



English

# Installation, Operation and Maintenance Instructions

## SB3

3 Inch Solar Water Pumping Systems

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# Declaration

## CE Declaration of Conformity

### The Manufacturer of the products covered by this Declaration is:

Mono Pumps (Australia) Pty Ltd  
338-348 Lower Dandenong Road  
Mordialloc, Victoria, 3195, Australia

### The directives covered by this Declaration:

89/336/EEC	Electromagnetic Compatibility directive, as amended.
73/23/EEC	Low Voltage Equipment directive, amended by 93/68/EEC.
98/37/EC	Machinery directive.

### The products covered by this Declaration:

SUN SMC3I, SUN ELECT TRACK.

### The basis on which conformity is being declared:

The products identified above comply with the protection requirements of the EMC directive, with the principal elements of the safety objectives of the Low Voltage Equipment directive, and with the essential health and safety requirement of the Machinery directive. The manufacturer has applied the following standards:

IEC61010, EN 55011

The technical documentation required to demonstrate that the products meet the requirements of the Low Voltage Equipment directive has complied and is available for inspection by the relevant enforcement authorities.

The CE mark was first applied in:

2007

Signed: S. Watt

Authority: Engineering Manager  
Mono Pumps (Australia) Pty Ltd

Date: August 30<sup>th</sup>, 2007

## Attention!

The attention of the specifier, purchaser, installer, or user is drawn to requirements and limitations to use that must be observed when these products are taken into service to maintain compliance with the above directives. Details of requirements and limitations to use are contained in the product manual.

# Warranty

## Warranty Statement

1. The SB3 (3 Inch Solar Water Pumping System) manufactured by Mono Pumps is covered by a warranty for a period not exceeding twenty-four months from date of purchase.
2. Mono Pumps will make good by repair, or at their option, the replacement of faulty parts under warranty, providing always that:
  - (a) The equipment was correctly installed and properly used in accordance with Mono Installations and Operating instruction and accepted codes of good engineering practice.
  - (b) The claim for goods under warranty arises solely from faulty design, material or workmanship.
  - (c) The repair is carried out in the Mono Pumps factory or by an authorised agent or distributor appointed by Mono Pumps.
  - (d) All freight costs to and from the factory or repair agent are to be paid by the purchaser.
3. In the case of equipment or components which are not of Mono Pumps manufacture, but supplied by them, the warranty is limited to that extended by the suppliers or manufacturers of such equipment.
4. Mono Pumps warranty does not cover any of the following:
  - (a) Claims for third party liability of damage caused by failure of any of the company's products.
  - (b) Damage caused by abnormal operating conditions, war, violence, storm cataclysm or any other force.
  - (c) Damage caused by the equipment being used for an application for which it is not recommended.
  - (d) Damage caused by sand or abrasive materials, corrosion due to salt water or electrolytic action.
  - (e) Damage to the SMC if the SMC has been opened by removal of the back plate before being returned to Mono.
  - (f) Damage to the motor if the motor is found to have been disassembled before being returned to Mono Pumps.

(g) Damage caused by running the pump dry.

5. The decision of Mono Pumps in relation to any claims or disputes over warranty is final.
6. The warranty is in lieu of all other warranties and conditions expressed or implied, written or oral, statutory or otherwise, which are hereby negated and excluded.
7. This express warranty does not exclude any conditions or warranty implied by the Trade Practices Act 1974 or separate State laws and in addition to any other right, that the original purchasers or any subsequent purchaser may have at law.

In case of claim please contact your Authorised Mono Pumps dealer or contact Mono Pumps (Australia) Pty Ltd.

# Introduction

## Intended Use

The SB3 (3 Inch Solar Water Pumping System) is designed for pumping potable water from boreholes using solar power. Do not use the system for any other purpose.

The protection provided by the equipment may be impaired, if the equipment is used in any other manner than designed.

## System Overview

Mono Pumps SB3's are comprised of four main parts:

- 1 Either a stationary or tracking solar array.
- 2 Solar Motor Controller (SMC).
- 3 Submersible Motor with electrical drop cable.
- 4 Subrotor Pump (Wet End) which is direct coupled to the submersible motor.

Additional items such as Bore Caps, Termination Kits, Water Level Controllers (WLC's), Float Switches, etc. may also be supplied with the system. The pump rising main, discharge piping, bore cap and all equipment foundations and ancillary structures, unless otherwise requested is the responsibility of the installer. The installation, operation and maintenance of the Solar Array are not covered in this manual. Please refer to the Solar Arrays manual for information on this part of the solar water pumping system.



## Warnings



**Solar arrays can deliver voltage levels up to 160V DC. Always unplug the SMC from the array before working on any electrical wiring on the SMC or Motor Cables.**

**In the event that alterations are required to the array itself, it is essential to cover the front of the array with a blanket or other suitable material to completely stop electrical generation.**



**The output voltage from the SMC to the Motor is 180V AC. Always unplug the SMC from the array before working on any electrical wiring on the SMC or Motor Cables.**



**All electrical connections in the solar water pumping system are made via plug and socket. The solar array must be fitted with a switched socket to accept the plug from the SMC and to ensure that the system can be completely isolated from the power source when required.**



**When installing or removing the pump from the borehole always use suitable lifting equipment to prevent injury.**



**The SMC AC output is only suitable for the specially wound AC motor supplied by Mono Pumps, and shall not be used to run a standard 3 phase motor.**

# Introduction

## Solar Motor Controller (SMC)



**Do not handle electrical connections when wet. Electric shock can occur.**

The SMC comprises a solar maximum power point tracker (MPPT) and AC motor control electronics combined in the one enclosure.



The MPPT converts/adjusts the voltage on the solar array to maximise power generation and increases or reduces this voltage to suit the demands of the motor controller.

The motor controller is a 3 phase Variable Voltage/Variable Frequency Drive providing an Approximated AC output. It should be noted that this 3 phase AC output is not suitable for running a standard AC motor as the voltage is too low and the performance has been matched to the motor supplied by Mono Pumps.

### Features include:

- Input power ranges from 150 Watts to 300 Watts from solar modules (refer to specifications for voltage, current and power limits for each SMC model.)

- Microprocessor controlled maximum power point tracking continuously changes the array voltage and monitors the input power level thus following changes in the maximum power point of the array. This technology extracts the maximum available power from the solar modules.
- Remote On/Off control via float switch, pressure switch or water level control via probes placed in the bore hole.
- Easily accessible On/Off switch.
- Interface to an optional Hand Held Display Unit
- Variable motor speed control via front panel or the optional Hand Held Display Unit.
- Thermal overload protection
- Input current overload protection detects if too many solar modules are connected to the SMC or if high currents are supplied from a battery source.
- Output current overload protection stops the system if the discharge pressure from the pump is too high.
- If the power output from the array is too low to start the pump, the system goes into “sleep” mode before attempting to restart the pump. This reduces load on the circuits and heating of DC motors.
- Low motor speed cut off to reduce pump and motor wear.
- Float Switch Input Protection prevents damage if accessory devices connected to the float switch socket are wired incorrectly.
- Status lights to tell the operator what the system is doing.

**Note:** The SB3 Motor Controller does not have inbuilt pressure cut off control.  
(Programable via the H.H.D.U)

# Introduction

## AC Submersible Motor

The SB3 uses an AC submersible motor designed for coupling to the Mono® Subrotor submersible pump. The pump and motor are suitable for use in 75mm (3") or larger standard boreholes.

## Subrotor Pump Wet End

The Mono® SB3 System has been specifically designed for use with the progressing cavity pump. The low interference design of the rotor and stator ensure low starting torque while maximising the pumping efficiency.

## Optional Bore Level Probe



Part # SUN S0346

Mono can supply a separate level probe for fitment into the bore or well. This probe device plugs into the Float Switch outlet on the SMC.

