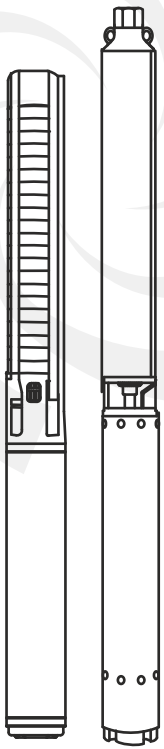
NORTHAM®©

Installation and Operating Instructions



4" Submersible Deep Well Pumps and Motors

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PURCHASER'S INFORMATION

Pump Model #: _____

Pump Serial #: _____

Motor Model #: _____

Motor Serial #: _____

Dealer Name: _____

Dealer Telephone: _____

Purchase Date: _____

Installation Date: _____

Volts: _____

Amps: _____

GENERAL DESCRIPTION

NORTHAM Submersible Pumps and Motors shall provide you with years of reliable, efficient and safe pumping solution for your water needs provided the installation is carried out as described in this manual.

Before installing, operating, using, or maintaining the submersible pump and/or motor, it's essential to read these instructions. Additionally ensure that the submersible pump and/or motor is not utilized until all safety conditions outlined in the instruction manual are satisfied.

The purpose of the instructions, warnings, cautions and notes included in this manual is to help you become familiar with the product and its allowed uses.

The instructions may not take into account local regulations; ensure such regulations are properly complied by all, including those installing the product. Ensure that installation and operation adhere to local regulations and accepted standards of good practice.

These instructions apply specifically to NORTHAM submersible pumps and motors. If the pump or motor is coupled or is going to be coupled with a motor or pump of any other make other than NORTHAM, then kindly refer to instructions provided with the submersible motor or pump of other make and ignore the motor or pump instructions provided in this manual.

Before proceeding with installation, carefully review these instructions for safe and proper installation.

SYMBOLS USED IN THIS DOCUMENT

Warning
Neglecting these safety instructions could result in explosion, fire or electric shock, posing a significant risk of severe personal injury, or even death, as well as property damage.

Caution Failure to adhere to these safety instructions may lead to equipment malfunction or damage.

Note These notes or instructions aim to streamline the task and ensure safe operation.

GENERAL SAFETY INFORMATION

During installation, operation as well as servicing of the submersible pumps and/or submersible motors follow safety instructions as listed below. Failure to follow these instructions may result in electrical shock, fire hazard, personal injury or death, equipment damage, inadequate product performance and may also void manufacturer's warranty.

SAFETY INSTRUCTIONS

- The pump and/or motor should be installed, connected to power source and serviced by qualified electrician only.
- During installation, operation as well as servicing of the pump and/or motor, do not touch any electrical components when power supply is switched on.
- Ensure all power sources are disconnected and locked in OFF position when installing or repairing the pump and/or motor.
- Follow all appropriate electrical codes.
- Always follow the National Electrical Code (NEC), or the Canadian Electrical Code. Check local codes and regulations before installation. The installation must comply with these requirements.
- Failure to follow electrical codes & OSHA safety standards could lead to personal injury or death and may also lead to damage of the equipment.
- The pumps and motors are not designed and investigated for safety when used in swimming pools.
- Do not use to pump flammable, combustible, or explosive liquids such as gasoline, oil, kerosene, etc.
- This pump should be used to pump clear water only
- Please wear protective clothes and safety glasses for personal protection when installing or repairing the pump and/or motor.
- Operators should be properly instructed on operating procedures & safety guidelines.
- During installation make sure that the lifting apparatus is properly tightened before attempting to lift the pump and/or motor. Carelessness during lifting or transportation may cause injury to personnel or damage to the pump and/or motor.
- Pump and/or motor must be lifted manually or by means of a hoist. Never lift the pump and/or motor by means of the motor cable.
- Assembled pumping units and their components are heavy. Failure to properly lift and support equipment can result in serious physical injury and/or equipment damage.
- Pump must be installed in a vertical position. Horizontal installation is allowed only if the pump size is identical to the motor size, e.g. 4" pump with 4" motor. Pump installed in any other position will void the warranty.
- Pump with Motor should always be electrically grounded. Motor cable shall only be connected to power source after grounding is done.
- Motor must be completely submerged in water when it is used.
- Lock the mains switch in "OFF" position when maintenance is progress.
- Do not put your hands or any tool into the pump suction or discharge port after the pump has been connected to the power supply, unless the pump has been switched off by removing the fuses or switching off and locking the mains switch in OFF position. It must be ensured that the power supply cannot be accidentally switched on.
- Never disassemble the motor.
- Never use the motor in combination with damaged pump units or parts.
- Do not run pump dry. Dry running can overheat pump and will void warranty.
- Always use only original genuine factory spare parts.
- Please keep out of the reach of children.

INSTALLATION

Before commencing the installation, ensure to turn off the power supply and securely lock the main switch in the OFF position.

Caution Avoid starting the pump to check the direction of rotation until it has been fully immersed in water.

