	10	5	8	10	4	15
234306	3.0	2.2	200	35	20	30	35	15	30
234316			230	30	17.5	25	30	12	25
234346			380	20	12	15	20	8	15
234326			460	15	9	15	15	6	15
234336			575	15	7	10	11	5	15
234307	5	3.7	200	60	35	50	60	25	50
234317			230	50	30	40	45	20	40
234347			380	30	17.5	25	30	12	25
234327			460	25	15	20	25	10	20
234337			575	20	12	20	20	8	20
234308	7.5	5.5	200	90	50	70	80	35	70
234318			230	80	45	60	70	30	60
234348			380	45	25	40	40	20	40
234328			460	40	25	30	35	15	30
234338			575	30	17.5	25	30	12	25
234349	10	7.5	380	70	40	60	60	25	60
234329			460	60	30	45	50	25	45
234339			575	45	25	35	40	20	35
234549			380	70	35	60	60	25	60
234595			460	60	30	45	50	25	45
234598			575	45	25	35	40	20	35

Motor Model Prefix	Rating			Circuit Breakers or Fuse Amps (Maximum per NEC)			Circuit Breakers or Fuse Amps (Typical Submersible)		
	HP	KW	Volts	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker
234646	15	11	380	90	50	70	80	35	70
234626			460	80	45	60	70	30	60
234636			575	60	35	50	60	25	50

6-inch Motor Fuses/Circuit Breakers

6-inch/1-Phase/Encapsulated

Motor Model Prefix	Rating			Circuit Breaker or Fuse Amps					
				Maximum per NEC			Typical Submersible		
	HP	KW	Volts	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker
226110	5	3.7	230	80	45	60	70	30	60
226111	7.5	5.5	230	125	70	100	110	50	100
226112	10	7.5	230	150	80	125	150	60	125
226113	15	11	230	200	125	175	200	90	175

6-inch/3-Phase/3-Lead/Standard & Hi-Temp Encapsulated

Motor Model Prefix		Rating			Circuit Breakers or Fuse Amps (Maximum per NEC)			Circuit Breakers or Fuse Amps (Typical Submersible)		
Standard	Hi-Temp	HP	KW	Volts	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker
236650	276650	5	3.7	200	60	35	45	50	25	45
236600	276600			230	45	30	40	45	20	40
236660	276660			380	30	17.5	25	30	12	25
236610	276610			460	25	15	20	25	10	20
236620	276620			575	20	12	15	20	8	15
236651	276651	7.5	5.5	200	80	45	70	80	35	70
236601	276601			230	70	40	60	70	30	60
236661	276661			380	45	25	35	40	20	35
236611	276611			460	35	20	30	35	15	30
236621	276621			575	30	17.5	25	25	11	25
236652	276652	10	7.5	200	100	60	90	100	45	90
236602	276602			230	90	50	80	90	40	80
236662	276662			380	60	35	45	50	25	45
236612	276612			460	45	25	40	45	20	40
236622	276622			575	35	20	30	35	15	30
236653	276653	15	11	200	150	90	125	150	60	125
236603	276603			230	150	80	110	125	60	110
236663	276663			380	80	50	70	80	35	70
236613	276613			460	70	40	60	60	30	60
236623	276623			575	60	30	45	50	25	45
236654	276654	20	15	200	200	110	175	175	80	175
236604	276604			230	175	100	150	175	70	150
236664	276664			380	100	60	90	100	45	90
236614	276614			460	90	50	70	80	35	70
236624	276624			575	70	40	60	70	30	60