A bore level switch is recommended if the inflow of the bore is lower than the maximum flow rate of the pump. Meaning the bore will be pumped dry and the pump will be damaged.

The bore level probe will protect the pump from dry running if the water level in the bore drops to the level of the inlet to the pump.



**Dry running of the pump will damage the rubber stator in the pump. Damage resulting from dry running is not covered by the system warranty.**

# Performance

## Performance for 150W system

Typical Peak Flow Rates 150W system at 1000 W/m<sup>2</sup> in Litres/min

Head	5	10	15	20	25	30	35	40	45
Flow	16.7	14.6	12.5	9.9	7.5	5.3	3.4	1.1	0.2

The following tables relate the daily flow rate with the appropriate Solar Radiation Zone. Zones are from A to F along with the daily radiation in kiloWatt/hours (kW·h)

150W System Stationary Flow rate (m<sup>3</sup>/day)

Zone	A	B	C	D	E	F
Head(m)	4.5kW·h	5kW·h	5.5kW·h	6kW·h	6.5kW·h	7kW·h
5	6.8	7.5	8.1	8.9	9.6	10.2
10	4.9	5.4	6.0	6.5	7.0	7.5
15	3.1	3.9	4.3	4.7	5.1	5.4
20	2.2	2.4	2.9	3.3	3.6	3.9
25	1.4	1.7	1.9	2.0	2.2	2.4
30	1.0	1.1	1.3	1.4	1.6	1.7
35	0.7	0.7	0.8	0.9	1.0	1.1
40	0.3	0.4	0.4	0.5	0.5	0.6

150W System Tracking Flow rate (m<sup>3</sup>/day)

Zone	A	B	C	D	E	F
Head(m)	4.5kW·h	5kW·h	5.5kW·h	6kW·h	6.5kW·h	7kW·h
5	7.5	8.9	9.9	11.0	12.1	13.2
10	5.3	6.2	7.2	8.0	8.8	9.7
15	3.8	4.3	5.1	5.8	6.5	7.1
20	2.6	3.0	3.4	4.1	4.6	5.1
25	1.7	1.9	2.3	2.5	2.8	3.0
30	1.2	1.3	1.5	1.8	2.0	2.2
35	0.8	0.9	1.0	1.2	1.3	1.4
40	0.4	0.5	0.5	0.6	0.7	0.8



# Performance

## Performance for 300W system

Typical Peak Flow Rates 300W system at 1000 W/m<sup>2</sup> in Litres/min

Head	5	10	15	20	25	30	35	40	45	50
Flow	27.6	25.5	24.4	22.0	16.4	14.4	11.9	9.3	6.5	4.12

300W System Stationary Flow rate (m<sup>3</sup>/day)

Zone	A	B	C	D	E	F
Head(m)	4.5k/Whs	5k/Whs	5.5k/Whs	6k/Whs	6.5k/Whs	7k/Whs
5	13.8	15.1	16.4	17.6	19.6	20.8
10	10.7	11.9	13.0	14.1	15.0	16.2
15	6.9	7.7	8.5	9.2	9.9	10.6
20	5.9	6.6	7.3	8.0	8.7	9.3
25	5.0	5.6	6.2	6.8	7.4	8.0
30	4.0	4.5	5.1	5.6	6.2	6.7
35	3.1	3.5	3.9	4.4	4.9	5.3
40	2.3	2.6	2.9	3.1	3.4	3.6
45	1.6	1.8	2.0	2.1	2.3	2.5
50	0.8	0.9	0.9	1.0	1.1	1.2

300W System Tracking Flow rate (m<sup>3</sup>/day)

Zone	A	B	C	D	E	F
Head(m)	4.5k/Whs	5k/Whs	5.5k/Whs	6k/Whs	6.5k/Whs	7k/Whs
5	16.0	17.9	19.9	21.9	23.8	25.7
10	12.4	14.1	15.7	17.5	19.1	20.9
15	8.1	9.1	10.2	11.3	12.5	13.7
20	6.9	7.8	8.9	9.9	11.0	12.0
25	5.5	6.6	7.5	8.5	9.4	10.4
30	4.5	5.4	6.2	7.0	7.9	8.7
35	3.5	4.1	4.8	5.5	6.2	6.9
40	2.6	3.1	3.5	3.9	4.3	4.7
45	1.8	2.1	2.4	2.7	2.9	3.2
50	0.9	1.0	1.2	1.3	1.4	1.6

# Specifications

## Specifications

### Motor Specifications

#### Size Range

Output Power Rating	<b>300W</b>
Nominal Torque Rating	0.7Nm
Nominal Speed at rated power	3000rpm
Variable Speed Control	Yes via SMC

Efficiency at Nominal Torque Rating	60 %
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#### Electrical Characteristics

Maximum Operating Voltage (motor)	180V
Input Voltage Range	0-180V DC
Operating Frequency Range	0 - 100 Hz
Maximum Current	5 amps

#### Mechanical Specifications

Motor Casing Length	XXX mm
Outside Diameter	XX mm
Weight	X kg

Minimum Bore Diameter	75 mm (3")
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#### Mounting arrangement

All motors built to NEMA standard 17/5/72 (**except Shaft**)

“Submersible Motors for Deep Well Pumps 4 inch”

Output shaft designed for direct connection to the Subrotor Pump Flexishaft.

#### Materials

	<b>All models</b>
Casing, end caps, rotor can, external shaft	316 stainless steel
Studs, screws, nuts and washers	316 stainless steel
Cable plug	Santoprene/gold plated contacts/nylon
Rotor core	Mild Steel
Thrust bearing	7203 BECBP
Radial bearings	6202
Mechanical seal	Carbon / Ceramic
Magnets	NdFeBr (Neodymium Iron Boron)
Lubricant	Caltex White Oil Pharma. Complies with FDA regulation CFR 172.878 and CFR 178.3620(a)
Cable	4 core 1.5mm <sup>2</sup> submersible
O rings	Nitrile

#### Water Quality

Maximum Water Temperature	34 deg C, also see Pump Specifications
pH range	8.5 to 6.0
Hardness Range	2000 Mg/L
Salt Concentration	500 ppm

# Specifications

## Solar Motor Controller Specifications

### Electrical

#### Solar Array Input

300W / 350W SMC  
Voltage : 30 to 100 VDC  
Current : 0 to 5 A  
Solar Array: 350W Max.

#### Motor output

SMC  
Voltage : 0 to 180V  
AC Output  
Frequency: 0 to 60 Hz  
Current : 0 to 4 A

#### Float Switch connector

Switch input (pin 3,4)  
Operation Normally closed  
Shutdown on open contact  
Current: 3mA (closed circuit)  
Voltage: 15V (open circuit)

Auxiliary Supply (pin 1,2)  
Voltage: 15VDC Nominal  
Current: 50mA max (10V)

**Com Connector** RS232  
9600 baud  
rts/cts

#### Environmental

Storage Temperature: -10 to 60C  
Operating Temperature: -10 to 50C  
IP Rating: Type 3, Water and dust tight.  
Humidity: 95% Max.

#### Dimensions & Weight

Dimensions (Carton )  
390 x 275 x 290mm  
Weight (in carton) 6.5Kg  
Refer following page for further  
dimensions.

