



SOLAR PUMPING SYSTEMS



Installation & Operating Manual

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Congratulations on selecting a Dayliff SunFlo Solar Pumping System. They are manufactured to the highest standards and if installed and operated correctly will give many years of efficient and trouble free service. Careful reading of this Installation Manual is therefore important, though should there be any queries they should be referred to the equipment supplier.

1. SPECIFICATIONS

1.1 PUMP

Solar Pumping Systems are available with several pump options as follows:-

SunFlo-S: Pumps are of positive displacement three-chamber diaphragm design and can run dry without damage. An internal by-pass is incorporated to prevent damage in the event of delivery cut-off.

Pump components are manufactured from high quality engineering plastic with santoprene used for the diaphragm and EPDM for the valves. Casings are plastic for the 150 and stainless steel for the 300.

PV connection is either direct or through a charge controller that is connected to a battery for 24hrs operation.

SunFlo- A: Pumps are of rotary screw design, the screw being made of stainless steel with a rubber stator. They feature an in-built controller for starting and running the pump which incorporates over and under current and voltage protection.

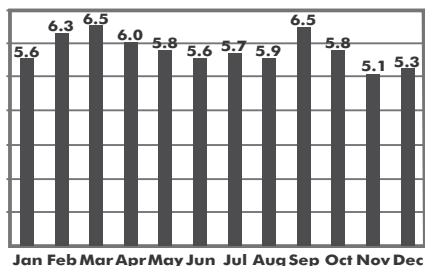
SunFlo-B: Pumps are of either rotary screw or centrifugal design depending upon model. Material of construction for rotary screw design is stainless steel screw with rubber stator while centrifugal pumps feature noryl impellers and stainless steel chambers.

Pumps are supplied with a self-contained multifunction MPPT (Maximum Power Point Tracking) controller that provides high efficiency output, typically +25% higher than conventional pumps of a similar water output. The controller also protects for over current, over and under voltage and low water level (with provided electrode) and features indicator lights that give the pump's operating status. The system can be optionally installed with batteries so the pump operates when there is insufficient solar irradiation.

1.2 POWER OUTPUTS

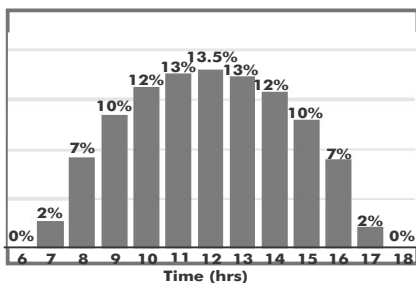
Typical performance figures are given at standard test conditions of 1000W/m^2 solar irradiance and 25°C . Output will vary throughout the year depending upon prevailing irradiation levels. For indicative purposes, factors of 1.1 can be applied for hot arid areas and 0.9 for temperate high altitude areas in East Africa. Output will vary throughout the day as a proportion of the estimated hourly irradiation as shown in Graph 2.

Average Daily Irradiation Values (Kwhr/m)



Graph 1

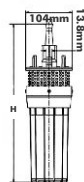
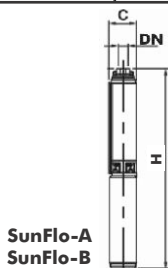
% Daily Output



Graph 2

1.3 PUMP DATA

Pump Model	Indicative Performance	Input Voltage (V)	Motor Rating Watts	Peak Voltage (V)	Open Circuit Voltage (VoC)	PV Modules	Cable length, 2.5mm ²	Outlet Size
SUNFLO-S 150	1m ³ /day at 30m	24	120	24	≤50	1x200W	30m	1/2"
SUNFLO-S 300	3m ³ /day at 60m	24	300			2x200W	60m	3/4"
SUNFLO-A 150H	2m ³ /day at 30m	24	150	≥20	≤60	1x200W	30m	
SUNFLO-A 270H	3m ³ /day at 50m	36	270			2x200W	50m	
SUNFLO-A 600H	4m ³ /day at 70m	48	600	≥30	≤125	4x200W	70m	
SUNFLO-B 120H	3m ³ /day at 30m	24	120	≥30	≤50	1x200W	30m	1"
SUNFLO-B 500C	6m ³ /day at 40m	48	500	≥60	≤100	4x200W	40m	
SUNFLO-B 1000C	12m ³ /day at 70m	110	1000	≥112	≤200	8x200W	70m	1 1/4"



SunFlo-S

2. EQUIPMENT INSTALLATION

Before commencing installation check all systems components that should include the pump with cable, safety rope, DC Isolator, controller (if applicable), supply cable for PV module array to pump controller/isolator, pipe fittings and PV solar modules.

