

Owners Guide and Installation Instructions



Rheem HS Series



This water heater system must be installed and serviced by an authorised person.
Please leave this guide with the unit at all times.

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PROPERTY OWNER - We recommend you read Chapter 1. The other pages are intended for the installer but may be of interest.

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Chapter 1 - Product Information for the Owner

The Rheem HS Series is a solar water heating package intended for use in commercial or industrial applications. It can be integrated into an existing installation to provide solar pre-heating for energy cost reduction, used in the replacement of existing equipment, or used in new installations.

The HS Series provides superior benefits to conventional solar water heaters including ultimate frost and over-temperature protection by way of its unique drain back function.

The system comprises a quantity of Rheem's proven high performance solar collectors, connected to a central heat store located at a lower level, which serves as the energy source to instantaneously heat the fresh potable water supply on demand, via a highly efficient delivery skid.

System Features

Hygienically Clean Hot Water

The compact heat exchanger delivery skid heats the water only at the moment it is needed - a quick, safe and hygienically clean solution.

The skid contains a pair of completely integrated high-efficiency stainless steel plate heat exchangers, allowing for high heat transfer with a low temperature difference between the primary and secondary circuits, and minimising both flow rate and return temperature in the primary circuit.

Accurate Temperature Regulation

The delivery skid incorporates an integral variable speed energy efficient supply circulator for the primary circuit heating source, which is regulated by an on board controller to optimise the primary fluid flow rate. The electronic controller monitors the temperature of the hot-water outlet temperature and the flow rate of the cold water supply, to accurately control the primary circulator speed (and rate of energy transfer), to meet the hot water temperature and flow rate required by the user.

Intelligent Energy Management

The ability to control the rate of energy transfer allows the solar energy to be stored at a higher temperature than the fresh water temperature that is actually supplied to the user. This subsequently allows for increased energy storage density and efficiency, and on days when available solar energy input exceeds the hot water demand, the energy surplus can be stored for use on subsequent days rather than wasted.

Automatic Drain Back Feature - Freezing & Over Temperature Protection

The automatic drain back feature of the closed circuit prevents wet stagnation of the closed circuit fluid in the collector array. This eliminates potential damage due to boiling of the fluid and also ensures that the collected energy remains in the storage vessel. This same feature protects the collectors from freezing during frost periods.

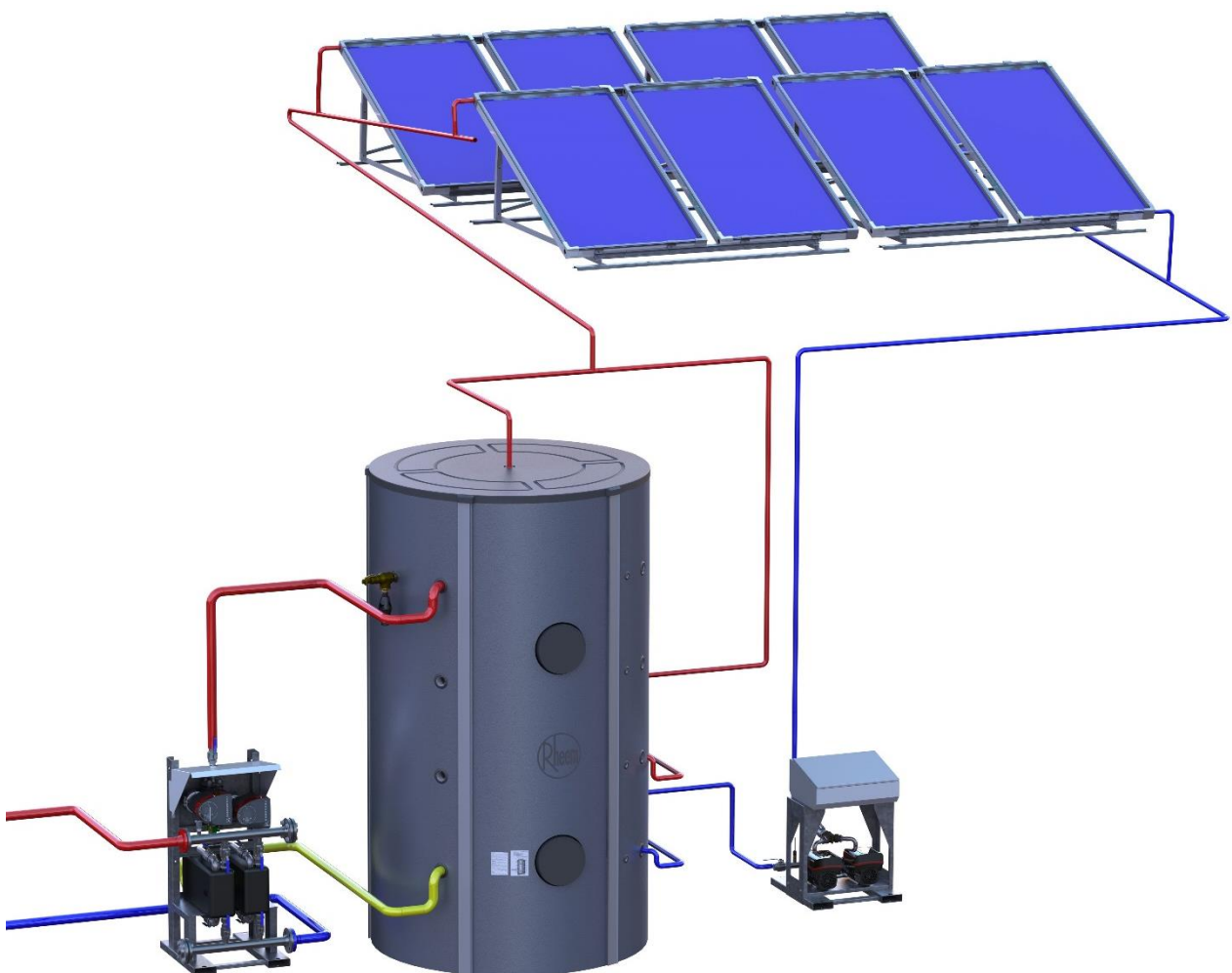
How does it work?

The system combines a number of Rheem's efficient Commercial solar collectors with a centralised heat store to extract the sun's free energy and hold it ready for use.

The storage tank has a fully welded steel cylinder and is treated on the outside to prevent corrosion. The storage tank maintains a low pressure, closed circuit fluid that is used to store and transfer heat. The fluid is not consumed and contains a corrosion inhibitor.

A highly efficient heat exchanger then transfers the stored energy to the potable water supply to meet the hot water requirements on demand.

Boosting may be required and can be achieved in a number of ways to ensure sufficient hot water is available at all times.



Energy Capture

Solar collectors are used to absorb energy from the sun, supplying heat to the closed circuit fluid pumped through them. The collectors are typically installed on the roof of the facility in which the system is used.

A pump is used to circulate closed circuit fluid between the storage tank and the solar collectors. This solar pump is controlled by an intelligent differential controller with optional data logging capability. This differential controller measures the temperature in the solar collector array and the storage tank. When the solar collector array temperature is sufficiently higher than the storage tank temperature, the differential controller will switch on the solar pump.

As the solar pump operates, closed circuit fluid is drawn from the coolest portion of the storage tank and pumped through the collector array. The fluid is heated by the sun as it flows through the collectors and returns to the storage tank. This continual heating and recirculation process increases the temperature of the fluid in the tank.

The solar pump will continue to operate, regulating the pump speed to maximise capture of the available solar energy, until the differential controller senses that the collector array temperature has fallen to an unsatisfactory level (i.e. insufficient solar gain) or the storage tank has reached its user defined temperature (maximum 90°C at the base of the tank).

When the controller instructs the solar pump to switch off, the closed circuit fluid will drain back to the storage tank. The drain back function ensures that frost damage will not occur in colder climates and over-heating of the system will not occur during periods of high solar contribution and low water consumption. An additional benefit is that the solar water heating system can be sized to maximise the winter solar contribution without causing over performance in summer.

Boosting

Boosting may be achieved in a number of ways to ensure sufficient hot water is available at all times. Options include:

- Electric heating units placed within the storage tank, or
- Heat pump or gas auxiliary boosters on a flow and return circuit with the storage tank, or
- In line booster between the storage tank and the delivery skid, or
- In line booster downstream of the delivery skid on the secondary side.

Your Rheem representative will advise the best boost options based on the design needs of the facility.

Energy Transfer

The captured solar energy is transferred to the potable water supply on demand (i.e. only at the moment it is needed) via the Delivery Skid. The high-efficiency stainless steel plate heat exchanger allows for high energy transfer with a low temperature difference between the primary and secondary circuits, minimising both flow rate and return temperature to the primary circuit.

The Delivery Skid incorporates an intelligent control system which regulates the energy input from the primary heat transfer fluid, to precisely control the hot water temperature supplied to the user. An integral variable speed circulator for the primary circuit is regulated by an on board controller to optimise the primary supply flow rate. The electronic controller monitors the hot-water outlet temperature and controls the primary circulator speed, to accurately produce the set point temperature based on the incoming cold water temperature and flow rate and the temperature of the stored primary circuit fluid.

The system of heat transfer and storage allows flexibility in the capacity of the system to provide large volumes of hot water over short periods at low temperature difference from the store temperature. This performance is further enhanced by maintaining temperature stratification within the storage tank, and drawing the primary supply from the highest available temperature source, located in the top of the tank.

In addition, the ability to control the rate of energy transfer allows the solar energy to be stored at a higher temperature than the temperature of the potable water that is actually supplied to the building. This subsequently allows for an increase in energy storage density and efficiency. Furthermore, on days when available solar energy input exceeds the hot water demand, the energy surplus can be stored for use on subsequent days, rather than wasted.

System Configuration

The Rheem HS Series can utilise a varying number of solar collectors to meet the hot water demand of the proposed installation. Consult your Rheem dealer for guidance on the optimum number of collectors to suit application specific requirements.

Solar Collectors

The Rheem HS Series is used in conjunction with Rheem CSA2013 solar collectors. Each solar collector is constructed with an aluminium outer casing and is lined with heavy insulation to minimise heat losses. Low iron, tempered glass is utilised to enable the maximum amount of solar energy to be received by the absorber.

The CSA2013 collector is designed to generate maximum solar performance in all climatic conditions. The ultra-high efficiency copper absorber with its blue sputtered selective surface maximises absorption and minimises emission. Heat loss is minimised with the use of glass wool insulation. The 13 copper risers are mechanically bonded to the copper absorber sheet, ensuring maximum heat transfer.