## Lightning Protection

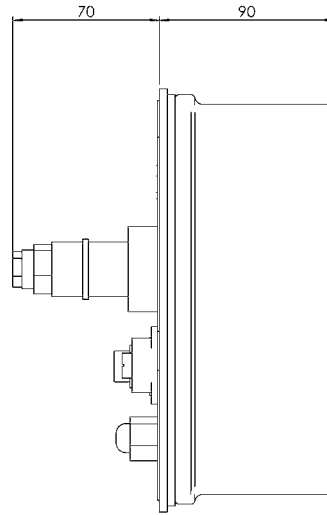
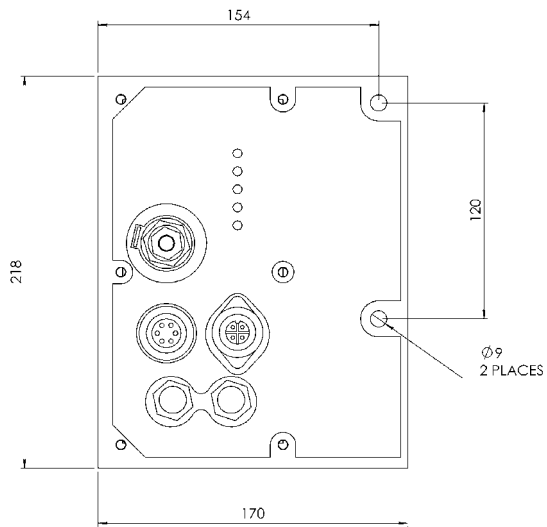
In a solar water pumping system it is necessary to avoid having two earth points. (e.g. The motor itself and the earth rod attached to the solar array frame.) Mono recommends tying the pump safety wire to earth and bonding across to the earth stake with a 1.0"-2.0" galvanized earth strap.

The most vulnerable point is at the motor cable entry to the electronics where it is possible to receive an extreme earth potential rise after a lightning strike nearby.

Metal Oxide Varistors are fitted on the array input and Transorbs on the Motor output.

# Specifications

## 350 / 700W SMC Dimensions



# Specifications

## Cable Specification

### Motor

Motor Plug	180V, 9A	
Cable	Double Insulated	
	250V	
	4 Core	2.5mm <sup>2</sup> for lengths <80m 4mm <sup>2</sup> for lengths >80m

### Array

Array Plug	165V, 15A	
Cable	Double Insulated	
	1000V	
	Single Core	4mm <sup>2</sup>

### Float Switch

Float Switch Plug	15V, 50mA	
Cable	Double Insulated	
	250V	
	4 Core 0.5mm <sup>2</sup>	Systems with two float switches
	2 core 0.5mm <sup>2</sup>	System with one float switch

### Com Port

Com Port Plug	15V, 50mA	
Cable	Double Insulated	
	250V	
	6 Core	

# Specifications

## Pump Specifications

### Size Range

Model Numbers	SM022	SM041
Maximum Speed [rpm]	3000	3000
Flow at Maximum Speed [Lpm]	20	40
Max Discharge Pressure [kPa]*	1500	750
Pump length without motor [mm]	860	850

(\* Discharge pressures are maximum for the pump only. Pressure limitations due to motor current will result in lower maximum pressures for some system.)

### Mechanical Specifications

Typical Weight without motor 7.9 kg  
1½ inch BSP threaded outlet

### Materials

Motor Adaptor  
Pump Barrel  
Socket Adaptor  
Stator  
Flexishaft  
Rotor (Standard)  
Rotor MK 3  
Rotor MK 5  
Non Return Valve  
O rings

### All models

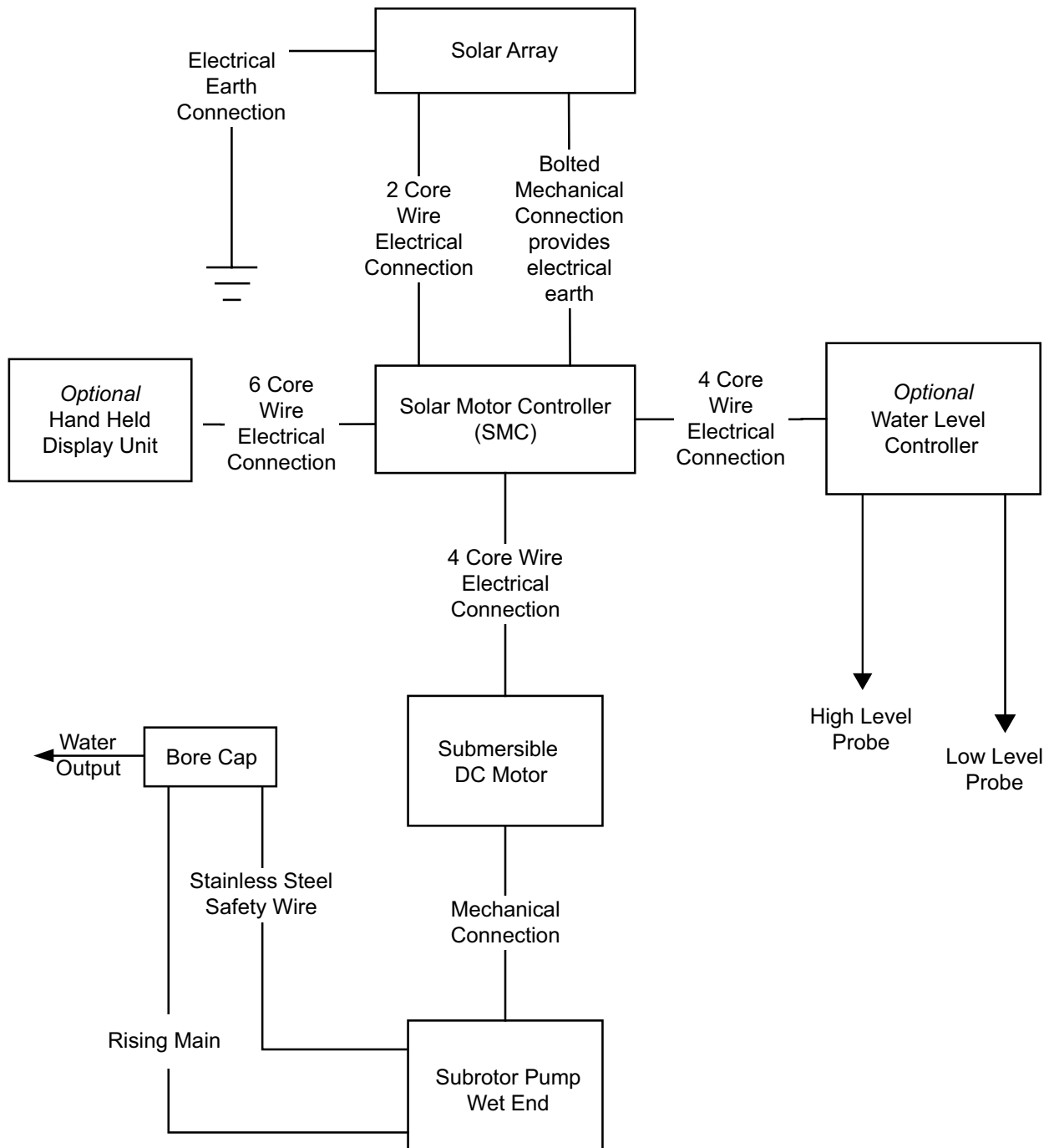
316 cast stainless steel  
304 stainless steel  
304 stainless steel  
304 stainless steel tube with natural rubber lining  
431 stainless steel coated with Halar  
316 stainless steel coated with Hard Chrome Plating  
316 stainless steel  
316 stainless steel  
Bronze with Nitrile seat and anti-rotating pin  
Nitrile

### Rotor Selection - Temperature

150W and 300W SYSTEMS		
Temperature	Model	
	SM022	SM041
up to 25°C	Mark 3 Rotor	Mark 3 Rotor
up to 34°C	Mark 3 Rotor	Mark 5 Rotor
34°C+	Contact Mono Pumps	Contact Mono Pumps

**NOTE: performance may slightly reduce at temperatures below 15°C"**

# Installation



# Installation

## Installation Procedure

### General

The following describes the installation of the Pump, Motor and SMC. Refer to the separate Solar Arrays manual for information on installing the Solar Array.

