6", 8" & 10" STAINLESS STEEL SUBMERSIBLE PUMPS

Installation and Operating Instructions

TABLE OF CONTENTS

Please leave these instructions with the pump for future reference.

GRUNDFOS®

Leaders in Pump Technology

SAFETY WARNING

Grundfos Stainless Steel Submersible Pumps

Your Grundfos Submersible Pump is of the utmost quality. Combined with proper installation, your Grundfos pump will give you many years of reliable service.

To ensure the proper installation of the pump, carefully read the complete manual before attempting to install the pump.

Shipment Inspection

Examine the components carefully to make sure no damage has occurred to the pump-end, motor, cable or control box during shipment.

This Grundfos Submersible Pump should remain in its shipping carton until it is ready to be installed. The carton is specially designed to protect it from damage. During unpacking and prior to installation, **make sure that the pump is not dropped or mishandled.**

The motor is equipped with an electrical cable. Under no circumstance should the cable be used to support the weight of the pump.

You will find a loose data plate with an adhesive backing with the pump. The nameplate should be completed in pen and attached to the control box.

Pre-Installation Checklist

Before beginning installation, the following checks should be made. They are all critical for the proper installation of this submersible pump.

A. Condition of the Well

If the pump is to be installed in a new well, the well should be fully developed and bailed or blown free of cuttings and sand. The stainless steel construction of the Grundfos submersible make it resistant to abrasion; however, no pump, made of any material, can forever withstand the destructive wear that occurs when constantly pumping sandy water.

If this pump is used to replace an oil-filled submersible or oil-lubricated line-shaft turbine in an existing well, **the well must be blown or bailed clear of oil.**

Determine the maximum depth of the well, and the draw-down level at the pump's maximum capacity. Pump selection and setting depth should be based on this data.

The inside diameter of the well casing should be checked to ensure that it is not smaller than the size of the pump and motor.

B. Condition of the Water

Submers ble pumps are designed for pumping clear and cold water that is free of air and gases. Decreased pump performance and life expectancy can occur if the water is not cold and clear or contains air and gasses.

Maximum water temperature should not exceed 102°F. Special consideration must be given to the pump and motor if it is to be used to pump water above 102°F.

The Grundfos stainless steel submers ble is highly resistant to the normal corrosive environment found in some water wells. If water well tests determine the water has an excessive or unusual corrosive quality, or exceeds 102°F, contact your Grundfos representative for information concerning specially designed pumps for these applications.

C. Installation Depth

A check should be made to ensure that the installation depth of the pump will always be at least (5) five to (10) ten feet below the maximum draw-down level of the well. For flow rates exceeding 100 gpm, refer to performance curves for recommended minimum submergence.

The bottom of the motor should never be installed lower than the top of the well screen or within five feet of the well bottom.

If the pump is to be installed in a lake, pond, tank or large diameter well, the water velocity passing over the motor must be sufficient to ensure proper motor cooling. The minimum recommended water flow rates which ensure proper cooling are listed in Table A.

D. Electrical Supply

The motor voltage, phase and frequency indicated on the motor nameplate should be checked against the actual electrical supply.

Wire Cable Type

The wire cable used between the pump and control box or panel should be approved for submersible pump applications. The conductor may be solid or stranded. The cable may consist of individually insulated conductors twisted together, insulated conductors molded side by side in one flat cable or insulated conductors with a round overall jacket.

The conductor insulation should be type RW, RUW, TW, TWU or equivalent and must be suitable for use with submers ble pumps. An equivalent Canadian Standards Association certified wire may also be used. See Table D for recommended sizes of cable lengths.

Splicing the Motor Cable

A good cable splice is critical to proper operation of the submersible pump and must be done with extreme care.

If the splice is carefully made, it will work as well as any other portion of the cable, and will be completely watertight.

Grundfos recommends using a heat shrink splice kit. The splice should be made in accordance with the kit manufacture's instructions. Typically a heat shrink splice can be made as follows:

1. Examine the motor cable and the drop cable carefully for damage.

2. Cut the motor leads off in a staggered manner. Cut the ends of the drop cable so that the ends match up with the motor leads (See Figure 4-A). On single-phase motors, be sure to match the colors.

3. Strip back and trim off 1/2 inch of insulation from each lead, making sure to scrape the wire bare to obtain a good connection. Be careful not to damage the copper conductor when stripping off the insulation.

4. Slide the heat shrink tubing on to each lead. Insert a properly sized "Sta-kon" type connector on each lead, making sure that lead colors are matched. Using a "Sta-kon" crimping pliers, indent the lugs (Figure 4-B). Be sure to squeeze hard on the pliers, particularly when using large cable.

5. Center the heat shrink tubing over the connector. Using a propane torch, lighter, or electric heat gun, uniformly heat the tubing starting first in the center working towards the ends (Figure 4-C).

6. Continue to apply the heat to the tubing using care not to let the flame directly contact the tubing. When the tubing shrinks and the sealant flows from the ends of the tubing, the splice is complete (Figure 4-D).

FIGURE 4-A

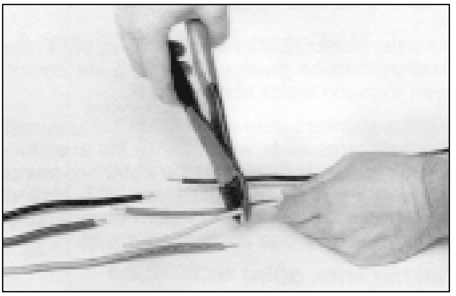


FIGURE 4-B

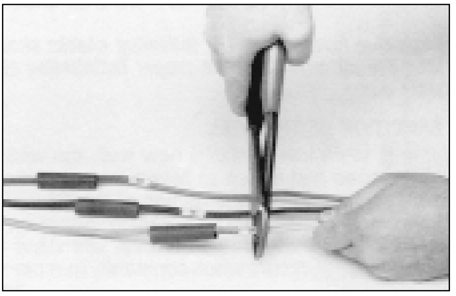


FIGURE 4-C

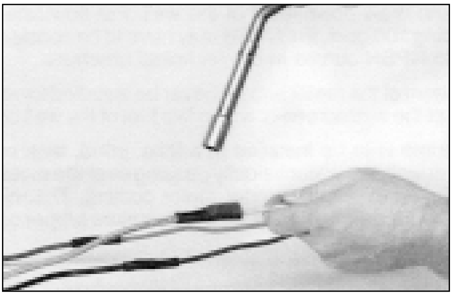
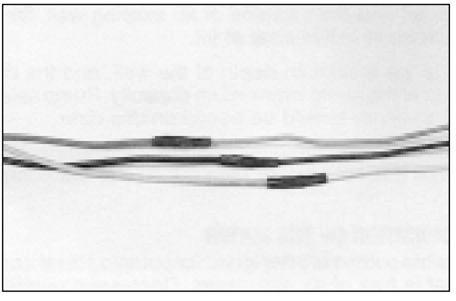
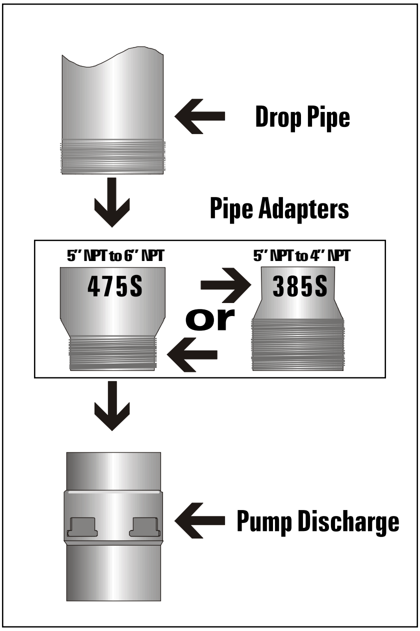


FIGURE 4-D



The riser pipe or hose should be properly sized and selected based on estimated flow rates and friction-loss factors.