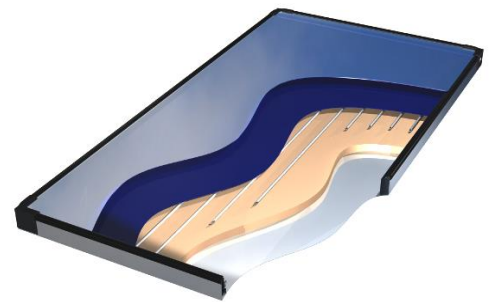


Table 1 - Collector Specifications

Collector	Units	CSA2013
Overall Dimension	mm	1941 x 1027 x 83
Aperture Area	m ²	1.86
Weight	kg	31
Number of risers	-	13
Fluid Capacity	Litres	2.1
Max Working Pressure	kPa	1400
Insulation	-	Glass Wool
Glazing Type	-	Satin-Matt
Absorber Material	-	Sputtered Copper
Collector Tray	-	Aluminium

Storage Tank

The storage tank has a fully welded carbon steel cylinder and is treated on the outside to prevent corrosion. The storage tank maintains a low pressure, closed circuit fluid that is used to store and transfer heat. The fluid is not consumed and contains a corrosion inhibitor.

The storage tank is available in nominal 1000, 2000, 3000, 4000, 5000L capacities. Multiple tanks of the same capacity can be manifolded in parallel to store larger volumes of fluid.

The storage tank is supplied with two flanges to allow the fitment of electric heating unit bundles. The positioning allows for boosting within the solar storage tank via the top flange, referred to as “in-tank electric boosting” or boosting via a separate tank in-series with the solar tank, in which case the bottom flange is used. This is referred to as “in-series electric boosting”. Further, the tank is supplied with a variety of fittings to allow multiple configurations to be connected such as boosting by auxiliary heat pump or gas water heaters.

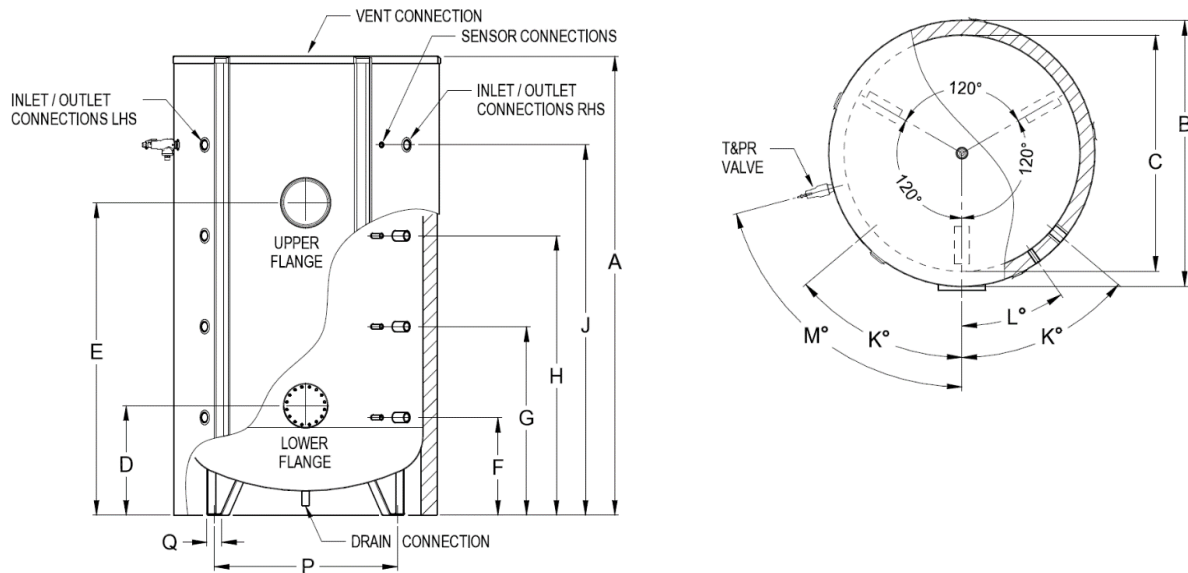


Table 2 - Tank Specifications

Nominal Capacity		1000	2000	3000	4000	5000	
Construction		Steel S235 UNI EN 10025					
Corrosion Protection		Cylinder Interior - TRAC107PLUS Cylinder Exterior - with rust-protection coating					
Insulation (supplied loose)		100mm polyethylene insulation with PVC outer cover					
Indoor installation		100mm polyethylene insulation with bonded aluminium cladding					
Outdoor installation		100mm polyethylene insulation with bonded aluminium cladding					
Storage Volume	Litres	920	2055	2960	3820	5180	
Top Element Flange Boost Volume	Litres	304	678	977	1261	1709	
Dimensions	A	mm	2200	2565	2845	2918	3128
	B	mm	1000	1300	1450	1600	1800
	C	mm	800	1100	1250	1400	1600
	D	mm	510	555	600	628	747
	E	mm	1435	1735	1945	1963	2132
	F	mm	471	462	505	533	667
	G	mm	879	1024	1135	1163	1287
	H	mm	1341	1586	1765	1793	1907
	J	mm	1803	2148	2395	2423	2527
P	mm	685	988	1140	1290	1378	
Q	mm	80	100	100	100	100	
K	degree	50	50	50	50	50	
L	degree	35	35	35	35	35	
M	degree	75	75	75	75	75	
Weight Empty	kg	115	245	334	455	535	
Weight Full	kg	1035	2300	3294	4275	5715	
Inlet/Outlet Connections	BSPF	RP2	RP2	RP2	RP2	RP2	
TPR Valve Connection	NPT	1¼"	1¼"	1¼"	1¼"	1¼"	
Vent Connection	BSPF	RP1½	RP2	RP2	RP2	RP2	
TPR Valve Setting	kPa	500	500	500	500	500	
Max Supply Pressure	kPa	400	400	400	400	400	
Max Operating Temperature	°C	90	90	90	90	90	
Gasket Material		EPDM					

Tank Capacity at Various Fittings

Nominal Capacity		1000	2000	3000	4000	5000
Storage Volume	Litres	920	2055	2960	3820	5180
Volume Above Dimension E	Litres	299	623	861	1146	1489
Volume Above Dimension D	Litres	758	1732	2511	3201	4274
Volume Above Dimension J	Litres	116	235	309	438	695
Volume Above Dimension H	Litres	345	763	1082	1408	1942
Volume Above Dimension G	Litres	575	1292	1855	2377	3188
Volume Above Dimension F*	Litres	804	1820	2628	3347	4435

*inlet/outlet connections have downward facing dip tubes which will equal storage volume

Delivery Skid

The Delivery Skid is used to transfer the heat from the primary or solar circuit to the secondary or domestic hot water circuit.

It contains two insulated 316L stainless steel single walled brazed plate-type heat exchangers, and a temperature controlled variable speed circulator for the primary fluid circuit to regulate the rate of energy transfer to the potable water at the set temperature. The package is furnished with 316L stainless steel manifolds and fittings and the frame is fully welded and hot dip galvanised for superior corrosion resistance.

The Delivery Skid is available with a dual head duty/standby pump for redundancy.

The temperature setting is factory set but can be adjusted on site as required.

Each heat exchanger can be separately isolated and removed for individual maintenance, thus providing redundancy capability.

Further details regarding the operation of the Delivery Skid can be found in Chapter 2 and details regarding the operation and commissioning can be found in Chapter 3.

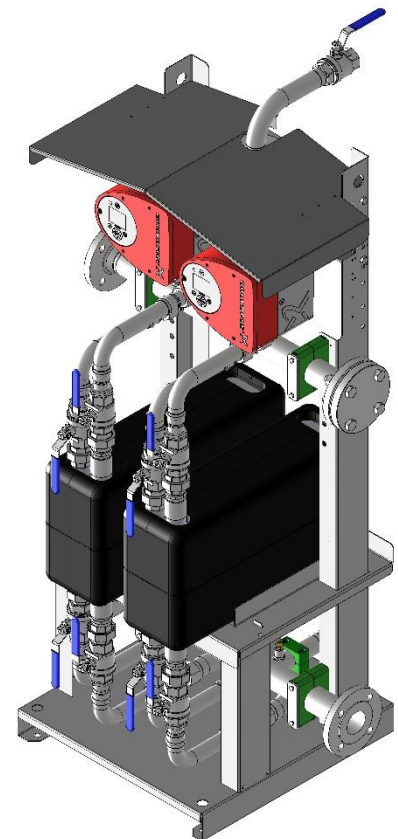
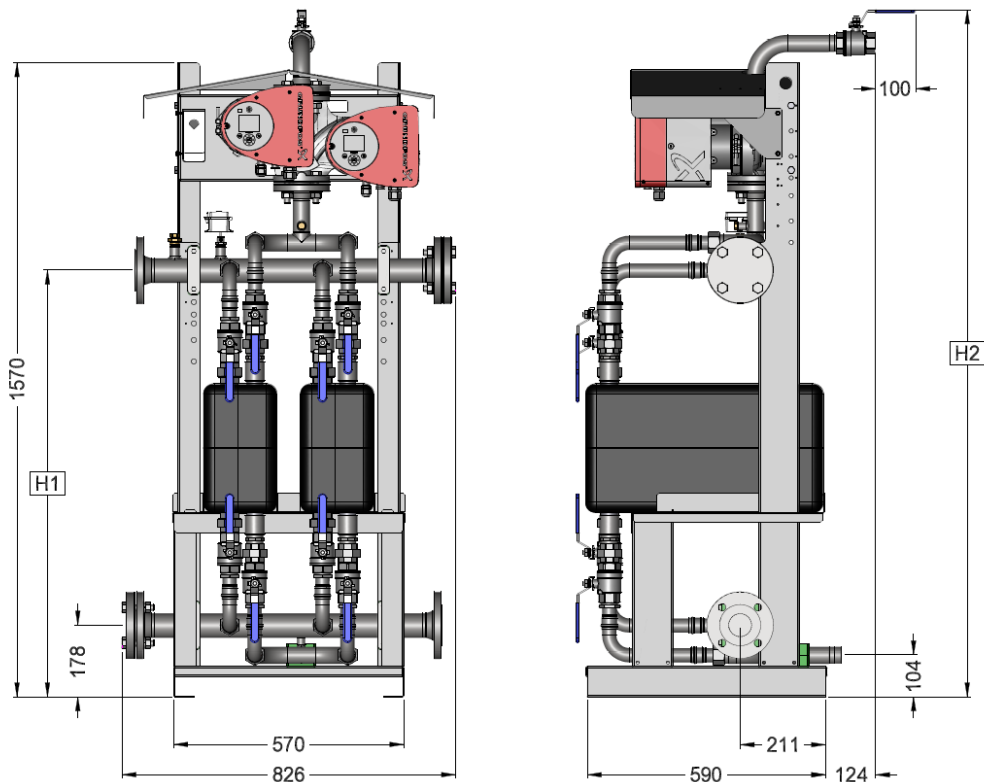