Also required will be the necessary length of piping, surface pipe fittings and module support which is not included in the systems but is available from the pump supplier on request.

2.1 MODULE POSITIONING



When positioning the PV Modules avoid all shade .

The PV module array should be positioned ideally on an East-West axis at 15° from the horizontal facing North in the Southern hemisphere and South in the Northern hemisphere. It is essential that modules are fully exposed to direct sunlight as any shading will greatly reduce performance.

PV modules are light and simple to fix, frame mounting being recommended. This can be sited either on a roof or on a ground structure. Frames are available on request.

2.2 PUMP INSTALLATION



For borehole installations it is important to ensure adequate water availability as damage can occur in the event of dry running. This should be checked from the Driller's report if available or by careful testing during commissioning.

Pumps can be installed in wells or boreholes and should be provided with fittings as indicated in Fig 1. Piping options are Dayliff PVC for deep wells, galvanized steel or HDPE. The latter is recommended for shallower wells due to simplified lowering. When installing the pump ensure to fit the safety rope which can be used to lower the pump down. The rope should be secured at the well head.

When lowering, it is recommended that the drop cable, electrode cable (if fitted) and rope are secured to the drop pipe by the tape provided and are not left loose.

- A wide range of pump models are available and the pump selected must be matched to the well/borehole output to provide optimal operating performance. This should be done with reference to the borehole drillers report in consultation with a borehole installation specialist where applicable. As a rule pump output should not exceed 65% of maximum tested borehole yield.
- Minimum Borehole Diameter 3" pumps-84mm, 4" pumps-110mm.
- Maximum Pump Immersion Depth SunFlo-S- 30m, SunFlo-A/B - 20m.
- Pumped liquid should be clean, thin and non-explosive containing no solid particles or fibres. Sand content should not exceed 50gm/m or else pump life will be reduced and any warranties will be invalidated .
- Liquid temperature should not exceed 40°C in order to preserve rubber components.
- Pumps can be installed either vertically or at an angle, though if installed at an angle the discharge outlet should never fall below 10° to the horizontal plane as shown in Fig. 2. For all angled installations a flow sleeve should be used with a minimum of 0.5m water depth above the pump to prevent the formation of a vortex.

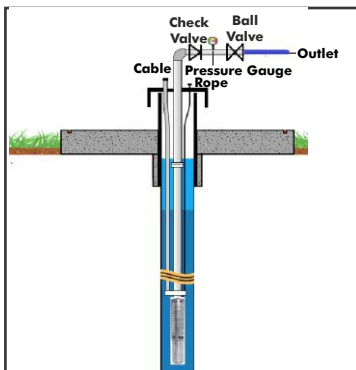


Fig. 1 Pump Installation Arrangement

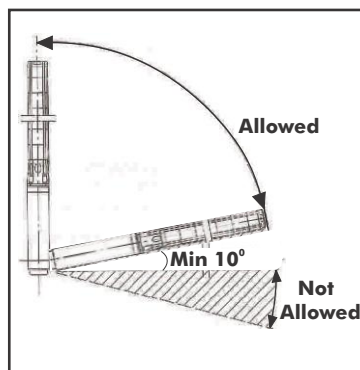


Fig. 2 Pump Axis Limits

2.3 ELECTRICAL WIRING



Cover modules during connection to avoid electric shocks, Connections should be done in the early morning or late afternoon when irradiation is low.



Electrical connection should be carried out by an authorized Electrician in accordance with local regulations.



Ensure input power is isolated before wiring and connection



Ensure secure earth grounding of the system to avoid dangerous power surges.



Ensure tight cable connections as loose connections are the most common source of system failures.



Ensure that the Isolator and Controller are mounted adjacent and close to the PV module array. Distance between controller and PV module should not exceed 10m or pump performance will be impaired. They must be well protected from rain and weather.

Modules should be wired as per the arrangement shown in Fig. 3,4 & 5 depending on system. Note most systems are series connected +ve to -ve terminals, though larger systems include parallel arrays. All module cables should be firmly connected with the provided plugs to avoid short circuits.