If An Adapter Needs To Be Installed:

It is recommended to first install the drop pipe to the pipe adapter. Then install the drop pipe with the adapter to the pump discharge.

A back-up wrench should be used when the riser pipe is attached to the pump. The pump should be gripped only by the flats on the top of the discharge chamber. The body of the pump, cable guard or motor should not be gripped under any circumstance.

If Steel Riser Pipe Is Used:

We recommend that steel riser pipes always be used with the larger submers bles. An approved pipe thread compound should be used on all joints. Make sure the joints are adequately tightened in order to resist the tendency of the motor to loosen the joins when stopping and starting.

When tightened, the first section of the riser pipe must not come in contact with the check valve retainer in the discharge chamber of the pump.

After the first section of the riser pipe has been attached to the pump, the lifting cable or elevator should be clamped to the pipe. **Do not clamp the pump.** When raising the pump and riser section, be careful not to place bending stress on the pump by picking it up by the pump-end only.

Make sure that the electrical cables are not cut or damaged in any way when the pump is being lowered in the well.

The drop cable should be secured to the riser pipe at frequent intervals to prevent sagging, looping or possible cable damage. Nylon cable clips or waterproof tape may be used. The cable splice should be protected by securing it with clips or tape just above and below the splice.

If Plastic or Flexible Riser Pipe Is Used:

It is recommended that plastic type riser pipe be used only with the smaller domestic submersibles. The pipe manufacturer or representative should be contacted to insure the pipe type and physical characteristics are suitable for this use. Use the correct joint compound recommended by the pipe manufacturer. In addition to making sure that joints are securely fastened, the use of a torque arrester is recommended when using plastic pipe.

Installation

Do not connect the first plastic or flexible riser section directly to the pump. Always attached a metallic nipple or adapter into the discharge chamber of the pump. When tightened, the threaded end of the nipple or adapter must not come in contact with the check valve retainer in the discharge chamber of the pump.

The drop cable should be secured to the riser pipe at frequent intervals to prevent sagging, looping and possible cable damage. Nylon cable clips or waterproof tape may be used. The cable splice should be protected by securing it with clips or tape just above each joint.

IMPORTANT – Plastic and flexible pipe tend to stretch under load. This stretching must be taken into account when securing the cable to the riser pipe. Leave 3 to 4 inches of slack between clips or taped points to allow for this stretching. This tendency for plastic and flexible pipe to stretch will also affect the calculation of the pump setting depth. As a general rule, you can estimate that plastic pipe will stretch to approximately 2% of its length. For example, if you installed 200 feet of plastic riser pipe, the pump may actually be down 204 feet. If the depth setting is critical, check with the manufacturer of the pipe to determine who to compensate for pipe stretch.

When plastic riser pipe is used, it is recommended that a safety cable be attached to the pump to lower and raise it.

Check valves:
A check valve should always be installed at the surface of the well. In addition, for installations deeper than 200 feet, check valves should be installed at no more than 200 foot intervals.

Protect the well from contamination:
To protect against surface water entering the well and contaminating the water source, the well should be finished off above grade, and a locally approved well seal or pitless adapter unit utilized.

Electrical

WARNING: To reduce the risk of electrical shock during operation of this pump requires the provision of acceptable grounding. If the means of connection to the supply connected box is other than grounded metal conduit, ground the pump back to the service by connecting a copper conductor, at least the size of the circuit supplying the pump, to the grounding screw provided within the wiring compartment.

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

Verification of the electrical supply should be made to ensure the voltage, phase and frequency match that of the motor. Motor voltage, phase, frequency and full-load current information can be found on the nameplate attached to the motor. Motor electrical data can be found in Table E.

If voltage variations are larger than ± 10%, do not operate the pump.

Direct on-line starting is used due to the extremely fast run-up time of the motor (0.1 second maximum), and the low moment of inertia of the pump and motor. Direct on-line starting current (locked rotor amp) is between 4 and 6.5 times the full-load current. If direct on-line starting is not acceptable and reduced starting current is required, an auto-transformer or resistant starters should be used for 5 to 30 HP motors (depending on cable length). For motors over 30 HP, use auto-transformer starters.

Engine-Driven Generators

If the submersible pump is going to be operated using an engine driven generator, we suggest the manufacturer of the generator be contracted to ensure the proper generator is selected and used. See Table B for generator sizing guide.

If power is going to be supplied through transformers, Table C outlines the minimum KVA rating and capacity required for satisfactory pump operation.

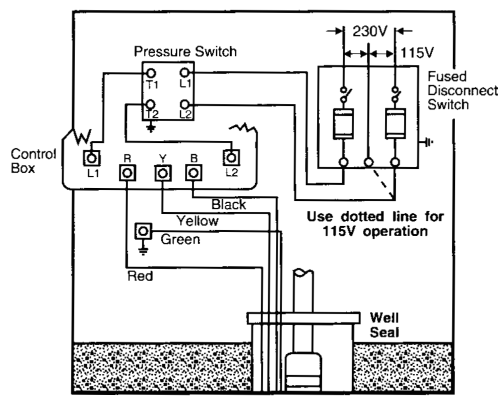
Control Box/Panel Wiring

1. Single-Phase Motors: Single-phase motors must be connected as indicated in the motor control box. A typical single-phase wiring diagram using a Grundfos control box is shown (Figure 6-A).

2. Three-Phase Motors: Three-phase motors must be used with the proper size and type of motor starter to ensure the motor is protected against damage from low voltage, phase failure, current unbalance and overload current. A properly sized starter with ambient-compensated extra quick-trip overloads must be used to give the best possible motor winding protection. ***Each of the three motor legs must be protected with overloads.*** The thermal overloads must trip in less than 10 seconds at locked rotor (starting) current. For starter and overload protection guide, see Table H. A three-phase motor wiring diagram is illustrated below (See Figure 6-B).