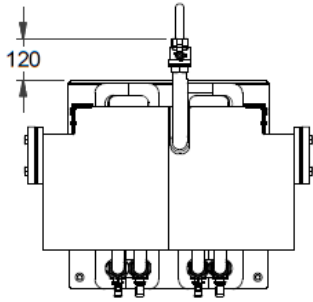
Table 3 - Delivery Skid Specifications

Model		RD200	RD400	RD600	RD800	
Nominal Capacity	kW	200	400	600	800	
Parameters for Nominal Capacity Rating	Primary Side (non-potable)					
	Inlet Temp	°C	80	80	80	80
	Flow Rate	L/min	48	114	144	186
	Pressure Drop	kPa	24	47	36	36
	Secondary Side (potable)					
	Inlet/Outlet Temp	°C	15/65	15/65	15/65	15/65
	Flow Rate	L/min	57	115	172	223
Pressure Drop	kPa	37	47	51	48	
Dimensions	H x W x D	mm				1570 x 783 x 630
Weight	kg	143	152	161	171	
Pipe Connections Primary Circuit	BSPF	RP1¼				
Pipe Connections Secondary Circuit		DN50 ISO EN 1092-1 11B PN40 Flange				
Max Operating Pressure Primary Circuit	kPa	1000*				
Max Operating Pressure Secondary Circuit	kPa	1400*				
Electrical Supply		230-240V 50/60Hz Hard Wired By Electrician				
Min Recommended Circuit Size	Amps	10				

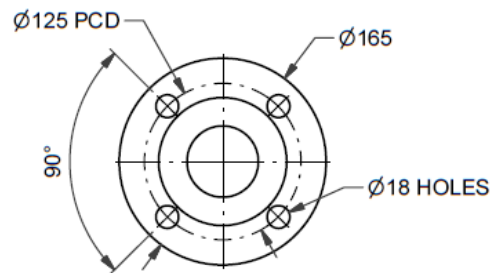
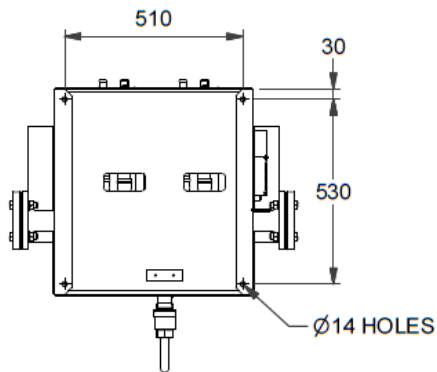
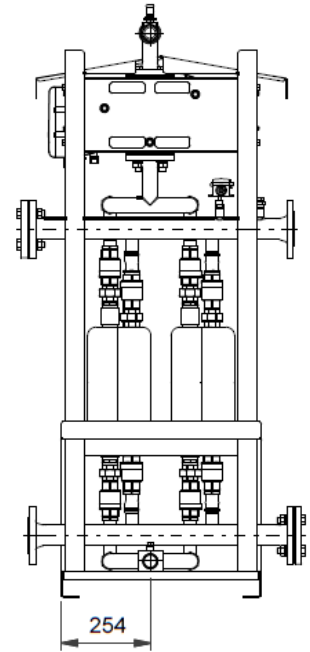
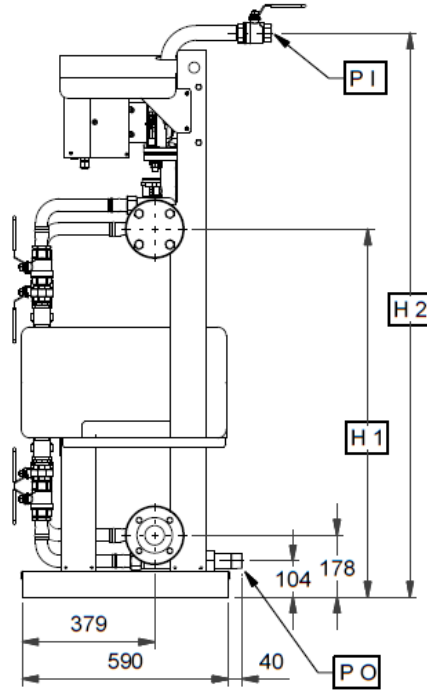
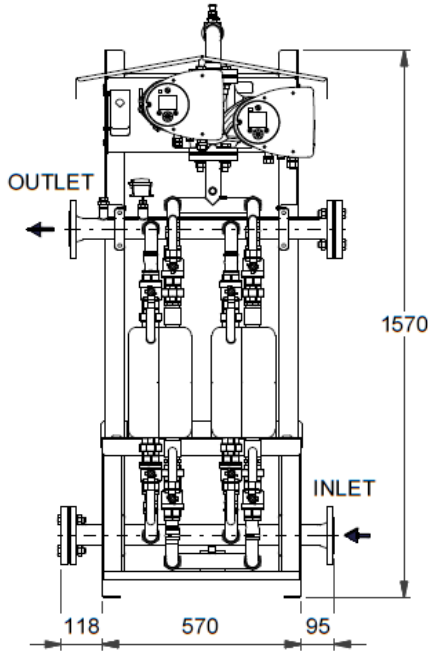
*The maximum working pressure of each side of the system will be governed by the lowest operating appliance connected to it. The potable water side (secondary side) must be higher than the non-potable side (primary side).

Delivery Skid Dimensions





RHEEM MODEL No	MODEL TYPE	DIM. 'H 1'	DIM. 'H 2'	PRIMARY INLET 'P I'	PRIMARY OUTLET 'P O'	NETT WEIGHT
RD200D701	200 kW	877	1440	Rc1 1/4	R1 1/4	143 kg
RD400D701	400 kW	930	1493	Rc1 1/4	R1 1/4	152 kg
RD600D701	600 kW	993	1556	Rc1 1/4	R1 1/4	161 kg
RD800D701	800 kW	1056	1619	Rc1 1/4	R1 1/4	171 kg



FLANGE DETAIL
(EN 1092-1/11/B1/DN50/PN40)

Table 4 - Delivery Skid Output

Maximum Delivery Skid Output
 ($T_{in} 15^{\circ}C - T_{out} 65^{\circ}C$) vs Primary Supply Temp

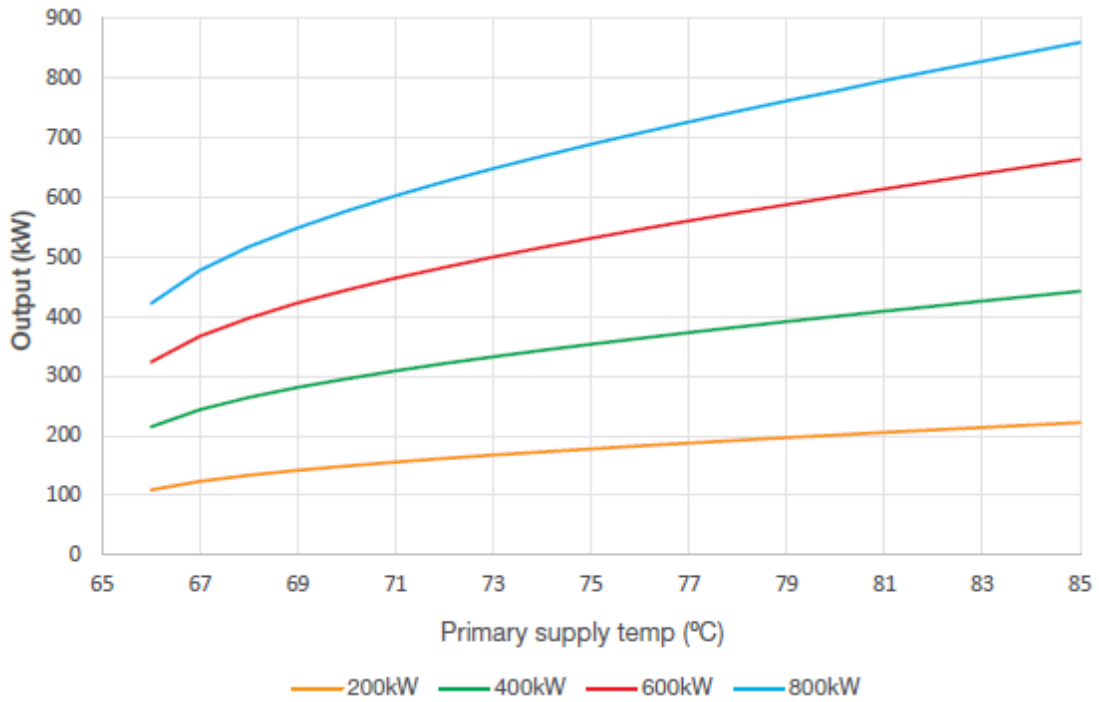
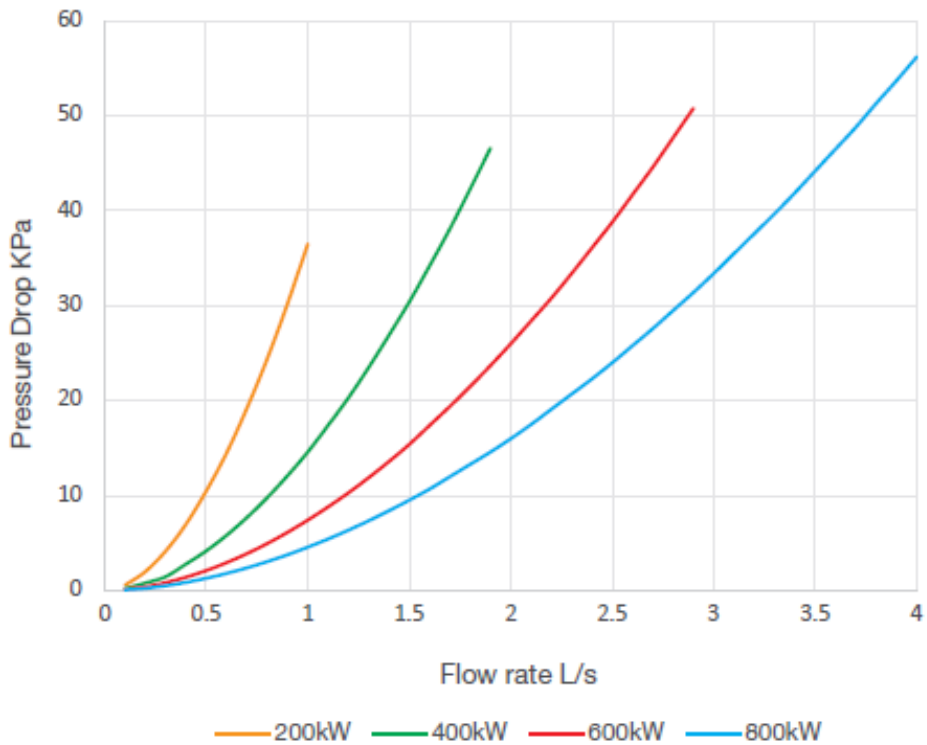


