FLOWSERVE

USER INSTRUCTIONS

Submersible Water Well Pumps

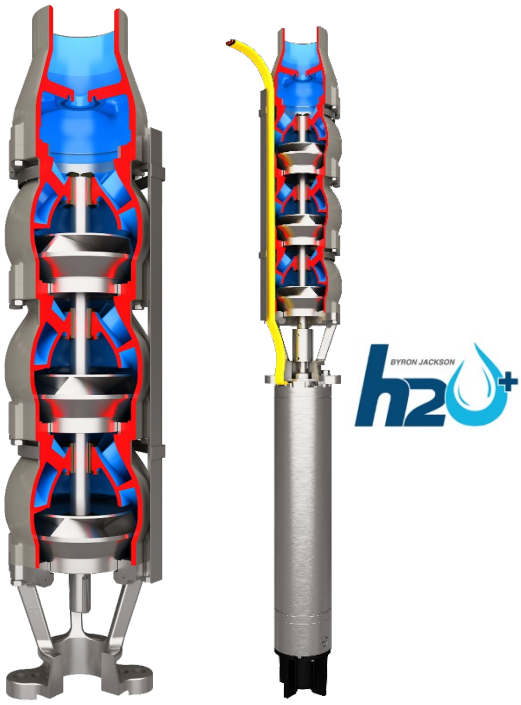
Byron Jackson H2O+ Submersible Pumps and Motors Including Byron Jackson H2O Standard and Premium Motors (Water filled)

Installation
Operation
Maintenance

LM028843-01 EN

Original Instructions

⚠ ***These instructions must be read prior to installing, operating, and maintaining this equipment.***



Experience In Motion

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1 General Information

1.1 Scope of manual

These instructions must be kept close to the product's operating location or directly with the product.

These instructions must be read prior to installing, operating, using, or maintaining the equipment in any region worldwide. The equipment must not be put into service until all the safe operating conditions noted in the instructions have been met. Failure to comply with the information provided in the User Instructions is considered misuse. Personal injury, product damage, delay in operation, or product failure caused by misuse are not covered by the Flowserve warranty.

Flowserve products are designed, developed and manufactured with state-of-the-art technologies in modern facilities. The unit is produced with great care and commitment to continuous quality control, utilizing sophisticated quality techniques, and safety requirements.

Flowserve is committed to continuous quality improvement and being of service for any further information about the product with its installation and operation or about its support products, repair and diagnostic services.

Byron Jackson H2O+ Submersible Pumps and Motors (water-filled)

These instructions are intended to familiarize the reader with the product and its permitted use. Operating the product in compliance with these instructions is important to help ensure reliability in service and avoid risks. These instructions may not reflect all local regulations; ensure all local regulations are observed by all, including those installing the product. Always coordinate repair activities with operations personnel and follow all plant safety requirements and applicable safety and health legislation.

1.2 Disclaimer

Information in this User Instruction is believed to be complete and reliable. Despite all Flowserve's efforts to provide comprehensive information and instructions, sound engineering and safety practices should always be used. Please consult with a qualified engineer.

Flowserve manufactures products to applicable International Quality Management System Standards as certified and audited by external Quality Assurance organizations. Genuine parts and accessories have been designed, tested, and incorporated into the products to help ensure continued product quality and performance in use. As Flowserve cannot test parts and accessories sourced from other vendors, the incorrect incorporation of such parts and accessories may adversely affect the performance and safety features of the product. The failure to properly select, install, or use authorized Flowserve parts and accessories is considered misuse. Damage or failure caused by misuse is not

covered by Flowserve's warranty. In addition, any modification of Flowserve products or removal of original components may impair the safety of these products in use.

1.3 Symbol explanation

Information: *This symbol indicates a recommendation and important information when handling the pump.*

Note: *This sign is not a safety symbol but indicates an important instruction in the assembly process. Safety symbols are explained in section 2.2*

1.4 Certification

It is a legal requirement that machinery and equipment put into service within certain regions of the world shall conform to the Marking Directives applicable to Flowserve products (i.e. Machinery Directive, Low Voltage Directive, Electromagnetic Compatibility (EMC) Directive, Pressure Equipment Directive (PED), Equipment for Potentially Explosive Atmospheres (ATEX), etc.). The standard certification for products includes (example Declarations or Certificates as applicable can be found in Annex of these user instructions):

- *Directive 2006/42/EC (CE Marking for European point of use market)*
- *UKCA Marking (from 1st of January 2023 for UK)*
- *Certification to ANSI / NSF 61 for potable water service (USA/countries requiring NSF, other regions are provided to their regulations)*

Note: Additional certifications are possible on request (e.g. CUTR,…) contact FLOWSERVE for specific applications where other certification is required. If applicable, copies of other certificates sent separately to the Purchaser should be obtained by the Purchaser for retention with this User Instructions.

1.5 Units

Both US Customary and Metric system units may be utilized in the document.

2 Safety Information

2.1 Intended use

The product/system must not be operated beyond the parameters specified for the application. If there is any doubt as to the suitability of the product/system for the application intended, contact Flowserve for advice, quoting the serial number.

- *Installing, operating, or maintaining the product/system in any way that is not covered in this User Instruction could cause death, serious personal injury, or damage to the equipment. This includes any modification to the product/system or use of the parts not provided by Flowserve.*
- *Only operate the product/system when it has successfully passed all inspection acceptance criteria.*
- *Do not operate the product/system in a partially assembled condition.*
- *If the condition of service changes (i.e. pumping fluid, temperature, or duty conditions) it is requested that the user seeks written agreement from Flowserve before start-up.*
- *Observe equipment labels, such as arrows designating the direction of rotation, warning signs, etc., and keep them in a legible condition. Replace any damaged and/or illegible labels immediately.*
- *Do not use or install this equipment in areas considered or classified as hazardous locations such as areas where flammable liquids, gases, vapours or combustible dusts exist in quantities to produce an explosion or fire.*
- *Catastrophic or fatal electric shock may result from failure to connect motor controller, metal plumbing, and all other metal near the motor or cable to the power supply ground terminal, using a wire size and connector complying with local regulations. To reduce the risk of electrical shock, disconnect power before working on or around the water system.*
- *Do not install this pumping system in areas used for swimming*

2.2 Safety symbols and description

This User Instruction contains specific safety markings where non-observance of an instruction would cause a hazard. The specific safety markings are:

Table2.2.a: Definition of safety symbols and markings

Symbol	Description
	**DANGER** This symbol indicates a hazardous situation which, if not avoided, will result in death or serious injury
	**WARNING** This symbol indicates a hazardous situation which, if not avoided, could result in death or serious injury
	**CAUTION** This symbol indicates a hazardous situation which, if not avoided, could result in minor or moderate injury

	**Safety Instruction** This symbol indicates specific safety-related instruction or procedures
	**NOTICE** This symbol is used to address practices not related to physical injury

Table 2.2.b: Additional symbols

Symbol	Description
	**SAFETY ALERT** This is the safety alert symbol. It is used to alert you to potential physical injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.
	**ELECTRICAL HAZARD** This symbol indicates electrical safety instructions where non-compliance would affect personal safety and could result in loss of life
	**TOXIC HAZARD** This symbol indicates "hazardous substances and toxic fluid" safety instructions where non-compliance would affect personal safety and would damage the equipment or property
	**ATEX EXPLOSION PROTECTION** This symbol indicates explosive atmosphere marking according to ATEX. It is used in safety instructions where non-compliance in the hazardous area would cause the risk of an explosion

2.3 General hazard sources

2.3.1 Mechanical Hazards

a) Lifting limits and guidelines

Note: The load values mentioned in this section are Flowserve guidelines only. All lifting must be done in compliance with site safety protocol, local regulations, and related industry standards.

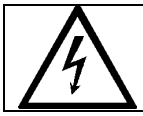
Many precision parts have sharp corners which require appropriate personal protective equipment during handling. Prior to any attempt to lift an item, employees must first determine the approximate weight and stability of the load.

- *Large, unstable, or awkward loads should always be handled with the assistance of additional personnel or appropriate mechanical means.*
- *Loads in excess of 23kg (50 lb.) should only be lifted by appropriate mechanical means and in accordance with current local legislation or with the assistance of additional personnel.*
- *Lifting items less than 23kg (50 lb.) may be prohibited without assistance if the lift is repetitive and/or awkward (i.e., away from the body, above the shoulders or below the knees) thus placing excessive stress on the personnel.*
- *Repetitive lifting of any kind should be evaluated as part of a documented end-user safety program.*

2.3.2 Electrical hazards

Protective measures against shock-hazard voltages must be taken according to applicable local and national regulations and the local electric power company requirements.

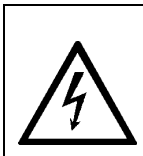
In most districts, the ground conductor must be connected directly to the motor on new systems. This also applies when the unit is installed in an inaccessible well.



DANGER

NEVER DO MAINTENANCE WORK WHEN THE UNIT IS CONNECTED TO POWER

2.3.3 Insulation Resistance Testing (Megohm Test)



DANGER

NEVER CONDUCT THIS TEST IN AN AREA THAT HAS BEEN DESIGNATED AS A HAZARDOUS LOCATION

ONLY CONDUCT THIS TEST ON OTHERWISE NON-ENERGIZED EQUIPMENT

2.4 Responsibility of the operator of the equipment

- *Complete a risk assessment of the site where the product/system will be in operation, by observing the working conditions.*
- *Create site specific work instructions for the operation of the product*
- *Ensure that the personnel have read and understand all applicable instructions*
- *Provide regular training to the necessary personnel in regular intervals*
- *Provide the required personal protective equipment*

2.5 Qualified personnel and targeted group

All personnel involved in the operation, installation and maintenance of the unit must be qualified to carry out the work involved. If the personnel in question does not already possess the necessary knowledge and skill, appropriate training and instruction must be provided. If required, the operator may commission the manufacturer / supplier to provide applicable training.

Always co-ordinate repair activities with operation and health and safety personnel.

Follow all plant safety requirements and applicable safety and health laws and regulations.



DANGER

All work on the electrical system may only be performed by qualified electricians!

All work on the hydraulic connections may only be performed by qualified fitters.

2.6 Industrial health and safety measures

Follow industry safety standards including the use of appropriate equipment in required areas.

2.7 Potential explosive areas



This equipment is not rated to operate in potential explosive areas.

2.8 Protective equipment

During transportation, installation and removal of the pumping unit, all personal must wear

- *Helmet/ hard hat*
- *Safety tools*
- *Protective gloves*
- *Other Personal Protective Equipment as prescribed by local regulatory requirements*

2.9 Sound Level

In principle, any noise emission should be avoided as far as possible at the location of origin. If the noise protection cannot be reduced by suitable measures to the values approved by regional laws, the concerned staff must be provided with personal hearing protection.

Attention must be given to the exposure of personnel to the noise, and local legislation will define when guidance to personnel on noise limitation is required, and when noise exposure reduction is mandatory. This is typically 80 to 85 dBA.

Submerged motor pumps are in principle submerged in fluid during operation. The fluid jacket has a dampening impact so that the noise pressure level of the units is lower or equal to 70 dB(A). Noise generation from pipelines and valves must be evaluated by the system designer or those putting it into operation.

3 Product Description

3.1 General product description

The Byron Jackson H2O+ submersible motor and pumping unit is a combination of

- *a vertical pump bowl assembly*
- *a water filled electric submersible motor*

Designed for sustained operation submerged in water, the motor is positioned directly below the pump bowl assembly. The rotating element of the pump bowl assembly is driven from the bottom where its extended shaft is connected to the motor shaft by a coupling. Power is supplied to the motor through a submarine power cable which is fastened to the riser pipe and extends to the starting equipment. Motor and pump bowl assembly are connected to the riser pipe. The riser pipe is threaded or flanged and coupled in random lengths and the entire unit is coupled to a wellhead assembly.