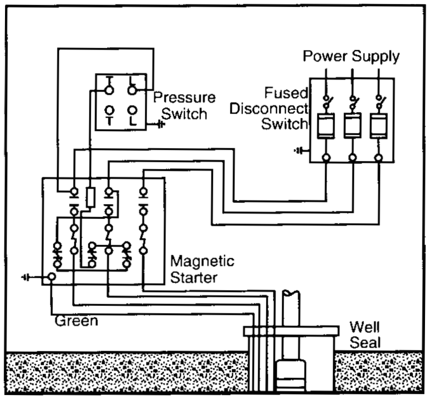
Pumps should NEVER be started to check rotation unless the pump is totally submerged. Severe damage may be caused to the pump and motor if they are run dry.

FIGURE 6-A



Single-Phase Wiring Diagram for GRUNDFOS Control Boxes

FIGURE 6-B



Three-Phase Wiring Diagram for GRUNDFOS and FRANKLIN Motors

High Voltage Surge Arresters

A high voltage surge arrester should be used to protect the motor against lightning and switching surges. Lightning voltage surges in power lines are caused when lightning strikes somewhere in the area. Switching surges are caused by the opening and closing of switches on the main high-voltage distribution power lines.

The correct voltage-rated surge arrester should be installed on the supply (line) side of the control box (Figure 6-C and 6-D). The arrester must be grounded in accordance with the National Electrical Code and local codes and regulations

FIGURE 6-C

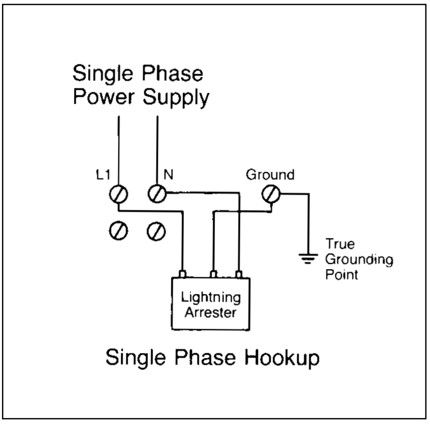
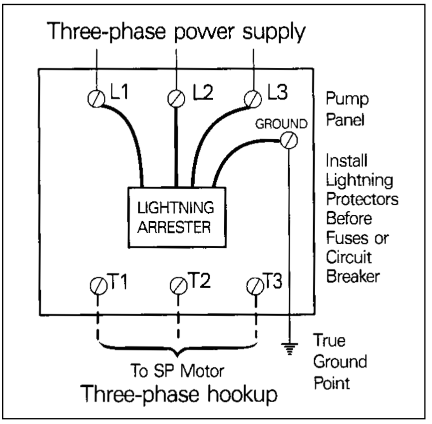


FIGURE 6-D



The warranty on all three-phase submersible motors is VOID if:

1. **The motor is operated with single-phase power through a phase converter.**
2. **Three-leg ambient compensated extra quick-trip overload protectors are not used.**
3. **Three-phase current unbalance is not checked and recorded. (See START-UP Section 7 for instructions.)**
4. **High voltage surge arresters are not installed.**

Control Box/Panel Grounding

The control box or panel shall be permanently grounded in accordance with the National Electrical Code and local codes or regulations. The ground wire should be a bare copper conductor at least the same size as the drop cable wire size. The ground wire should be run as short a distance as possible and be securely fastened to a true grounding point.

True grounding points are considered to be: a grounding rod driven into the water strata, steel well casing submerged into the water lower than the pump setting level, and steel discharge pipes without insulating couplings. If plastic discharge pipe and well casing are used or if a grounding wire is required by local codes, a properly sized bare copper wire should be connected to a stud on the motor and run to the control panel. Do not ground to a gas supply line. Connect the grounding wire to the ground point first and then to the terminal in the control box or panel.

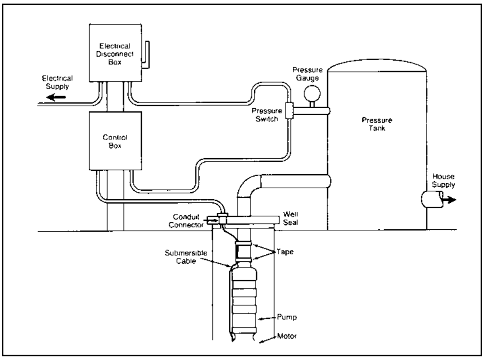
Operating Procedures

Wiring Checks and Installation

Before making the final surface wiring connection of the drop cable to the control box or panel, it is a good practice to check the insulation resistance to ensure that the cable and splice are good. Measurements for a new installation must be at least 2,000,000 ohm. Do not start the pump if the measurement is less than this.

If it is higher than 2,000,000 ohm, the drop cable should then be run through the well seal by means of a conduit connector in such a way as to eliminate any possibility of foreign matter entering the well casing. Conduit should always be used from the pump to the control box or panel to protect the drop cable (See Figure 6-E). Finish wiring and verify that all electrical connections are made in accordance with the wiring diagram. Check to ensure the control box or panel and high voltage surge arrester have been grounded.

FIGURE 6-E



Start-Up

After the pump has been set into the well and the wiring connections have been made, the following procedures should be performed:

A. Attach a temporary horizontal length of pipe with installed gate valve to the riser pipe.
B. Adjust the gate valve one-third of the way open.
C. On three-phase units, check direction of rotation and current unbalance according to the instructions below. For single-phase units proceed directly to “Developing the Well.”
D. Under no circumstances should the pump be operated for any prolonged period of time with the discharge valve closed. This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed at the well head to prevent the pump from running against a closed valve.

Three-Phase Motors

1. Check the direction of rotation

Three-phase motors can run in either direction depending on how they are connected to the power supply. When the three cable leads are first connected to the power supply, there is a 50% chance that the motor will run in the proper direction. To make sure the motor is running in the proper direction, carefully follow the procedures below:

A. Start the pump and check the water quantity and pressure developed.
B. Stop the pump and interchange any two leads.
C. Start the pump and again check the water quantity and pressure.
D. Compare the results observed. The wire connection which gave the highest pressure and largest water quantity is the correct connection.

2. Check for current unbalance

Current unbalance causes the motor to have reduced starting torque, overload tripping, excessive vibration and poor performance which can result in early motor failure. It is very important that current unbalance be checked in all three-phase systems. **Current unbalance between the legs should not exceed 5% under normal operating conditions.**

The supply power service should be verified to see if it is a two or three transformer system. If two transformers are present, the system is an "open" delta or wye. If three transformers are present, the system is true three-phase.

Make sure the transformer ratings in kilovolt amps (KVA) is sufficient for the motor load. See Table C.