Motor Fuses/Circuit Breakers

Motor Model Prefix		Rating			Circuit Breakers or Fuse Amps (Maximum per NEC)			Circuit Breakers or Fuse Amps (Typical Submersible)		
Standard	Hi-Temp	HP	KW	Volts	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker
236655	276655	25	18.5	200	250	150	200	225	100	200
236605	276605			230	225	125	175	200	90	175
236665	276665			380	125	80	110	125	50	110
236615	276615			460	110	60	90	100	45	90
236625	276625			575	90	50	70	80	35	70
236656	276656	30	22	200	300	175	250	300	125	250
236606	276606			230	250	150	225	250	100	200
236666	276666			380	150	90	125	150	60	125
236616	276616			460	125	70	110	125	50	100
236626	276626			575	100	60	90	100	40	80
236667	276667	40	30	380	200	125	175	200	90	175
236617	276617			460	175	100	150	175	70	150
236627	276627			575	150	80	110	125	60	110
236668	276668	50	37	380	250	150	225	250	110	225
236618	276618			460	225	125	175	200	90	175
236628	276628			575	175	100	150	175	70	150
236669	276669	60	45	380	300	175	250	300	125	250
236619	276619			460	250	150	225	250	100	225
236629	276629			575	200	125	175	200	80	175

6-inch/3-Phase/6-Lead/Encapsulated

Motor Model Prefix Standard	Rating				Circuit Breakers or Fuse Amps					
					Maximum per NEC			Typical Submersible		
	HP	KW	Volts	SF	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker
236767	40	30	200	1.15	400	225	350	400	175	350
236727			230		350	200	300	350	150	300
236768	50	37	200	1.15	500	300	400	450	200	400
236728			230		450	250	350	400	175	350
236729	60	45	230	1.15	500	300	450	500	225	450

8-inch Motor Fuses/Circuit Breakers

8-inch/3-Phase/3-Lead/Encapsulated

Motor Model Prefix	Rating			Circuit Breakers or Fuse Amps (Maximum per NEC)			Circuit Breakers or Fuse Amps (Typical Submersible)		
Standard	HP	KW	Volts	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker
239660	40	30	380	200	125	175	200	80	175
239600			460	175	100	150	175	70	150
239000			460	175	100	150	175	70	150
239610			575	150	80	110	125	60	110
239661	50	37	380	250	150	200	225	100	200
239601			460	200	125	175	200	80	175
239001			460	200	125	175	200	80	175
239611			575	175	90	150	150	70	150

Motor Model Prefix	Rating			Circuit Breakers or Fuse Amps (Maximum per NEC)			Circuit Breakers or Fuse Amps (Typical Submersible)		
Standard	HP	KW	Volts	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker
239662	60	45	380	300	175	250	300	125	250
239602			460	250	150	200	225	100	200
239002			460	250	150	200	225	100	200
239612			575	200	110	175	175	80	175
239663	75	55	380	350	200	300	350	150	300
239603			460	300	175	250	300	125	250
239613			575	250	150	200	225	100	200
239664	100	75	380	500	275	400	450	200	400
239604			460	400	225	350	400	175	350
239614			575	350	200	300	300	125	300
239165	125	93	380	700	400	600	600	250	600
239105			460	500	300	450	500	225	450
239115			575	450	250	350	400	175	350
239166	150	110	380	800	450	600	700	300	600
239106			460	600	350	500	600	250	500
239116			575	500	300	400	450	200	400
239167	175	130	380	800	500	700	800	350	700
239107			460	700	400	600	700	300	600
239117			575	600	350	450	600	225	450
239168	200	150	380	1000	600	800	1000	400	800
239108			460	800	450	700	800	350	700
239118			575	600	350	500	600	250	500

8-inch/3-Phase/3-Lead/Encapsulated Hi-Temp (75 °C)

Motor Model Prefix	Rating			Circuit Breakers or Fuse Amps (Maximum per NEC)			Circuit Breakers or Fuse Amps (Typical Submersible)		
Standard	HP	KW	Volts	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker	Standard Fuse	Dual Element Time Delay Fuse	Circuit Breaker
279160	40	30	380	225	125	175	200	90	175
279100			460	175	110	150	175	70	150
279110			575	150	90	125	125	60	125
279161	50	37	380	250	150	225	225	110	225
279101			460	200	125	175	200	90	175
279111			575	175	100	150	150	70	150
279162	60	45	380	300	175	250	300	125	250
279102			460	275	150	225	250	100	225
279112			575	200	125	175	175	80	175
279163	75	56	380	400	200	350	350	150	350
279103			460	300	175	275	300	125	275
279113			575	275	150	225	225	100	225
279164	100	75	380	500	300	450	450	200	450
279104			460	400	250	350	400	175	350
279114			575	350	200	300	300	125	300
279165	125	93	380	700	400	600	600	250	600
279105			460	500	300	450	500	225	450
279115			575	450	250	350	400	175	350
279166	150	110	380	800	450	600	700	300	600
279106			460	600	350	500	600	250	500
279116			575	500	300	400	450	200	400