Each pumping unit has been individually manufactured according to the special requirements of the customer. The technical data is given in Section 9 "Technical Data".

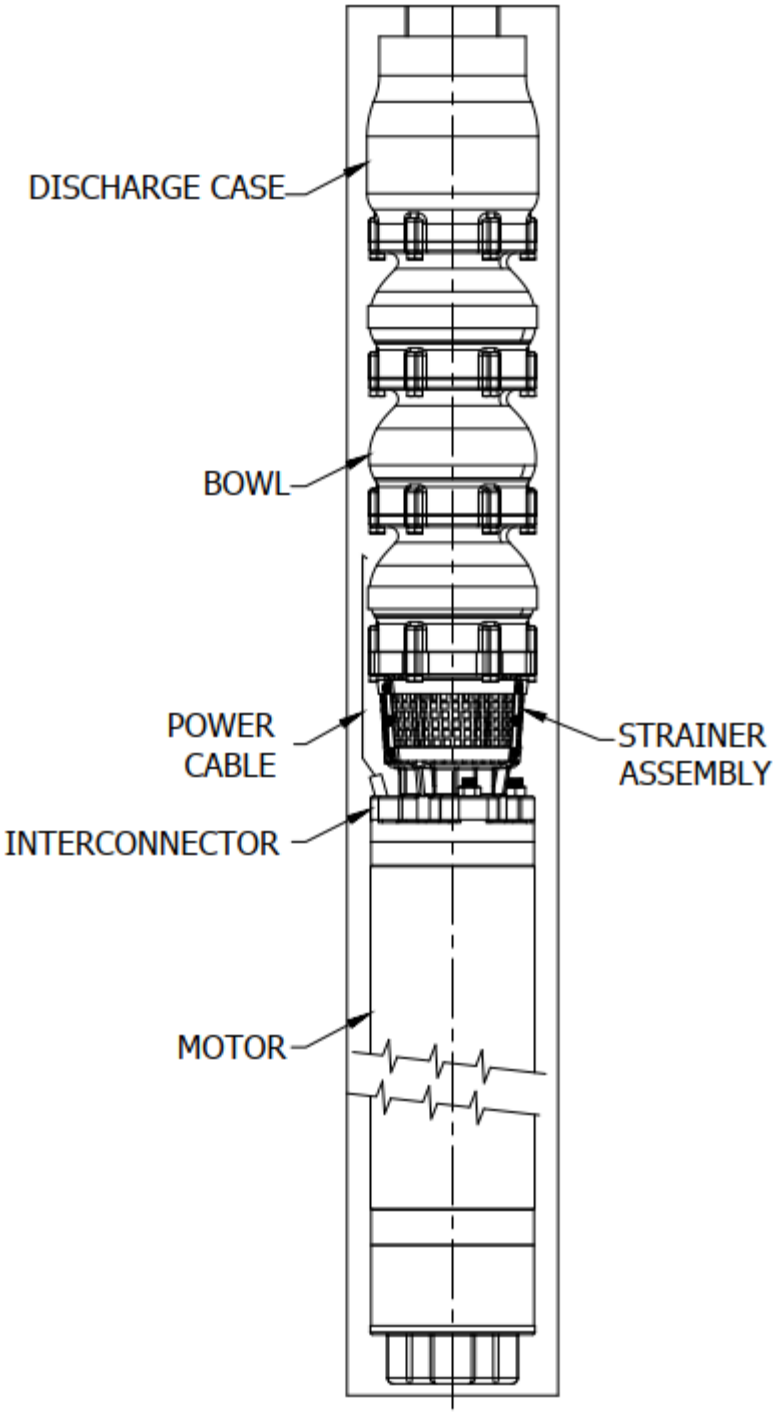


Figure 3.1: Submersible Pump and Motor Assembly

3.2 Design and Function Description

A pumping unit consists of

- *Motor*
- *Pump bowl assembly*
- *Power cable*
- *Discharge tubing or column or riser*
- *Cable banding or brackets to fasten the motor power cable onto the riser pipe*

NOTE: Not all components or sub-assemblies of a pumping unit are necessarily supplied by Flowserve or part of this delivery. These user instructions apply only to the components or sub-assemblies supplied by Flowserve in this delivery.

Motor

The electric motor is a water-filled three-phase AC squirrel-cage motor with a watertight winding, which is operating in water and is designed especially for direct drive of submersible pumps. The motor filling-water cools the winding and bearings as well as lubricating the thrust and radial bearings.

The submersible-motor-pump is connected to the lower end of a riser pipe and submerged in the pumped medium. The power supply is through submersible power cables fastened to the riser pipes with cable clips.

Interconnector

One of the main components of the pumping system in which one side of the interconnector is connected to the bowl assembly and other side is used to mount the motor. The interconnector also serves as the suction of the pumping system and strainer is mounted to the interconnector.

Pump Bowl

The bowl(s) contain passageways to transfer the liquid between the outside diameter of the preceding impeller and the eye of the subsequent impeller. Pump bowl assembly consists of impeller mounted on the shaft with collet and wear ring fitted to bowl. Each pump bowl stage has a sleeve bearing to support the pump shaft.

Non-return or check valve

A non-return valve is used to avoid the flow back to the pump from piping system which in turn eliminates the rotation of pump in reverse direction when the unit is shut down, protecting the motor thrust bearing. If one or more vertical riser pipe check valves are to be used on an installation, each valve, which should have a bleed-back self-draining feature, will take the place of a riser pipe coupling. The non-return is only supplied by Flowserve if specifically requested and included in the scope of supply.

The recommended installation is as follows:

- *One valve:*

Locate the valve approximately 23 m (75 feet) above the pump bowl assembly.

- *Two valves:*

Locate the first valve 30 m (100 feet) above the pump bowl assembly. Locate the second valve at 3/5 of the distance between first valve and the surface support plate.

Power Cable

The submersible power cable is constructed to operate in a submersed and wet environment and supply power to the motor. The cable is spliced to the motor leads with waterproof materials and is affixed to the riser piping up to the surface and connected to either a junction box or the controller. Proper sizing of the cable is required to ensure adequate voltage is supplied to the motor and to ensure the cable does not over heat. The installing electrician has final responsibility of the correct cable sizing according to relevant local regulations.

Riser pipe

Riser pipe is also called discharge tubing or column pipe. The riser pipe is not typically supplied by Flowserve. It can be constructed in numerous forms such as steel piping, PVC piping, flexible tubing, etc. Riser pipe is assembled to the non-return valve or top pump bowl and the entire submersible pump/motor assembly is suspended from this riser pipe.

Cable bands or brackets

The cable bands or brackets are used to mount the power cable from motor onto the riser/discharge pipe.

Auxiliary Equipment

Other equipment may be used or required depending upon the specific requirements of local regulatory authorities, well design, and system requirements.

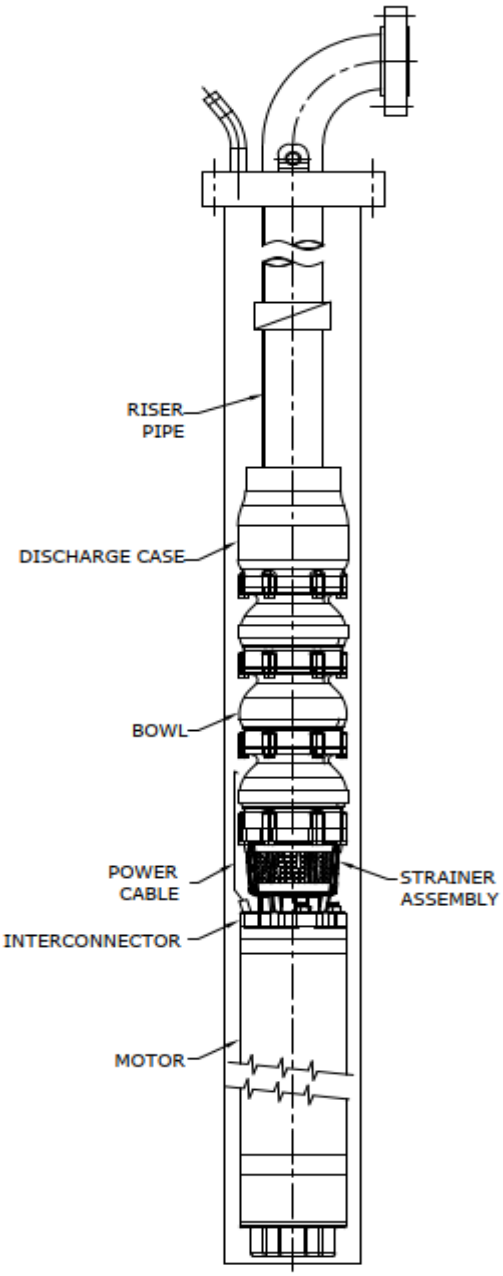


Figure3.2: Diagram of Typical Water Well System

3.3 Connections

3.3.1 Electrical connections

 *Electrical connections must be made by a qualified electrician in accordance with relevant local, national and international regulations.*

 *It is important to be aware of the EUROPEAN DIRECTIVE on potentially explosive areas where compliance with IEC60079-14 is an additional requirement for making electrical connections.*

 *It is important to be aware of the EUROPEAN DIRECTIVE on electromagnetic compatibility when wiring up and installing equipment on site. Attention must be paid to ensure that the techniques used during wiring/installation do not increase electromagnetic emissions or decrease the electromagnetic immunity of the equipment, wiring or any connected devices.*

 *The motor must be connected in accordance with the requirements in this manual and the local governing electrical codes. The nameplate should be checked to ensure the power supply is appropriate.*

3.4 Controls

3.4.1 General remarks

Installation of lightning arrestors is recommended to protect the control panel, motor cables and the motor. Any failure due to lightning is not covered by warranty.

Reduced voltage starting using soft starters, autotransformers, variable speed drives, star delta starters (if motor is provided with 6 leads), etc. require additional care to ensure the motor is not subjected to additional problems. Please ensure compliance with the following:

- *Overload settings and breakers must be sized appropriately and properly set to protect the motor.*
- *The starter must allow the motor to accelerate the pump with sufficient torque to allow it to reach full speed as quickly as possible. The motor must be up to full speed in 3 seconds. Failure to do so will cause overheating of the motor and/or thrust bearing wear.*
- *Ensure the voltage reaches full voltage within 3 seconds. Operation at reduced voltage for longer than a few seconds will cause the motor to overheat and fail.*

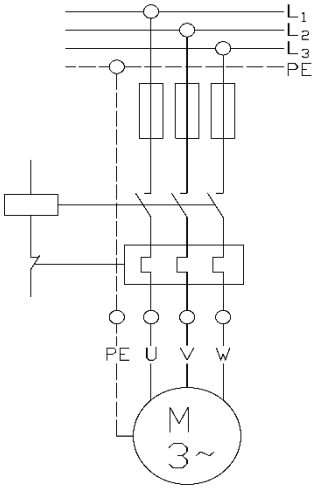
3.4.2 Inverters

Inverters are referred to by different names including Variable Speed Drive (VSD), Variable Frequency Drive (VFD), Adjustable Speed Drive (ASD), or Adjustable Frequency Drive (AFD)), Variable Voltage Variable Frequency controllers (VVVF) Inverters are controllers with the ability to vary the speed of the submersible pumping unit. The ability to change speed provides more flexibility for operating the pump at a variety of conditions. With this ability, extra care must be taken to ensure proper system configuration and operational controls.