PRE-INSTALLATION CHECKLIST

Before initiating the installation procedures, please conduct the following checks:

- Inspect all components for potential damage during transit and notify the shipping carrier or your dealer/ distributor if any damage is found.
- Confirm motor and pump rating that are paired and ensure that the power supply matches with motor as well as controller too.
- The mounting location of the controller should be dry and shaded.
- Use waterproof splice connections for all splices which are underwater and underground.
- Inspect all piping connections to ensure they are tight and sealed with PTFE thread sealing tape.
- Confirm that the pressure rating of the pipe is higher than the shut-off pressure of the pump.
- Install a pressure relief valve on any pumping system when the pump shut off pressure exceeds the recommended working pressure of the pressure tank.
- Inspect the condition of the well for proper installation.
- Check the condition of the water and ensure that it is compatible with material of construction of the pump and motor.
- Check water temperature being pumped to ensure it does not exceed more than the maximum temperature of service declared by the manufacturer of pump and motor. Ensure that the flow of water on surface of the motor in the well exceeds the minimum velocity required for proper cooling of the motor.
- Prepare the motor for installation and add cable length as required based on depth of installation. Prepare for installation of piping and pipe work connections.

All of these checks are essential for correctly installing the submersible pump and it's imperative to adhere to all safety regulations during the installation process.

The pump must always be connected to a suitable electrical ground, such as a grounded water pipe, a grounded metal pathway, or a grounded wire system.

Do not put your hands or any tool into the pump suction or discharge port after the pump has been connected to the power supply, unless the pump has been switched off by removing the fuses or switching off the mains switch. It must be ensured that the power supply cannot be accidentally switched on.

Do not lift the pump and/or motor by power cable. Only use the lifting apparatus for lifting the pump. Do not use it to hold the pump when in operation.

Caution ***THE WARRANTY SHALL BECOME VOID UNDER THE FOLLOWING CIRCUMSTANCES***

- If the pump has pumped an excessive amount of sand, it can lead to premature wear and damage to the pump.
- If the water is corrosive or contaminated with dirt.
- If there is entrained gas or air in the water being pumped, it can decrease the flow and lead to cavitation, potentially causing damage to the pump.
- Operating the pump with discharge valve closed may result in severe internal damage due to increase in temperature of water.
- Damage resulting from failure to install the product as specified in the owner's manual.
- Damage caused by unauthorized product modifications or failure to use NORTHAM original replacement parts.
- Damage caused by negligence, or failure to properly maintain product as specified in the owner's manual.
- Accidental damage, fire, acts of God, or other circumstances outside the control of NORTHAM.

INSTALLATION

CONDITION OF THE WELL

For installation of the pump in a new well, ensure the well is fully developed by using compressed air to clear the sand from the well.

The careful selection of materials used in construction of NORTHAM submersible pump offers resistant to abrasion; nevertheless, no material regardless of its composition, can indefinitely withstand the erosive effects of continuous pumping of sand-laden water.

Determine the maximum well depth and the draw-down level when the pump operates at maximum capacity. Use this data to select pump and determine the appropriate setting depth.

Ensure that the inside diameter of the well casing is adequate for pump installation.

INSTALLATION DEPTH

- Verify that the pump is installed at a depth of at least 30 feet below the maximum draw-down level of the well to ensure optimal operation.
- Avoid positioning the bottom of the motor lower than the top of the well screen or within 5 feet of the well bottom.
- When installing the pump in a lake, pond, tank or large diameter well, ensure that the water velocity passing over the motor is adequate for proper cooling.

POSITIONAL REQUIREMENTS

Depending on the size of the motor joining, the pump can be positioned vertically or horizontally. Horizontal installation is permitted only when the pump size matches the motor size (e.g. a 4" pump with a 4" motor). However, the pump shaft must never fall below the horizontal plane, see fig. 1.