The percentage of current unbalance can be calculated by using the following formulas and procedures:

$$\text{Average current} = \frac{\text{Total of current values measured on each leg}}{3}$$

$$\text{\% Current unbalance} = \frac{\text{Greatest amp difference from the average}}{\text{average current}} \quad \text{X 100}$$

To determine the percentage of current unbalance:

A. Measure and record current readings in amps for each leg (hookup 1). Disconnect power.
B. Shift or roll the motor leads from left to right so the drop cable lead that was on terminal 1 is now on 2, lead on 2 is now on 3, and lead on 3 is now on 1 (hookup 2). Rolling the motor leads in this manner will not reverse the motor rotation. Start the pump, measure and record current reading on each leg. Disconnect power.
C. Again shift drop cable leads from left to right so the lead on terminal 1 goes to 2, 2 to 3 and 3 to 1 (hookup 3). Start pump, measure and record current reading on each leg. Disconnect power.
D. Add the values for each hookup.
E. Divide the total by 3 to obtain the average.
F. Compare each single leg reading from the average to obtain the greatest amp difference from the average.
G. Divide this difference by the average to obtain the percentage of unbalance.

Use the wiring hookup which provides the lowest percentage of unbalance. (See Table F for a specific example of correcting for three-phase power unbalance.)

Developing the Well

After proper rotation and current unbalance have been checked, start the pump and let it operate until the water runs clear of sand, silt and other impurities.

Slowly open the valve in small increments as the water clears until the dseired flow rate is reached. Do not operate the pump beyond its maximum flow rating. **The pump should not be stopped until the water runs clear.**

Start-Up

If the water is clean and clear when the pump is first started, the valve should still be **slowly opened until the desired flow rate is reached.** As the valve is being opened, the drawdown should be checked to ensure the pump is always submerged. **The dynamic water level should always be more than 3 feet above the inlet strainer of the pump.**

Disconnect the temporary piping arrangements and complete the final piping connections.

Under no circumstances should the pump be operated for any prolonged period of time with the discharge valve closed. This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed at the well head to prevent the pump from running against a closed valve.

Start the pump and test the system. Check and record the voltage and current draw on each motor lead.

Operation

1. The pump and system should be periodically checked for water quantity, pressure, drawdown, periods of cycling and operation of controls.

2. If the pump fails to operate, or there is a loss of performance, refer to Troubleshooting, Section 8.

Troubleshooting

The majority of problems that develop with submersible pumps are electrical, and most of these problems can be corrected without pulling the pump from the well. The following chart covers most of the submersible service work. As with any troubleshooting procedure, start with the simplest solution first; always make all the above-ground checks before pulling the pump from the well.

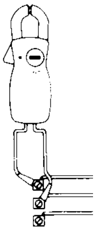
Usually only two instruments are needed – a combination voltmeter/ammeter, and an ohmmeter. These are relatively inexpensive and can be obtained from most water systems suppliers.

WHEN WORKING WITH ELECTRICAL CIRCUITS, USE CAUTION TO AVOID ELECTRICAL SHOCK. It is recommended that rubber gloves and boots be worn and that care is taken to have metal control boxes and motors grounded to power supply ground or steel drop pipe or casing extending into the well. WARNING: Submersible motors are intended for operation in a well. When not operated in a well, failure to connect motor frame to power supply ground may result in serious electrical shock.

Troubleshooting

Preliminary Tests

SUPPLY VOLTAGE



How to Measure

By means of a voltmeter, which has been set to the proper scale, measure the voltage at the control box or starter.

On single-phase units, measure between line and neutral.

On three-phase units, measure between the legs (phases).

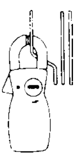
What it Means

When the motor is under load, the voltage should be within ± 10% of the nameplate voltage. Larger voltage variation may cause winding damage.

Large variations in the voltage indicate a poor electrical supply and the pump should not be operated until these variations have been corrected.

If the voltage constantly remains high or low, the motor should be changed to the correct supply voltage.

CURRENT MEASUREMENT



How to Measure

By use of an ammeter, set on the proper scale, measure the current on each power lead at the control box or starter. See Electrical Data, Table E, for motor amp draw information.

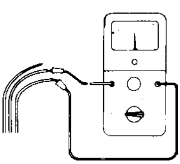
Current should be measured when the pump is operating at a constant discharge pressure with the motor fully loaded.

What it Means

If the amp draw exceeds the listed service factor amps (SFA) or if the current unbalance is greater than 5% between each leg on hree-phase units, check for the following:

1. Burnt contacts on motor starter.
2. Loose terminals in starter or control box or possible cable defect. Check winding and insulation resistances.
3. Supply voltage too high or low.
4. Motor windings are shorted.
5. Pump is damaged, causing a motor overload.

WINDING RESISTANCE



How to Measure

Turn off power and disconnect the drop cable leads in the control box or starter. Using an ohmmeter, set the scale selectors to Rx1 for values under 10 ohms and Rx10 for values over 10 ohms.

Zero-adjust the meter and measure the resistance between leads. Record the values.

Motor resistance values can be found in Electrical Data, Table E. Cable resistance values are in Table G.

What it Means

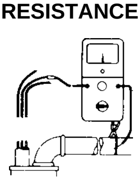
If all the ohm values are normal, and the cable colors correct, the windings are not damaged.

If any one ohm value is less than normal, the motor may be shorted.

If any one ohm value is greater han normal, there is a poor cable connection or joint. The windings or cable may also be open.

If some of the ohm values are greater than normal and some less, the drop cable leads are mixed. To verify lead colors, see resistance values in Electrical Data, Table E.

INSULATION RESISTANCE



How to Measure

Turn off power and disconnect the drop cable leads in the control box or starter. Using an ohm or mega ohmmeter, set the scale selector to Rx 100K and zero-adjust the meter.

Measure the resistance between the lead and ground (discharge pipe or well casing, if steel).

What it Means

For ohm values, refer to table below. Motors of all HP, voltage, phase and cycle duties have the same value of insulation resistance.

Troubleshooting Chart

OHM VALUE	MEGAOHM VALUE	CONDITION OF MOTOR AND LEADS
		Motor not yet installed:
2,000,000 (or more)	2.0	New Motor.
1,000,000 (or more)	1.0	Used motor which can be reinstalled in the well.
		Motor in well (Ohm readings are for drop cable plus motor):
500,000 - 1,000,000	0 5 - 1.0	A motor in reasonably good condition.
20,000 - 500,000	0.02 - 0.5	A motor which may have been damaged by lightning or with damaged leads. Do not pull he pump for this reason.
10,000 - 20,000	0.01 - 0.02	A motor which definitely has been damaged or with damaged cable. The pump should be pulled and repairs made to he cable or he motor replaced. The motor will still operate, but probably not for long.
less than 10,000	0 - 0.01	A motor which has failed or wi h completely destroyed cable insulation. The pump must be pulled and the cable repaired or the motor replaced. The motor will not run in his condition.