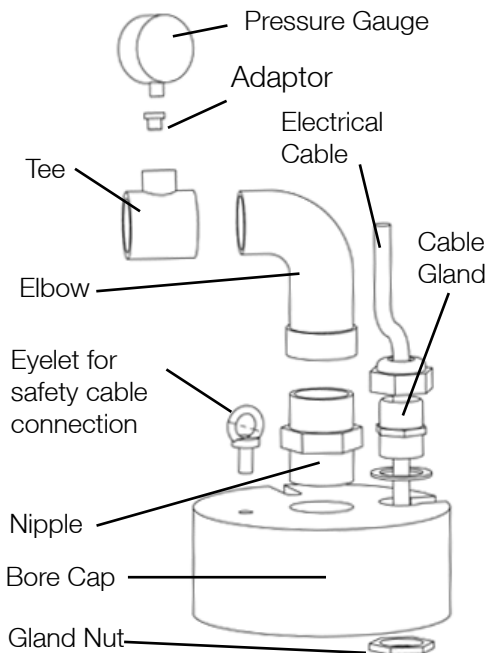
The Warranty does not cover damage due to running the pump dry. If there is a possibility that the pump will pump more water than the borehole can supply Mono Pumps recommends that a Water Level Controller is fitted to the system.

Note that the Warranty does not cover damage to the motor or pump caused by water quality outside the limits specified in the Specifications section of this manual.

### Installing the Pump

#### Prepare the Bore Cap

Assemble the bore cap as shown below



#### Determine the Pump Setting Depth

It is important to set the pump at the correct level in the borehole. Make sure that the unit is at least one metre above any gravel layer and one metre below the maximum drawdown level. When pumping, the water level in the bore will move lower (this is the drawdown).

### Prepare the Pump

The pump can be installed on various rising main materials including polyethylene pipe. If using a polyethylene rising main Mono Pumps recommends that Class 12 pipe be used with cone type compression couplings. Screw the fitting that connects the pump to the rising main into the threaded outlet on the top of the pump.

Lay the rising main out along the ground. Cut the rising main to the correct length and connect to the pump and borecap. The motor cable should be taped to the rising main every 3 metres with electrical tape. Leave 100 mm of slack in the electrical cable between each taping to allow for stretch of the rising main.

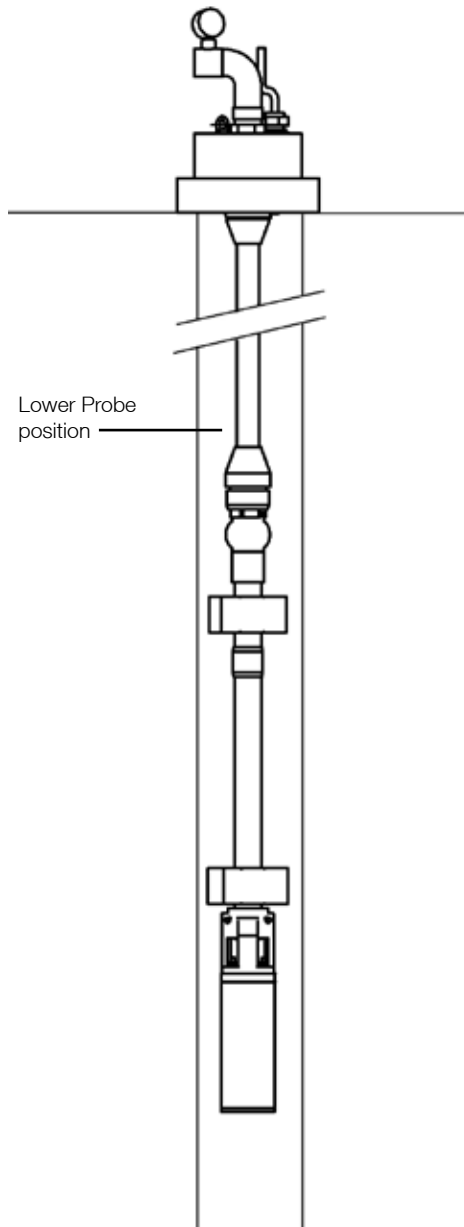


**If the stretch of the rising main is not allowed for, the electrical cable will be pulled tight when the pump is installed resulting in failure of the cable splice or cable gland on the motor.**



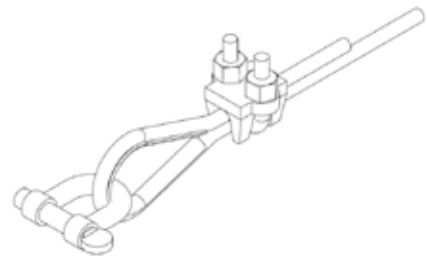
# Installation

If a Water Level Controller is being used the bottom probe should be taped to the raising main with the power cable. The bottom probe should be positioned above the pump as shown below. The top probe is best left untapped so that it can be raised and lowered in the bore as required.

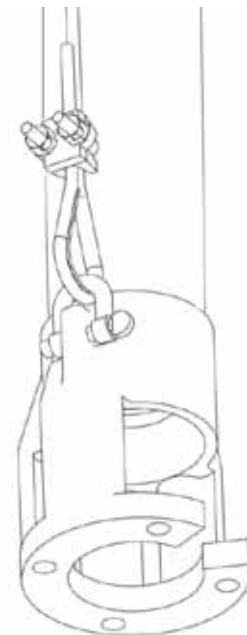


As an initial setting the top probe should be positioned about 1 metre above the bottom probe. It is not necessary to separate the probes by a large distance as it is with some AC pumping systems. **(In AC systems the probe separation is used to control the number of pump starts per hour because more than 20 starts per hour can cause the motor to overheat).** The SB3 system will not be damaged by repeated starts so large separations are not required.

The pump must be supported by means of a stainless steel safety cable. Assemble the clamps onto each end of the stainless steel safety cable.



Connect the stainless steel safety cable to the pump as shown below. **(Note the motor is not shown for clarity.)**



# Installation

The other end of the safety cable will be connected to the bore cap when the pump has been installed.

Before installing the pump the rotor and rubber stator of the pump needs to be lubricated with a little water. Tip the Pump upside down and pour clean water in to the pump via the motor adapter opening. Rotate pump in clock wise direction (may need a tool).



**Do not use any lubricants on the rubber stator as these may interfere with or damage the stator's rubber material.**

## Installing the pump into the borehole



**Warning: Do not lower or support the pump by the submersible electrical cable.**

As the pump is lowered down the bore, the weight should be taken through the safety cable or rising main.

When the pump has reached its required depth the bore cap should be positioned on the top of the bore. Slacken the safety cable slightly so that it can be ensured that the pump is hanging vertically. The safety cable can be secured to the bore cap at the completion of the installation.

The electrical cable should be passed through a cable gland where it passes through the borecap to prevent chafing of the insulation. The electrical cable should be buried underground in electrical conduit between the borecap and the array frame to protect it from damage.

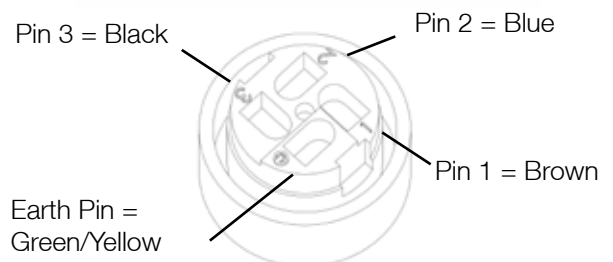
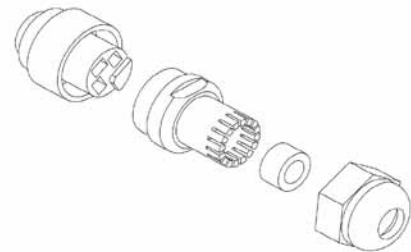
## Motor Plug



**The output voltage from the SMC to the Motor is 180V AC. Always unplug the SMC from the array before working on any electrical wiring on the SMC or Motor Cables.**

## SMC End

If the motor plug is removed from the cable during the installation process it is important that the wires are reconnected correctly to ensure that the pump runs in the correct direction.