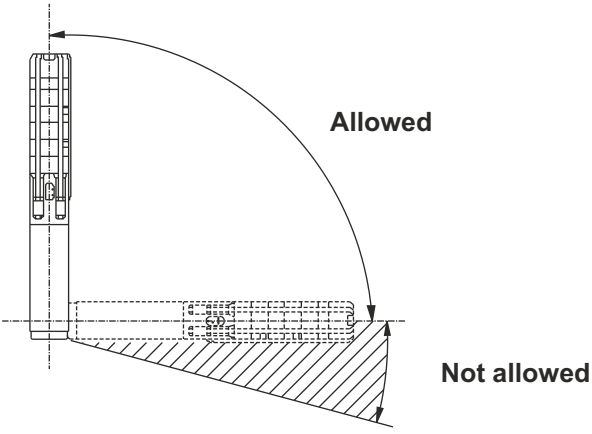

Fig. 1 PUMP POSITION

TYPICAL INSTALLATION

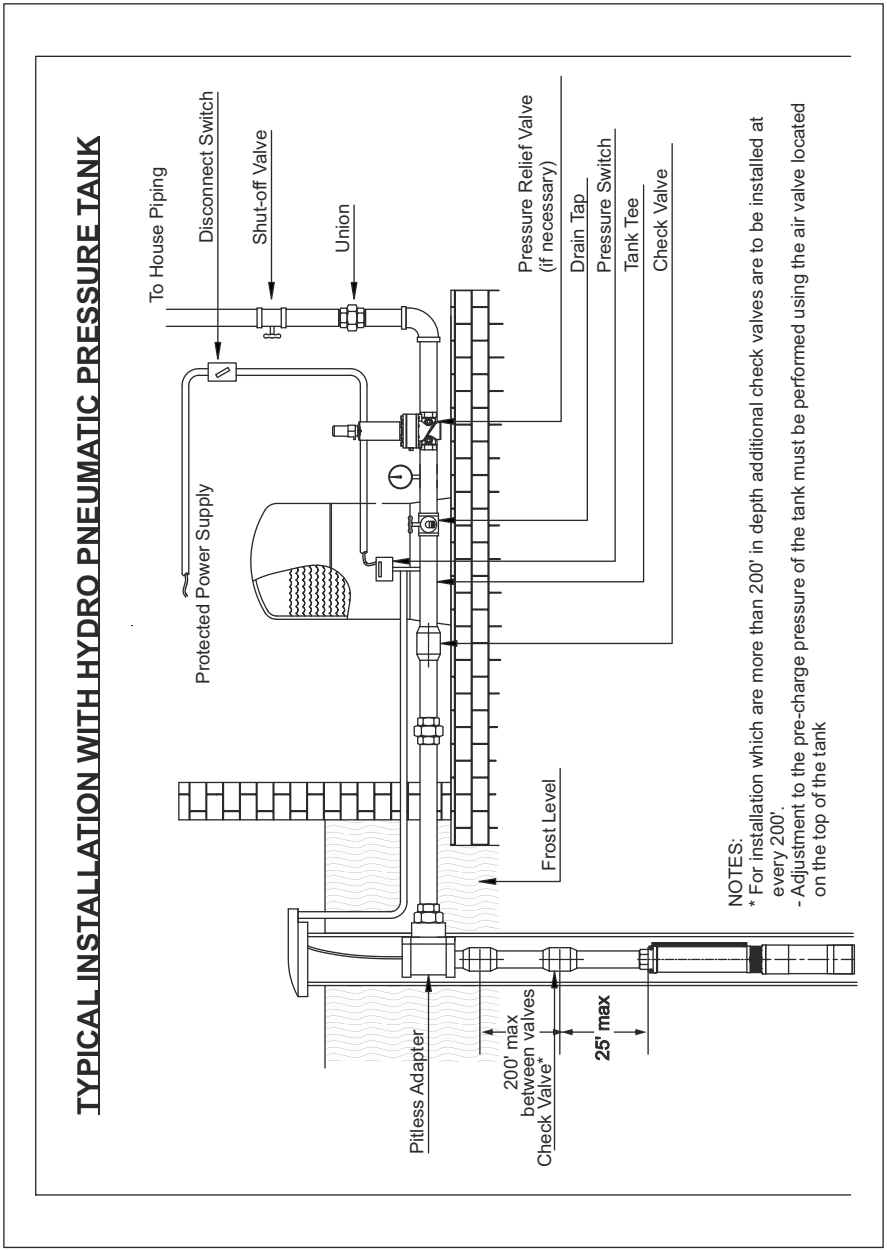

Fig. 2 TYPICAL PUMP INSTALLATION

PIPEWORK CONNECTIONS

Ensure that the pump discharge pipes are adequately sized to optimize pump performance.

Recommended pipe size:
Up to 10 GPM - 1"
Up to 30 GPM - 1¼"
Up to 45 GPM - 1½"
Up to 80 GPM - 2"

It is advisable to use larger pipe size for long pipe runs.
Note You can contact your pipe supplier, for suitable pipe size.

HYDRO PNEUMATIC PRESSURE TANK

The Hydro Pneumatic Pressure tank should be placed in dry and well ventilated location.

Caution Select a location where any tank leakage won't result in damage to the property.

Ensure that the pressure switch is positioned no more than 4' away from the tank, ideally it should be located at the tank's cross tee.

Caution To prevent switch chatter, do not install valves and filters between the switch and the tank.

Position the pressure switch as centrally as possible when installing multiple tanks. For this set-up, use a header pipe with a diameter at least 1.5 times larger than the supply pipe from the pump to minimize friction loss in the header pipe.

Install a pressure relief valve in the system capable of handling pressures up to 100 psi or 230' of TDH.

To check the pre-charge pressure of tank, use a high quality pressure gauge and measure after emptying the tank. The pressure should be set 2 to 5 psi below the pump cut-in pressure. As an instance, a 30-50 psi system would require a tank pre-charge of 28 to 25 psi.

DISCHARGE PIPE

Most discharge outlet of the pump are threaded onto the housing with left-hand threads. When installing accessories, only hold the pump at the discharge outlet. Failure to secure the discharge outlet can cause it to loosen and damage the pump during start-up.

If the adapter for piping is required, stainless steel is recommended to avoid corrosion. Never connect fittings other than stainless steel directly to a stainless steel discharge outlet to prevent corrosion in the piping.

The pump discharge outlet comes with a loop for attaching a safety cable. It's always advisable to use a safety cable when using polyethylene or any plastic pipe, as the pipe stretches when under pressure and in case of pipe failure the pump can be prevented to fall in the well.

ASSEMBLE PUMP END TO MOTOR END

Prior to commencing any work on the pump/motor, ensure that the power supply has been deactivated and it cannot be accidently activated. The mains has to be locked in OFF position.

Prevent the pump, pressure tank, piping, or any water containing system components from freezing, as it can cause damage to the system, potentially leading to injury or flooding. Allowing freezing to occur will void the warranty.