A. Pump Does Not Run

POSSIBLE CAUSES	HOW TO CHECK	HOW TO CORRECT
1. No power at pump panel.	Check for voltage at panel.	If no voltage at panel, check feeder panel for tripped circuits.
2. Fuses are blown or circuit breakers are tripped.	Remove fuses and check for continuity with ohmmeter.	Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation and motor must be checked.
3. Motor starter overloads are burnt or have tripped out (three-phase only).	Check for voltage on line or load side of starter.	Replace burnt heaters or reset. Inspect starter for other damage. If heater trips again, check the supply voltage and starter holding coil.
4. Starter does not energize (three-phase only).	Energize control circuit and check for voltage at the holding coil.	If no voltage, check control circuit. If voltage, check holding coil for shorts. Replace bad coil.
5. Defective controls.	Check all safety and pressure switches for operation. Inspect contacts in control devices.	Replace worn or defective parts.
6. Motor and/or cable are defective.	Turn off power. Disconnect motor leads from control box. Measure the lead-to-lead resistances with the ohmmeter (Rx1). Measure lead-to-ground values with ohmmeter (Rx100K). Record measured values.	If open motor winding or ground is found, remove pump and recheck values at the surface. Repair or replace motor or cable.
7. Defective capacitor (single-phase only).	Turn off he power, hen discharge capacitor. Check with an ohmmeter (Rx100K). When meter is connected, the needle should jump forward and slowly drift back.	If there is no needle movement, replace the capacitor.

Troubleshooting Chart

B. Pump Runs But Does Not Deliver Water

POSSIBLE CAUSES	HOW TO CHECK	HOW TO CORRECT
1. Groundwater level in well is too low or well is collapsed.	Check well draw-down. Water level should be at least 3 ft. above pump inlet during operation.	If not, lower pump if possible, or hrot le discharge valve and install water level control.
2. Integral pump check valve is blocked.	Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shut-off. After taking reading, open valve to its previous position. Convert PSI to feet. (For water: PSI x 2.31 ft/PSI = ____ ft.), and add this to the total vertical distance from he pressure gauge to he water level in the well while he pump is running. Refer to the specific pump curve for he shut-off head for that pump model. If the measured head is close to the curve, pump is probably OK.	If not close to the pump curve, remove pump and inspect discharge section. Remove blockage, repair valve and valve seat if necessary. Check for other damage. Rinse out pump and re-install.
3. Inlet strainer is clogged.	Same as B.2 above.	If not close to the pump curve, remove pump and inspect. Clean strainer, inspect integral check valve for blockage, rinse out pump and re-install.
4. Pump is damaged.	Same as B.2 above.	If damaged, repair as necessary. Rinse out pump and re-install.

C. Pump Runs But at Reduced Capacity

POSSIBLE CAUSES	HOW TO CHECK	HOW TO CORRECT
1. Wrong rotation (three-phase only).	Check for proper electrical connection in control panel.	Correct wiring and change leads as required.
2. Draw-down is larger than anticipated.	Check draw-down during pump operation.	Lower pump if possible. If not, throttle discharge valve and install water level control.
3. Discharge piping or valve leaking.	Examine system for leaks.	Repair leaks.
4. Pump strainer or check valve are clogged.	Same as B.2 above.	If not close to the pump curve, remove pump and inspect. Clean strainer, inspect integral check valve for blockage, rinse out pump and re-install.
5. Pump worn.	Same as B.2 above.	If not close to pump curve, remove pump and inspect.

D. Pump Cycles Too Much

POSSIBLE CAUSES	HOW TO CHECK	HOW TO CORRECT
1. Pressure switch is not properly adjusted or is defective.	Check pressure setting on switch and operation. Check voltage across closed contacts.	Re-adjust switch or replace if defective.
2. Level control is not properly set or is defective.	Check setting and opera ion.	Re-adjust setting (refer to manufacturer data) Replace if defective.
3. Insufficient air charging or leaking tank or piping.	Pump air into tank or diaphram chamber. Check diaphram for leak. Check tank and piping for leaks wi h soap and water solution. Check air to water volume.	Repair or replace damaged component.
4. Plugged snifter valve or bleed orifice.	Examine valve and orifice for dirt or corrosion.	Clean and/or replace if defective.
5. Tank is too small.	Check tank size. Tank volume should be approximately 10 gallons for each gpm or pump capacity.	If tank is too small, replace with proper size tank.

E. Fuses Blow or Circuit Breakers Trip

POSSIBLE CAUSES	HOW TO CHECK	HOW TO CORRECT
1. High or low voltage.	Check voltage at pump panel. If not within ± 10%, check wire size and length of run to pump panel.	If wire size is correct, contact power company. If not, correct and/or replace as necessary.
2. Three-phase current unbalance.	Check current draw on each lead. Unbalance must be within ± 5%.	If current unbalance is not within ± 5%, contact power company.
3. Control box wiring and components (single-phase only).	Check that control box parts match the parts list. Check to see hat wiring matches wiring diagram. Check for loose or broken wires or terminals.	Correct as required.
4. Defective capacitor (single-phase only).	Turn off power and discharge capacitor. Check using an ohmmeter (Rx100K). When the meter is connected, he needle should jump forward and slowly drift back.	If no meter movement, replace the capacitor.
5. Starting relay (Franklin single-phase motors only).	Check resistance of relay coil with an ohmmeter (Rx1000K). Check contacts for wear.	Replace defective relay.

Technical Data

Table A

Minimum Water Flow Requirements for Submersible Pump Motors

MOTOR DIAMETER	CASING OR SLEEVE I.D. IN INCHES	MIN. FLOW PAST THE MOTOR (GPM)
4”	4	1.2
	5	7
	6	13
	7	21
	8	30
6”	6	10
	7	28
	8	45
	10	85
	12	140
	14	198
	16	275
8”	8	10
	10	55
	12	110
	14	180
	16	255
10”	10	30
	12	85
	14	145
	16	220
	18	305

NOTES:

1. A flow inducer or sleeve must be used if he water enters the well above the motor or if there is unsufficient water flow past the motor.
2. The minimum recommended water velocity over 4” motors is 0.25 feet per second.
3. The minimum recommended water velocity over 6, 8, and 10” motors is 0.5 feet per second.

Table B

Guide for Engine-Driven Generators in Submersible Pump Applications

	MINIMUM KILOWATT RATING OF GENERATOR FOR THREE-WIRE SUBMERSIBLE PUMP MOTORS	
MOTOR HP SINGLE OR THREE PHASE UNITS	EXTERNALLY REGULATED GENERATOR	INTERNALLY REGULATED GENERATOR
0.33 HP	1.5 KW	1.2 KW
0.50	2.0	1.5
0.75	3.0	2.0
1.0	4.0	2.5
1.5	5.0	3.0
2.0	7.5	4.0
3.0	10.0	5.0
5.0	15.0	7.5
7.5	20.0	10.0
10.0	30.0	15.0
15.0	40.0	20.0
20.0	60.0	25.0
25.0	75.0	30.0
30.0	100.0	40.0
40.0	100.0	50.0
50.0	150.0	60.0
60.0	175.0	75.0
75.0	250.0	100.0
100.0	300.0	150.0
125.0	375.0	175.0
150.0	450.0	200.0
200.0	600.0	275.0

NOTES:

1. Table is based on typical 80°C rise continuous duty generators with 35% maximum voltage dip during start-up of single-phase and three-phase motors.
2. Contact the manufacturer of the generator to assure the unit has adequate capacity to run he submersible motor.
3. If the generator rating is in KVA instead of kilowatts, multiply the above ratings by 1 25 to obtain KVA.