Table 5 - Delivery Skid Pressure Drop (Secondary Side)

Secondary Side Pressure Drop vs Flow Rate



Delivery Skid Secondary Side Flow Rate for Varying Primary Supply Temperatures and Secondary Side Temperature Rise

200kW						
Primary Temp	90	85	80	75	70	65
Output (kW)	270	215	200	190	160	100
Temp Rise	Secondary Side Flow Rate (L/min)					
65	60	47	44	42	35	
60	65	51	48	45	38	24
55	70	56	52	50	42	26
50	77	62	57	54	46	29
45	86	68	64	61	51	32
40	97	77	72	68	57	36
35	111	88	82	78	66	41

400kW						
Primary Temp	90	85	80	75	70	65
Output (kW)	500	450	400	365	300	200
Temp Rise	Secondary Side Flow Rate (L/min)					
65	110	99	88	80	66	
60	119	108	96	87	72	48
55	130	117	104	95	78	52
50	143	129	115	105	86	57
45	159	143	127	116	96	64
40	179	161	143	131	108	72
35	205	184	164	149	123	82

600kW						
Primary Temp	90	85	80	75	70	65
Output (kW)	740	680	600	535	450	300
Temp Rise	Secondary Side Flow Rate (L/min)					
65	163	150	132	118	99	
60	177	162	143	128	108	72
55	193	177	156	139	117	78
50	212	195	172	153	129	86
45	236	217	191	170	143	96
40	265	244	215	192	161	108
35	303	278	246	219	184	123

800kW						
Primary Temp	90	85	80	75	70	65
Output (kW)	940	870	800	695	580	400
Temp Rise	Secondary Side Flow Rate (L/min)					
65	207	192	176	153	128	
60	225	208	191	166	139	96
55	245	227	208	181	151	104
50	269	249	229	199	166	115
45	299	277	255	221	185	127
40	337	312	287	249	208	143
35	385	356	328	285	238	164

2 x 600kW						
Primary Temp	90	85	80	75	70	65
Output (kW)	1480	1360	1200	1070	900	600
Temp Rise	Secondary Side Flow Rate (L/min)					
65	326	300	265	236	198	
60	354	325	287	256	215	143
55	386	354	313	279	235	156
50	424	390	344	307	258	172
45	471	433	382	341	287	191
40	530	487	430	383	323	215
35	606	557	491	438	369	246

2 x 800kW						
Primary Temp	90	85	80	75	70	65
Output (kW)	1880	1740	1600	1390	1160	800
Temp Rise	Secondary Side Flow Rate (L/min)					
65	415	384	353	307	256	
60	449	416	382	332	277	191
55	490	453	417	362	302	208
50	539	499	459	398	333	229
45	599	554	510	443	369	255
40	674	624	573	498	416	287
35	770	713	655	569	475	328

Solar Pump Skid

The HS Series system uses the Rheem model SHCX controller to operate and regulate the solar pump and drain back function.

The main function of the controller is to measure the temperature in the buffer storage tank and collector array to determine when to operate the solar pump. The solar controller can also be used to operate other functions such as solar secondary recirculation or boost functions.

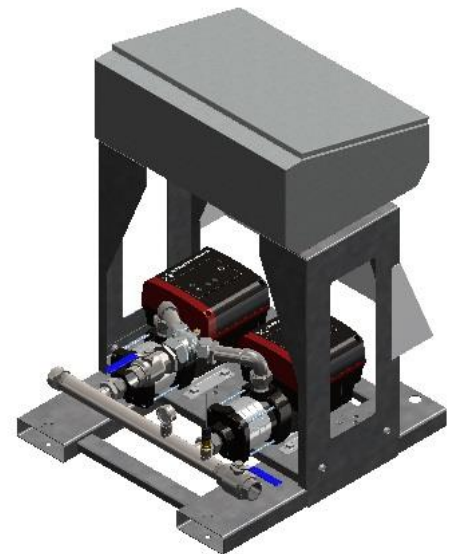


Deluxe models also incorporate BMS run/fail and data logging capability.

A pair of Grundfos CME variable speed cast iron pumps are incorporated to provide duty/standby redundancy.

All switch gear is located with an IP55 powder coated enclosure and the frame is welded steel construction and hot dip galvanised for superior corrosion resistance.

The SHCX controller will control solar operation by way of a differential thermostat to turn the solar pump on when the user defined temperature difference between the solar collector temperature and the storage tank temperature is reached, and off when the temperature difference falls below the set switch off value. It also provides other system information such as the return fluid temperature and flow rate when connected to a flow meter (not supplied).



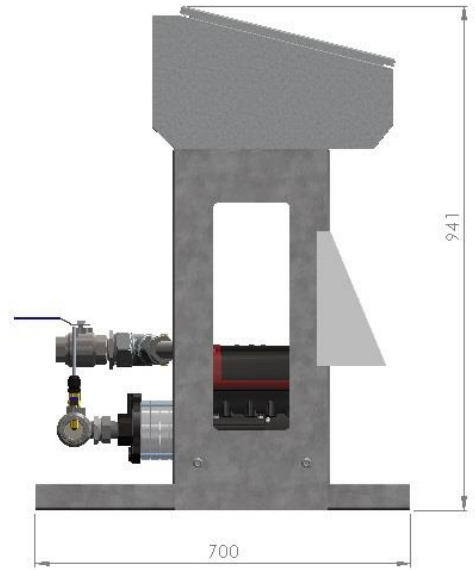
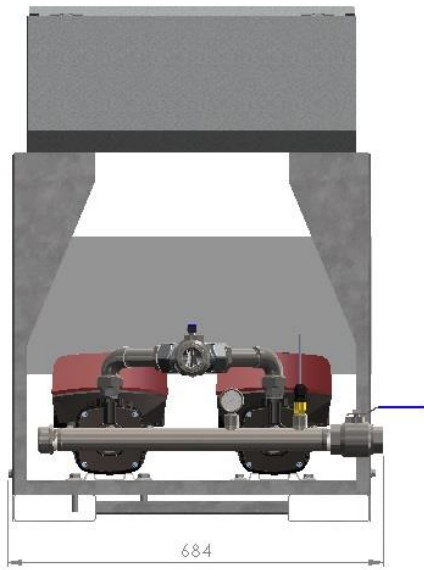
The controller regulates the speed of the solar pump to optimise the flow rate through the solar collectors. This helps to optimise system efficiency, reduce energy consumption, and also reduce possible frequent starting and stopping of the pump.

Further details regarding the installation of the controller can be found in Chapter 2, and details regarding the operation and commissioning can be found in Chapter 3.

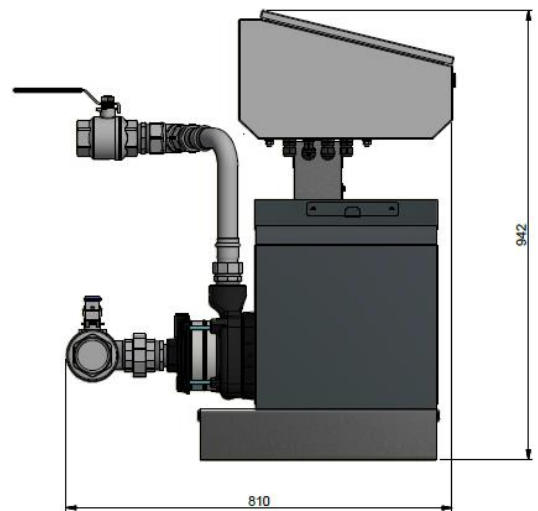
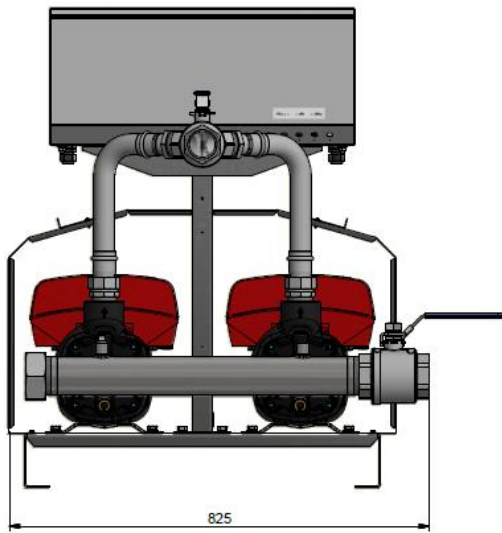
Table 6 - Solar Pump Skid Specifications

Model		RP013	RP015	RP033	RP035	RP055	RP103	RP153	
Number of Collectors	CSA2013	Up to 8	8-16	16 - 24	16 - 24	24-40	40-90	90-150	
Maximum Height*	m	20	40	20	40	40	40	40	
Dimensions	H x W x D	941 x 684 x 700					942 x 825 x 810		
Pipe Connections Inlet	BSPF	RP1¼					RP2		
Pipe Connections Outlet	BSPF	RP1¼					RP2		
Enclosure Rating		IP55							
Electrical Supply		230-240V 50/60Hz Hard Wired By Electrician				380-415V 50/60Hz Hard Wired By Electrician			
Max Current	Amps	10					15		
Min Circuit Size	Amps	16					20		

*Heights are approximate. Refer to Table 10 – Solar Pipe Size / Pump Selection Chart on page 26 for more accurate information



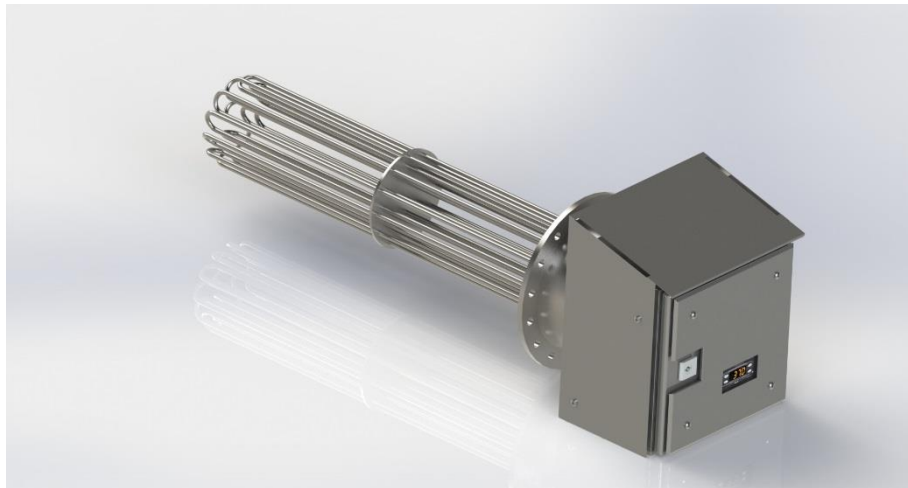
Model: RP013- RP055



Model: RP103- RP153

Electric Boosting

The HS Series may be supplied with an electric heating unit bundle as part of the design specification. The heating unit bundle is supplied with a digital thermostat which can be adjusted to suit site specific requirements. Also included is all switch gear and over temperature energy cut out (ECO).