PIPEWORK CONNECTIONS

FITTING THE MOTOR TO THE PUMP

When the pump end & the motor are supplied as separate units, couple the motor onto the pump as follows:

1. Remove the cable guard from the pump end.
2. Position the motor vertically on a level surface.
3. Lift the pump end manually if light in weight or use pipe clamps fitted to the extension pipe, see fig. 3 if the pump is heavy or long and cannot be safely lifted. Use a hoist of adequate capacity for lifting safely.
4. Place the pump end on top of the motor, align the motor shaft splines with those in pump coupling as well as motor studs have to be aligned with the holes on suction casing of the pump. Once this is aligned properly the pump shall drop onto the motor.
5. Place spring washer and coupling nuts on all the four coupling studs and securely tighten the coupling nuts with a spanner.
6. Reattach the cable guard over the motor cable on the pump end.
7. After assembly ensure that the pump is moving axially by minimum of 0.039 inch.
8. The pump-set is now ready for installation.

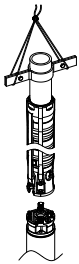

Fig. 3
LIFTING THE PUMP WITH A HOIST

RISER PIPE

If a tool (e.g. a chain pipe wrench) is used when the riser pipe is fitted to the pump, the pump must only be gripped by the pump discharge outlet.

The threaded portion on the riser pipe must be well cut and fit on the discharge outlet threads of the pumps easily. Ensure that riser pipe would not get loose in operation due to torque reaction caused by the starting and stopping of the pump. The thread on the first section of the riser pipe which is to be screwed into the pump outlet should not be longer than the threads in the pump.

If noise may be transmitted to the building through the pipework, it is advisable to use plastic pipes.

INSTALLING PUMP IN WELL

Before lowering the pump, it's recommended to inspect the borehole inside diameter using an inside calliper to ensure that the motor and pump can easily be lowered in the well and there is no possibility of it getting stuck during installation.

Gently lower the pump into the borehole, being cautious not to damage the motor cable or the submersible drop cable.

Caution Do not lower or lift the pump/motor using the motor cable.

When using a torque arrestor it is advisable to install it according to the instructions provided by the seller or the manufacturer of the torque arrestor.

Use discharge pipe when lowering the pump into the well. Install the pump in the well by means of pitless adaptor or similar device at the wellhead and follow the instructions provided by it's manufacturer.

While lowering the pump and motor in the well, secure the cable to the discharge pipe at 10' intervals by using waterproof electrical tape. Clip-on type connectors also can be used to connect it with discharge pipe.

CHECK VALVES

We insist that a check valve must be provided within 25 feet of pump discharge outlet to prevent back-flow once the pump is stopped. A check valve is strongly recommended to maintain constant pressure in the pumping system and also prevent premature bearing wear, damage caused by back-flow of the pump and motor. It also prevents water hammer and upward thrust damage.

Additional Check valves should be installed in 200' interval for the installations deeper than 200'.

Kindly refer fig. 2 for check valve placement recommendations.

ELECTRICAL CONNECTIONS

GENERAL

The electrical connections should be carried out by an authorised electrician in accordance with local regulations.

Always follow the National Electrical Code (NEC), or the Canadian Electrical Code. Also check local codes and regulations.

Before making any connections to the pump motor, make sure that the electricity supply is switched off and that it cannot be accidently switched on by locking the mains in OFF position.
The pump, motor, controller, and mains switch must be grounded.

The operating voltage and frequency are stated on the motor nameplate. Make sure that the motor is suitable for the electricity supply at the installation site.

CABLE SPLICING

At the time of joining motor cable with additional length of cable, precaution should be taken that the cable splicing is done so that no moisture or water can enter the joints of the cable.

Waterproof splicing is required when the drop cable is connected to the motor cable or when drop cable is to be spliced. The process can be done with either heat shrink kits or waterproof tape.

METHOD 1 : USING HEAT SHRINK SPLICE

1. For each wire, carefully remove about ½" of the insulation protecting the copper strands.
2. Insert shrink tubing onto one wire.
3. Crimp butt connector on both wires.
4. Center shrink tubing over the splice.
5. Hot air heating of tubing should begin in the center and slowly work its way to one end while maintaining the heat source moving. Then shrink the same way to opposite end from center. Avoid extreme heat above 120° F to prevent damage to heat shrink tube. One may use a little gas torch or an electric heat gun. Once the tubing shrinks to shape and sealant oozes from the ends, the splice is accomplished. Stagger the location of the splices on all the wires so as not to create a big bundle.

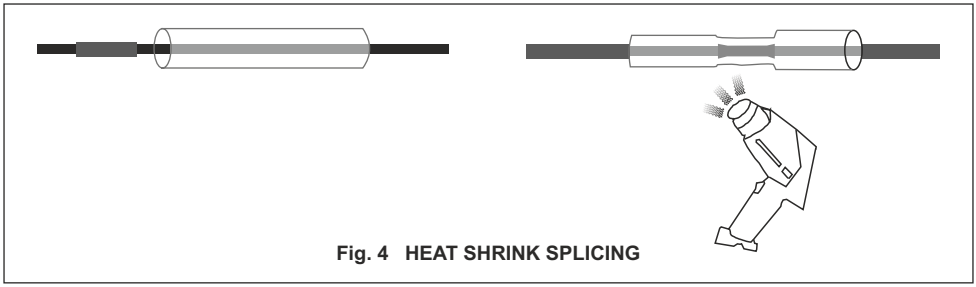

Fig. 4 HEAT SHRINK SPLICING

For splicing with a significant difference between wire sizes, an additional shrink sleeve can be shrunk to on the smaller wire so that it can be tight enough for the bigger sleeve. For your specific application, refer to the instructions provided in the splice kit.