GLOSSARY

Term	Definition
A	Amp or amperage
AWG	American Wire Gauge
BJT	Bipolar Junction Transistor
°C	Degree Celsius
CB	Control Box
CRC	Capacitor Run Control
DI	Deionized
DOL	Direct on Line
dV/dt	Rise Time of the Voltage
EFF	Efficiency
°F	Degree Fahrenheit
FDA	Food & Drug Administration
FL	Full Load Amps at Nameplate HP
ft	Foot
ft-lb	Foot Pound
ft/s	Feet per Second
GFCI	Ground Fault Circuit Interrupter
gpm	Gallons per Minute
HERO	High Efficiency Reverse Osmosis
hp	Horsepower
Hz	Hertz
ID	Inside Diameter
IGBT	Insulated Gate Bipolar Transistor
in	Inch
kVA	Kilovolt Amp
kVAR	Kilovolt Amp Rating
KW	Kilowatt (1000 watts)
L1, L2, L3	Line One, Line Two, Line Three
lb-ft	Pound Feet
L/min or lpm	Liters per Minute
mA	Milliamp
max	Maximum
MCM	Thousand Circular Mils
mm	Millimeter
MOV	Metal Oxide Varister
NEC	National Electrical Code
NEMA	National Electrical Manufacturer Association
Nm	Newton Meter
NPSH	Net Positive Suction Head
OD	Outside Diameter
OL	Overload
PF	Power Factor
psi	Pounds per Square Inch
PSIG	Pounds per square inch gauge
PWM	Pulse Width Modulation
QD	Quick Disconnect
R	Resistance
RMA	Return Material Authorization
RMS	Root Mean Squared

Term	Definition
rpm	Revolutions per Minute
SF	Service Factor = Amps at Maximum HP Loads
SFhp	Service Factor Horsepower
S/N	Serial Number
TDH	Total Dynamic Head
UNF	Unified Fine Thread
V	Voltage
VAC	Voltage Alternating Current
VDC	Voltage Direct Current
VFD	Variable Frequency Drive
W	Watts
XFMR	Transformer
Y-D	Wye-Delta
Ω	ohms

FORMULAS

Cable Size

Refer to "Cable Size Combinations" on page 50.

$$\frac{\text{Actual Length}}{\text{Max Allowed}} + \frac{\text{Actual Length}}{\text{Max Allowed}} = 1.00$$

Cooling Flow

Refer to "Required Cooling Flow" on page 8.

$$fps = \frac{gpm \times 0.409}{ID^2 - OD^2}$$

fps = feet per second

gpm = gallons per minute

ID = internal diameter (in inches) of casing or sleeve

OD = outside diameter (in inches) of the motor

0.409 is a constant used because of the various units of measurement (inches, feet, meters, etc.)

Submersible Motor Operating Costs

$$\text{kilowatt hours consumed at the motor terminals} = \frac{\text{\# of operating hours} \times 0.746 \times hp}{\text{motor efficiency}}$$

$$\text{cost per hour of pumping} = \frac{0.000189 \times gpm \times \text{head in feet} \times \text{power cost per kWh}}{\text{pump efficiency} \times \text{motor efficiency}}$$

VFD Generator Sizing / X-Drive

Watts = **Maximum** VFD Amp Rating x 1.5 x 1.732 x Motor Nameplate Voltage

Maximum VFD Amps = nameplate max of the VFD unit.
(This value will typically be higher than the motor max amps)

1.5 (or 150%) = an industry value to provide tolerance for different generator manufacturers and designs.

1.732 = square root of 3 (For 1-phase generators, delete this value).

Nameplate volts = voltage rating of the motor, not the power source (IE. 460v, not 480v).