The heating unit electrical connections are housed in a 304 stainless steel IP55 enclosure and the bundle connects to the storage tank via a 16 bolt flange and gasket.

The elements are low watts density Incoloy 800, designed to provide long service life. A variety of kW ratings are available. Note: not all element ratings suit all tank capacities.

The elements can be fitted in the top flange for “in-tank” boosting of the solar heat store or located in the bottom flange of a tank which is connected “in series” with the heat store. Refer to **Application Guide**.

Table 7 - Element Specifications

Tank Model			1000	2000	3000	4000	5000					
Tank Capacity		L	920	2055	2960	3820	5180					
Boost Capacity		L	304	678	977	1261	1709					
Available Heating Unit Rating		kW	15, 30, 45, 60, 75	15, 30, 45, 60, 75	15, 30, 45, 60, 75, 100, 125	15, 30, 45, 60, 75, 100, 125	15, 30, 45, 60, 75, 100, 125, 150, 180					
Recovery Rate @ 50°C Rise		Max Current per phase*	Heat Up Time (Hrs) at 50°C Rise									
			Whole Tank	Boost	Whole Tank	Boost	Whole Tank	Boost	Whole Tank	Boost	Whole Tank	Boost
kW	L/hr	Amps										
15	258	21	3.6	1.2	8.0	2.6	11.5	3.8	14.8	4.9	20.1	6.6
30	516	42	1.8	0.6	4.0	1.3	5.7	1.9	7.4	2.4	10.0	3.3
45	774	63	1.2	0.4	2.7	0.9	3.8	1.3	4.9	1.6	6.7	2.2
60	1032	83	0.9	0.3	2.0	0.7	2.9	0.9	3.7	1.2	5.0	1.7
75	1290	104	0.7	0.2	1.6	0.5	2.3	0.8	3.0	1.0	4.0	1.3
100	1720	139	-	-	-	-	1.7	0.6	2.2	0.9	3.0	1.0
125	2150	174	-	-	-	-	1.4	0.5	1.8	0.7	2.4	0.8
150	2580	208	-	-	-	-	-	-	-	-	2.0	0.7
180	3096	250	-	-	-	-	-	-	-	-	1.7	0.6
Sheathing Material			Incoloy 800									
Watts Density		kW/m ²	107kW/m ²									
*Electrical Supply			415 V / 3 phase / 50/60Hz									
Max Operating Temperature		°C	83									
ECO Setting		°C	90									

System Operation



CAUTION:

This water heater is **ONLY** intended to be operated by persons who have the experience or the knowledge and the capabilities to do so.

This water heater is **NOT** intended to be operated by persons with reduced physical, sensory or mental capabilities i.e. the infirm and children.

Children should be supervised to ensure they **DO NOT** interfere with the water heater.

Care should be taken **NOT TO** touch the pipe work connecting the solar storage tank and the solar collectors. Pipe work and storage tank can reach very high temperature causing burns / scalding when touched if not appropriately insulated.

The setting of the HS Series controls will be completed during the commissioning of the system. The system is designed for drain back operation to ensure there is no risk of freezing or over temperature. In the event of power loss the HS Series system will come back to normal operation without the need for human intervention.

For issues arising during operation, see the “Troubleshooting” section in Chapter 4 of this guide. A number of maintenance aspects are also discussed in the “Maintenance” section in Chapter 4 of this guide.

Chapter 2 - Installation Requirements



IMPORTANT:

It is the responsibility of the plumber/installer that all installations are made in accordance with the building, electrical, and plumbing codes applicable in the installation region.

General Requirements

Codes and Regulations

Besides these instructions, all installations of the HS Series system shall be carried out in accordance with:

- Local Regulations
- Municipal Building Codes
- Occupational Health, Safety & Welfare Regulations

Permits

All correct permits shall be obtained from the appropriate regulatory authorities.

Inspection of Installation Site

The installation site for the system shall be identified and inspected to ensure suitability. Refer to [‘Installation Overview’ on page 18](#).

Safety

Safety is the first priority in all installations. Please observe the safety warnings in this manual and other safety information provided on the HS Series system. Common safety precautions are:

- System must only be installed, commissioned or serviced by a qualified person.
- Scalding occurs at 50°C. This appliance is capable of providing hot water above this temperature. Installers and users must ensure scalding risk is mitigated. If the Delivery Skid is used as the sole means of scald prevention, then it is recommended that the temperature of Delivery Skid is set to achieve a temperature no greater than 50°C at the first point of use.

Water Quality

The warranty of this water heater **does not** apply if the HS Series System is connected at any time to a water supply which exceeds the water chemistry limits of:

- Chloride (Cl) > 250 mg/L - affects Delivery Skid heat exchanger and pipe work
- Chloride (Cl) > 100 mg/L - affects electric heating element tube bundle
- Sulfate (SO₄) > 240 mg/L
- pH < 6.0 - affects Delivery Skid and Solar Pump Skid
- pH > 8.5
- Hardness (CaCO₃) > 150 mg/L - affects the Delivery Skid heat exchanger
- Saturation Index (SI) < -1.0 - affects Delivery Skid heat exchanger
- Saturation Index (SI) > +0.8 - affects the storage tank

*Note: This Chloride limit is only applicable if the maximum temperature of the potable hot water delivered is 60°C or less. At higher hot water supply temperatures, the Chloride allowable limit will be reduced. Please contact your Rheem dealer for further information.

It is important to sample the quality of the water intended to be used in the closed circuit prior to commissioning the system. The report should be referred to your Rheem dealer to confirm the particular water treatment that may be required for optimal long term performance of the system.

Installation Overview

Installation of the HS Series system involves:

- Preparation of installation site for the system (materials not supplied).
- The positioning of the storage tank and application of tank insulation.
- Installation of the Delivery Skid and interconnection to the storage tank (pipework and fittings not supplied).
- Installation of Solar Pump Skid and interconnection to the storage tank (pipework and fittings not supplied).
- Installation and interconnection of the collectors using the components supplied (pipework and fittings not supplied).
- Interconnection of the collector array to the storage tank and Solar Pump Skid (pipework and fittings not supplied).
- Pressure testing of the complete primary circuit, including collector array, storage tank, piping between collector array, Solar Pump Skid and storage tank, and piping between storage tank and Delivery Skid.
- Draining of any excess closed circuit fluid to ensure the fluid is at a point just below the roof line if less than 55m.
- Supply of potable water to the Delivery Skid and connection of hot water to the customer's hot water reticulation system (pipework not supplied).
- Supply of a single phase power supply to the Delivery Skid, single or three phase power supply to the Solar Pump Skid and three phase power supply to the electric heating unit bundle (if installed), which may require the installation of an electrical distribution board (not supplied).
- Electrical connections of the Solar Pump Skid, Delivery Skid and electric heating unit bundle to mains power (e.g. from distribution board).
- Connection of the Solar Pump Skid to both the solar collector sensor mounted in the collector array, and the storage tank sensor mounted in the storage vessel.
- BMS connections (Deluxe models).
- Commissioning the Delivery Skid, Solar Pump Skid and electric heating unit bundle as per the settings beginning on [page 52](#).

Installation of the Storage Tank

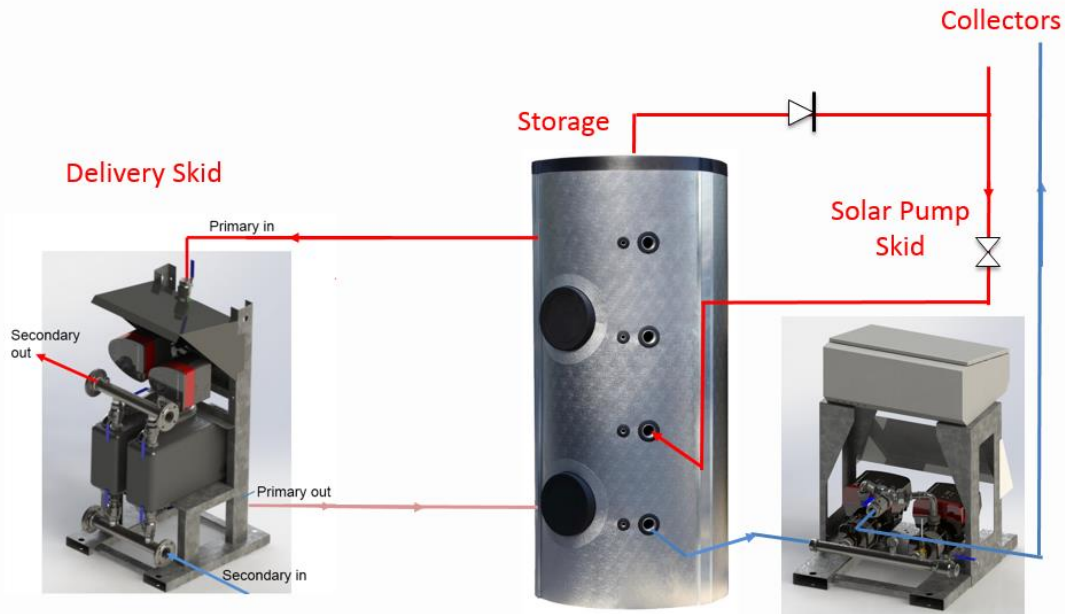
Lifting of Storage Tank

Each storage tank is supplied with certified lifting lugs located at the top of the cylinder. Refer to storage tank technical data and the rating plate for tank weight. The tank must be lifted from the horizontal into its vertical orientation. Take care when removing the straps from the palletised storage cylinder as they will be under tension. Employ safe lifting techniques when locating the tank during installation.



Storage Tank Location

Plan the layout to include positioning of the Solar Pump Skid and Delivery Skid. The storage tank has duplicate water fittings on both sides. It is suggested for ease of installation that the Solar Pump Skid be and the Delivery Skid be installed on opposite sides of the storage tank. Locate the storage tank as close as possible to the collector array. Ensure the selected location provides access for maintenance.