Once all the wires are spliced they can be bunched together and then a tight wrap of electrical tape can be done to secure them together.

METHOD 2 : USING TAPE SPLICE

Cable joint can be done carefully with the tape as described below.

1. As shown in fig. 5 cut the cable in a staggered manner for cable joining.
2. Strip individual conductor of insulation only as far as needed for a dowel type connector or a neatly twisted joint. If a twisted joint is used, It is essential that it be soldered. Tubular connectors of dowel are always preferred over soldering. (If connector o.d. is not as large as cable insulation build up with rubber electrical tape).
3. Tape individual joints with rubber electrical tape using two layers, the first extending 2 inch beyond each end of the conductor insulation end, the second layer 2 inch beyond the ends of first layer. Wrap tightly, eliminating airspaces as much as possible.
4. Tape over the rubber electrical tape with #33 Scotch electrical tape using two layers as in step #3 & making each layer overlap the end of preceeding layer by at least 2 inch.
5. Total thickness of joint after taping should not be less then conductor insulation. Add additional tape layers if required.

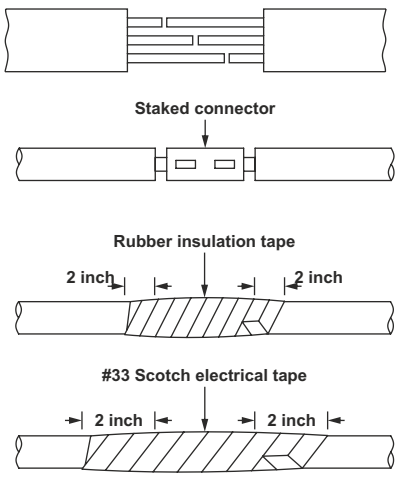

Fig. 5 TAPE SPLICING

MOUNTING - CONTROL BOX

Single phase 3-wire control box have to be mounted vertically in dry and shaded location for both indoor & outdoor locations with operating temperature range between 14°F and 122°F (10°C - 50°C).

Make sure that there is enough space to remove the cover. Make sure that the motor voltage is suitable for the power supply voltage at the installation site. Ensure that the circuit breaker or disconnect switch is locked in OFF position to prevent the pump motor from accidentally starting before you are ready. Three-phase starting coils are very sensitive to voltage; always check the actual supply voltage with a voltmeter. The required voltage quality for NORTHAM submersible motor is ±10%. Higher or lower voltage will damage the motor and void the warranty.

CONNECTING MOTOR LEADS TO MOTOR CONTROL BOX, PRESSURE SWITCH OR STARTER

Always follow the National Electrical Code (NEC), or the Canadian Electrical Code. Also check local codes and regulations. Do not turn on unit or start the pump until all electrical and piping connections have been made. Before connecting the pressure switch line wires to the power source, make sure the circuit breaker or disconnect switch is locked in OFF position

3-WIRE, 1 PHASE MOTOR:
Connect the motor cables to the motor control box terminals following the cable color code (Y-YELLOW, R-RED, B-BLACK). Additionally connect the ground wire identified by its Green color, to the designated Green ground screw. Then, establish connections between the load terminals on the pressure switch and the L1 and L2 terminals on the control box using wires.

2-WIRE, 1 PHASE MOTOR:
Connect the ground wire identified by its Green color, to the designated Green ground screw and both the Black motor leads to the pressure switch's load terminals.

3 PHASE MOTOR:
Connect the motor cables to terminals T1, T2 and T3 on the three-phase starter. Connect the ground wire to the starter box's ground screw.

ELECTRICAL CONNECTIONS

CONNECT TO POWER SUPPLY

1 PHASE:
Complete the wiring by connecting the single-phase pressure switch line connections to the circuit breaker panel or disconnect switch where used.

3 PHASE:
Make connections between L1, L2, L3 and ground at the starter and connect the starter incoming to the disconnect switch and then to the circuit breaker panel.

Check motor direction of rotation and phase imbalance. In order to change the rotation interchange two wires.

OVERLOAD PROTECTION

1 PHASE MOTOR:
A protective device is normally provided in the control box for three wire Northam motors. Some motor manufacturers provide thermal overload protector inside the motors.

Caution Please check the 2 wire motor nameplate and if it does not say “Thermally Protected” then an overload protection device has to be installed.

3 PHASE MOTOR:
NORTHAM three-phase submersible motors must be protected by a motor starter with thermal overload relay.

THREE PHASE POWER UNBALANCE

Each motor lead must be checked for the current, to determine the current unbalance; follow the steps as described below.

Leave the cables connected as it is if the current unbalance is 2% or lower. If the current unbalance is greater than 2%, verify current reading on each motor lead with each of the three possible connections. Roll the motor leads across the starter in the same direction to prevent motor rotating in opposite direction.

To determine the current unbalance percentage:

1) Add the three motor leads amp values together.
2) Divide the sum by three, to get the average current.
3) Choose the current value that is furthest from the average current, whether high or low.
4) Calculate the difference between this current value (the one furthest from the average) and the average.
5) Divide the difference as calculated in #4 above by the average. Multiply the result by 100 to determine the percentage of unbalance.
6) Kindly see three examples of such calculation provided below.