Table C

Transformer Capacity Required for Three-Phase Submersible Pump Motors

		MINIMUM KVA RATING FOR EACH TRANSFORMER	
THREE-PHASE MOTOR HP	MINIMUM TOTAL KVA REQUIRED*	2 TRANSFORMERS OPEN DELTA OR WYE	3 TRANSFORMERS DELTA OR WYE
1 5	3	2	1
2	4	2	1-1/2
3	5	3	2
5	7-1/2	5	3
7.5	10	7-1/2	5
10	15	10	5
15	20	15	7-1/2
20	25	15	10
25	30	20	10
30	40	25	15
40	50	30	20
50	60	35	20
60	75	40	25
75	90	50	30
100	120	65	40
125	150	85	50
150	175	100	60
200	230	130	75

* Pump motor KVA requirements only, and does not include allowances for o her loads.

Table D

Submersible Pump Cable Selection Chart (60 Hz)

The following tables list the recommended copper cable sizes and various cable lengths for submersible pump motors.

These tables comply with the 1978 edition of the National Electric Table 310-16, Column 2 for 75°C wire. The ampacity (current carrying properties of a conductor) have been divided by 1.25 per the N.E.C., Article 430-22, for motor branch circuits based on motor amps at rated horsepower.

To assure adequate starting torque, the maximum cable lengths are calculated to maintain 95% of the service entrance voltage at the motor when the motor is running at maximum nameplate amps. Cable sizes larger than specified may always be used and will reduce power usage.

The use of cables smaller than the recommended sizes will void the warranty. Smaller cable sizes will cause reduced starting torque and poor motor operation.

Single-Phase Motor Maximum Cable Length
(Motor to service entrance) (2)

VOLTS	HP	14	12	10	8	6	4	2	0	00	000	0000	250	300
115	1/3	130	210	340	540	840	1300	1960	2910					
	1/2	100	160	250	390	620	960	1460	2160					
230	1/3	550	880	1390	2190	3400	5250	7960						
	1/2	400	650	1020	1610	2510	3880	5880						
	3/4	300	480	760	1200	1870	2890	4370	6470					
	1	250	400	630	990	1540	2380	3610	5360	6520				
	1-1/2	190	310	480	770	1200	1870	2850	4280	5240				
	2	150	250	390	620	970	1530	2360	3620	4480				
	3	120	190	300	470	750	1190	1850	2890	3610				
	5			180	280	450	710	1110	1740	2170				
	7-1/2				200	310	490	750	1140	1410				
	10					250	390	600	930	1160				

CAUTION: Use of wire size smaller han listed will void warranty.

FOOTNOTES:

1. If aluminum conductor is used, mul iply lengths by 0.5. Maximum allowable length of aluminum is considerably shorter than copper wire of same size.
2. The por ion of the total cable which is between the service entrance and a 3Ø motor starter should not exceed 25% of the total maximum leng h of assure reliable starter operation. Single-phase control boxes may be connected at any point of the total cable length.
3. Cables #14 to #0000 are AWG sizes, and 250 to 300 are MCM sizes.

Technical Data

Three-Phase Motor Maximum Cable Length

(Motor to service entrance) (2)

VOLTS	HP	14	12	10	8	6	4	2	0	00	000	0000	250	300
208	1-1/2	310	500	790	1260									
	2	240	390	610	970	1520								
	3	180	290	470	740	1160	1810							
	5		170	280	440	690	1080	1660						
	7-1/2			200	310	490	770	1180	1770					
	10				230	370	570	880	1330	1640				
	15					250	390	600	910	1110	1340			
	20						300	460	700	860	1050	1270		
	25							370	570	700	840	1030	1170	
	30							310	470	580	700	850	970	1110
230	1-1/2	360	580	920	1450									
	2	280	450	700	1110	1740								
	3	210	340	540	860	1340	2080							
	5		200	320	510	800	1240	1900						
	7-1/2			230	360	570	890	1350	2030					
	10	`			270	420	660	1010	1520	1870				
	15					290	450	690	1040	1280	1540			
	20						350	530	810	990	1200	1450		
	25						280	430	650	800	970	1170	1340	
	30							350	540	660	800	970	1110	1270
460	1-1/2	1700												
	2	1300	2070											
	3	1000	1600	2520										
	5	590	950	1500	2360									
	7-1/2	420	680	1070	1690	2640								
	10	310	500	790	1250	1960	3050							
	15			540	850	1340	2090	3200						
	20			410	650	1030	1610	2470	3730					
	25				530	830	1300	1990	3010	3700				
	30				430	680	1070	1640	2490	3060	3700			
	40						790	1210	1830	2250	2710	3290		
	50						640	980	1480	1810	2190	2650	3010	
	60							830	1250	1540	1850	2240	2540	2890
	75								1030	1260	1520	1850	2100	2400
	100									940	1130	1380	1560	1790
	125											1080	1220	1390
	150												1050	1190
	200												1080	1300
	250													1080
575	1-1/2	2620												
	2	2030												
	3	1580	2530											
	5	920	1480	2330										
	7-1/2	660	1060	1680	2650									
	10	490	780	1240	1950									
	15		530	850	1340	2090								
	20			650	1030	1610	2520							
	25			520	830	1300	2030	3110						
	30				680	1070	1670	2560	3880					
	40					790	1240	1900	2860	3510				
	50						1000	1540	2310	2840	3420			
	60						850	1300	1960	2400	2890	3500		
	75							1060	1600	1970	2380	2890	3290	
	100								1190	1460	1770	2150	2440	2790

CAUTION: Use of wire size smaller han listed will void warranty. FOOTNOTES: 1. If aluminum conductor is used, multiply lengths by 0.5. Maximum allowable length of aluminum is considerably shorter han copper wire of same size. 2. The portion of the total cable which is between he service entrance and a 3Ø motor starter should not exceed 25% of the total maximum length of assure reliable starter operation. Single-phase control boxes may be connected at any point of the total cable length. 3. Cables #14 to #0000 are AWG sizes, and 250 to 300 are MCM sizes.