The top of the storage tank **MUST** be a minimum of one (1) metre **BELOW** the bottom of the collector array to enable the drain back system to function.

The base of the Delivery Skid and storage tank **MUST** be located at least on the same level or the Delivery Skid base on a level **LOWER** than the storage tank base (feet).

The storage tank is supplied with the insulation separate, requiring onsite installation to the storage tank. The insulation is available with PVC outer skin suitable for indoor installations **ONLY** or aluminium clad suitable for outdoor or indoor installation. The insulation **MUST** be fitted **AFTER** locating the storage tank into position and **BEFORE** commencing any pipe work to the storage tank.

IMPORTANT! Ensure the drain is connected to fitting 'R' **BEFORE** fitting insulation and whilst the tank is in the horizontal position before lifting to the vertical.

Concrete Pad

Position the storage tank on a well-drained level concrete pad that is adequate to support the weight of the filled storage tank (refer to tank technical data on [page 7](#)). Consult with a local structural engineer if required.

The support Legs of the storage tank are coated with a corrosion resistant material, however it is recommended a moisture barrier e.g. plastic, not rubber, be placed between the support legs and the supporting surface. It is not necessary to allow for free air circulation under the base of the storage tank.

Locate the storage cylinder **BEFORE** fitting insulation as the lifting lugs will be covered once the insulation is in place.



Fitting Insulation

Follow the instructions supplied with the insulation for PVC or Aluminium Clad insulation as appropriate.

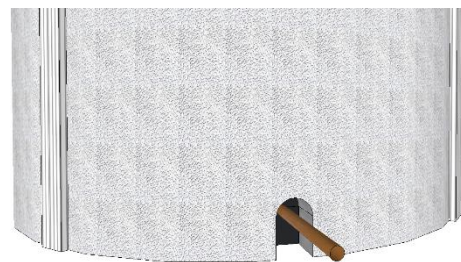
Plumbing Connections

The storage tank is supplied with many fittings allowing maximum flexibility in system design and layout. Refer to the Application Guide for system configurations. Fittings A -D may be interchanged with their respective opposite fitting E - H to suit site specific layout requirements. All other tank fittings must be employed as advised in these instructions.

Disconnection unions and isolation valves must be installed on all piping connections to the storage tank. Unused fittings must be plugged (plugs not supplied).

A drain **MUST** be plumbed to fitting connection 'R' to allow complete drainage of chemicals used to treat the storage tank. Failure to do this will render the cylinder warranty **VOID**.

Note: We recommend connecting the drain line on the larger models before standing the tank up as there is limited space between the floor and the connection point. The drain line can be run in any direction, however a mouse hole will need to be made in the bottom of the insulation panel where the drain line protrudes from the insulation. Be careful not to run the pipe in line with a tooth lock section.

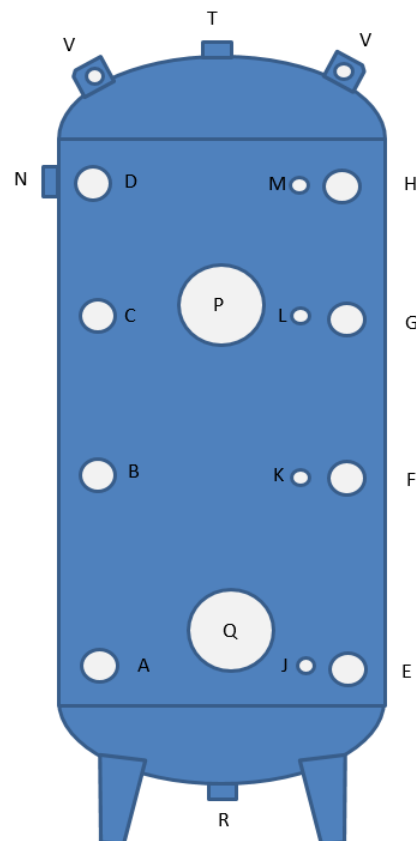


Treatment Filling Valve

Fit an elbow and isolation valve to any one of the unused 2" ports on the side of one tank. Orientate the valve so it is pointing vertically up. This will be used to add pre-treatment and corrosion inhibitor to the tank before filling.

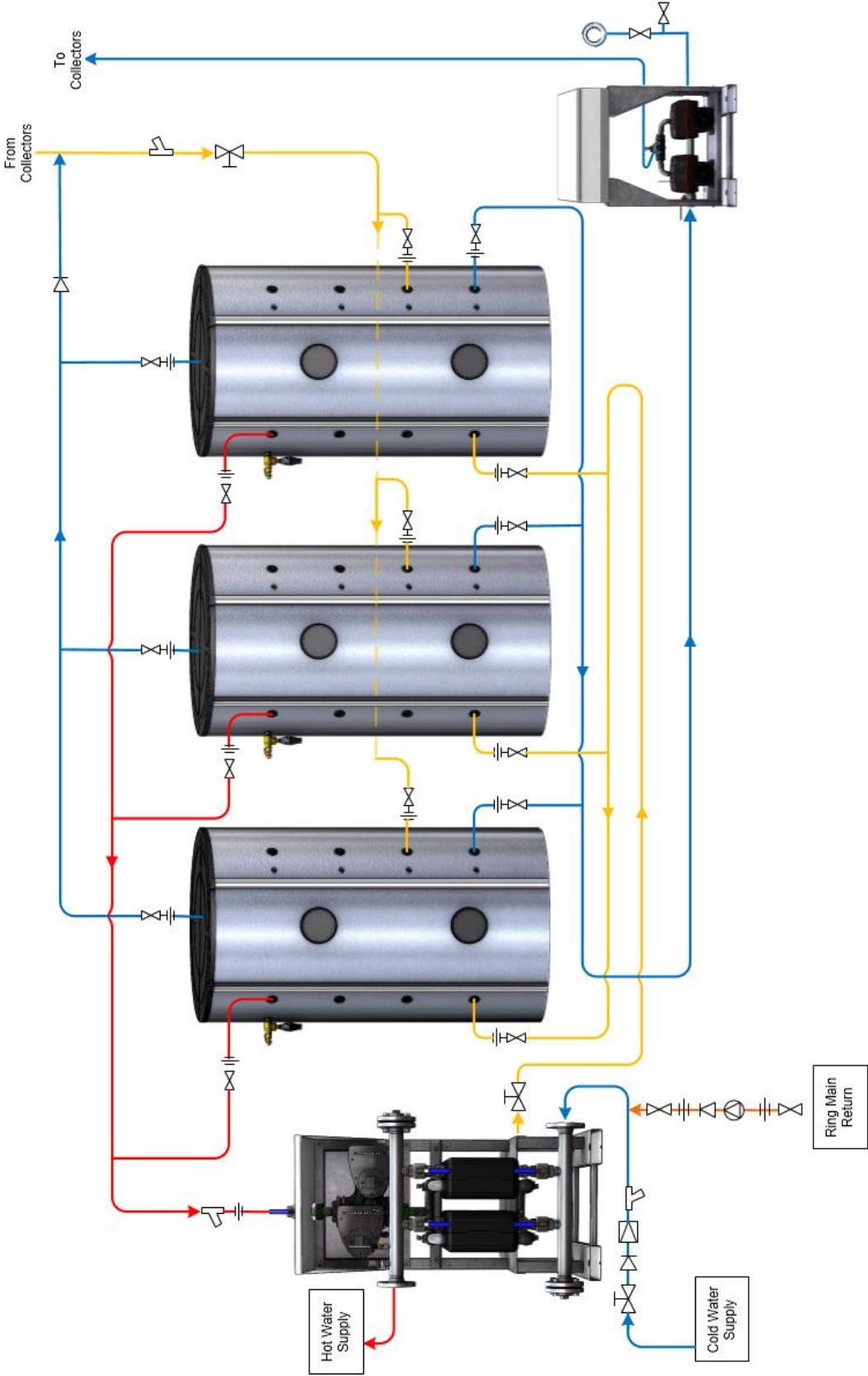
Storage Tank Fitting Locations

Fitting	Description
A, B, C, D, E, F, G, H	AUXILIARY FITTINGS RP2 BSPF
J, K, L, M	TEMPERATURE SENSOR PORTS RP½ BSPF
N	TPR SOCKET 1¼" NPTF
P	TOP ELEMENT FLANGE
Q	BOTTOM ELEMENT FLANGE
R	DRAIN RP1 BSPF
T	DRAIN BACK VENT: 1000L = RP1½ BSPF 2000, 3000, 4000, 5000L = RP2 BSPF
V	LIFTING LUGS



Multiple Tank Installation

Refer to the drawing below if multiple storage tanks are to be manifolded together. Ensure equal friction method is used when making the plumbing connections.



Multiple Tank Installation

Temperature and Pressure Relief Valve

NOTE: the TPR valve thread is NPT. Do not fit a valve with ISO 7 / BSP threads to fitting “N” on the storage tank.

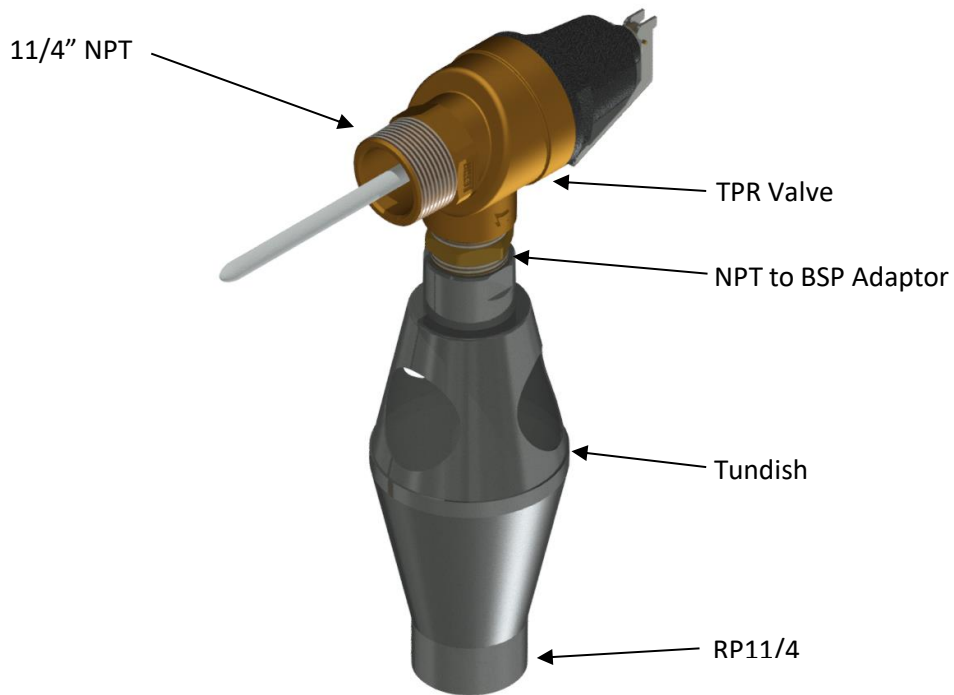
Fit the supplied Temperature and Pressure Relief Valve (TPR) to fitting “N” on each storage tank. Fit the supplied tundish to the TPR valve outlet.