	Connection 1			Connection 2			Connection 3		
LINE TERMINALS	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**
	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤
MOTOR LEADS	**R**	**B**	**Y**	**Y**	**R**	**B**	**B**	**Y**	**R**
	A3	**A1**	**A2**	**A2**	**A3**	**A1**	**A1**	**A2**	**A3**
EXAMPLE:	A3-R = 53 amps			A2-Y = 52 amps			A1-B = 51 amps		
	A1-B = 48 amps			A3-R = 47 amps			A2-Y = 49 amps		
	A2-Y = 49 amps			A1-B = 51 amps			A3-R = 50 amps		
	Total = 150 amps			Total = 150 amps			Total = 150 amps		
	÷ 3 = 50 amps			÷ 3 = 50 amps			÷ 3 = 50 amps		
	- 48 = 2 amps			- 47 = 3 amps			- 49 = 1 amps		
	2 ÷ 50 = 0.04 or 4%			3 ÷ 50 = 0.06 or 6%			1 ÷ 50 = 0.02 or 2%		

The current unbalance should not exceed 5% for reliable installation. If the unbalance cannot be corrected by rolling motor leads in same direction, the source of the current unbalance must be found and corrected.
If the majority of the imbalance is coming from the line leads, contact your local power supply company to resolve the imbalance.

START-UP

For a new well it is required to install discharge valve on the pump discharge line. When the pump has been connected correctly and it is submerged in the liquid to be pumped, it should be started with the discharge valve open to approx. 1/3 of its maximum volume of water.

If there are impurities or sand in the water, the valve should be opened gradually as the water becomes clearer. The pump should not be stopped until the water is completely clean, as otherwise the pump parts and the non-return valve may choke up with sand or mud. Turn the pump power off when water runs clear.

Remove the discharge valve from the pump's discharge line and connect it to the home plumbing, pressure tank and switch. Turn on the electricity and run a few cycles through the tank to rinse it and ensure that the pump and switch are operating properly

TROUBLESHOOTING

Before removal/dismantling of the pump, make sure that the electricity supply has been switched off and locked in OFF position and cannot be accidentally switched on. All rotating parts must have stopped moving.

FAULT	CAUSE	REMEDY
THE PUMP/MOTOR DOES NOT RUN.	1) The fuses are blown.	1) Replace the blown fuses. If the new ones blow too, the electric installation and the submersible drop cable should be checked for insulation resistance.
	2) The circuit breaker has tripped out.	2) Cut in the circuit breaker.
	3) Inadequate power supply.	3) Check power supply or generator capacity.
	4) No electricity supply.	4) Contact the electricity supply company.
	5) Motor thermal overload protector has tripped out, due to incorrect/faulty electrical connections, low voltage, incorrect control box, higher ambient temperature of control box/starter,locked pump.	5) Thermal overload protector may have to be manually reset.
	6) The motor/power cable is defective.	6) Repair/replace the motor/cable.
THE PUMP RUNS BUT DELIVERS LITTLE OR NO WATER.	1) Faulty or incorrectly installed check valve.	1) Repair/replace the check valve.
	2) The pump is defective/worn.	2) Repair/replace the pump.
	3) Pump is air locked.	3) Repeatedly start & stop pump until it delivers flow.
	4) Pump is locked due to sand.	4) Pull out the pump & clean it. adjust depth if required,
	5) The inlet strainer is choked up.	5) Pull out the pump and clean the strainer.
	6) Incorrect direction of rotation.	6) Interchange any two motor cable leads.
	7) Lift is too high for pump.	7) Check the pump performance
	8) Pump not fully submerged.	8) Lower the pump if possible.
MOTOR STARTS AND STOPS TOO OFTEN	1) Setting of pressure switch limits not set properly or pressure switch is defective	1) Readjust the pressure switch settings or replace the switch if required.
	2) The check valve is leaking or stuck open.	2) Pull out the pump and clean/replace the check valve.
	3) Leakage in the system.	3) Replace damage pipes or repair leaks.
	4) The pressure tank is too small or has failed.	4) Replace the pressure tank with adequate capacity.
MOTOR RUNS CONTINUOUSLY	1) Leakage in the system.	1) Replace damage pipes or repair leaks.
	2) The pump is defective/worn.	2) Repair/replace the pump.
	3) Pressure switch setting may be too high. Switch contacts may be “welded” in closed position.	3) Readjust the pressure switch settings/replace it if required. Clean switch contacts.
	4) The inlet strainer is choked up. Pump may installed in mud/sand.	4) Pull out the pump and clean the strainer. It may be necessary to clean the well.
	5) The check valve is stuck in closed position and no water will be delivered.	5) Replace it if defective.
OVERLOAD PROTECTOR TRIPPED OUT	1) Worn pump/motor.	1) Repair/replace the pump/motor.
	2) Defective motor or cable	2) Repair/replace the motor/cable..
	3) Defective control box	3) Repair/replace the control box.
	4) Incorrect voltage	4) Contact electricity supply company if voltage is incorrect.

MOTOR INSULATION RESISTANCE READINGS

Normal Ohms/megaohms, all motors, between all wires and ground.

Before starting insulation resistance measurement make sure that the electricity supply is switched off and that it cannot be accidently switched on by locking the mains in OFF position.

Caution Perform an insulation resistance test by opening the circuit breaker and disconnecting all wires from the control box or pressure switch. Connect one ohmmeter or meggar lead to one motor lead and the other to a metal drop pipe of good ground, R X 100K scale.