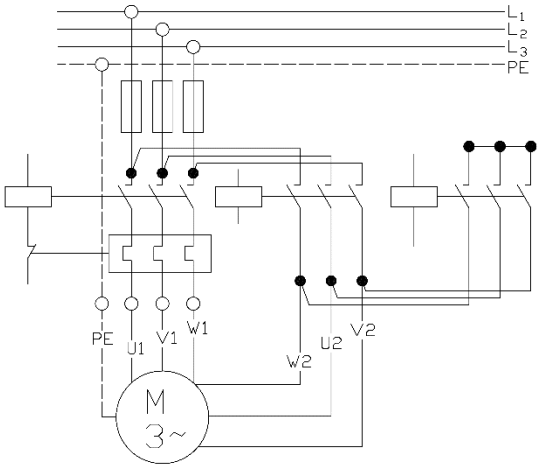
a. *Accurate and calibrated quick trip overload settings should be set to trip if any phase exceeds the safety factor full load current.*
b. *A constant ratio of V/Hz must be maintained (7.67 for 460 V, 60 Hz and 380 V, 50 Hz motors)*
c. *Minimum operating frequency should be 30 Hz for short periods but for normal operation, it should be above 42 Hz for 60 Hz nameplated motors and 35 Hz for 50 Hz nameplated motors.. This is for protection of all bearings and because most submersible applications require a certain speed to lift water to the surface. If no water is lifted to the surface, there will not be any cooling flow over the motor and the motor will overheat and fail.*
d. *Maximum Run Down time to Power Off shall not exceed 4 seconds. Coast down stopping instead of ramping down is preferred to avoid temporary voltage increases resulting from the VVVF generator mode if the motor is decelerated too fast.*
e. *Maximum operating frequency is nameplate frequency.*
f. *Motor should be ramped up to at least 35 Hz within 4 sec*
g. *Dynamic braking options on the inverter should be disabled. Actively attempting to brake the motor could cause shaft breakage, voltage spikes and other motor issues.*
h. *Voltage boost during starting is permitted in order to ensure a rapid acceleration time to minimum speed in the required time.*
i. *The inverter switching frequency should be as per the inverter manufacturer's recommendations for non-dynamic loads such as pumps. Direct Torque Control or other similar operating schemes are not allowed as they can cause fatiguing of shafts and shaft failure.*
j. *Most modern inverters use IGBT's which can present rapidly peaking high voltage spikes that can stress the motor insulation windings. These peaks can be exacerbated by long cables typically used in submersible applications. Flowserve strongly recommends the use of an output filter to protect the motor insulation.*
k. *Grounding should be in compliance with the drive manufacturer's recommendations plus local regulatory requirements. Failure to adequately ground the motor presents the potential erosion/corrosion of the pump and motor due to current loops unable to be handled in the ground circuit.*
l. *Care must be taken to ensure adequate flow velocity past the motor as changing speeds could drastically drop the velocity.*

3.4.3 Motor connection Diagrams

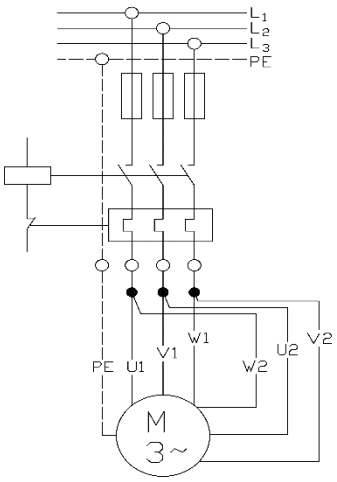
Clockwise rotation



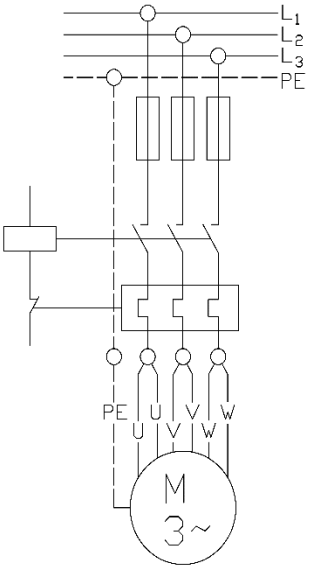
Direct-on-line-starting – one power supply cable



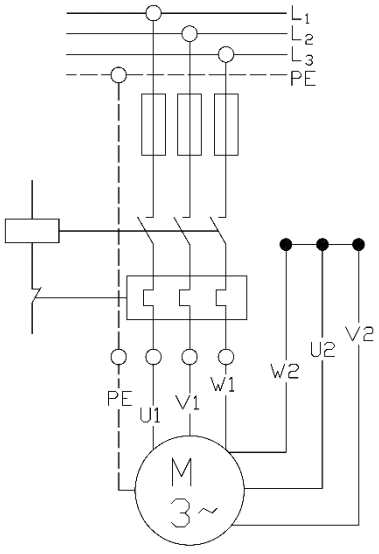
Star-delta-starting



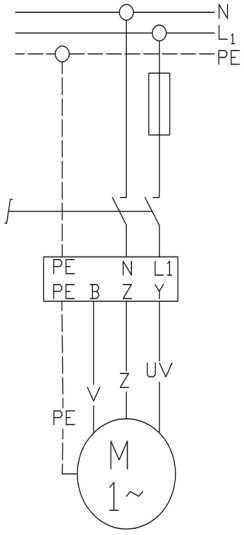
Direct-on-line-starting-delta connection in control panel



Direct-on-line-starting – two power supply cable

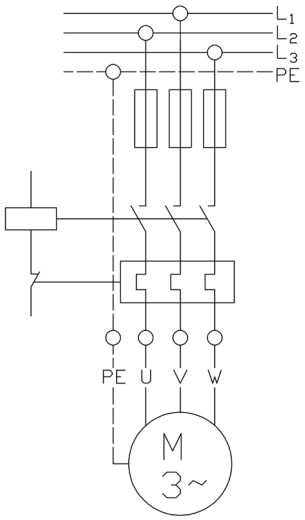


Direct-on-line-starting-star connection in control panel

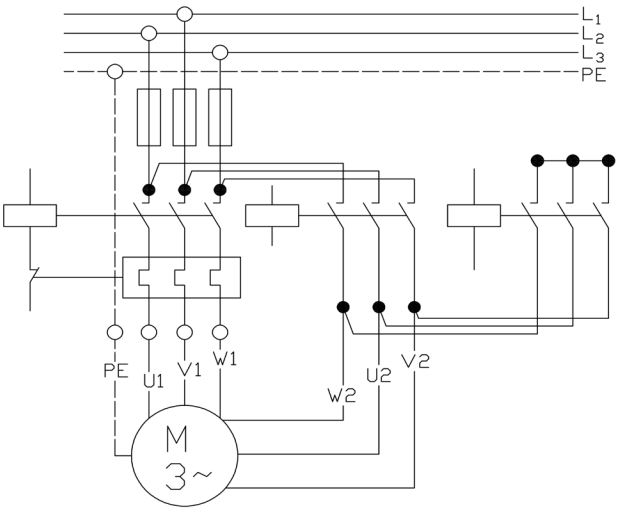


Single-phase motor

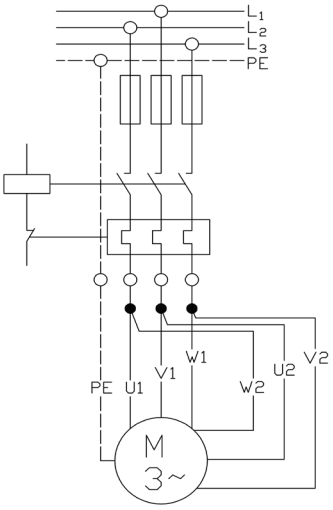
Counter-Clockwise rotation



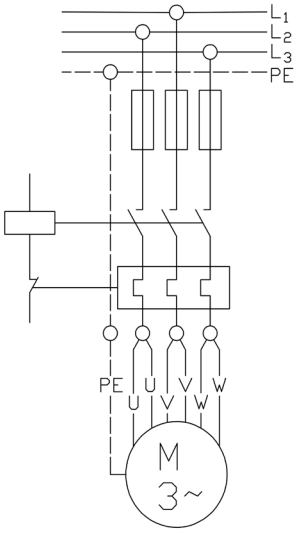
Direct-on-line-starting – one power supply cable



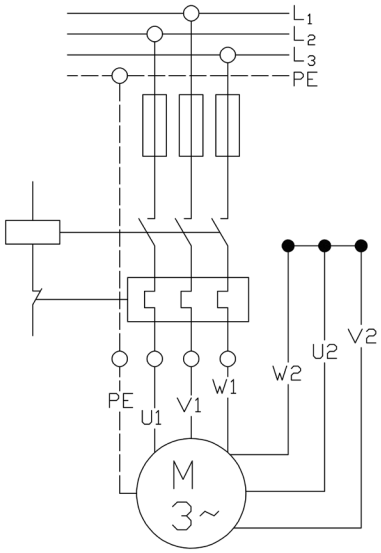
Star-delta-starting



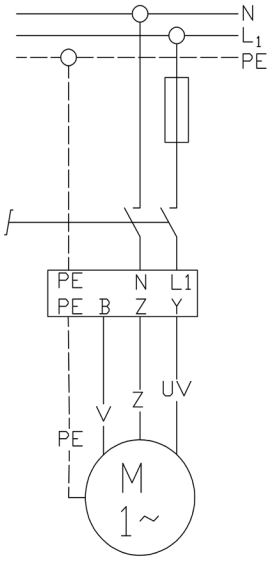
Direct-on-line-starting-delta connection in control panel



Direct-on-line-starting – two power supply cable



Direct-on-line-starting-star connection in control panel

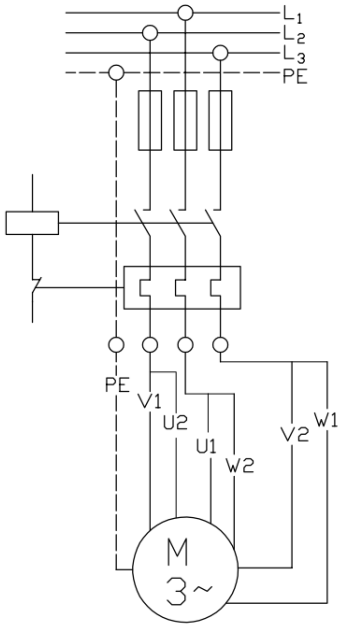


Single-phase motor

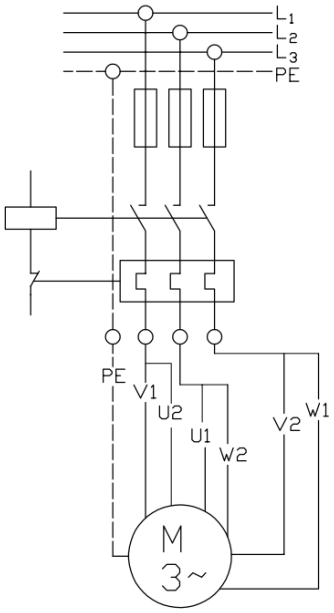
Note: Certain motors (see below table 3.4.3.1) require to be connected in a delta connection. The delta connection is made in the junction box as indicated in Figure 3.4.4

Motor	kW Rating	HP Rating	Voltage	Hz
10" Standard	166	225	400V 460V	50 Hz 60 Hz
	185	250		
	220	300		

Table 3.4.3.1



Counter-clockwise
Dual Voltage Motors–Low Voltage (Δ) Connection



Clockwise
Dual Voltage Motors–Low Voltage (Δ) Connection

Fig 3.4.4

3.5 Accessories

If your submersible motor is provided with temperature monitoring, the PT100 probes should be connected to a temperature monitor. The instrument leads will require an additional instrument cable to the surface. The temperature limits should be set at 70°C (158°F) or below to maintain a safety margin for the insulation winding temperature limits. Records should be maintained of temperature and any rise in temperature should be investigated to understand the cause for the rise.