## Motor End

The motor cable is spliced to the drop cable. Using a splicing kit part number ESA301111.

# Installation

## Splicing The Motor Cable

The connection between the motor cable and the motor leads must be perfectly watertight. We recommend using the MONO SUBMERSIBLE - JOINING KIT: PART NO. ESA301111.

Contents	Quantity
Crimp Connector - Small	4
Crimp Connector - Large	4
Heat Shrink Tube - Small	4
Heat Shrink Tube - Large	1

- Kit is for use when connecting 4" submersible motors, to motor cable up to size 10mm.
- Small sized crimp connectors should be used when connecting all sized cables 4 and 6mm<sup>2</sup>.

Preparation:

1. Outer insulation to be cleaned with an alcohol impregnated cloth.
2. The three motor leads together with the earth to which the drop cable will be connected must be cut off in a staggered manner as illustrated.
3. The motor cable must be prepared in a like manner making sure that wires to be connected, are properly matched for length to the correct motor lead.
4. Match motor lead colours to motor cable colours as follows:

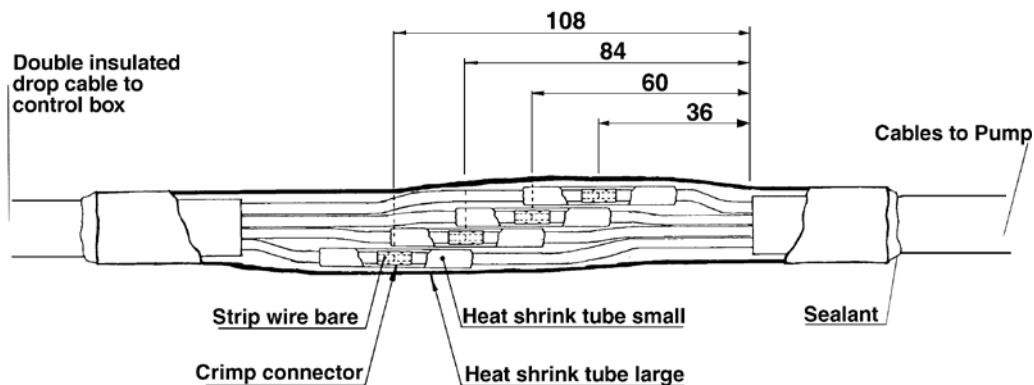
Motor Leads		Motor Cable Lead
Blue	to	Blue
Black	to	Black
Brown	to	Brown
Green/Yellow	to	Green/Yellow

Note: Always be certain to match green/yellow earth leads of motor and motor cable.

5. Next, slide the large diameter heat shrink tubing back over the motor cable clear of the joint and the four smaller tubes over the motor leads, clear of the joint.

## Splicing and Insulating Connection:

1. Trim the insulation back 8mm on each lead.
2. Join leads using correct size crimp connectors and a suitable crimping tool. (Alternatively joints may be twisted and soldered).
3. Slide each of the smaller heat shrink tubes in turn back over each connection.
4. Using a heat source such as a gas torch, candle, heat gun, etc., carefully heat tubing, starting from centre of splice and working towards end while rotating wire.
5. Shrinkage is complete when sealant runs from joint at each end.
6. When cool, each joint should be sealed.
7. Slide larger diameter shrink tube back over splices and heat in a similar manner as for small shrink tube.
8. The seal is now fully watertight and ready for installation.



# Installation

## Non-Return Valve on the Delivery Pipe

If the system is fitted to a pressure tank or the static head above the bore cap is greater than 20 metres then it is recommended that a non-return valve be installed as close as possible to the outlet at the bore head, even though the pump is already fitted with one. The use of a non-return valve will ensure that the pump does not turbine backwards if the non-return valve on the pump were to leak.

## Mounting the Solar Motor Controller (SMC)

Attach the SMC to the bracket on the array frame using stainless steel M8 bolts, nuts and washers.

## Earthing the Solar Array

The post or one of the support legs of the solar array must be earthed to provide lightening protection for the system and to prevent the array structure from becoming "live" in the case of a fault with the array or SMC. If the array frame is more than a few metres from the bore hole the earth point of the array must be connected to the pump safety cable. This is to prevent large voltage differences occurring between the motor and the SMC if lightening strikes the ground near the solar system.

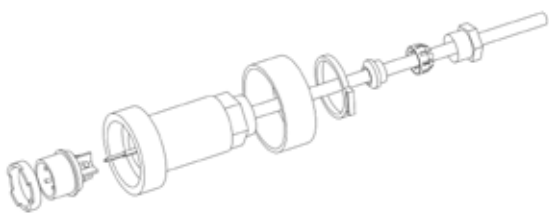
Refer to the Commissioning section on the following page for instructions on connecting the electrical wiring and starting the system for the first time.

## Wiring the Float Switch Plug



**Warning: Ensure that all plugs are fitted correctly to the SMC. Failure to fit the plugs correctly will allow water to enter into the SMC leading to failure. This is not covered by warranty.**

The Float Switch is fitted with a blanking plug as standard. The assembly of the float switch plug and wiring of the blanking plug are shown below.



The SMC will only operate when pins 3 and 4 of the float switch are connected. The blanking plug contains a link wire to connect these two pins. External switches can be wired into the float switch to remotely start and stop the pump.

## Float Switch Pin Connections

Pin 1 is the positive output of 15 volt DC power supply used to power the optional water level controller.

Pin 2 is the negative output of the 15 volt DC power supply

Pin 3 is the positive connection to the float switch.

Pin 4 is the negative connection to the float switch.

Note: The 15 Volt power supply is not suitable for charging lead acid batteries.

# Commissioning

(Starting the system for the first time)



**Warning: Incorrectly connecting the positive and negative wires between array and the SMC will result in damage to the electronics inside the SMC.**

## Electrical Connections

The Solar Motor Controllers utilise 2 “MC” style leads to connect the SMC to the Solar array.

Switch the SMC off using the On/Off Switch on the front of the SMC.

Plug the Motor Plug into the motor socket on the SMC. Ensure that the motor cable is adequately protected from damage by animals or livestock. The cable should be attached to the array post or support frame with electrical ties to prevent the motor plug from being accidentally pulled out of the SMC.



**Solar arrays can deliver voltage levels up to 160V DC. Always unplug the SMC from the array before working on any electrical wiring on the SMC or Motor cables. In the event that alterations are required to the array itself, it is essential to cover the front of the array with a blanket or other suitable material to completely stop electrical generation.**



**Warning: Removing the motor plug from the SMC or shorting the wires together when the SMC is operation, could result in damage to the electronics in the SMC.**



**Warning: Ensure that all plugs are fitted correctly to the SMC. Failure to fit the plugs correctly will allow water to enter into the SMC leading to failure. This is not covered by warranty.**



Switch the isolation switch on the array to the off position (if fitted).

Connect the 2 metre MC cables between the SMC and solar array switch located on the back of the solar array.

Fit the blank float switch plug into the float switch socket on the front of the SMC. The SMC will not operate without either the blank plug or a correctly wired accessory plug fitted to the SMC. For the initial system test, it is recommended to use the jumper plug. Other accessories such as the Water Level probe can be installed if necessary after the operation of the SMC and motor is confirmed.

## Starting the system

When starting the system for the first time it is recommended that the discharge pipe is not connected to the outlet at the bore cap. This will allow the water to flow freely and the quality of the water can be observed.

Turn the array isolation switch to the ON position (if fitted).

The Solar Power Status Light should light up indicating that power is available from the array.

Switch the SMC on using the On/Off switch on the SMC. The Motor Start status light should flash indicating that the pump is starting. When the pump has started the Motor Start status light will turn off and the Max Speed / Motor Run status light will flash or turn on continuously.