Fit a DN32 drain line to the TPR valve tundish to carry the discharge clear of the storage tank. Connect the drain line to the tundish using a disconnection union. The drain line from the tundish to the point of discharge should be as short as possible, have a continuous fall all the way from the storage tank to the discharge outlet and have no tap, valves or other restrictions in the pipe work.

The outlet of a drain line must be in such a position that flow out of the pipe can be easily seen, but arranged so discharge will not cause injury, damage or nuisance. The drain line must not discharge into a safe tray.

In locations where water pipes are prone to freezing, drain lines should be insulated.

For multiple installations, where the storage tanks are used as a closed loop, the drain line from each storage tank can discharge into a common DN32 line. For direct system installations, the line must be sized to accommodate the volume of fluid which may be discharged. Refer to the table on [page 22](#).



TPR Valve Assembly

Table 8 - Common TPR Drain Line Size

No x Tanks	Common TPR Drain Line Size	
	Direct Systems	Indirect Systems
1	DN32	DN32
2	DN50	DN32
3	DN50	DN32
4	DN65	DN32

**WARNING:**

NEVER block the outlet of a relief valve or its drain line for any reason.

⚠ Warning: As the function of the temperature pressure relief valve on this water heater is to discharge high temperature water under certain conditions, it is strongly recommended the pipe work downstream of the relief valve be capable of carrying water exceeding 93°C. Failure to observe this precaution may result in damage to pipe work and property.

⚠ Warning: Never replace the temperature and pressure relief valve with one of a higher or lower pressure rating or lower thermal relief capacity.

Auxiliary Heater Connections

If an auxiliary heater such as a heat pump or gas water heater are to be connected to the storage tank, the primary flow (from auxiliary heater) and primary return (to auxiliary heater) connections would typically be made at fittings “H” and “G” respectively. Refer to the **Application Guide** for specific system installation details.

Note: An auxiliary heater **MUST** have its own temperature control and over temperature cut out, and the total energy input from all heating sources, ie auxiliary heaters PLUS solar input **MUST NOT** exceed the rating capacity of the total number of TPR valves fitted to the system. Refer to the storage tank rating label for maximum input rating. The remainder of unused fittings are to be plugged (plugs not supplied).

Installation of the Delivery Skid**Delivery Skid Primary Connections**

Position the Delivery Skid in the required location, as close to the tank as possible and secure to the ground if required. Access to the Delivery Skid and removal of components is from the front, however sufficient clearance should be left on either side to allow for wrench access.

The base of the Delivery Skid and storage tank **MUST** be located at least on the same level or the Delivery Skid base on a level **LOWER** than the storage tank base (feet).

Refer to Delivery Skid Pipe Size Chart on [page 25](#) for pipe sizing between the storage tank and Delivery Skid. If more than 2 Delivery skids are to be manifolded, or the pipe run exceeds a total of 10m flow and return between the Delivery Skid and the **closest** tank, or different pipe material is being used, consult Rheem for appropriate pipe sizing.

Install a line strainer on the primary flow (Heating Source In) to the Delivery Skid.

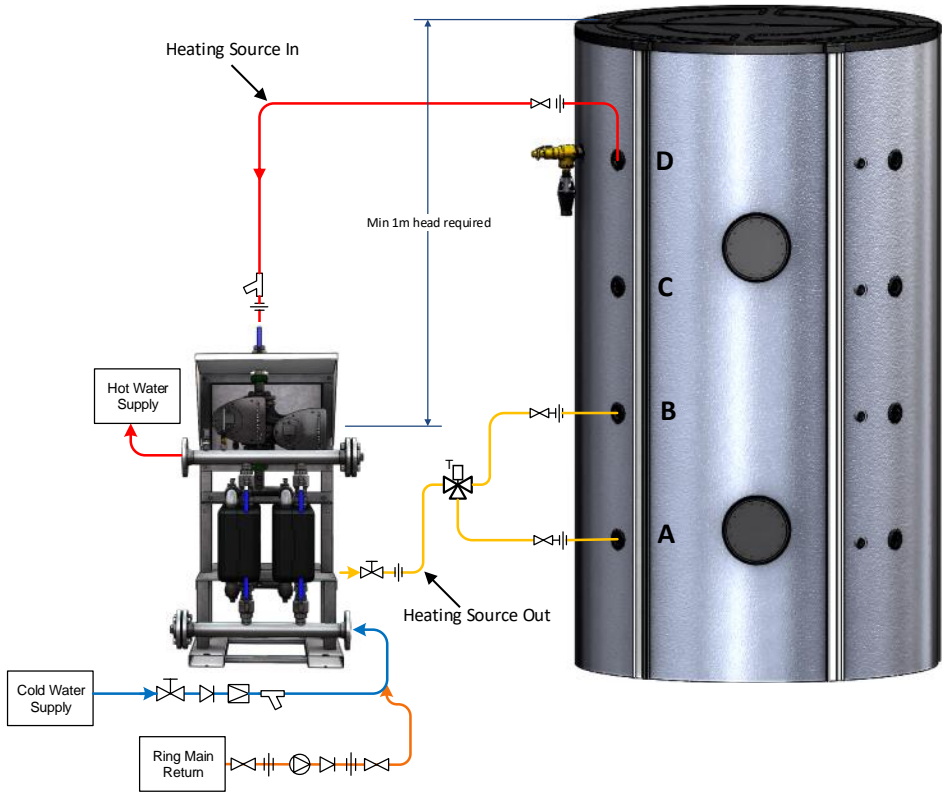
Make sure that the piping of the delivery skid has no trapped air in the line. An air bleed valve can be installed at the highest level of the piping to get rid of trapped air.

Connect hot supply from tank fitting “D” to the fitting marked “Heating Source In” on the Delivery Skid.

Install the globe valve (not required with 800kW model) at the connection marked “Heating Source Out” on the Delivery Skid.

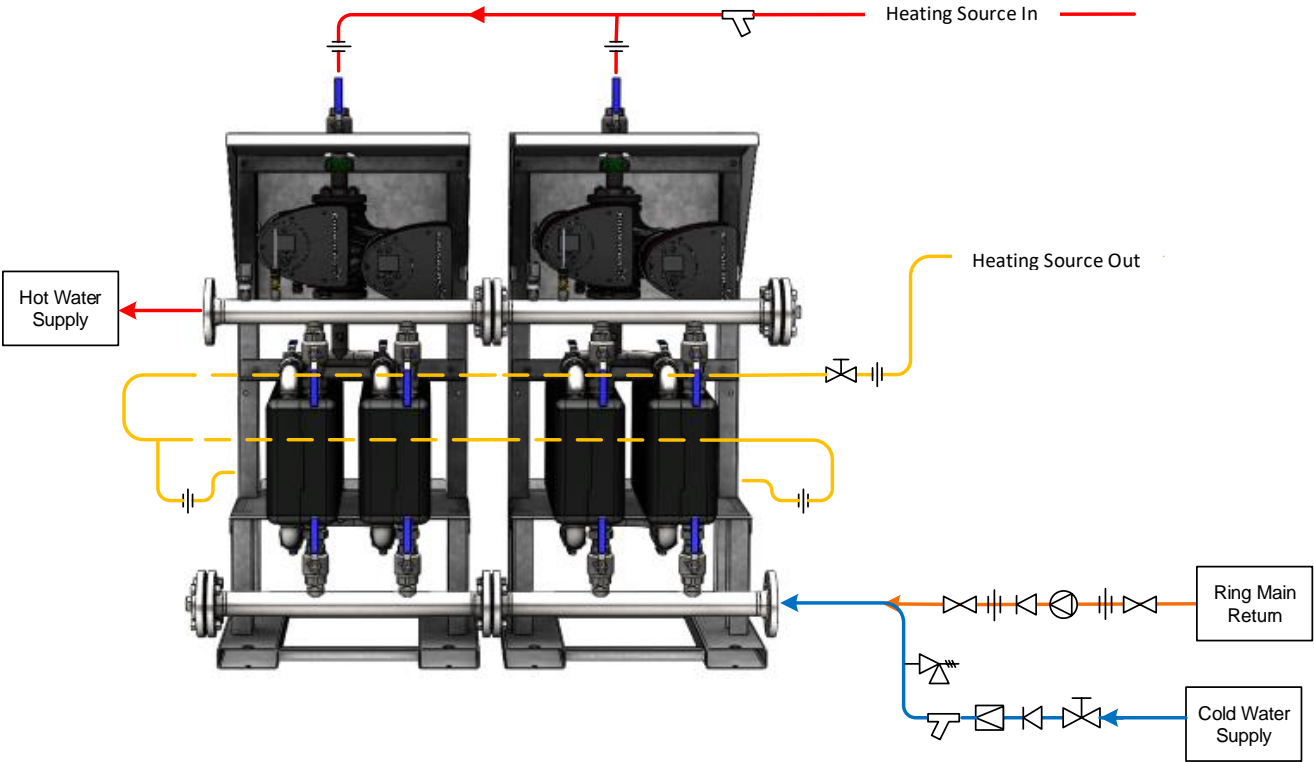
If the potable side of the Delivery Skid is connected to a flow and return circuit, connect from the fitting marked “Heating Source Out” on the Delivery Skid to tank fitting “A” and “B” via a motorised 3 way valve. If the potable side is connected to a dead leg, or building return water does not return via the Delivery Skid, connect to fitting “A” only. Refer to the **Application Guide** for specific system layouts.

Refer to Potable Water Connections to Delivery Skid on [page 28](#) for potable water connection details.



Storage Tank and Delivery Skid Connections

If multiple Delivery Skids are to be manifolded together to provide greater flow rate capability, follow the diagram on [page 24](#). Ensure equal-friction method is used when making the plumbing connections.



Multiple Delivery Skid Manifolding

Table 9 - Delivery Skid Primary Side Pipe Sizing

Delivery Skid Model	Output (kW)	Pipe Size (copper) DN
RD200	200	40
RD400	400	50
RD600	600	65
RD800	800	80
2 x RD600	1200	100
2 x RD800	1600	100

Note: Pipe sizing is based on maximum Delivery Skid output, using 20m total of copper pipe and 20 x 90 degree bends, with a maximum flow velocity of 1.2m/sec

Installation of the Solar Pump Skid

Solar Pipe Size / Pump Selection Chart

The table below is used to determine the appropriate Solar Pump Skid and pipe sizing with reference to the number of collectors and total pump lift required from the solar pump skid base to the top of the collector array.