4 Packaging, Transportation and Storage

4.1 Receipt and Unpacking

Submersible pumps are subjected to a thorough inspection before leaving the factory and are supplied with operating instructions for fitting, starting, care etc, that conform to international safety regulations.

During all aspects of handling, transportation and installation, the unit must be protected from mechanical shock to prevent damage to the components.

Immediately after receipt of the equipment, check the delivery/shipping documents for completeness of the shipment and verify there has been no damage in transportation. Any shortage and/or damage must be reported immediately to Flowserve.

Check any crates, boxes and wrappings for any accessories or spare parts that may be packed separately with the equipment or attached to side walls of the box or equipment.

Each product has a unique serial number. Check that this number corresponds with that advised and always quote this number in correspondence as well as when ordering spare parts or further accessories.

4.1.1 Handling and lifting

⚠	**⚠ CAUTION** *Take special care when handling the pump unit. Make certain that it does not impact against walls, steel structures or floors etc.* *Under no circumstances must the power cables be used for lifting or moving the motor.*

⚠ *Do not lift heavy equipment overhead of personnel.*

A safe distance must be kept when lifting and moving the equipment.

Use approved and suitable lifting equipment only.

The height of the lifting equipment should be such that the pump and motor are able to be lifted in vertical position.

Do not attempt to lift the pump or motor using eyebolts on pump/motor components as this could damage sealing and machined fit surfaces.

Do not remove the protection cover from the pump discharge until installation in the well as it prevents contamination of the pump.

In general, care is to be taken when removing crating, coverings, and strapping in order not to damage any auxiliary equipment and/or the paint finish.

If a pump and motor is shipped assembled, then care must be taken not to lift the unit from the packaging in such a way to allow the unit to "bend". This will likely cause damage to the interconnector.

4.2 Transportation

⚠ *A crane must be used for all pump sets weighing more than 23 kg (50 lb). Fully trained personnel must carry out lifting, in accordance with local regulations.*

Sling, ropes and other lifting gear should be positioned where they cannot slip and where a balanced lift is obtained. Care must be taken to ensure safe handling of the equipment during all transportation and handling.

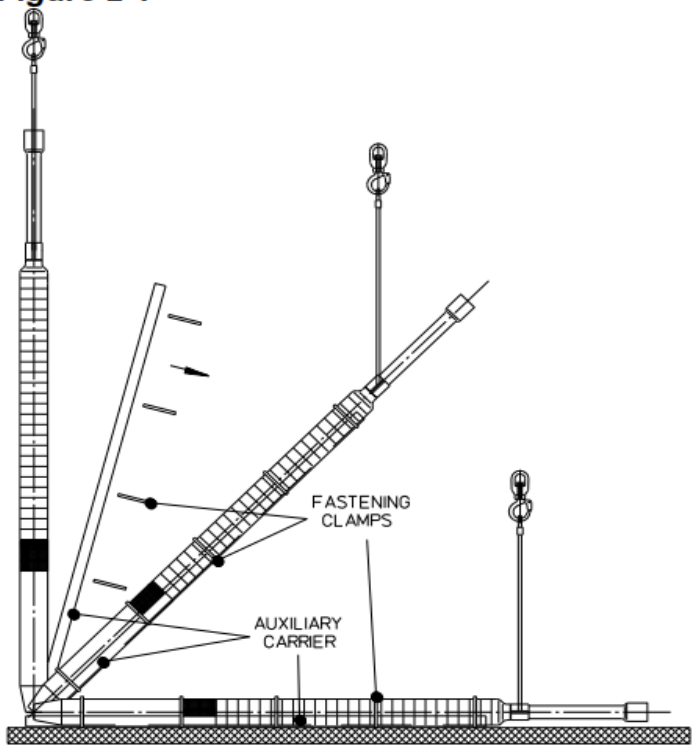
⚠	**⚠ CAUTION**
	Do not use eye bolts to lift pump, motor and assemblies as they can potentially damage machined alignment surfaces.

⚠	**⚠ CAUTION**
	Care must be taken to lift components or assemblies above the centre of gravity to prevent the unit from flipping

4.2.1 Lifting

⚠	**⚠ CAUTION**
	Due to the danger of sagging, pump units that exceed the permissible length must be supported by an auxiliary carrier (U or H carrier) when lifted into the vertical position. This carrier may only be removed after the pump unit is hanging vertically from the crane or lifting block (See figure 2-1.) When a carrier is not available, it is recommended that the pump and motor be lifted using a strongback beam.

Figure 2-1



When assessing the diameter of the unit, use the smaller size from the pump and motor. This can be found on the rating plate or the data sheet.

Table 2-1

Rated diameter	Permissible length
6 in. (152 mm)	3.3 m (10.8 ft)
8 in. (203 mm)	3.5 m (11.5 ft)
10 in. (254 mm)	4.4 m (14.4 ft)
12 in. (305 mm)	4.7 m (15.4 ft)

Under no circumstances must the power cables be used for lifting or moving the motor.

4.3 Storage

4.3.1 General remarks

⚠	**⚠ CAUTION**
	Store the pump and motor vertically and properly secured to prevent their tipping over in a clean, dry location away from vibration. Leave piping connection covers in place to keep dirt and other foreign material out of pump casing.

⚠	**⚠ CAUTION**
	Submersible pump units need special storage conditions. For functional reasons some inner parts (e.g. the stator and rotor plates) cannot be produced from corrosion resistant materials and are therefore sensitive to any type of air humidity.

All units may basically be stored either in a filled or unfilled condition; however, these two types of storage require different treatment of the unit.

The leads of the power cables must be protected from moisture and sunlight. Ensure that the power cables and, if applicable, the signal cables are not bent during storage.

4.3.1.1 Requirements for the storage area

a) The storage area must be well ventilated.

b) Air humidity should be in a range of 40 to 60%.

c) Temperatures: +50 to -25 °C (+122 to -13 °F) for units with unfilled motors +50 to -15 °C (+122 °F to +5 °F) for units with filled motors.

d) For temperatures down to -15°C, (+5 °F) see the guidelines in the instructions for filling submersible pump motors in section 5.2.3, Antifreeze.

4.3.2 Storing for up to four weeks

No other special arrangements are required.

4.3.3 Storing between one and 24 months

For storage between one and 24 months, it is recommended that the shaft of the unit be turned at intervals of approximately 8 weeks On pump units where this is not possible, the pump and motor must be separated. The motor unit has to be filled with water and has verified and adjusted if necessary as per values in Table 5.2

4.3.4 Storing for over 24 months

For long term storage over 24 months, it is recommended to rotate the shaft at 8-week intervals and check the motor insulation resistance at least yearly. Record the date and insulation resistance reading. If insulation resistance deteriorates over this period, then it is recommended to replace the motor or to service it if possible. If possible, store the motors under water to ensure the components do not dry out or drain and lead to corrosion damage.

4.3.5 Inspection before storage

a) Inspect the preservative coating/painted surfaces on the various parts. Touch up the areas, If necessary.

b) Inspect all covers over pump openings and piping connections. If found damaged, remove the covers and inspect interiors of the opening for any deposits of foreign materials or water.

c) If necessary, clean and preserve the interior parts as noted above to restore the parts to the "as shipped" condition. Replace covers and fasten securely.

d) Exercise caution with pumps exposed to weather. Containers are not leak proof. Parts may be coated with a residual amount of protective coating, which will wash away if exposed to elements.

4.3.6 Recycling and end of product life

At the end of the service life of the product or its parts, the relevant materials and parts should be recycled or disposed of using an environmentally acceptable method according to local regulations. If the product contains substances that are harmful to the environment, these should be removed and disposed of in accordance with current regulations. These requirements include the liquids in the motor.



Make sure that hazardous substances are disposed of safely and that the correct personal protective equipment is used. The safety specifications must be in accordance with the current regulations at all times.

5 Installation

This equipment is intended for installation and operation in vertical orientation only. Flowserve should be contacted to ensure the equipment is suitable for any installation in a horizontal application**.**

5.1 Inspection and preparation

Conduct an inspection of the equipment and the facility where it is to be installed. If any deterioration of equipment is noticed it is recommended the equipment be repaired or replaced to ensure reliable system operation.

⚠	**⚠ CAUTION**
	Take special care when handling the pump unit. Make certain that it does not hit against walls, steel structures or floors etc.

5.1.1 Insulation Resistance Testing

This test will be conducted on a number of different steps during installation or storage inspection of the motor, cable, or other electrical components. Only qualified personnel should conduct this test and interpret the results.

For conducting the insulation resistance test, use a megohmmeter rated for 500 VDC.

Attach insulation resistance tester return lead to a suitable ground path for the test. This may be the motor housing, metal well casing, or ground wire (if so constructed). Set the voltage test level at 500 VDC.

Attach other lead to device to be tested (motor, cable, other) at the copper terminal or wire conductor.

Start test and after 60 seconds have elapsed record the insulation resistance value in MΩ.

Disengage power from the insulation resistance tester and ensure any residual voltage is discharged through a shorting lead for at least 4 minutes or 4X the length of time energized

If possible, record the temperature of the motor and/or the environment. Insulation resistance varies with temperature, so consideration of ambient temperature is required when comparing readings in different environments or times.

Logging of readings for future reference and comparison can be a useful method to evaluate the change in insulation condition over time.

5.2 Installation

5.2.1 Equipment, tools, and materials required for installation of unassembled pumps

The following list covers the principal tools/items required for installation.

a) Potable water optionally with antifreeze if there is a risk of freezing (ref section 5.2.3).
b) Cranes or rigs capable of hoisting and lowering the pump and/or motor and the tubing string and cable.
c) Power cables and, if applicable, signal cables are fixed to the tubing by means of cable clamps, ties, or banding. Cable sheaves or guides may be needed to ensure there is no damage as the cable enters the well.

d) Centralizers for preventing cable damage during installation in tight wells or wells deviating from vertical.
e) Submersible cable splicing materials to connect the power cable to the motor leads. See data sheet for lead wire details.
f) Tubing and associated tooling required for installation.
g) General purpose hand tools, pipe wrenches, end wrenches, socket set, screwdrivers, Allen wrenches, wire brush, scraper and fine emery cloth.
h) Thread sealing compound designed for stainless steel and light machinery oil.

Note: Parts and accessories may be placed inside shipping containers or attached to skids in individual packages. Inspect all containers, crates and skids for attached parts before discarding.

5.2.2 General advice for installation

Required minimum flow velocity past the motor as per Table 5.2.2.1. For applications requiring lower flow velocities, Flowserve should be contacted for application review and approval to operate at the lower velocity. Generally, Flowserve will require a flow shroud to ensure velocity is above the minimum.

Note: Contact your Flowserve representative if you require assistance determining the flow velocity in your application.