Form 2207 – Action Facts

SUBMERSIBLE MOTOR INSTALLATION RECORD

INFORMATION SUPPLEMENT

1.0 MOTOR

1.1 Verify motor nameplate data meets the application – hp, voltage, phase, and Hertz.

1.2 Check that the motor shaft rotates freely by hand on the second of two complete rotations. (On large motors, this usually requires a motor coupling with a cheater handle welded to it.)

1.3 Check that the motor lead assembly is not damaged.

1.4 Measure insulation resistance to ground at 500 VDC (1000 VDC max) with a megohmmeter or megger, before submerging. It should be a minimum of 200 megohms or 200,000,000 ohms.

1.5 Measure insulation resistance to ground at 500 VDC (1000 VDC max) with a megohmmeter or megger, after submerging. It should be a minimum of 0.5 megohms or 500,000 ohms.

1.6 Verify the system is operating within the ±10% of nameplate voltage requirement.

1.7 Verify the system will not ever operate in excess of the maximum amps indicated on the nameplate.

1.8 Verify the system is operating at 5% or less current unbalance.

Notice:

- If current unbalance exceeds 5%, the maximum operating amps must be derated to the nameplate Full Load Amps.
- Warning - System current unbalance can not exceed 10% without causing heating and mechanical wear issues.
- The submersible motor amperage % unbalance is typically 6x greater than its voltage % unbalance.
- Thus, 0.8% voltage unbalance = greater than 5% current unbalance, and 1.7% voltage unbalance = greater than 10% current unbalance.

2.0 PUMP

2.1 Verify the pump nameplate and curve data meets the application hp, rpm, and flow/TDH requirements.

2.2 Verify the pump NPSH requirement will be met at all times.

2.3 Check that the pump shaft rotates freely by hand before installation.

2.4 Check that the pump shaft moves up about ¼ inch when it is coupled to the motor.

2.5 Check that the pump guard is not pinching the motor leads, especially where it enters and exits the guard.

Notice:

- Pumps and motors 5 hp and above should be assembled in a vertical position to ensure correct alignment.
- A motor-pump assembly 5 hp and above should never be lifted from a non-vertical position by the pump discharge because it can bend the shaft in one or both of the products.

3.0 POWER SUPPLY (3-PHASE)

3.1 Verify the transformer kVA rating is adequate for the motor per the Franklin Application (AIM) manual requirement.

3.2 Verify that all transformers have the same kVA rating.

3.3 Verify the 3-Phase pump panel fuses or its circuit breaker are correctly sized per the Franklin Application (AIM) manual requirement.

3.4 Verify the 3-Phase pump panel motor contactor is correctly sized per the Franklin Application (AIM) manual requirement.

3.5 Verify the 3-Phase pump panel motor overload is ambient compensated.

3.6 Verify the 3-Phase pump panel motor overload has a NEMA Class 10 trip curve.

3.7 Verify the 3-Phase pump panel motor overload heaters or its dial setting are correctly selected based on the system's operating point and not just arbitrarily set at the maximum motor operating amps.

3.8 At no time should the system operating amps or the motor overload system running point setting be higher than the motor nameplate maximum amp rating.

Notice:

- Electronic overloads should be set at the normal system operation point.
- Electronic overloads have a built-in multiplier of 115-125% times the input amps to determine the overload trip point.

4.0 POWER SUPPLY (1-PHASE)

Form 2207 – Action Facts

SUBMERSIBLE MOTORS INSTALLATION RECORD

4.2 Verify the motor control box and the motor are made by the same manufacturer.

4.3 Verify the motor control box hp rating and its voltage match the motor rating exactly. If not, a premature failure of the control box or motor should be expected.

5.0 HIGH SURGE PROTECTION

5.1 Verify the submersible motor has a dedicated surge arrestor.
All submersible motors require a dedicated surge arrestor.
Motors 5 hp and smaller marked "Equipped with Lightning Arrestors", have a built-in surge arrestor.

5.2 Verify the surge arrestor is mounted as close to the motor as practical.
The location is usually in the pump panel, but sometimes it is placed at the well head in a separate electrical box.

5.3 Verify the surge arrestor is grounded below the lowest drawdown water level.
This is usually accomplished by attaching the drop cable ground wire to the motor lead or the motor ground lug.