The module connection cable should be connected to the PV Isolator that is provided with MCB overload protection. All wiring connections should be made with the isolator 'off'.

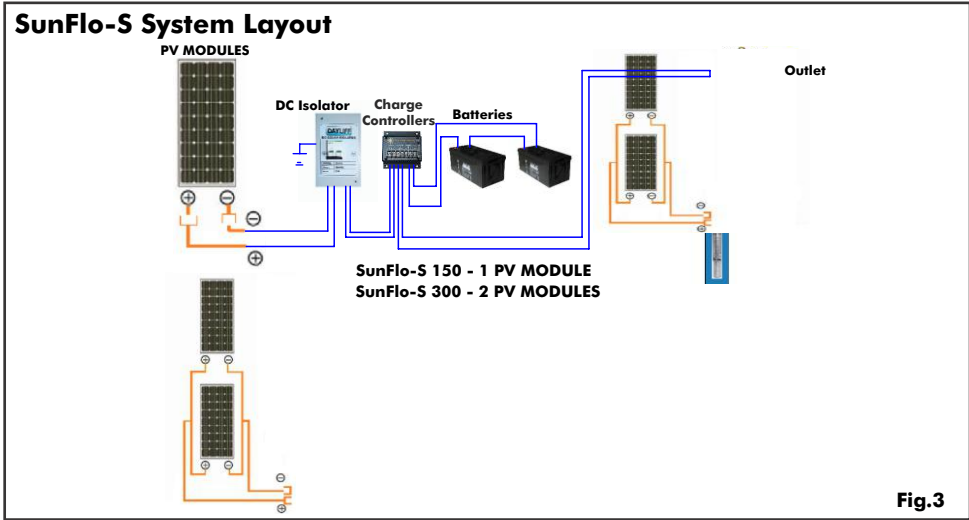


Fig.3

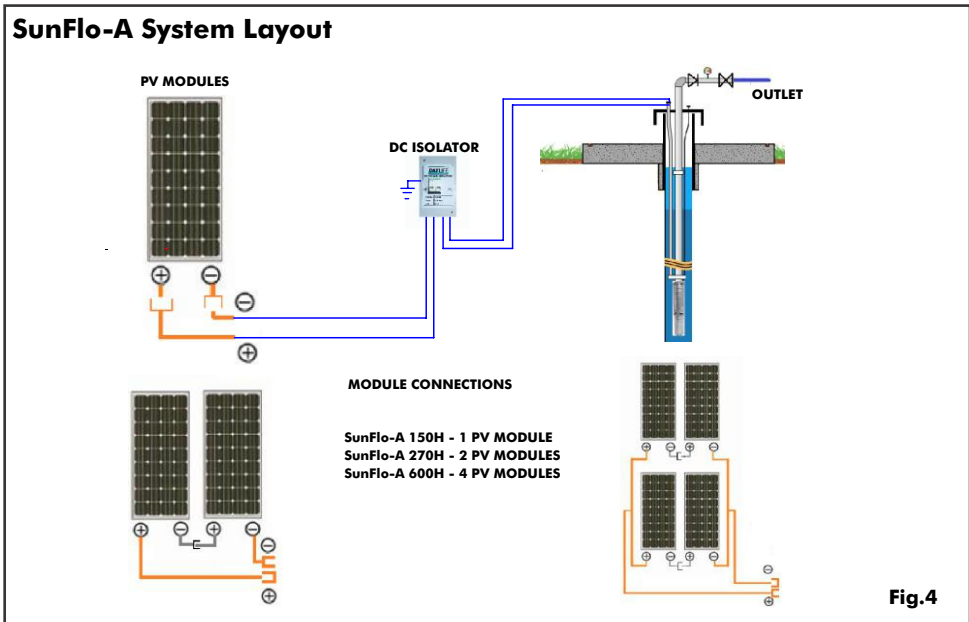


Fig.4

SunFlo-B System Layout

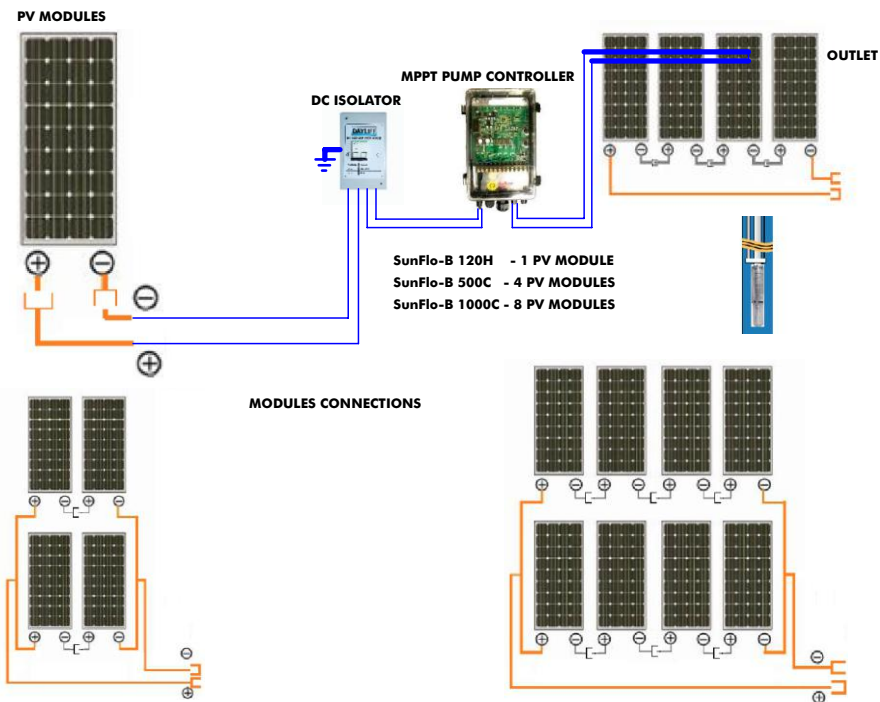


Fig.5

SunFlo-B Controller Connection

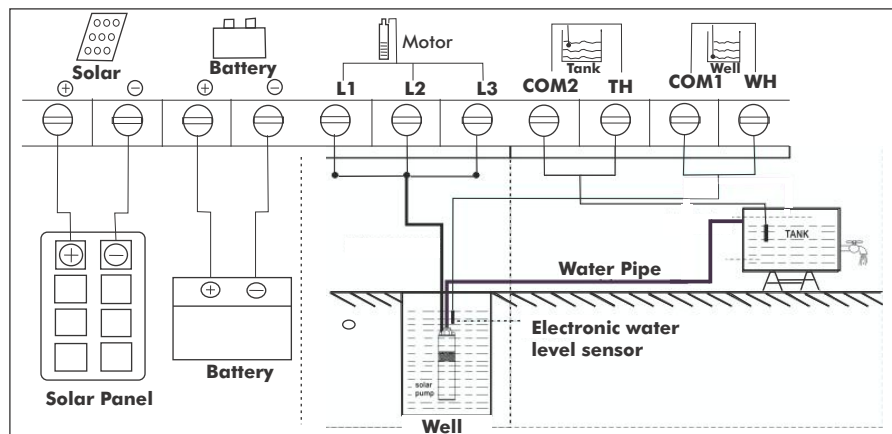


Fig.6

When provided, separate Controllers should be located adjacent to the Isolator and care taken to ensure correct connections to the terminal block. The controller isolator must be 'off' during connections.

2.4 LOW WATER LEVEL PROTECTION



Water level sensors are unnecessary when there is no risk of draw down to the pump.

SunFlo-A

A paddle type float switch is provided on the main pump cable that is suitable for large diameter well installation where there is sufficient space for paddle operation.

If installed in a borehole the paddle should be removed by cutting the cable and the three cable ends bared, joined together and bound by insulation tape to the main drop cable. Care should be taken to ensure a tight connection so the switch leads are in closed circuit.

SunFlo-B



The total length of cable used for water level sensors should not exceed 200m.



The water level sensor should be installed not less than 100mm above the pump suction.

A separate level probe is provided that should be connected to the Controller as indicated. When fitted it is important to set the timer delay on Switch B (see section 4.2) to protect the pump from cycling as the water level rises. When no low level sensor is fitted terminal COM1 and WH should be directly connected with a looped cable.

2.5 HIGH WATER LEVEL TANK SENSOR

A high level sensor is also provided that can be used to control the pump when the pump output is delivered to a high level tank. In the event of this being fitted it should be connected to the terminals as shown in Fig 6 and also the timer delay controlled by Switch B must be set to approx. 20 mins.