Motor	Nameplate power		Minimum required flow velocity past motor	
	kW Range	HP Range	(m/s)	(ft/sec)
Standard 6"	4 to 18.5 kW	5.4 to 25	0.2	0.66
	22 to 30.5 kW	29 to 41	0.5	1.6
Standard 8"	22 to 37 kW	29 to 50	0.2	0.66
	60 to 93 kW	80 to 125	0.5	1.6
Standard 7"	All		0.5	1.6
Standard 10"	All		0.5	1.6
Premium (all sizes)	All		0.15	0.5

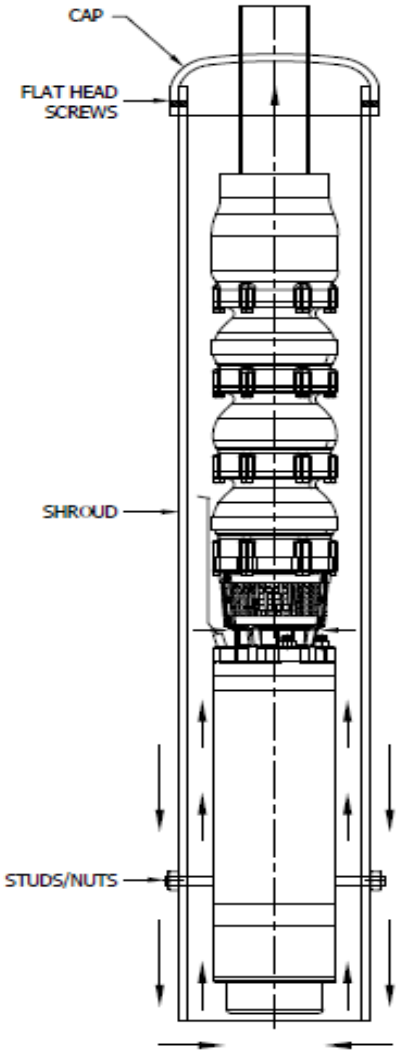
Table 5.2.2.1

The following criteria must be considered to determine the installation depth:

- Location of the motor in the well above the well casing perforations so that an adequate motor cooling flow is guaranteed along the external motor surface. Consult the Drilling Contractor to provide the recommended pump setting and ensure minimum flow velocity past the motor.

- If there is insufficient flow velocity in your application and/or the flow will be coming from above the pump, then a flow inducing shroud as pictured below will be required. The non-closed end of the shroud should be fixed to the center of the motor in the shroud without causing deformation of the motor or pump housing. Failure to install a shroud when required can cause premature failure and voids the warranty.

- Your motor is designed to operate in applications with water temperatures of 50°C (122°F) or less. Please contact your Flowserve representative if the application temperature is hotter for recommendations.



- The pump must have adequate depth in the well to ensure adequate submergence including when the water level draws down after pumping commences.
- In addition to pump depth, the cable splice to the motor leads should be submerged to ensure adequate cooling of the leads.
- A dynamic water level above the interconnect, cable splice, motor, and pump NPSH requirements is required. (See pump characteristic curve.)
- Flow rate. (See pump characteristic curve.)

⚠	**⚠ CAUTION**
	Regardless of the above, the pump unit should be installed above the well screen whenever possible, to avoid foreign matter being drawn directly into the pump inlet, and to ensure that there is adequate water flowing across the motor to assist heat transfer. If this is not possible a flow shroud should be provided to induce the flow of water over the motor.

⚠	**⚠ CAUTION**
	Pump units can only be operated with a fully filled and submersible motor. The liquid level of the motor must always be checked before installation and, if necessary, filled according to the instructions in this manual. Check table 5.2 for the ideal values. Failure to do so could damage the motor during operation.

⚠	**⚠ CAUTION**
	If a flexible hose or tubing is used instead of steel pipes to suspend the pump in the well, the system will twist against the direction of rotation of the motor when it is started. In this case, the power cable (and, if provided, the signal cable) fastened to the hose or tubing would also twist and tighten. To prevent the cables being pulled out of their junction boxes, they should not be laid parallel to the riser hose but wound around it in the opposite direction to the rotation of the motor. The number of turns required will depend on the length and stiffness of the riser hose line and the locked rotor torque of the motor. The exact twisting characteristics will need to be requested from the hose or tubing manufacturer.

⚠	**⚠ CAUTION**
	Under no circumstances must the power cables be used for lifting or moving the motor.

5.2.3 Antifreeze

General Information about Filling.

The General information about filling in this section applies to all motor types, unless stated otherwise in the individual descriptions.

Motors are usually delivered pre-filled with water only. If a motor must be filled or topped up with a mixture of water and antifreeze, this must be prepared in a clean container before filling the motor.

Motors must be filled and topped during the installation process.

In the case of freezing environments (shipping and/or storage) the motors can be filled with a mixture of water and antifreeze. The mixing ratio is typically 30% propylene glycol and 70% water. Other ratios can be used if protection is required at temperatures less than -15°C (5°F).

Drinking water

If the product is used for drinking water, the following precautions must be taken to avoid contamination:

•Before use, make sure that the product does not come into contact with dust or with chemicals not suitable for contact with drinking water, for example lubricants, greases or oils.

•If the pump is used with potentially toxic liquids, it can no longer be used for drinking water.

•In case of maintenance, be sure to always use original parts to maintain the initial hygienic characteristics of the product.

The antifreeze should be a food grade Propylene Glycol such as Dowfrost HD.

In most cases, the motors will be delivered with pre-filled water and will just require topping off to ensure the motor is completely filled so that no air is trapped in the motor.

It is important to check what is the approved antifreeze agent that is been approved by the local country where the pump is going to be used.

⚠	**⚠ CAUTION**
	Never use distilled water

Topping off pre-filled motors

If the Storage time of the pump is more than 1 month then topping off pre-filled motors must be done with potable water without antifreeze.

Filling of motors that have been drained or never filled

Remove the filling hole screw/plug (PT 100 Tap) located near the top end of the motor. Fill the water thru PT100 tap by placing the motor at 45 deg. Dismantle the tap of check valve and fill the water Bring the motor to horizontal position Measure the value using Vernier. If the value is not correct, press to the check valve with needle in order to drain water unless value to appropriate gap. The measure to be as per Table 5.2.3



Below values are the measurement for the ideal water level in motor measured in horizontal position.

Motor Type	Measure(mm)
6" 3S	30 ± 2
7" 3S	30 ± 2
8" 3S	30 ± 2
10"3S	40 ± 2

Table 5.2.3

5.2.4 Checks before Installation

The following checks should be made before starting actual installation.

a) The water chemistry should be within the following range
PH 6.5-8
Max chlorine 500 PPM

Max Sulphur acid 15 PPM
Max fluorine 0.8 PPM

b) Verify that the wellhead foundation is poured and cured, if made of concrete. The total load on the wellhead foundation will consist of the motor, pump bowl assembly, riser tubing (full of water), wellhead assembly and power cable.
c) Verify that open discharge run-off, ditch, etc. for flushing out well and testing unit is prepared.
d) Verify that a log of the well recording depth, straightness, casing variations, standing water level, rated capacity, pumping level, etc., is at the installation site.
e) Some wells taper to smaller diameters at lower depths. Ensure that the well diameter is large enough down to the installation depth so that the pumping unit can be fitted without difficulties.
f) Check all pump connections (bolts, nuts etc.) for any shipping and handling related problems.
g) Before beginning installation, check the dependability of auxiliary equipment, as well as comparing the information on the data sheet with that on the rating plate on the motor.
h) The motor controller should be capable and set to shut the motor down within 3 seconds if the motor experienced locked rotor or starting current conditions.
i) The maximum permissible supply fluctuations can be
    i. +/-10% voltage at the rated frequency
    ii. +/-5% frequency at the rated voltage
    iii. Combined variation of voltage and frequency of +/-10% (sum of absolute values) provided the frequency variation does not exceed +/-5% of rated frequency
j) Before installing, the insulation resistance of the motor alone must be measured. (See section 5.1.1 for instructions). The insulation resistance for the motor should be as indicated in the table 5.2.4

Condition of the Motor and Power Cable	Minimum Insulation Resistance Value (MΩ) at 40°C(104°F)
New motor or used motor in good condition which is not installed, rated less than 1000 V (Ref NEMA MG1 20.18.1 and IEEE 43, 12.3)	100
New motor or used motor in good condition with cable installed	10

Table 5.2.4

In the event the insulation resistance value is lower than the minimum after the cable is installed, then the electrical insulation is potentially compromised. Check splices, connections, cable condition for damage or leakage. Correct the damage or replace the component as needed

Connection of Power Cables

The motor leads must be connected to the power cable securely and in a manner that will ensure water tight sealing of the connection to ensure electrical integrity. Failure to make this connection properly will lead to premature failure of the system. Flowserve recommends this work be done by professionals only who have been

trained in the procedures required to achieve a successful and reliable submersible splice. Splice kits can be obtained, and the kit should provide the procedure for completing the splice.

Meg Test post splicing and prior to install and confirm the insulation resistance is at least the value indicated in Table 5.2.4.

⚠	**⚠ CAUTION** *When pump units are installed in narrow or deviated wells, the risers, whether steel pipes, tubing, or hose lines, will need to be centralized to prevent them from touching the wall of the well which could cause damage to any cables fastened to them.*

5.2.5 Assembly of submersible motor pumps before installation

If your pump and motor has come preassembled to each other, this section may be skipped. Proceed to section 5.5

Submersible motor pump units that are delivered in sub-assemblies must be assembled during or before installation. For assembly of these submersible motor pump units the specific installation instructions must be requested from the manufacturer if they have not been delivered with the unit. The following provides general guidelines but may require modification dependent on the pump and motor to be installed.

Note:

- Check the motor shaft size against the coupling bore to ensure proper fit.
- Verify the motor shaft turns freely with little resistance except from the mechanical seal. The initial rotation may be difficult until the thrust bearing is freed.
- The coupling should be a tight sliding fit on the shaft. Do not hammer or force the coupling on the shaft as this could damage your motor or pump.

5.3 Impeller Lift Requirement

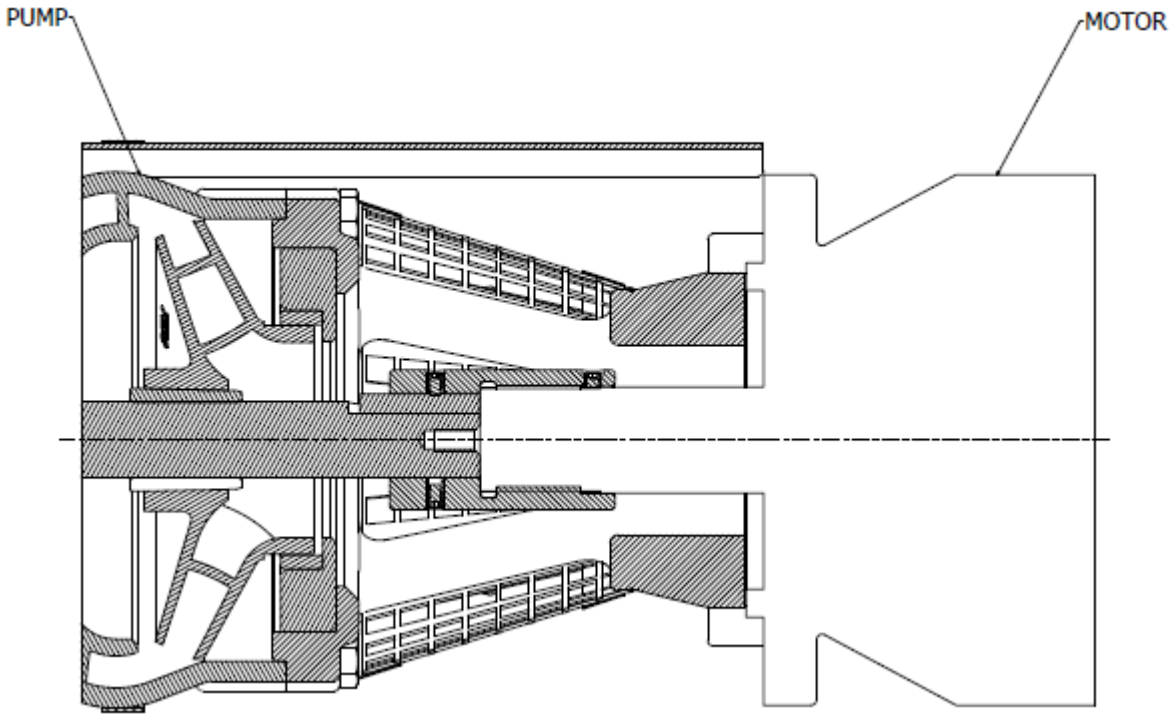


Fig 5.3 Typical Pump and Motor Connection

If the pump was not supplied assembled to the motor, then proper impeller lift is required. This is usually accomplished by the motor shaft lifting the pump shaft from its lowest position. Typical pump lift should be 3mm (0.12 in.) or according to the pump manufacturer's requirements.