Listen to the operation of the pump. If air can be heard bubbling up in the bore the pump may be running backwards. Immediately turn off the SMC and check the SMC motor plug wiring before restarting the system. If the pump is run backwards for more than 20 seconds the stator may be damaged.

# Commissioning

It may take a few minutes for the bore water to reach the surface depending on the depth of the pump setting. If the water that flows from the bore cap is cloudy or contains sand it is important the pump is not turned off until the water flows clear. Turning off the pump before the water clears could result in sand being left in the pump preventing the pump from restarting. If this occurs it will be necessary to pull up the pump and clean the rotor and stator.

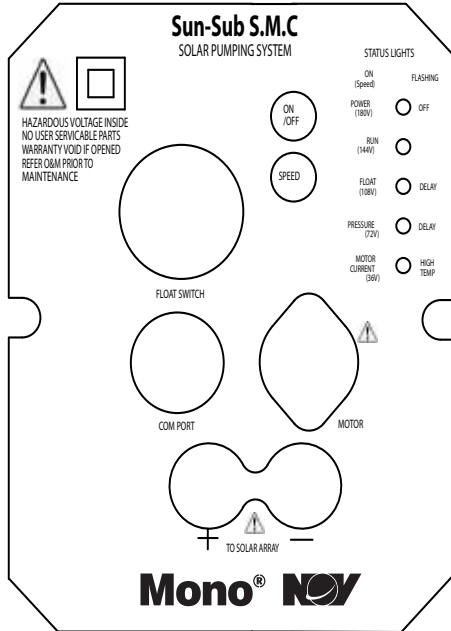
Turn off the SMC and connect any discharge pipe work. Connect any accessory systems such as the WLC, float switches, pressure switches etc.

Turn on the SMC and re-check the operation of the system.

If during the initial operation the pump lowers the well water level until suction is discontinued (i.e. the pump is running dry) turn off the system immediately. If possible, the pump should be lowered further into the bore hole or a bore level controller should be fitted to prevent the pump from running dry and damaging the rubber stator. Allow the bore to "recover" for about 30 minutes before restarting the pump. The maximum speed of the pump can be reduced using the optional Mono Solar Display Unit as a means of preventing dry running. (Refer to the Pump speed control instruction in the operation section of this manual). If this method is used it will be necessary to carefully monitor the bore for a number of days to ensure that the pump does not run dry at any time. Damage to the pump caused by dry running is not covered by the warranty.

# Operation

## Operation of the SMC



### Status Lights

The SMC features five multifunction system status lights (LED's). The first function of each light is indicated by continuous illumination of the LED. A flashing LED indicates the second function. The functions of the LED's are as follows:

### SMC's Diagnostic Indicators

#### Power LED

Lights up when solar power is available.

The indicator flashes when the unit is turned off via the On/Off switch or via the Com Port.

The indicator turns off if insufficient power is available to the SMC.

#### RUN LED

Lights up fully when the motor is running at maximum speed

Flashes proportional to the speed of the motor at lower speeds

#### FLOAT LED

The indicator lights up when the float switch input is open which is when it is not in water.

It flashes when the SMC is in the float switch delay mode which is a delay between the float switch closing and the pump starting.

#### PRESSURE LED

Not Used

#### MOTOR CURRENT LED

Lights up if the motor is overloaded

Flashes slow if the input current reaches the maximum value

Flashes fast if the SMC overheats

# Operation

## Float Switch input

The SMC's Float switch input has been designed to operate on single bore probe (SUN S0346) or tank float switch. The SMC will attempt to start the motor if there is a closed electrical connection across the float switch input (Pins 3,4). If the circuit is opened via the bore/float switch the motor will be stopped and the Float LED will illuminate. Once the bore/float switch has re-closed, a 15 minute time delay will become active, continuing to stop the motor. The Float LED will flash as the timer is counting down. When 15 minutes has elapsed the SMC will attempt to start the Motor and the indicator will turn off.

Pushing the On/Off button will cancel the time delay on the float switch input.

***The float switch input can be configured to run the optional Mono tank and bore level controller (SUN 0415).***

## Pump Speed Control

The pump speed feature can be used to limit the maximum speed of pump, therefore reducing the peak flow of the pump. This is useful when the peak flow needs to be reduced as in a low yielding bore.

### Front Panel Speed Button

Pushing the Speed button will increase the maximum speed by 20% each push. The initial push will illuminate the number of indicators corresponding to the current maximum speed setting, if the switch is pushed again the maximum speed will be increased by 20%. Once the absolute maximum setting of 100% has been attained the next push will revert back to the 20% setting.



# Operation

## Solar Display Unit



The Solar Display Unit is an optional accessory that allows the operator to extract data from the SMC and change software settings within the SMC. The unit has a two line display. The first line displays information on the current operating mode of the SMC. E.g. Motor Starting, Input current overload, maximum motor speed etc. The second line of the display shows information depending on the currently selected function. The primary functions are listed on the keypad on the front of the unit. E.g. To see the array voltage press key 1 then the Enter key. The second line will now display the array voltage. The voltage will be updated continuously until a new function is selected.

The display unit is powered from the SMC but also contains a 9 volt battery. If the SMC is running the display unit takes power from the SMC (i.e. it will operate even if the internal battery is flat.) If the SMC is not connected to an array or the array is not generating any power, the display unit will run from the internal battery. The display unit will also power up the microprocessor on the Power Master so that settings can be changed in the SMC without the SMC being connected to a solar system. When the SMC is powered from the Solar Display Unit the Power LED light on the SMC will flash indicating that there is insufficient power to operate the pump.

A list of the primary functions is shown below.

### Primary Functions

- 0 Motor On/Off (turns the system on or off)
- 1 Array Volts
- 2 Array Amps
- 3 Array Maximum Power Point (Normally auto but if the voltage has been fixed the set voltage will be displayed.)
- 4 Motor Volts
- 5 Motor Amps
- 6 Max Motor Volts (The default is 180 volts but by setting a lower maximum motor voltage the maximum speed of the pump can be controlled. This is useful in applications where the yield of the bore is low.)
- 7 Motor RPM
- 8 Serial Number and Date of Manufacture of the SMC
- 9 Unit ID of the Solar Display Unit

### Second Functions

There are additional functions that can be accessed by pressing the \* key followed by the number key and enter then the value and Enter. E.g. To set a new maximum motor voltage of 90 volts press \* 6 enter 9 0 enter.

- 1 Array Power
- 3 Set Array MPP (Used to turn off the maximum power point tracking and set the voltage to a fixed value. 0 returns to auto mode.)
- 4 Motor Power
- 6 Set Maximum Motor Speed
- 9 Restores the SMC to the factory default settings

# Operation

## Trouble Shooting Guide

Status Light	State	Possible Problem	Solution
Solar Power	Off	Loose array connection	Test array & rectify problem
		Faulty array	Test array & rectify problem
		Faulty SMC	Return to Mono for assessment
		Not enough solar power	Check array position or wait for more sun light
	Flashing	On/Off switch set to off	Push On/Off switch
Remote control set to off		Push On/Off switch	
Motor Speed	On but no flow from pump	Motor disconnected from pump	Reconnect motor to pump / check direction of rotation
		Broken Flexishaft /Coupling	Replace Flexishaft / Coupling
	Flashing / slow	Array partially faulty	Test array & rectify problem
		Pump load increased	Check for obstruction in the pump non-return valve or increased head due to pipe blockage
	Off	System is waiting for enough power	Need more solar power
		Stuck pump	Clear or prime pump
		Faulty motor	Return to Mono for assessment
Off/Float	On	Pins 3,4 of float switch connector open circuit	Check link in dummy plug
		Float / pressure switch open circuit	Check operation of float / pressure switch
	Flashing	In delay mode	Push On/Off switch twice
Overload	On	Motor overload	Check system head
		Pump over pressured	Remove source of flow obstruction
	Flashing	Wrong array configuration	Test array & rectify problem
	Flashing/fast	SMC too hot	Check SMC location for ventilation

# Maintenance

## Solar Motor Controller (SMC)

There are no user serviceable parts inside the SMC. If the SMC is not functioning correctly it must be returned to Mono Pumps for service.