CONDITION OF MOTOR AND LEADS	OHM VALUE	MEGOHM VALUE
New motor, without power cable	20,000,000 (or more)	20.0
Used motor, which can be reinstalled in well	10,000,000 (or more)	10.0
MOTOR IN WELL – READINGS ARE FOR POWER CABLE PLUS MOTOR		
New motor	2,000,000 (or more)	2.0
Motor in reasonably good condition	500,000 to 2,000,000	0.5 – 2.0
Motor which may be damaged or have damaged power cable Do not pull motor for these reasons	20,000 to 500,000	0.02 – 0.5
Motor definitely damaged or with damaged power cable Pull motor and repair	10,000 to 20,000	0.01 – 0.02
Failed motor or power cable Pull motor and repair	Less than 10,000	0 – 0.01

GENERATOR RATING

When a generator is utilized as a standby or backup, failing to employ a manual or automatic transfer switch can result in burns, shock, or even death.

Caution Observe guidelines provided by the generator manufacturer.

Motor Type	Motor HP	Minimum Rating of Generator			
		Externally Regulated		Internally Regulated	
		kW	KVA	kW	KVA
2-Wire, Single Phase	0.5	2.5	3.1	1.8	2.2
	0.75	3.5	4.4	2.5	3.1
	1	5	6.3	3.2	4
	1.5	6	7.5	4	5
3-Wire, Single Phase or Three Phase	0.5	2	2.5	1.5	1.9
	0.75	3	3.8	2	2.5
	1	4	5	2.5	3.2
	1.5	5	6.3	3	3.8
	2	7.5	9.4	4	5
	3	10	12.5	5	6.3
	5	15	18.8	7.5	9.4
	7.5	20	25	10	12.5

CABLE SELECTION CHART

CABLE SIZING

Note Cable size given here are for Copper wire. If aluminum conductor is used, multiply lengths by 0.5. Maximum allowable length of aluminum is considerably shorter than copper wire of same size. Cable size are based on Service Factor Amps, 30º C Ambient and 5% Voltage Drop.

2-WIRE, SINGLE PHASE - NC SERIES - ENCAPSULATED WATER FILLED MOTOR

Volts	HP	kW	Maximum Cable Length in Feet - From Motor to Service Entrance									
			60º C and 75º C Insulation - AWG Copper Wire Size									
			14	12	10	8	6	4	2	1/0	2/0	3/0
110	0.5	0.37	126	201	301	500	794	1228	1701	2390	2615	3276
115	0.5	0.37	134	215	321	532	844	1303	1799	2520	2754	3437
230	0.5	0.37	561	896	1340	2219	3519	5424				
230	0.75	0.55	465	741	1104	1815	2847	4322	5865	8011		
230	1	0.75	357	570	853	1416	2253	3491	4842	6821	7469	
230	1.5	1.1	263	420	629	1043	1656	2559	3539	4965	5429	6789

3-WIRE, SINGLE PHASE - NC SERIES - ENCAPSULATED WATER FILLED MOTOR

Volts	HP	kW	Maximum Cable Length in Feet - From Motor to Service Entrance									
			60º C and 75º C Insulation - AWG Copper Wire Size									
			14	12	10	8	6	4	2	1/0	2/0	3/0
110	0.5	0.37	127	202	301	494	771	1164	1570	2126	2299	2784
115	0.5	0.37	144	228	340	556	868	1308	1760	2378	2569	3104
230	0.5	0.37	597	948	1407	2299	3572	5351	7162			
230	0.75	0.55	441	700	1039	1698	2639	3952	5290	7089	7640	
230	1	0.75	366	582	865	1416	2208	3323	4469	6029	6511	7857
230	1.5	1.1	266	424	632	1043	1645	2516	3441	4752	5169	6368
230	2	1.5	202	322	481	794	1254	1920	2631	3641	3964	4895
230	3	2.2	153	245	367	610	970	1502	2084	2936	3214	4036
230	5	3.7	91	145	217	362	577	897	1249	1769	1941	2451

CABLE SELECTION CHART

THREE PHASE - NC SERIES - ENCAPSULATED WATER FILLED MOTOR

Volts	HP	kW	Maximum Cable Length in Feet - From Motor to Service Entrance										
			60º C and 75º C Insulation - AWG Copper Wire Size										
			14	12	10	8	6	4	2	1/0	2/0	3/0	4/0
230	0.5	0.37	1690	2687	3998	6554							
230	0.75	0.55	1178	1867	2767	4503	6959						
230	1	0.75	864	1375	2047	3361	5261	7961					
230	1.5	1.1	578	920	1371	2252	3529	5349	7248	9876			
230	2	1.5	474	755	1125	1851	2906	4415	5996	8198	8891		
230	3	2.2	349	556	827	1360	2131	3230	4376	5963	6460	7865	9953
230	5	3.7	200	319	476	783	1231	1873	2547	3491	3788	4635	5909
230	7.5	5.5	138	219	326	536	840	1273	1724	2350	2546	3099	3922
460	0.5	0.37	5771	9183									
460	0.75	0.55	4521	7169									
460	1	0.75	3488	5523	8173								
460	1.5	1.1	2434	3875	5772	9489							
460	2	1.5	1935	3077	4578	7508							
460	3	2.2	1352	2153	3207	5272	8265						
460	5	3.7	835	1328	1976	3240	5062	7640					
460	7.5	5.5	566	902	1345	2215	3483	5304	7224	9915			