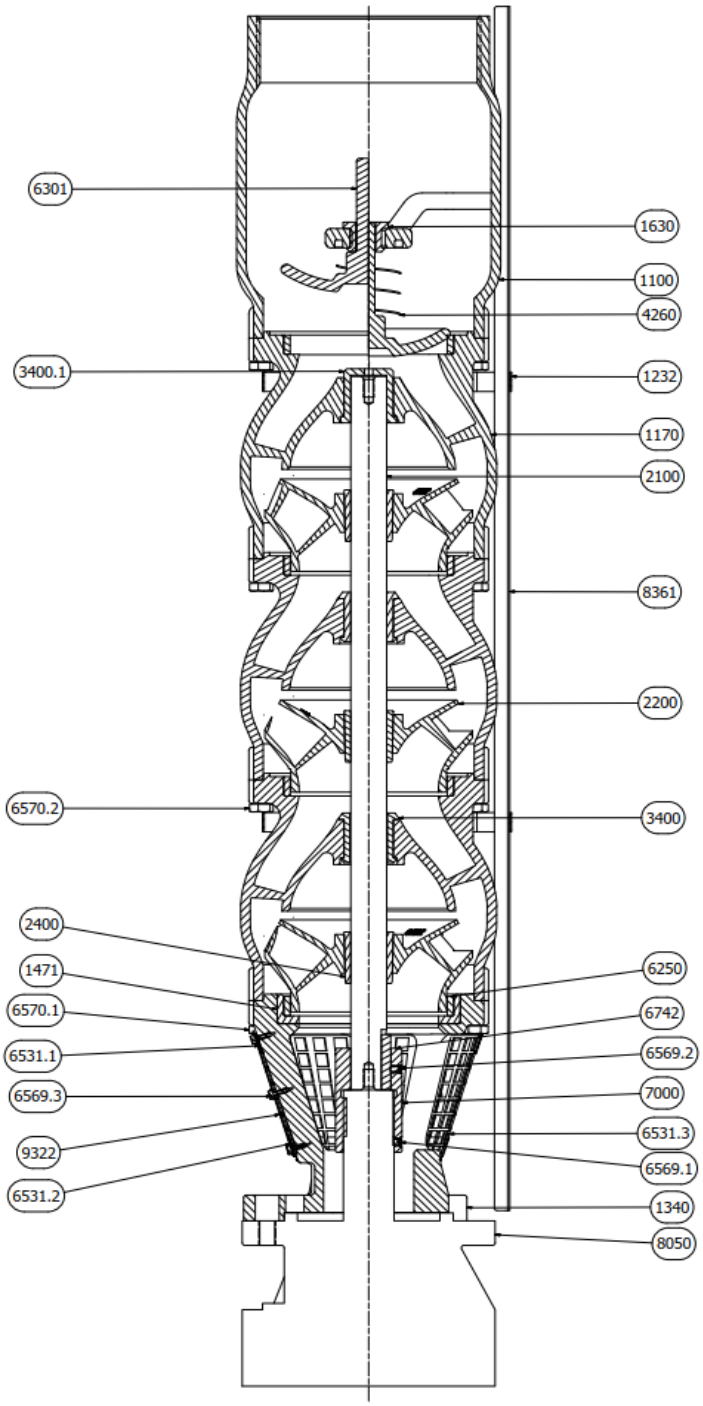


Fig 5.4 Typical Cross-sectional drawing

REF. NO.	DESCRIPTION	MATERIAL
1100	DISCHARGE CASING	ASTM A743 CF8 (304SS)
1170	BOWL	ASTM A743 CF8 (304SS)
1232	CLAMPS FOR CABLE GUARD	SS
1340	INTERCONNECTOR	ASTM A743 CF8 (304SS)
1471	IMPELLER ADAPTER PLATE	ASTM A743 CF8 (304SS)
1630	VALVE BUSH - FABRICATION	BUNA-N
2100	SHAFT	ASTM A582 TYPE 416 SS
2200	IMPELLER	ASTM A743 CF8 (304SS)
2400	COLLET	304 (D3058/A276 Type 304)
3400	BEARING SLEEVE	BUNA-N
3400.1	UPTHRUST CAP	BRONZE - C89835
4260	SPRING	316 SS
6250	WEAR RING	GREENE TWEED ARHT
6301	VALVE DISC	ASTM A743 CF8 (304SS)
6531.1	STRAINER CLAMP TOP	ASTM A240 (304SS)
6531.2	STRAINER CLAMP BOTTOM	ASTM A240 (304SS)
6531.3	STRAINER MESH	ASTM A240 (304SS)
6569.1	SET SCREWS	AISI 304SS
6569.2	SET SCREWS	AISI 304SS
6569.3	#6 SELF DRILLING SLOTTED HEX WASHER HEAD SCREWS	AISI 304SS
6570.1	SOCKET HEAD CAP SCREWS	316 SS
6570.2	SOCKET HEAD CAP SCREWS	316 SS
6742	KEY - PUMP COUPLING	304 (D3058/A276 TYPE 304)
7000	COUPLING	D4 (C3063/A744 Gr CF-8M)
8050	NSF COMPLYING SS BODY MOTOR	SS
8361	CABLE GUARD	AISI 304SS
9322	METAL PLATE	ASTM A240 (304SS)

5.4 Connecting Pump to Motor

Note: Pump and motor shaft may be keyed or splined according to NEMA MG1 standards. Generally, 6" and 8" motors will have a splined shaft and 10" motors will be keyed. If keyed, ensure keys are installed with coupling.

a) Assemble coupling on driver shaft (7000) (if not installed earlier).

b) *Install set screw (6569.1) into coupling (7000) to lock the position on the motor shaft. Check motor direction of rotation using a phase rotation meter.*

c) *Measure and write down pump manufacturer recommended impeller lift setting for final confirmation.*

d) *Verify impeller lift meets pump manufacturer recommended impeller setting.*

e) *Smaller pumps may be coupled to motor horizontally or vertically. Larger pumps requiring a crane or other lifting device should be installed on to the motor vertically. This operation can be done over the well.*

f) *Ensure shafts, coupling, interconnect flange (1340), and motor flange are clean and free of debris. Note: A gasket is not required here. Installation with a gasket will cause improper pump and motor alignment and premature failure.*

g) *Lift pump above motor. Center pump over motor.*

h) *Lower pump to motor and secure pump on to motor and coupling (with key (6742) if appropriate). Ensure the pump shaft easily slides into the coupling.*

i) *Bolt pump to motor.*

j) *Install set screw(s) (6569.2) in coupling (7000) to secure the pump shaft (2100) in the event of up thrust.*

5.5 Installation after pump and motor have been assembled together

Mount the first length of pipe, which should not be longer than 1 m (39 in.), onto the assembled pump unit. This piece is usually threaded into the pump discharge or the top of the non-return valve. Adequate torque should be used to prevent unthreading during starting or operation. For threaded pipe connections, it is recommended to use a permanent thread locking compound to ensure threads are not loosened on the short section of column pipe threaded into Discharge case. Use a product applicable to your region and application, For remaining column pipe threads, use a pipe thread compound applicable to your region and application that is capable of lubricating and sealing. Please note, the motor could turn in either direction. The amount of torque from the motor could be as high as indicated below:

Nameplate HP X 6 = Motor Torque (ft-lbs.) for 2 pole motors

Nameplate HP X 12 = Motor Torque (ft-lbs.) for 4 pole motors

Nameplate kW X 6= Motor Torque (N-m) for 2 pole motors

Nameplate kw X 12 = Motor Torque (N-m) for 4 pole motors

The support tubing and connections should be able to (at a minimum) handle repeated applications of this torque value in either direction. Torque arrestors are available for certain size motors if desired.

Fasten the power cables, control lines and instrument. leads (if any) with cable clamps, clips, or banding onto the pipe at 10 ft (3 m) intervals.

a) When lowering the unit, ensure the power cable is not damaged.

b) During lowering, the unit must always hang freely and must not become wedged in the well shaft. Always ensure that the pump/motor/tubing string can be rotated freely in the well during the entire installation. Attach a cable clip every 3 m (approx. 10 ft.) of pipe length to ensure support of the cable.

5.5.1 Riser pipe with threaded pipe

If riser pipe does not have threaded pipe, proceed to section 5.5.2

⚠	**⚠ CAUTION**
	The instructions in this section are meant as general guidelines because the specific details involved vary from location to location. For specific guidelines, refer to an experienced submersible pump installer or your riser pipe supplier.

Connect a lifting clamp underneath the pipe coupling of the threaded riser pipe and lift the complete pump unit with a suitable hoist.

- Lower the pump unit into the well as far as the installation clamp mounted underneath the coupling of the riser pipe.
- Fasten the power cables and, if necessary, the control lines and/or instrument leads with cable clips onto the riser pipe.
- Lower the unit and rest it on the well rim flange.

⚠	**⚠ CAUTION**
	Do not let the pump unit slip through the installation clamp.

- Remove the lifting clamp and attach it to the next riser pipe and connect this to the pipe already installed.
- Lift the unit and remove the resting supporting clamp.
- Install the remaining riser pipes as described above.
- Finally mount the wellhead support plate well head gasket onto the last riser pipe. Feed the power cables and, if necessary, the control lines and/or instrument leads through the corresponding holes in the wellhead support plate and connect them to the junction box or control panel.

5.5.2 Other riser pipe designs

If an alternative riser pipe design is being used such as flange pipe, composite pipe or other, consult pipe/tubing supplier for guidelines for installation.