5.4 Verify the ground conductor size meets the minimum requirements of the National Electrical Code and all other relevant national, state, regional, and local codes.

5.5 Verify the motor is connected to both the electrical system ground and the motor.

6.0 ELECTRICAL DROP CABLE

6.1 Verify the temperature rating of the drop cable – typically 60 °C, 75 °C, 90 °C or 125 °C.

6.2 Verify if the cable is single conductor or jacketed conductor. Web cable is considered jacketed cable by regulating agencies.

6.3 Verify the conductor size – typically AWG, MCM or mm^2.

6.4 Verify if the conductor material is copper; if not, determine the material and contact the factory for acceptability.

6.5 Verify the drop cable meets or exceeds the requirements of the Franklin Application (AIM) manual.

Notice:

- If the service entrance to pump panel or the pump panel to motor cable is not a copper material, contact the factory for the correct length derating factors.

7.0 MOTOR COOLING

7.1 Verify that the well water temperature does not exceed the maximum ambient temperature indicated on the nameplate of the motor.

7.2 Verify there is a minimum of 10 feet of clear water between the bottom of the motor and the bottom of the well.

7.3 Verify that all water entering the well is coming from below the lowest part of the motor.

7.4 Verify the system pumping rate will never deliver less flow than is required by the Franklin Application (AIM) manual to flow by-and-around the full length of the motor for cooling purposes.

7.5 Verify that 3-phase motors above 7.5 hp in a vertical potable water well should not exceed 100 starts in 24 hours and each start should include a minimum of 3 minutes ON and 10 minutes OFF.

Notice:

- If any water is entering the well above the lowest part of the motor, a flow sleeve is required.

8.0 MOTOR-PUMP INSTALLATION

8.1 Verify that the drop cable is supported to the drop pipe every 10 feet.

8.2 Verify at least one spring loaded (non-drilled) check valve is in the drop pipe.
Preferably, the first check valve should be located at the top of the first pipe joint above the pump discharge (~20 feet) if the pump does not have a check built in to its discharge.

8.3 Verify all pipe joints are as tight as practical.
The minimum torque should never be less than 10 foot-pounds times the motor nameplate hp rating.

8.4 Verify the rotation of the pump is correct.
It is preferable to do this by checking the flow and current in both directions on 3-phase motors.
This can be done by having the electrician swap any two leads.
This is considered "best practice" since pumps under some conditions can supply amp readings and a visual flow observation that can be extremely misleading.

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SUBMERSIBLE MOTORS INSTALLATION RECORD

RMA Number

KEY DEALER #

DISTRIBUTOR	INSTALLER	END USER
Name:	Name:	Name:
City:	City:	City:
State: Zip:	State: Zip:	State: Zip:

Well ID or GPS: _____ _____ _____ Water Temperature: _____ °F °C

Application/Water Use (e.g. potable water, irrigation, municipal, fountain, etc.): _____

Date Installed (mm/yy): _____ Date Failed (mm/yy): _____ Motor Position Shaft-Up: Yes No

Operating Cycle: ON Time Per Start _____ Hrs. Mins. Time OFF Between Stop & Restart _____ Hrs. Mins.

MOTOR

Model: _____ Serial Number: _____ Date Code (if updated): _____

MOTOR OVERLOAD

System Typical Operating Current: _____ Amps @ _____ Volts

Overload: ◯ FE SubMonitor Input Amps _____ D3 Attached ◯ Yes ◯ No Fault Settings Attached ◯ Yes ◯ No

◯ Other Manufacturer Model: _____ Dial Set at: _____ or Heater # _____

NEMA Class: ◯ 10 ◯ 20 ◯ 30 Ambient Compensated: ◯ Yes ◯ No

Power to Motor by: ☐ Full Volt Starter ☐ VFD ☐ Soft Starter VFD or Soft Starter Mfr. & Model: _____

PUMP

Manufacturer: _____

Model: _____

Stages: _____

Design Rating: _____ gpm @ _____ ft TDH

Horsepower Required by Pump End: _____

Actual Pump Delivery: _____ gpm @ _____ psi

What Controls When System Runs & Stops:

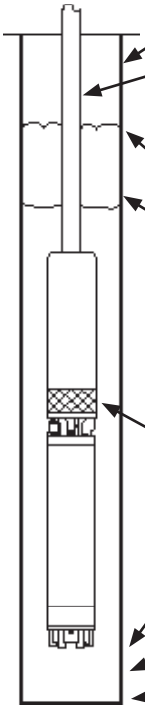
_____

(e.g. pressure, level, flow, manual on/off, timer, time clock etc.)