**Any disassembly of the SMC by unauthorized personnel will invalidate all warranty. The back plate/heat sink must not be removed under any circumstances.**

## Motor

There are no user serviceable parts inside the Motor. If the Motor is not functioning correctly it must be returned to Mono Pumps for service.

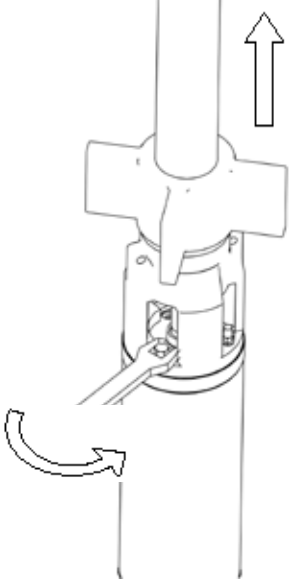


**The Warranty on the motor is void if it is disassembled. All repairs and maintenance must be carried out at the Mono Pumps factory.**

## Subrotor Pump Wet End

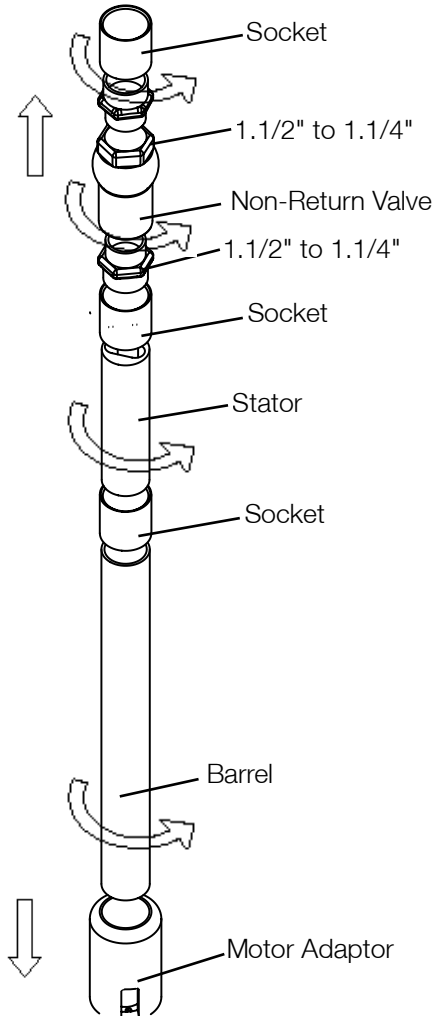
### Disassembly

Remove the four nuts and spring washers connecting the pump to the motor.



Pull the pump off the rotating assembly being careful to pull in a straight line to prevent damage to the flexishaft coating.

To remove the stator grip the Non-Return Valve in a vice or pipe wrench and unscrew the Stator by gripping the Socket in a second wrench.



**WARNING: When removing the Stator it is very important that the tube is not distorted by pipe wrenches, vice jaws etc. Damage to the outside of the stator tube can result in loss of performance and seizure of the pump.**

# Maintenance

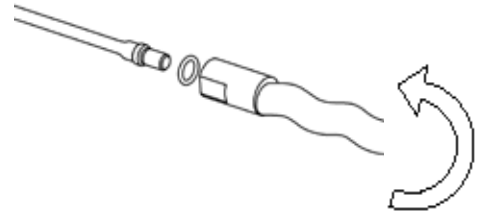
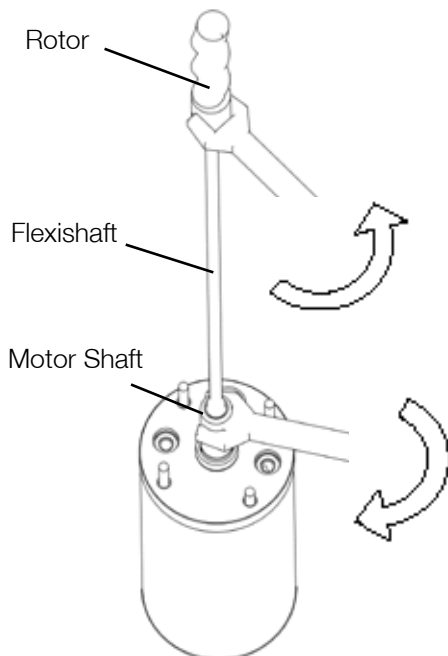
Inspect the stator for signs of damage to the rubber surface and replace if necessary. It is not generally necessary to disassemble the Pump Barrel from the Motor Adaptor.

Inspect the Rotor for signs of wear and replace if damaged. If it is necessary to replace the rotor it is recommended that the stator be replaced at the same time.



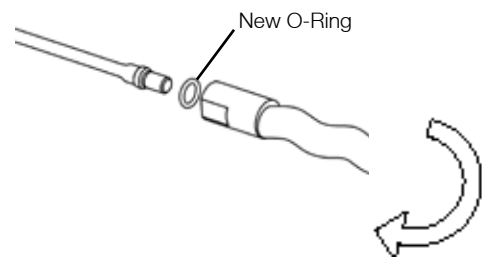
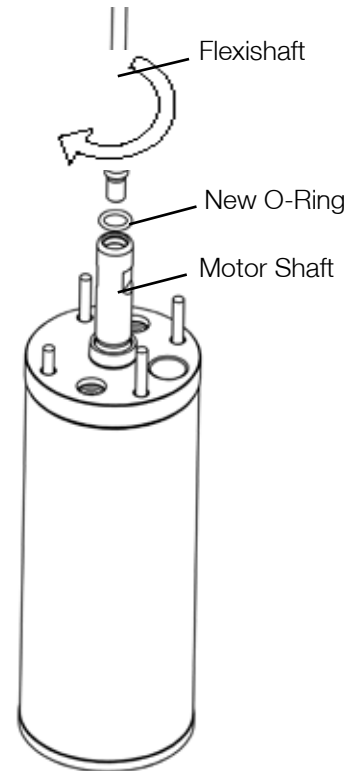
**WARNING: Do not damage the green Halar coating on the flexishaft. Attempting to remove the flexishaft by gripping it with a pipe wrench will destroy the coating and void the warranty. The Halar coating protects the flexishaft from corrosion. Damage to the coating can lead to fatigue failure of the flexishaft.**

To remove the Rotor from the Flexishaft, unscrew the rotor by using a spanner on the flat on the rotor and a second spanner on the flats on the motor shaft. Do not grip the flexishaft. If the flexishaft unscrews from the rotor it will be necessary to carefully grip the exposed metal between the thread and the green Halar coating with multigrips or similar and unscrew the rotor using a spanner on the flats.

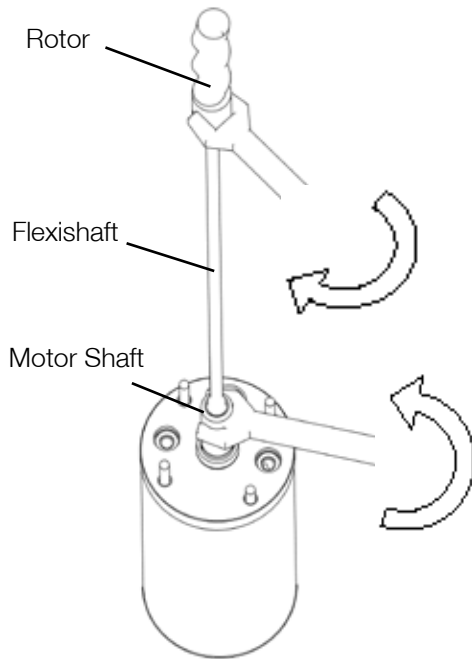


## Assembly

Always replace the o-rings in the motor shaft and rotor with new parts. Coat the Flexishaft threads with nickel or copper based anti-seize. Screw the assembly together by hand and tighten using a spanner on the rotor head flat and a second spanner on the motor shaft.