Electrical Data

Submersible Pump Motors - 60Hz

GRUNDFOS MOTORS

HP	PH	VOLT	S.F.	CIR. BRKR OR FUSES STD.	CIR. BRKR OR FUSES DELAY	AMPERAGE START	AMPERAGE MAX.	FULL LOAD EFF. (%)	FULL LOAD PWR FACT.	MAX. THRUST (LBS)	NAMEPLATE NO.	GRUNDFOS PRODUCT NO.
4-Inch, Single Phase, 2-Wire Motors (control box not required)												
1/3	1	230	1.75	15	5	25.7	4.6	59	77	750	79952101	791595016
1/2	1	230	1.60	15	7	34.5	6.0	62	76	750	79952102	791595026
3/4	1	230	1.50	20	9	40.5	8.4	62	75	750	79952103	791595036
1	1	230	1.40	25	12	48.4	9.8	63	82	750	79952104	791595046
1-1/2	1	230	1.30	35	15	62.0	13.1	64	85	750	79952105	791595056
4-Inch, Single Phase, 3-Wire Motors												
1/3	1	230	1.75	15	5	14.0	4.6	59	77	750	79453101	791545016
1/2	1	230	1.60	15	7	21.5	6.0	62	76	750	79453102	791545026
3/4	1	230	1.50	20	9	31.4	8.4	62	75	750	79453103	791545036
1	1	230	1.40	25	12	37.0	9.8	63	82	750	79453104	791545046
1-1/2	1	230	1.30	35	15	45.9	11.6	69	89	750	79453105	791545056
4-Inch, Three Phase, 3-Wire Motors												
1-1/2	3	230	1.30	15	8	40.3	7.3	75	72	750	79302005	791530056
		460	1.30	10	4	20.1	3.7	75	72	750	79362005	791536056
		575	1.30	10	4	16.1	2.9	75	72	750	79392005	791539056
2	3	230	1.25	20	10	48	8.7	76	75	750	79302006	791530066
		460	1.25	10	5	24	4.4	76	75	750	79362006	791536066
		575	1.25	10	4	19.2	3.5	76	75	750	79392006	791539066
3	3	230	1.15	30	15	56	12.2	77	75	1000	79304507	96405801
		460	1.15	15	7	28	6.1	77	75	1000	79354507	96405810
		575	1.15	15	6	22	4.8	77	75	1000	79394507	96405815
5	3	230	1.15	40	25	108	19.8	80	82	1000	79304509	96405802
		460	1.15	20	12	54	9.9	80	82	1000	79354509	96405811
		575	1.15	15	9	54	7.9	80	82	1000	79394509	96405816
7-1/2	3	230	1.15	60	30	130	25.0	81	82	1000	79305511	96405805
		460	1.15	35	15	67	13.2	81	82	1000	79355511	96405814
		575	1.15	30	15	67	10.6	81	82	1000	79395511	96405819
6-Inch, Three Phase, 3-Wire Motors												
7-1/2	3	230	1.15	60	35	119	26.4	80.5	76	1000	78305511	96405781
		460	1.15	30	15	59	13.2	80.5	76	1000	78355511	96405794
10	3	230	1.15	80	45	156	34.0	82.5	79	1000	78305512	96405782
		460	1.15	40	20	78	17.0	82	79	1000	78355512	96405795
15	3	230	1.15	150	80	343	66.0	84	81	4400	78305516	96405784
		460	1.15	60	30	115	24.5	82.5	82	440	78355514	96405796
20	3	230	1.15	150	80	343	66.0	84	81	4400	78305516	96405784
		460	1.15	80	40	172	33.0	84	82	4400	78355516	96405797
25	3	460	1.15	100	50	217	41.0	84.5	80	4400	78355517	96405798
30	3	460	1.15	110	60	237	46.5	85	83	4400	78355518	96405799
40	3	460	1.15	150	80	320	64.0	85	82	4400	78355520	96405800

HITACHI MOTORS

6 Inch (Three Wire) Motors

60 HZ

HP	PH	Volts	Service Factor	Circuit Breaker or Standard Fuse	Dual Element Fuse	AMPERAGE Full Load	Locked Rotor	S.F. Amps	FULL LOAD Eff.	Power Factor	Line-to-Line Resistance (Ohms) Blk-Yel	Red-Yel	KVA Code ***	Three-Phase Overload Protection Starter Size	Furnas Amb. Comp	Maximum Thrust (lbs.)	GRUNDFOS PART NO.
											Delta						
5	1	230	1.15	80	35	23.8	124	27.1	74.8	91.2	0.51	2.2	G	-	-	1500	82.4119H
	3	230	1.15	45	20	14.8	110	16.4	76.8	82.5	0.81		K	1	K58	1500	82.9915H3
	3	460	1.15	25	10	7.4	55	8.2	76.8	82.5	3.05		K	1	K43	1500	82.9915H6
7-1/2	1	230	1.15	125	45	35.2	167	40.9	72.9	94.9	0.40	1.40	F	-	-	1500	82.4121H
	3	230	1.15	70	30	21.8	144	24.4	78.5	81.8	0.65		J	1	K64	1500	82.9116H3
	3	460	1.15	35	15	10.9	72	12.2	78.5	81.8	2.43		J	1	K54	1500	82.9916H65
10	1	230	1.15	175	60	48.0	202	54.0	73.6	93.2	0.32	1.05	#	-	-	3500	82.4123H
	3	230	1.15	80	40	28.2	208	32.0	79.3	82.8	0.45		K	1.75	K68	3500	82.9117H3
	3	460	1.15	40	20	14.3	104	16.0	79.3	82.8	1.62		K	1	K58	3500	82.9117H6
15	1	230	1.15	250	100	70.8	275	84.9	73.7	93.2	0.23	0.68	D	-	-	3500	82.9118H3
	3	230	1.15	125	60	41.4	320	46.2	81.7	83.2	0.31		K	2	K74	3500	82.9118H3
	3	460	1.15	60	30	20.7	160	23.1	81.7	83.2	1.07		K	1.75	K63	3500	82.9118H6
20	3	230	1.15	175	70	53.0	392	63.0	83.2	84.9	0.26		K	2.5	K77	3500	82.9119H3
	3	460	1.15	90	35	26.5	196	30.0	83.2	84.9	0.86		K	2	K67	3500	82.9119H6
25	3	230	1.15	200	90	67.2	530	75.4	83.0	83.9	0.21		K	3	K83	3500	82.9120H3
	3	460	1.15	100	45	33.6	265	37.7	83.0	83.9	0.67		K	2	K72	3500	82.9120H6
30	3	230	1.15	250	110	80.8	610	90.6	82.5	84.3	0.16		K	3	K86	3500	82.9121H3
	3	460	1.15	125	50	40.4	305	45.3	82.5	84.3	0.55		K	2.5	K74	3500	82.9121H6
40	3	460	1.15	150	70	51.7	340	58.8	84.0	86.3	0.46		H	3	K76	5000	82.3228H
50	3	460	1.15	200	90	69.7	465	78.8	82.5	81.4	0.39		J	3	K83	5000	82.3229H
60	3	460	1.15	225	100	80.8	465	92.8	82.4	84.4	0.39		G	3.5	K86	5000	82.3230H