3. BATTERY SYSTEMS

SunFlo-S and SunFlo-B installations can be provided with auxiliary batteries to provide extended pump operation. Batteries must be connected through the controller provided to the terminals indicated. They should not be connected directly to the pump. Batteries should be sized according to the table below:

Pump Power, Watts	Pump Voltage	Battery Capacity Series Connection	
		2hrs	5hrs
120	24	2No. 18Ah/12V	2No. 35Ah/12V
300	24	2No. 35Ah/12V	2No. 100Ah/12V
500	48	4No. 35Ah/12V	4No. 100Ah/12V

4. SYSTEM OPERATIONS

4.1 PUMP

Generally pump operation is fully automatic with pump flow starting with low output at around 8am building to a peak at mid-day and stopping around 5pm. Output will vary with conditions with low output during rainy or clouded periods. Equipment is water lubricated and requires no maintenance though periodically it is important to clean the module surface of dust and debris and check the installation for damage.

4.2 CONTROLLER

4.2.1 SunFlo-S

For battery operated systems a charge controller (supplied in the system) is required. The controller must not be used for systems without batteries as performance will be impaired.

Charge controllers are fitted with LED indicators for fault, battery and working status; automatic 12/24 identification, overload protection and anti-reverse protection.

Charge Controller Display

Parameter Indicator **Output**

Charging at daytime **Battery** **Load**

Units

LCD Icon	Indicated Item	Status
PV	Solar Panel Parameter	Steady on
BAT	Battery Parameter	Steady on
LOAD	Load discharging Parameter	Steady on
	Daytime or Charging	Steady on
	Night recognition	Steady off
	Load short-circuit or overload	Quick Flashing
	Load turned on	Steady on
	Load turned off	Steady off
	Battery in normal state	All lighting up
	Over discharge	Only the frame flashing
	Over voltage	The frame and 3 dashes all flashing

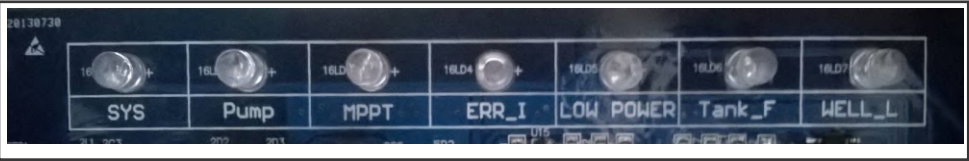
4.2.2 SunFlo-A

Pumps are controlled by an internal motor controller with no external monitoring or adjustment provisions. However, pumps must be connected through the PV Isolator that also provides over-current protection.

4.2.3 SunFlo-B

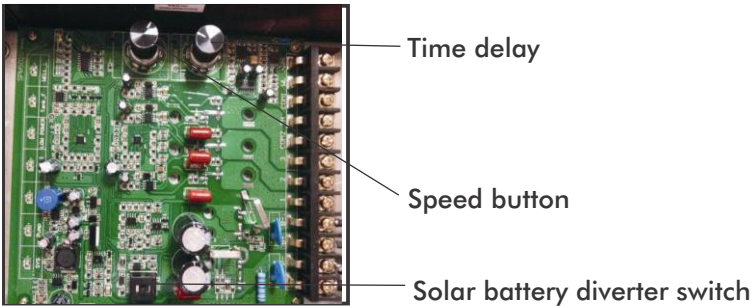
All SunFlo-B pumps are provided with an advanced MPPT controller that enhances pump performance by up to 25%. The controller includes an isolator switch, protection from over/under voltage, overcurrent, low level control (optional), indicator lights for pump operating status and provision for high level floatswitch.

Indicator Lights



Label	Definition	Instruction
SYS	System Power	Solar Mode: Indicator light is always on (not battery mode) Battery Mode: Green indicator light blinking
Pump	Pump running	Green indicator light will turn on after the pump starts running
MPPT	Maximum Power Point Tracking	Green light, monitor the power input from the solar arrays and adjust the voltage and current to gain the highest performance from the pump
ERR_I	Current Error	Red light is always on: Overload error Red light blinking : Over current error :
LOW_POWER	Voltage Error	Yellow light continuously on indicates the system voltage is too low
Tank_F	Tank Water Level Alarm	Green light, the tank is full
WELL_L	Well Water Level Alarm	Green light, the well is empty If the light is blinking, system is in time-delay mode

Controls



Speed Control – Modulates the pump speed by regulating pump efficiency. Turn fully clockwise for 100% efficiency and fully anti-clockwise for minimum 30% efficiency. This function allows PV module output to be shared between the pump and battery charging according to the set proportion and for reduced pump output in the event of over-pumping. For full output pump operation it should be set to 100% efficiency.