# Maintenance



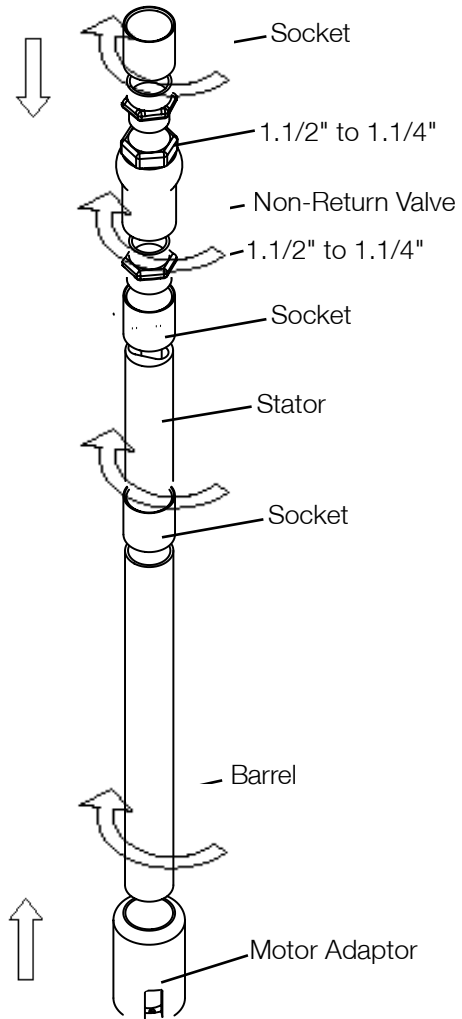
## Body Parts

If the pump barrel has been removed from the motor adaptor piece reassemble these components first. Fit a stabiliser over the pump barrel. Lightly coat both pump barrel threads with Stag pipe sealant. If too much Stag is used the excess could be washed into the stator causing damage to the stator and seizure of the pump. Screw the pump barrel into the motor adaptor piece by hand. Screw the socket onto the pump barrel.

Check the orientation of the stator - one end is marked "Suction This End". Fit a stabiliser over the stator. Lightly coat both stator threads with Stag pipe sealant - be careful not to use excessive amounts. Screw the suction end of the stator into the socket by hand.

Screw the non-return valve onto the stator. (Make sure the check valve is on the correct way such that the flow through the pump will open the valve).

Tighten the assembly using a spanner or wipe wrench on the check valve and by passing a rod or large screwdriver through the motor adaptor piece. It is important that this assembly is tight to prevent it unscrewing in service. The Stag pipe sealant will act as a thread-locking agent when dry.



**WARNING: Do not tighten the stator connections by using a pipe wrench, vice etc. on the stator tube. It is very important that the stator is not distorted by pipe wrenches, vice jaws etc. Damage to the outside of the stator tube can result in loss of performance and seizure of the pump.**

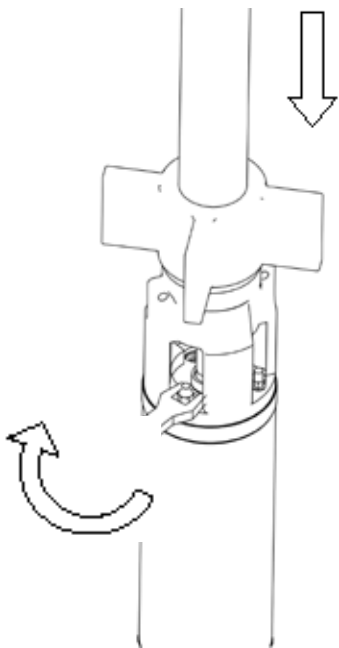


**WARNING: Do not use grease, soap, hand cream, etc. to lubricate the Stator. These products will damage the natural rubber stator and result in seizure of the pump. When assembling the rotor into the stator it is only necessary to wet the components in water.**

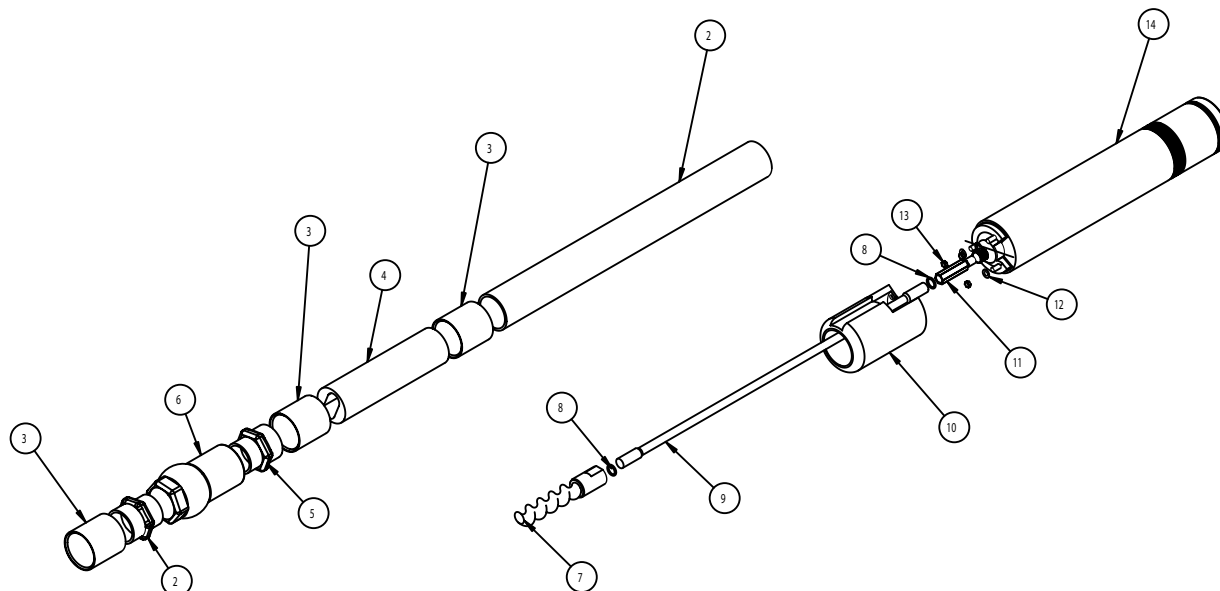
# Maintenance

## Final Assembly

Wet the rotor and stator with water and slide the stator assembly over the rotor assembly. Some resistance will be felt as the rotor is pushed into the stator. Align the motor adaptor piece with the cable outlet on the motor and the motor studs. Push the stator assembly home. Fit the four spring washers over the studs. Fit the four M8 nuts and tighten with a spanner.



# Spare Parts



ITEM	DESCRIPTION	QTY	PART NUMBER
1	PUMP BARREL	1	SS SM041 2120
2	1.1/2" Socket	3	SUN M0888
3	STATOR	1	<b>SEE CHART BELOW</b>
4	CHECK VALVE	1	<b>VCV125</b>
5	1.1/2" to 1.1/4" Adapter	2	SUN S0875
6	ROTOR	1	<b>SEE CHART BELOW</b>
7	O RING	2	S211120P
8	Flexi Shaft	1	SM SM151 2650
9	MOTOR ADAPTOR	1	SUN A0842M
10	HEX ADAPTOR	1	SUN M0656
11	Locking Washer	3	-
12	8mm Nut	3	-
13	3 Inch motor	1	SUN MOT3I

PUMP MODEL	ROTOR STATOR CHART	
	2500 - ROTOR	2200 - STATOR
SM022	SF SM022 2530	RA SM022 2210
SM041	SF SM041 2530	RA SM041 2210

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