5.5.3 Fastener Installation

Fastener Torques

ASTM/ASME/ Common name	A193 Gr B8(304 SS) A193 Gr B8M (316 SS)	Monel 400	A449 Gr 5 A479 Gr XM-16 A276 S31803	A193 Gr B7(410 SS)	A193 Gr B7 Monel 500	A354 Gr BD
Bolt/screw size	N-m(ft-lb)	N-m(ft-lb)	N-m(ft-lb)	N-m(ft-lb)	N-m(ft-lb)	N-m(ft-lb)
M3-0.5	0.3 (.22)	0.4 (.3)	0.5 (.37)	0.8 (.6)	1 (.74)	1.3 (1)
M4-0.7	0.7 (.5)	1 (.74)	1.3 (1)	1.9 (1.4)	2.4 (1.8)	3 (2.2)
M5-0.8	1.4 (1)	2 (1.5)	2.5 (1.8)	3.8 (2.8)	4.9 (3.6)	6.1 (4.5)
M6-1	2.4 (1.8)	3.5 (2.6)	4.3 (3.2)	6.5 (4.8)	8.4 (6.2)	10.4 (7.7)
M8-1.25	5.7 (4.2)	8.3 (6.1)	10.4 (7.7)	15.6 (11.5)	20 (14.8)	25 (18.4)
M8-1	6 (4.4)	8.8 (6.5)	11 (8.1)	16.4 (12)	21 (15.5)	26 (19.2)
M10-1.5	11.3 (8.3)	16.5 (12.2)	21 (15.5)	31 (23)	40 (29.5)	49 (36)
M10-1.25	11.8 (8.7)	17.1 (12.6)	21 (15.5)	32 (24)	41 (30)	51 (38)
M12-1.75	20 (14.8)	29 (21.4)	36 (26.5)	54 (40)	69 (51)	86 (63)
M12-1.25	21 (15.5)	31 (23)	38 (28)	57 (42)	74 (55)	92 (68)
M16-2	48 (35)	70 (52)	88 (65)	131 (97)	169 (125)	210 (155)
M16-1.5	50 (37)	73 (54)	92 (68)	138 (102)	178 (131)	220 (162)
M20-2.5	94 (69)	137 (101)	171 (126)	257 (190)	331 (244)	411 (303)
M20-1.5	101 (74)	147 (108)	184 (136)	276 (204)	356 (263)	442 (326)
M24-3	163 (120)	237 (175)	296 (218)	444 (327)	572 (422)	710 (524)
M24-2	173 (128)	252 (186)	315 (232)	472 (348)	608 (448)	755 (557)
M30-3.5	322 (237)	468 (345)	585 (431)	877 (647)	1131 (834)	1404 (1035)
M30-2	346 (255)	503 (371)	629 (464)	943 (695)	1216 (897)	1509 (1113)
M36-4	561 (414)	815 (601)	1019 (751)	1529 (1128)	1970 (1453)	2446 (1804)
M36-3	584 (430)	849 (626)	1061 (782)	1592 (1174)	2052 (1513)	2547 (1878)
M42-4.5	895 (660)	1302 (960)	1628 (1200)	2442 (1800)	3147 (2321)	3907 (2880)
M42-3	943 (695)	1371 (1011)	1714 (1264)	2571 (1896)	3313 (2443)	4113 (3033)
M48-5	1342 (990)	1953 (1440)	2441 (1800)	3661 (2700)	4719 (3480)	5858 (4320)
M48-4	1384 (1020)	2013 (1484)	2516 (1855)	3773 (2782)	4864 (3587)	6038 (4453)
M56-5.5	2150 (1585)	3128 (2307)	3910 (2883)	5865 (4325)	7559 (5575)	9384 (6921)
M56-4	2234 (1648)	3250 (2397)	4062 (2995)	6094 (4494)	7854 (5792)	9750 (7191)
M64-6	3231 (2383)	4699 (3465)	5874 (4332)	8812 (6500)	11360 (8378)	14100 (10400)
M64-4	3377 (2490)	4911 (3622)	6139 (4528)	9209 (6792)	11870 (8755)	14730 (10864)
M72-6	4670 (3444)	6792 (5009)	8490 (6262)	12740 (9396)	16410 (12100)	20380 (15031)
M80-6	6482 (4780)	9428 (6953)	11780 (8688)	17680 (13040)	22780 (16800)	28280 (20858)
M90-6	9336 (6885)	13580 (10000)	16980 (12523)	25460 (18778)	32820 (24206)	40740 (30049)
M100-6	12920 (9529)	18800 (13866)	23500 (17332)	35250 (26000)	45430 (33500)	56400 (41600)
M110-6	17330 (12781)	25210 (18600)	31510 (23240)	47270 (34864)	60920 (45000)	75630 (55781)

6 Commissioning

6.1 Safety instructions

NOTE Before commissioning, operation or shutdown of the pumping unit, read Section 2 "Safety Information"

⚠	**⚠ CAUTION**
	These operations must be carried out by fully qualified personnel. Turn off power supply for safety while pump commissioning is in progress. *The pumping unit may only be operated* • *By trained personnel* • *In a completely assembled condition* • *Fully filled and submerged*

6.2 General notes

Details concerning the electrical switchgear must be taken from the Operating Instructions from the control panel manufacturer.

6.3 Connection to starter/controller

⚠	**⚠ CAUTION**
	The work conducted here can present electrical hazards and risks. Refer to the starter/controller User Instructions for specific details. Instructions here are offered as general guidelines and should not take precedence over local regulations.

Prior to connecting the cable to the panel, the cable and motor insulation resistance should be checked and be at least as specified in table 5.2.4.

Connection to the starter/controller should be handled by a qualified electrician and by following the directions in the manual for the starter/control panel. Local electrical codes and regulations should be followed.

6.4 Starting the pump

6.4.1 Pre-starting checks

1) Before starting the pump, the following checks should be made.

2) Check that all piping connections are tight.

3) Ensure all downstream equipment is ready to receive water or ensure another means of handling the water has been prepared.

4) Check all bolting connections for tightness

5) Confirm all electrical connections are good.

6) *Confirm incoming voltage is correct. Do not attempt to start the motor if the voltage is less than 95% of nameplate.*
7) *For motor pumping units working with inverters (also known as Variable speed drive (VSD), Variable Frequency Drive (VFD), Adjustable Speed Drive (ASD), or Adjustable Frequency Drive (AFD)),care must be taken to ensure proper set up and limits are established.(See guidelines in Inverter Section 3.4.2)*
    a. *A constant ratio of V/Hz must be maintained (7.67 for 460 V, 60 Hz and 380 V, 50 Hz motors)*
    b. *Motor should be ramped up to at least 70% speed within 3 sec*
    c. *Dynamic braking options on the inverter should be disabled*

Operational Limits

- *NOTE: Never let the submersible motor pump run dry.*
- *Starting, including for test purposes, is never allowed if the pump is not submerged.*
- *For the minimum submersion depth in the delivery medium, refer to the Section 9 "Technical Data" or ask Flowserve.*
- *Failure to follow these restrictions can cause the following dangers:*
    - *Failure of important system functions*
    - *Failure of prescribed methods for maintenance and upkeep*
    - *Danger to persons due to electrical, mechanical or chemical impact*
    - *Danger to the environment by leakage when delivering hazardous media*

⚠	**⚠ CAUTION**
	Operation with a flow rate that is above rated flows can cause motor overload and cavitation in the pump. Low flow rates can cause shortened service life of the pump, overheating of the pump and motor, instability, cavitation and vibration.

- *The duty-point for which the pump unit has been designed can be found in Section 9 "Technical Data"*
- *To avoid overheating the motor, a pump must never be operated for more than 1 minute against a closed discharge valve.*
    - *Depending on your pump type, as the empty piping is being filled, the ammeter may show a higher current than in the data sheet even after the starting current has decayed during the initial start. This higher current may be due to high flow in the pump. If this condition continues after all piping is full, then the control valve may need to be adjusted to a flow rate that will not overload the motor.*
    - *Excessive flow can cause motor overload and excessive production of sand from the well. These conditions could cause premature wear on your submersible pump and motor unit.*
    - *It is possible over time that a minimal readjustment of the control valve and motor controller may be required, due to changing operating conditions, for example by the drawdown of the water level.*

⚠	**⚠ CAUTION**
	Motor protection settings that do not follow these guidelines could cause unsafe conditions or premature failure of your equipment. Please note, data sheet may have been supplied with quote or may be shipped with equipment. If required, consult your Flowserve representative for setting these limitations.

Control setting	*Minimum*	*Maximum*
Flow rate	*See data sheet minimum continuous flow*	*See data sheet maximum flow on curve*
Voltage	*See data sheet*	*See data sheet*
Voltage Imbalance		*See 5.2.4*
Current	*Typically set 10% below minimum load current*	*Typically set at no more than full load current X SF. Prefer setting at 10% over normal operating current.*
Current Imbalance		*10%*
Starts/hour		*See 7.1.4* *Recommend minimum possible*

Table 6.4.1 Control Settings

- *For monitoring the water level in the well and in the header tank, we recommend water level detectors or water level measuring units. Operation of the submersible pumping unit without adequate water level will cause early failure and void the warranty.*

6.4.2 First-time start-up of the pump

Do not start until the pump unit has been fully installed and all piping has been connected downstream as far as the control valve.

1) *Prior to connection to starter, measure insulation resistance (leads-to-ground) with power turned off and motor turned off to ascertain that no short circuits are present.*

⚠	**⚠ CAUTION**
	Do not attempt to start the pumping unit with an insulation resistance reading of less than indicated in Table 5.2.4

2) *Verify that balanced three-phase voltage is supplied and is at least 95% of nameplate voltage.*

⚠	**⚠ CAUTION** *Never attempt to run the pumping unit with an unbalanced voltage between two leads. An imbalance between two leads can cause 6-10 times of imbalances in an amperage and the resultant temperature increase means a decrease in motor life. Any voltage imbalance more than 1% requires the motor be de-rated as specified in NEMA MG1.*

An improperly sized engine driven generator can be very detrimental. Ensure proper sizing is achieved by consulting with the generator supplier.

3) *Partially close the pump discharge valve.*

4) *Start the motor and record the current after the starting current has dropped*

⚠	**⚠ CAUTION** *Do not run the pump for more than 1minute with discharge valve closed.*

When the direction of rotation is incorrect, the pump will have no water production or extremely

reduced water production. If current is lower than expected, rotation is not correct.

⚠	**⚠ CAUTION** *The unit must not be operated for longer than three minutes in the reverse direction.* *In the case of operating in the wrong direction* • *press STOP* • *turn off all power and confirm power is not being delivered to the cable junction box or terminals* • *exchange the motor power cable leads from two phases with one another in the control panel.* • *Mark the leads so that they can always be placed correctly any time they are removed.*

5) *After verifying proper rotation, open the discharge valve to the desired flow rate without exceeding the motor full load current.*

Recheck the current, which should be near full load current if it is rotating in the correct direction and the flow rate is near rated conditions.

⚠	**⚠ CAUTION** *If a circuit breaker trips, always correct the issue causing the trip prior to restart. Wait at least 10 minutes before resetting.*

During first-time start-up, take notice of the following:

a) When motor is started direct on line, it should attain full speed within 3 seconds.

If after this period the line current is still high (over twice normal value), the pumping unit is not attaining the full speed.

⚠	**⚠ CAUTION**
	In the event the pumping unit does not attain the full speed, stop the pumping unit and do not attempt to restart it until the problem is found and corrected.

During normal operation, the current must not exceed the motor name plate value.

6) *Measure the line voltage between phases while the pumping unit is pumping.*
The readings obtained should not be more than 10 % above or below the rated motor voltage.
7) *In case of malfunction, stop the pumping unit and refer to Section 8 "Trouble Shooting Guide ".*

7. Operation

7.1 Normal Operation

7.1.1 Normal start-up of the pump

⚠	**⚠ CAUTION**
	If maintenance has been performed, follow Section 6.4.2 "First-time start-up of the pump".

⚠	**⚠ CAUTION**
	NEVER RUN THE PUMP DRY

1) *Verify that the control panel door is closed.*
2) *Verify that balanced three-phase voltage is supplied by taking readings with the line volt-meter and using the voltmeter selector switch.*

⚠	**⚠ CAUTION**
	Never attempt to run the pumping unit with an unbalanced voltage between two leads.

3) *Start the pumping unit.*

4) *Verify that the pump motor comes up to speed within 3 seconds as indicated by normal readings of current, voltage, head and flow.*
5) *If one of the following conditions occurs*
   a) *current exceeds the rated value of the amperage or*
   b) *voltage varies + 10 % or - 10 % from the rated value or*
   c) *head and flow are abnormal*

   then stop the pumping unit and refer to Section 8 "Trouble shoot Guide".