CABLE SELECTION CHART

2-WIRE, SINGLE PHASE - NM SERIES - WATER FILLED REWINDABLE SUBMERSIBLE MOTOR

Volts	HP	kW	Maximum Cable Length in Feet - From Motor to Service Entrance									
			60º C and 75º C Insulation - AWG Copper Wire Size									
			14	12	10	8	6	4	2	1/0	2/0	3/0
115	0.5	0.37	137	220	328	545	865	1336	1848	2593	2835	3545
230	0.5	0.37	550	878	1314	2179	3460	5346				
230	0.75	0.55	364	581	869	1442	2290	3538	4893	6864		
230	1	0.75	317	507	758	1257	1996	3084	4265	5984	6543	
230	1.5	1.1	254	404	603	996	1570	2402	3285	4536	4934	6079

3-WIRE, SINGLE PHASE - NM SERIES - WATER FILLED REWINDABLE SUBMERSIBLE MOTOR

Volts	HP	kW	Maximum Cable Length in Feet - From Motor to Service Entrance									
			60º C and 75º C Insulation - AWG Copper Wire Size									
			14	12	10	8	6	4	2	1/0	2/0	3/0
115	0.5	0.37	137	220	328	545	865	1336	1848	2593	2835	3545
230	0.5	0.37	550	878	1314	2179	3460	5346	7393	10372	11341	14182
230	0.75	0.55	364	581	869	1442	2290	3538	4893	6864	7505	9385
230	1	0.75	317	507	758	1257	1996	3084	4265	5984	6543	8182
230	1.5	1.1	254	404	603	996	1570	2402	3285	4536	4934	6079
230	2	1.5	194	309	462	764	1208	1855	2548	3540	3858	4780
230	3	2.2	151	240	359	594	941	1447	1991	2773	3025	3756
230	5	3.7	89	142	213	354	563	874	1214	1714	1878	2364

THREE PHASE - NM SERIES - WATER FILLED REWINDABLE SUBMERSIBLE MOTOR

Volts	HP	kW	Maximum Cable Length in Feet - From Motor to Service Entrance										
			60º C and 75º C Insulation - AWG Copper Wire Size										
			14	12	10	8	6	4	2	1/0	2/0	3/0	4/0
230	1.5	1.1	542	863	1286	2118	3327	5062	6886	9436			
230	2	1.5	413	658	981	1618	2549	3892	5314	7319	7956	9780	
230	3	2.2	315	502	748	1232	1936	2945	4007	5490	5958	7289	9293
230	5	3.7	192	306	456	753	1186	1810	2472	3404	3701	4549	5841
230	7.5	5.5	131	209	312	514	809	1236	1687	2324	2526	3105	3987
460	1.5	1.1	2167	3452	5145	8471							
460	2	1.5	1651	2631	3926	6474							
460	3	2.2	1261	2008	2994	4928	7744						
460	5	3.7	768	1224	1826	3011	4742	7241	9886				
460	7.5	5.5	524	835	1246	2055	3237	4942	6748	9294			

WIRING DIAGRAMS

SINGLE PHASE MOTORS

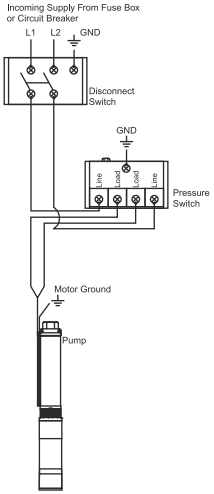

Fig. 6 Two wire motor - directly connected to pressure switch

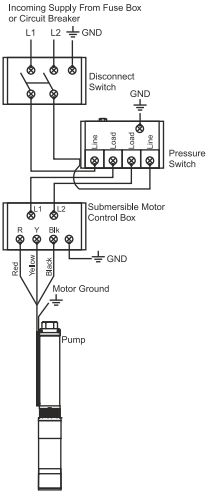

Fig. 7 Three wire motor - connected to pressure switch & control box

THREE PHASE MOTORS

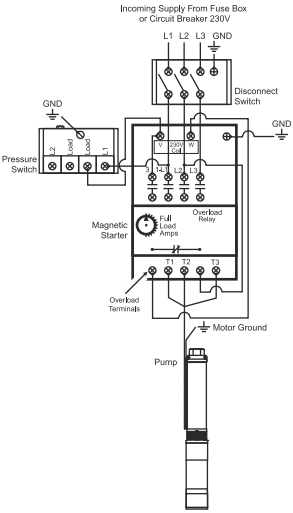

Fig. 8 Three phase motor with pressure switch

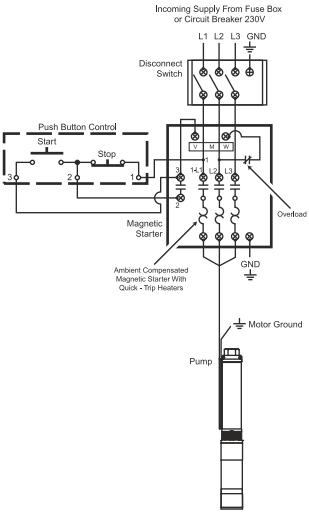

Fig. 9 Three phase motor with push button control

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