8 Inch Motors

40	3	460	1.15	150	70	54.3	380	60.9	83.9	82.1	0.37	J	3	K76	10,000	82,3270H
50	3	460	1.15	200	90	64.9	435	73.6	84.1	85.7	0.33	H	3	K78	10,000	82,3271H
60	3	460	1.15	225	100	77.8	510	88.5	84.7	85.3	0.28	H	3.5	K86	10,000	82,3272H
75	3	460	1.15	350	150	96.7	650	110	84.9	85.9	0.22	H	3.5	K88	10,000	82,3274H
100	3	460	1.15	400	175	127	795	145	85.2	86.6	0.16	H	4	K89	10,000	82,3275H
125	3	460	1.15	500	225	172.0	980	192	84.2	80.9	0.14	G	4.5	K28	10,000	82,36H042
150	3	460	1.15	600	250	187.0	1060	216	85.6	87.9	0.13	G	4.5	K29	10,000	82.36H043

10 Inch Motors

200	3	460	1.15	800	350	233.0	1260	270	87.2	92.2	0.09	F	5	K33	10,000	82,36H064
250	3	460	1.15	900	450	294.0	1500	344	86.5	92.1	0.08	E	6	K27	10,000	82,36H066

FRANKLIN MOTORS

(refer to the Franklin Submersible Motors Application Maintenance Manual)

Table F

Example: Correcting for Three-Phase Power Unbalance

Example: Check for current unbalance for a 230 volt, 3 phase, 60 Hz submersible pump motor, 18.6 full load amps.

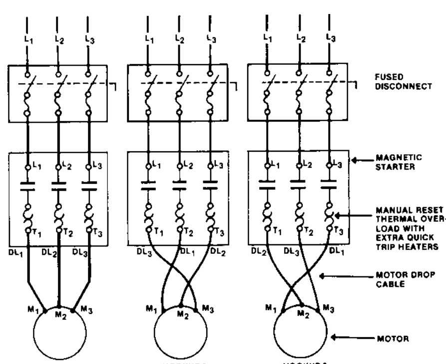
Solution: Steps 1 to 3 measure and record amps on each motor drop lead for Hookups 1, 2 and 3.

	Step 1 (Hookup 1)	**Step 2** (Hookup 2)	**Step 3** (Hookup 3)
(T_1)	Dl_1 = 25.5 amps	DL_3 = 25 amps	DL_2 = 25.0 amps
(T_2)	DL_2 = 23.0 amps	DL_1 = 24 amps	DL_3 = 24.5 amps
(T_3)	DL_3 = 26.5 amps	DL_2 = 26 amps	DL_1 = 25.5 amps
Step 4	Total = 75 amps	Total = 75 amps	Total = 75 amps
Step 5	Average Current =	total current = / 3 readings	75 / 3 = 25 amps
Step 6	Greatest amp difference from the average:	(Hookup 1) = 25-23 = 2 (Hookup 2) = 26-25 = 1 (Hookup 3) = 25.5-25 = .5	
Step 7	% Unbalance	(HOOKUP 1) = 2/25 X 100 = 8 (HOOKUP 2) = 1/25 X 100 = 4 (HOOKUP 3) = .5/25 X 100 = 2	

As can be seen, Hookup 3 should be used since it shows the least amount of current unbalance. Therefore, the motor will operate at maximum efficiency and reliability.

By comparing the current values recorded on each leg, you will note the highest value was always on the same leg, L_3. This indicates the unbalance is in the power source. If the high current values were on a different leg each time the leads were changed, the unbalance would be caused by the motor or a poor connection.

If the current is greater than 5%, contact your power company for help.



*For a detailed explanation of three-phase balance procedures, see Three-Phase Motor, section 2, page 6.

Technical Data

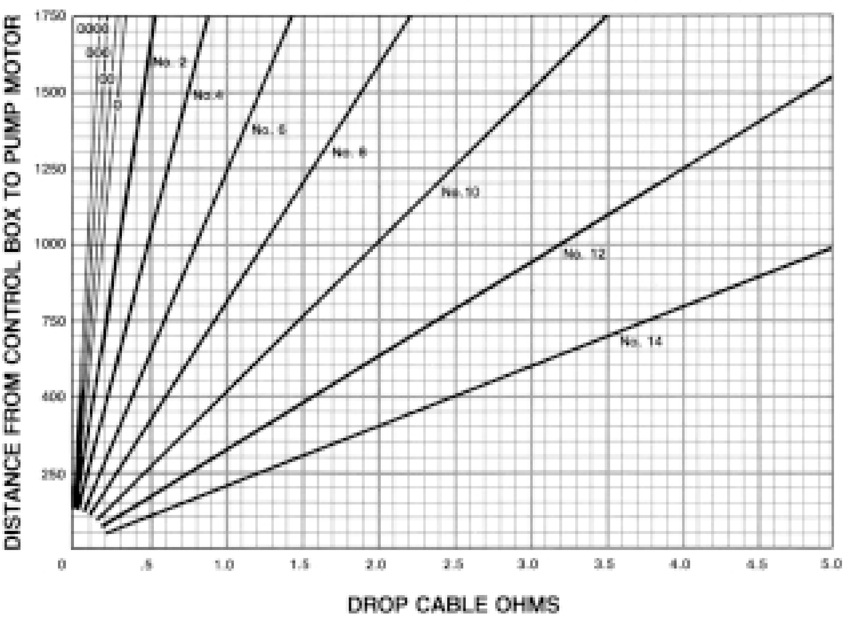
Table G

Total Resistance of Drop Cable (OHMS)

The values shown in this table are for copper conductors. Values are for the total resistance of drop cable from the control box to the motor and back.

To determine the resistance:

1. Disconnect the drop cable leads from the control box or panel.
2. Record the size and length of drop cable.
3. Determine the cable resistance from the table.
4. Add drop cable resistance to motor resistance. Motor resistances can be found in the Electrical Data Chart, Table E.
5. Measure the resistance between each drop cable lead using an ohmmeter. Meter should be set on Rx1 and zero-balanced for this measurement.
6. The measured values should be approximately equal to the calculated values.



Notes

LIMITED WARRANTY

Products manufactured by GRUNDFOS PUMPS CORPORATION (GRUNDFOS) are warranted to the original user only to be free of defects in material and workmanship for a period of 18 months from date of installation, but not more than 24 months from date of manufacture. GRUNDFOS' liability under this warranty shall be limited to repairing or replacing at GRUNDFOS' option, without charge, F.O.B. GRUNDFOS' factory or authorized service station, any product of GRUNDFOS' manufacture. GRUNDFOS will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by GRUNDFOS are subject to the warranty provided by the manufacturer of said products and not by GRUNDFOS' warranty. GRUNDFOS will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with GRUNDFOS' printed installation and operating instructions.

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Grundfos Pumps Corporation • 3131 N. Business Park Avenue • Fresno, CA 93727
Customer Service Centers: Allentown, PA • Fresno, CA
Phone: (800) 333-1366 • **Fax:** (800) 333-1363
Canada: Oakville, Ontario • **Mexico:** Apodaca, N.D.

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