YOUR NAME / DATE

_____ / _____

WELL DATA (All measurements from well head down.)



Casing Diameter _____ in

Drop Pipe Diameter _____ in

Drop Pipe Material _____ PVC _____ Steel _____ Poly _____ Other

Number of Sticks of Drop Pipe _____

Static Water Level _____ ft

Drawdown (pumping) Water Level _____ ft

Spring Assist Check Valves:
(Measured from Well Head Down)

#1 _____ #2 _____ #3 _____ #4 _____ ft

◯ Solid ◯ Drilled Poppet ◯ Break-Off Plug

Pump Inlet Setting _____ ft

Flow Sleeve ◯ No ◯ Yes, Dia. _____ in

Case Ends _____ ft

☐ Well Screen ☐ Perforated Casing

#1 from ____ to ____ ft & #2 from ____ to ____ ft

Well Depth _____ ft

Franklin Electric

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SUBMERSIBLE MOTORS INSTALLATION RECORD

RMA Number

TRANSFORMERS

Number of Transformers: ◯ Two ◯ Three Transformers Supply Motor Only: ◯ Yes ◯ No ◯ Unsure

Transformer #1: _____ kVA Transformer #2: _____ kVA Transformer #3: _____ kVA

POWER CABLES & GROUND WIRE

1 **Service Entrance to Pump Control Panel:**

Length: _____ ft. & Gauge: _____ AWG/MCM

Material: ◯ Copper ◯ Aluminum Construction: ◯ Jacketed ◯ Individual Conductors ◯ Web ◯ Twisted

Temperature Rating of Cable: ◯ 60 °C ◯ 75 °C ◯ 90 °C ◯ 125 °C or Insulation Type: _____ (e.g. THHN)

2 **Pump Control Panel to Motor:**

Length: _____ ft. & Gauge: _____ AWG/MCM

Material: ◯ Copper ◯ Aluminum Construction: ◯ Jacketed ◯ Individual Conductors ◯ Web ◯ Twisted

Temperature Rating of Cable: ◯ 60 °C ◯ 75 °C ◯ 90 °C ◯ 125 °C or Insulation Type: _____ (e.g. THHN)

3 **Ground Wire Size:** From Control Panel to Motor: _____ AWG/MCM

Control Grounded to (mark all that apply):

☐ Well Head ☐ Metal Casing ☐ Motor ☐ Driven Rod ☐ Power Supply

INCOMING VOLTAGE

No Load L1-L2 _____ L2-L3 _____ L1-L3 _____

Full Load L1-L2 _____ L2-L3 _____ L1-L3 _____

RUNNING AMPS & CURRENT BALANCE

Full Load L1 _____ L2 _____ L3 _____

% Unbalance: _____

CONTROL PANEL

1 **Pump Panel Manufacturer/Fabricator:** _____

2 **Short Circuit Protection – Fuses or Circuit Breaker**

Option #1 – Fuse

Manufacturer: _____ Model: _____ Rating: _____ Amps

Type: ◯ Time-Delay ◯ Standard

Option #2 – Circuit Breaker

Manufacturer: _____ Model: _____ Rating: _____ Amps Setting: _____

3 **Starter – Full Voltage, Reduced Voltage, Soft-Starter or VFD (Variable Frequency Drive)**

Option #1 – Full Voltage

Manufacturer: _____ Model: _____ Size: _____ Contacts: ☐ NEMA ☐ IEC

Option #2 – Reduced Voltage

Manufacturer: _____ Model: _____ Ramp Time to Full Voltage: _____ sec.