⚠	**⚠ CAUTION**
	DO NOT RUN THE PUMP AT ABNORMALLY HIGH OR LOW FLOW RATES *Operating at a flow rate higher than normal or at a flow rate with no back pressure on the pump may overload the motor and cause cavitation. Low flow rates may cause a reduction in pump/bearing life, overheating of the pump, instability and cavitation/vibration.*

7.1.2 Normal operating conditions

Submersible pumps serve to transport water under the operating conditions described in the following:

a) *Temperature monitoring if provided should follow requirements in section 3.5*
b) *Sand and other abrasives can damage the pump and motor components and steps may be required to eliminate or reduce the abrasives in the water.*
c) *Water velocity along motor surface: see table 5.2.2*
d) *No impurities that could lead to deposits and blockages within the pump or to deposits on the motor surface.*
e) *No water-hammer*
f) *Maximum 1-minute operation against closed discharge control valve.*
g) *Operation within prescribed voltage tolerances, see section 5.2.3*
h) *Permissible operational range: unless otherwise stated, 50 to 120 % of the best efficiency point (BEP)*
i) *Correctly selected and adjusted motor protection.*
j) *Observation of the maximum permissible number of starts per hour*

⚠	**⚠ CAUTION**
	At higher ambient temperatures and/or lower flow velocities on the external motor surfaces, or if there is risk of clogging, special measures for heat dissipation are required. This must be checked with the manufacturer by indicating the ambient conditions. In this case the suitability of the unit for its planned application must be confirmed by the manufacturer.

- *Water level*

A well should always be provided with means for determining the static water level, and pumping level. A good airline, with depth gage, is generally the simplest and most practical.

For continuous monitoring of the water level in the well, we recommend water level detectors or water level measuring units.

- *Sand*

When a pumping unit is first started, a new well may produce considerable amounts of sand, despite the fact it has been sand pumped after drilling.

The discharge flow rate should be throttled down to a minimum, then gradually opened to full discharge as the sand disappears.

This operation may last from a matter of minutes to several days or longer.

If the sand flow shows no signs of stopping

a) rework the well to screen out the sand (contact your well driller),

b) install a pumping unit with a capacity smaller than that of the currently installed unit.

⚠	**⚠ CAUTION**
	Prior to installation, the well driller should ensure correct well development has taken place to prevent pumping sand. Continued sand pumping will result in increased pump wear which in turn will show up as increased efficiency loss and may damage the motor.

Some wells will always produce a small amount of sand at start-up. Therefore, it may be necessary to bypass or trap out this first flow at each start-up, particularly if a closed piping system is used.

When a pumping unit is known to be installed near the bottom of a well, close monitoring should be made to ensure sure the well does not sand-up (fill in) around the motor.

Sand-up may occur without any noticeable effect in pumping or motor operation. However, the motor is dependent on adequate cooling from water, and any sand around it would eventually create overheating, resulting in motor overheating and failure.

If this problem cannot be cured by well work, contact Flowserve for devices that can be added to the pumping unit to prevent its sanding up.

- *Hydro-pneumatic pressure system*

If the pumping unit is coupled into a hydro-pneumatic pressure system, the set-up must be designed so that the pumping unit

a) does not get "water-logged" (loss of air through water absorption without replacement) and does not receive too much air at each start-up.

7.1.3 Motor operation

- *Always check the motor insulation resistance (megger) before resetting a tripped circuit breaker.*
- *Wait 10 minutes before restarting the motor.*
- *Breaking suction due to inadequate water level in the well can cause pump and motor damage and thus renders warranty void.*
- *Inadequate power supply can cause damage to the motor which renders warranty void.*
- *A time delay must be installed when any type of automatic system is used to prevent starting of the motor while it is spinning backwards due to riser pipe drain back through the pump. Even if a check valve is supplied, the timer delay may be necessary if the check valve is prevented from fully functioning (for example due to debris or corrosion)*
- *A 3-minute time delay is usually adequate. This provides a safety measure in the event a failure in the automatic control system creates a rapid recycle series. It also provides time for the rotating element of pump and motor to stop, after reverse rotation due to vertical riser pipe drain-back.*
- *A pumping unit should not be run at closed valve for more than 1 minute as all the energy supplied is then dissipated as heat. This condition can raise the water temperature to boil and create an overheating problem for the motor.*
- *After the pumping unit has operated for a longer period of time, a minimal readjustment of the motor circuit breaker may be required due to changed operating conditions, e. g. sinking of the water level.*

If the pumping unit has shut-off and the reason cannot be traced to a positive external source:

a) *Switch off the motor.*



⚠ WARNING

Ensure power is safely disconnected and de-energized. Only qualified electrical personnel should conduct next steps.

b) *Disconnect the motor from the main power supply.*

c) *Disconnect the power cable leads from the starter*

d) *Measure the insulation resistance of the power cable leads to the ground (the well casing). A low insulation resistance reading is an indicator of a damaged motor or cable.*



⚠ WARNING

Never reset a breaker or replace a blown fuse and start a motor without first measuring the insulation resistance of the unit.

7.1.4 Number of starts

Size	*Allowable Starts/hour*
6"	*4*
All other motors	*6*

Table 7.1 Allowable starts

Excessive starting of your submersible pumping unit can result in a shorter life and damage to the equipment. To protect the motor against non-permitted restart, use a timer relay or program the controller accordingly.

7.2 Shut down

To minimize water- hammer the control valve must be closed before the unit will be switched off. After the valve has been closed the unit must be switched off within 1 minute.

To stop the pump, follow the user instructions for the control panel.

The pump should be started at least monthly and operated for at least 10 minutes to ensure free rotation of the pump and prevent sanding that might lock up the pump.

⚠	**⚠ CAUTION**
	For prolonged shutdowns and especially when ambient temperatures are likely to drop below freezing point, the piping system must be drained or otherwise protected.

8. Trouble Shooting

The potential issues with pump production are often caused by factors external to the pump motor unit itself. The use of this guide is intended to cover many of the common factors, both internal and external, but it is not possible to cover every potential issue. An experienced pump installer and operator may need to be consulted to determine the root cause of any issue.

Pump is operating but no water or limited water is produced

The control valve or other valving is closed or partially closed	Open the valve
Motor is operating in the wrong direction	Exchange two phases of the power cable
The water level in the well is too shallow	Increase the installation depth. Close the valve to decrease flow and prevent the water level from dropping as quickly
Incorrectly selected pump	Replace with appropriately sized pump
Leakage in the riser tubing or discharge piping	Repair/replace as needed

The intake strainer if blocked with debris	Remove pump and clean the strainer
Pump or check valve passages are blocked	Remove pump and correct the issue
Motor is turning at a slower speed	Ensure proper voltage is being applied during operation
Pump shaft or coupling is damaged/broken	Remove pump and repair/replace
Pump is worn out	Repair/replace as needed

Pump discharge pressure is low

The water level in the well is too shallow	Increase the installation depth. Close the valve to decrease flow and prevent the water level from dropping as quickly
Pressure switch is malfunctioning or incorrectly set	Ensure pressure switch functionality
Leakage in the riser tubing or discharge piping	Repair/replace as needed
Pump is worn out	Repair/replace as needed
Pump or check valve passages are blocked	Remove pump and correct the issue

Motor Temperature is high

Motor is overloaded	Shut the unit down and troubleshoot to find the cause
Pump or motor is Locked	Remove pump and correct the issue Repair/replace as needed
Control settings are set incorrectly	Verify and correct if needed
Motor is operating on two phases	Check controls, fusing, and cable connections

Frequent Starts and Stops

Settings for level controls are too close to one another	Modify to ensure starting/stopping is limited as required
Pump is oversized for needs	Change pump for smaller flow rate or close valve to reduce flow rate (while ensuring adequate flow remains to cool motor)

Pump Operates Noisily and/or Vibrating

Pump or piping is partially or completely blocked	Diagnose and correct cause
Excessive air or gas in water	Pump intake is too high. Install pump more deeply
Pump or motor bearings are damaged	Remove pump and repair/replace pump/motor
Incorrectly selected pump	Replace with appropriately sized pump
Piping flanges/joints are not installed properly	Diagnose and correct cause

Pump is operating outside it's flow range limits	Adjust control valve to ensure flow rate is within the pump's operating range

Pump Does not Operate

No power being supplied	Correct electrical issues with controller and/or power supply
Fuses are blown or breaker is tripped	Diagnose the cause for the trip. Ensure motor has good insulation resistance. Replace fuses/ reset breaker once cause is found and corrected
The control has tripped due to low water level	Confirm the water level and do not start pump until water level is raised. Consider moving pump intake lower to ensure adequate water supply
Motor or cable has short circuited	Check insulation resistance and pull unit if too low.

Note: In the event the pump or motor needs to be repaired, spare parts should be ordered from Flowserve. Use of non-Flowserve parts could result in numerous risks and non-compliance with safety and performance requirements.

9 Returns and Disposal

9.1 Returns

Prior to sending the equipment to a FLOWSERVE service department, follow below steps.

1. Complete declaration of contamination
2. Send the declaration of contamination to the service department
3. Close the openings of the pump properly
4. Pack the pump securely for transport and send it to the service department.

	***NOTICE*** *Pumps sent to a FLOWSERVE service department will only be unpacked and opened with a correctly filled corresponding declaration of decontamination.*

9.2 Disposal and recycling

At the end of the equipment service life, the relevant materials and parts should be recycled or disposed of using local environmental regulation methods. If the product contains substances which are harmful to the environment, then the removal or disposal of the equipment must be in accordance with local/regional regulations.

	**⚠ WARNING** *Refer to Safety Data Sheets and make sure that hazardous substances or toxic fluids are disposed of safely and that the correct personal protective equipment is used. All activities involving hazardous substances or toxic fluids must be in compliance with published safety standards.*

Annex A: Example Declaration of Conformity for CE Marked Pumps

EU Declaration of Conformity

- Original -

The manufacturer:

Flowserve Pumps, Flowserve GB Ltd.
Hawton Lane, Newark, Notts NG24 3BU, United Kingdom

declares herewith that the product

Pumpset consisting of:
Pump: Byron Jackson H2O+
Motor: •••

Serial number: •••

fulfils all relevant provisions of the **Directive Machinery 2006/42/EC Annex IIA (**Applicable also to electrical with voltage input >1000 VAC).

Furthermore the aforementioned product complies with the provisions of the EC Directives:

Low Voltage Directive 2014/35/EU (Applicable to electrical with voltage input 50-1000 VAC)

Harmonised standards used:

BS EN 809
BS EN ISO 12100
BS EN 60204-1
BS EN 60034-1

Other technical standards and specifications used:

Person authorised to compile the technical file:

•••
•••

Place. date:

••.••.••••

Person empowered to draw up this declaration:

Product Line Manager

•••

Operation Manager

•••

Example

Annex B: Example Declaration of Conformity for UKCA Marked Pumps

UKCA Declaration of Conformity

- Original -

The manufacturer:

Flowserve Pumps, Flowserve GB Ltd.
Hawton Lane, Newark, Notts NG24 3BU, United Kingdom

declares herewith that the product

Pumpset consisting of:
Pump: Byron Jackson H2O+
Motor: •••

Serial number: •••

fulfils all relevant provisions of the **Directive Machinery 2006/42/EC Annex IIA** (Applicable also to electrical with voltage input >1000 VAC), and UK legislation **"The Supply of Machinery (Safety) Regulations 2008"**

Furthermore the aforementioned product complies with the provisions of the EC Directives:

Low Voltage Directive 2014/35/EU (Applicable to electrical with voltage input 50-1000 VAC) and UK legislation **"The Electrical Equipment (Safety) Regulations 2016"**

Harmonised standards used:

BS EN 809
BS EN ISO 12100
BS EN 60204-1
BS EN 60034-1

Other technical standards and specifications used:

Person authorised to compile the technical file:

•••
•••

Place. date:

••.••.••••

Person empowered to draw up this declaration:

Product Line Manager

•••

Operation Manager

•••

Example

10 Appendix

Flowserve factory contacts:

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Hastings,
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Telephone +1 (402) 463 1306

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Victoria 3450, Australia
Telephone +61 3 5479 1200

Flowserve Taneytown:
5310 Taneytown Pike
Taneytown, MD 21787
Telephone: +1 (410) 756-2602

Flowserve Pumps
Lowfield Works, Balderton
Newark, Notts NG24 3BU
United Kingdom
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