Speed Time Delay – Controls the delay on the low level cut-out re-start with up to 30mins delay being available. The WELL indicator will blink when the delay is activated. If no delay is required the control should be set to '0', the recommended setting unless the well has very poor output.

Solar/Battery Mode Selector Switch – A three position switch that selects solar operation, system isolation or battery operation.

When operating in 'Solar' mode all power from the PV modules will be used for the pump operation and the battery will be isolated. For non-battery systems the switch should always be in this position

When operating in 'Battery' mode the system will be powered by hybrid battery/PV module output according to power available and the battery is charged by surplus PV module output controlled by the Speed Control. Also when there is insufficient irradiation the charged battery will power the pump.

No	Indicator Lights	System Status
1	All the indicator lights blink once	System powered
2	'SYS' Blinking	System in self-check mode
3	'SYS + Pump + MPPT' Blinking	System starts charging mode

5. TROUBLE SHOOTING

PROBLEM	POSSIBLE CAUSE	SOLUTION
Pump operates with no flow or reduced flow	Low voltage	Check solar irradiation
	No water at pump level	Ensure the pump is installed below the lowest water level
	Pump located too deep	Correct installation to the recommended level
	Clogged filter screen	Remove filter screen and rinse
	Water flow restricted	Check for crimped hose or blocked pipes
	Loose connections or punctured hose	Check hose clamps or replace hose
Pump will not operate	Incorrect power supply	Check power supply
	Incorrect wire connections	Check electrical wiring
		Check for corrosion and looseness and correct
		Check for tripped MCB & reset
	Insufficient sunshine	Wait for sufficient sunshine conditions
For SunFlo-B pump shutdown with red LED ON for ERR_1	Motor or pump is blocked and very hard to turn	Clean all solids or sand out of the pump and reset by switching the pump OFF then ON again
	Low irradiation	Check the PV array is facing the sun and remove any shading. Otherwise wait for optimum sunshine conditions
	Incorrect wire connections	Check and correct wiring
		Check controller wiring is well done
		Inspect the controller for any burnt parts and repair/replace
		Check earthing connections are well done
For SunFlo-B pump shutdown with red LED ON for LOW_POWER	Low voltage on the system which is insufficient to power the pump	Insufficient power reaching the controller. A solar-direct (non-battery) system should start once there is sufficient sunshine
		A battery system should start if the battery supply voltage is higher than what the pump requires
		If the pump was recently connected (or reconnected) to the controller, it may be running in reverse direction due to wiring error

6. TERMS OF WARRANTY

i) General Liability

- In lieu of any warranty, condition or liability implied by law, the liability of Dayliff in respect of any defect or failure of equipment supplied **is limited to making good by replacement or repair** (at the Company's discretion) defects which under proper use appear therein and arise solely from faulty design, materials or workmanship within a specified period. This period commences **immediately after the equipment has been delivered to the customer** and at its termination all liability ceases. Also the warranty period will be assessed **on the basis of the date that the Company is informed of the failure**.
- **The warranty applies solely to equipment supplied and no claim for consequential damages**, however arising, will be entertained. Also the warranty specifically excluded defects caused by fair wear and tear, the effects of careless handling, lack of maintenance, faulty installation, incompetence on part of the equipment user, Acts of God or any other cause beyond the Company's reasonable control. Also, any repair or attempt at repair carried out by any other party **invalidates all warranties**.

ii) Standard Warranty

If equipment failure occurs in the normal course of service having been competently installed and when operating within its specified duty limits warranty will be provided as follows:-

- **Up to one year - The item will be replaced or repaired at no charge.**
- **Over 1 year, less than two years - The item will be replaced or repaired at a cost to the customer of 50% of the Davis & Shirtliff market price.**

The warranty on equipment supplied or installed by others is conditional upon the defective unit **being promptly returned free to a Davis & Shirtliff office** and collected thereafter when repaired. No element of site repair is included in the warranty and any site attendance costs will be payable in full at standard charge out rates. Also proof of purchase including the purchase invoice must be provided for a warranty claim to be considered.

DAYLIFF is a brand of **Davis & Shirtliff**
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