Option #3 – Soft-Starter or VFD

Manufacturer: _____ Model: _____ Max. Continuous Amp Output Rating: _____

Min. Setting: _____ Hz & GPM: _____ Max. Setting: _____ Hz & GPM: _____

Start Ramp Time to 30 Hz: _____ sec. Stop Mode: ◯ Power Off Coast ◯ 30-0 Hz Ramp _____ sec.

Special Output Filter Purchased: ◯ Yes ◯ No

Output Filter Manufacturer: _____ Model: _____ % Reactance: _____

4 **Surge Arrestor:** ◯ No ◯ Yes, Manufacturer: _____ Model: _____

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SUBDRIVE INSTALLATION RECORD

CONTACT INFORMATION

DISTRIBUTOR		INSTALLER		END-USER	
NAME:		NAME:		NAME:	
CITY:		CITY:		CITY:	
STATE:		STATE:		STATE:	
ZIP:		ZIP:		ZIP:	

DRIVE INFORMATION

MODEL NO.: SERIAL NO.: INSTALL DATE: FAILURE DATE:

APPLICATION INFORMATION

MOTOR VOLTAGE: 115VAC 230VAC 460VAC MOTOR TYPE: TWO-WIRE THREE-WIRE THREE-PHASE

MOTOR MODEL: MOTOR RATING (HP): NEW INSTALL EXISTING AGE (YR):

PUMP MODEL: PUMP RATING (HP): PUMP FLOW (GPM):

APPLICATION TYPE (CHECK ALL THAT APPLY): RESIDENTIAL COMMERCIAL IRRIGATION AGRICULTURE PRESSURE BOOSTING

APPLICATION DESCRIPTION:

INSTALLATION INFORMATION

MEASURED INPUT VOLTAGE (VAC): INPUT PHASE: SINGLE-PHASE THREE-PHASE

INPUT PROTECTION: CIRCUIT BREAKER FUSED DISCONNECT BREAKER/FUSE RATING (AMPS):

INPUT POWER SOURCE: PAD TRANSFORMER POLE TRANSFORMER GENERATOR GENERATOR RATING (KW):

SUPPLY PANEL TYPE: MAIN PANEL SUB-PANEL OTHER:

DRIVE LOCATION: INDOOR OUTDOOR DIRECT SUNLIGHT AMBIENT TEMPERATURE: °F °C

DESCRIPTION OF DRIVE LOCATION (BASEMENT, PUMP HOUSE, ETC):

DRIVE SYSTEM: STANDALONE DUPLEX ALTERNATOR (ACCESSORY) DUPLEX ALTERNATOR/MULTIDRIVE BUILT-IN

PRESSURE SENSOR TYPE: 4-20MA TRANSDUCER PRESSURE SENSOR/SWITCH PRESSURE SETPOINT (PSI):

PRESSURE TANK TYPE: BLADDER GALVANIZED NO TANK OTHER:

PRESSURE TANK SIZE (GAL): PRESSURE TANK PRE-CHARGE (PSI):

POWER CABLE & GROUND WIRE

DRIVE INPUT

LENGTH (FT): GAUGE (AWG/MCM):

MATERIAL: COPPER ALUMINUM TYPE: JACKETED INDIVIDUAL CONDUCTORS WEB TWISTED OTHER:

TEMPERATURE RATING: 60 °C 75 °C 90 °C 125 °C INSULATION RATING (E.G. THHN):

OFFSET WIRE

LENGTH (FT): GAUGE (AWG/MCM):

MATERIAL: COPPER ALUMINUM TYPE: JACKETED INDIVIDUAL CONDUCTORS WEB TWISTED OTHER:

TEMPERATURE RATING: 60 °C 75 °C 90 °C 125 °C INSULATION RATING (E.G. THHN):

DROP WIRE (SUBMERSIBLE PUMPS)

LENGTH (FT): GAUGE (AWG/MCM):

MATERIAL: COPPER ALUMINUM TYPE: JACKETED INDIVIDUAL CONDUCTORS WEB TWISTED OTHER:

TEMPERATURE RATING: 60 °C 75 °C 90 °C 125 °C INSULATION RATING (E.G. THHN):

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