Select the total number of collectors in the vertical left hand column. If in between, go to the next highest number of collectors eg if 21 x collectors, select 24. Next, select the total height from the base of the solar pump skid to the top of the collectors in the horizontal top row. If in between, go to the next height. Select the pipe size and pump model.

Table 10 - Solar Pipe Size / Pump Selection Chart

Number Collectors	Total Height from Base of Solar Pump Skid to Top of Collector (metres)						
	10	15	20	25	30	35	40
8	DN20 / RP013		DN20 / RP015			DN25 / RP015	
12	DN20 / RP015		DN25 / RP015				
16	DN25 / RP015			DN32 / RP035			
20	DN32 / RP033			DN32/RP035			
24	DN32 / RP033		DN32 / RP035				
28	DN32/RP055						
32	DN32/RP055						
36	DN32/RP055				DN40 / RP055		
40	DN40 / RP055						
45	DN40 / RP103						
50	DN40 / RP103						
60	DN50 / RP103						
70	DN50 / RP103						
80	DN50 / RP103					DN65 / RP103	
90	DN50 / RP103				DN65 / RP103		
100	DN65 / RP153						
125	DN65 / RP153						
150	DN65 / RP153						

Note: Pipe Sizing is based on copper pipe with a maximum fill velocity of 2.4m/sec and maximum run velocity of 1.6m/sec. Do not use plastic pipes in the solar flow and return circuit as they cannot withstand the temperatures and potential pressures which can be produced.

Example: 35 x CSA2013 collectors are being installed with a height from base to top of collectors of 27 metres. Select 36 x collectors and cross reference against 30 metres total height. A solar pump skid model RP055 (using CME5-5 pumps) with DN40 copper pipe is suitable.

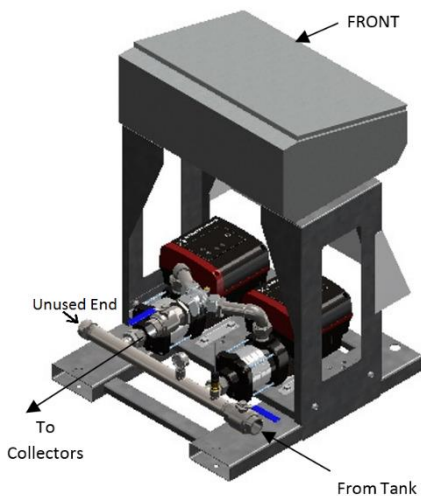
Solar Pump Skid Connections

Position the Solar Pump Skid in the required location and secure to the ground if required. Access to the Solar Pump Skid and removal of components is from the front when looking at the controller access, however sufficient clearance should be left on either side to allow for wrench access.

Refer to [Solar Pump and Pipe Size Chart on page 26](#) for the appropriate pump model and pipe sizing between the storage tank, Solar Pump Skid and collectors for the system being installed.

Note: The pipe sizing shown in the chart on page 26 are minimums and is for reference only. Specific site requirements may deem the pipe size to be different to that shown. Consult Rheem for further details.

Connect from tank fitting “E” to the fitting marked ‘Inlet’ on the Solar Pump Skid as shown in the diagram. The plumbing is from the left side of the Solar Pump Skid when looking at the controller access.

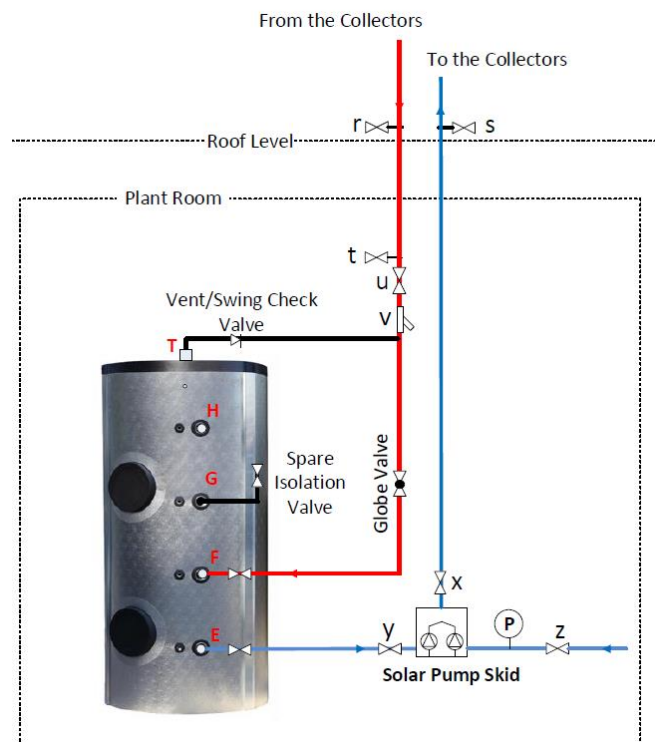


Fit a Tee piece (for pressure gauge) then an isolation valve “z” to the unused end of the Solar Pump Skid. This will be used to fill the system during commissioning and any subsequent top up.

Connect the outlet of the Solar Pump Skid to the solar collector array cold inlet ensuring plumbing is as direct as possible and maintains a continual rise. Failure to maintain a continual rise will hinder reverse flow in drain back mode. The Solar Pump Skid is fitted with a bi-directional flapper non-return valve which will allow automatic draining of fluid. **DO NOT** fit a non-return valve in the solar cold line.

Run the solar hot outlet from the collector array to the storage tank(s).

Solar Pump Skid Installation Diagram



High Level Cold and Hot Drain Valves (r, s)

Install a branch in the solar cold and solar hot lines at the penetration of the roof. Fit a ball valve on the end of each branch. These will be used to drain excess fluid from the solar circuit. If the drain valves cannot be installed above the roof line, it is important they are installed where they can be accessed and any excess fluid readily drained from the system.

At a point above the storage tank, fit a branch line and a tank bleed valve “t”, an isolation valve “u” and then fit a line strainer “v” and then a minimum DN20 Tee fitting in the solar hot line.

Note: The branch tank bleed valve “t” will be used to determine when the tank is full. The isolation valve “u” in the solar hot line will facilitate separate testing of the collector and tank circuits.

Drain Back Vent Check Valve

Fit the check valve supplied with the Solar Pump Skid to the horizontal outlet of the Tee fitting with the direction of flow pointing away from the storage tank(s) and towards the solar hot line.

The check valve should be installed ‘upside down’ such that the hinge of the flap is at the underside of the pipework. This will allow air to feed into the top of the storage tank during flooding but prevent fluid from entering the top of the storage tank once fully flooded.

Install a minimum DN20 horizontal line from fitting “T” on the storage tank to the check valve. A single check valve is sufficient for single and/or multiple storage tanks. Refer to [multiple storage tank diagram on page 21](#) . This line **MUST** be horizontal or have a slight upward grade towards the solar hot pipe to

avoid fluid trap. The proper operation of the check valve is essential to allow the fluid to drain back. Refer to diagram on page 27.

Globe Valve

Install the globe valve (supplied) after the remaining outlet of the Tee in the solar hot line with the direction of flow towards the storage tank/s. Refer to drawing on page 27. For future maintenance, it is recommended to install a line strainer with isolation valve immediately upstream of the globe valve.

It is recommended to install these components so access for maintenance and adjustment can be achieved without the use of ladders. Connect from the outlet of the globe valve to fitting “F” on the storage tank.

Ensure the flow of fluid to and from the collectors is plumbed in Equi-flow / Tichelmann. Refer to drawing on page 21.

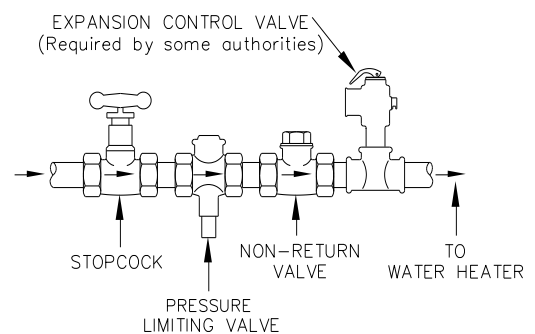
Potable Water Connections to Delivery Skid

Refer to the diagram on page 24 for potable water connections.

All pipe work must be cleared of foreign matter before connection and purged before attempting to operate the system.

Cold Water Supply

Install an isolation valve, non-return valve, line strainer and expansion control valve or appropriately sized expansion vessel (not supplied) on the cold water supply to the Delivery Skid.



The pressure relief setting should be no greater than the maximum operating pressure of the lowest pressure rated component of the plumbing system, eg, taps, valves, water heaters, other appliances, but **MUST NOT** exceed 1400kPa. The cold water supply pressure should be 20% below the ECV setting, if installed.

Hot Water Supply

Depending on the model selected, the Delivery Skid can be programmed by the installer to supply hot water at a temperature in excess of 50°C. We recommend that a temperature limiting device be fitted between the Delivery Skid and the hot water outlets in any ablution and public areas such as bathrooms, ensuites or public amenities, to reduce the risk of scalding. A tempering valve may be required to comply with local requirements. Refer to the plumbing codes applicable in your area to determine if a temperature limiting device is required to minimize the risk of scalding.

Connect the cold water supply and hot water flow at the flanges marked “Potable In” and “Potable Out”. The Delivery Skid is supplied such that cold water enters on the right and leaves on the left. It is important that it remains this way to ensure accurate temperature reading at the hot water outlet.

Multiple Installations

If multiple Delivery Skids are to be manifolded together to provide greater flow rate capability, follow the diagram on page 24. Ensure equal-friction method is used when making the plumbing connections.

Pipe Insulation

All hot water pipework shall be insulated to minimise heat losses. Use a minimum of 13 mm thick closed-cell polymer preformed pipe insulation or similar. Additionally, where temperatures reach -4°C for periods of greater than 8 hours, the potable cold water supply pipes shall be adequately insulated with at least 13 mm of closed-cell polymer insulation or equivalent. All insulation used shall be weatherproof and UV resistant if exposed, and protected from water ingress by tape, painting or sheathing.

Installation of the Solar Collectors



WARNING:

The solar flow and return pipes between the storage tank and the solar collectors **MUST BE** of copper or metallic pipe and all compression fittings must use brass or copper olives.

Plastic pipe **MUST NOT** be used as it will not withstand the temperature of the closed circuit fluid generated by the solar collectors. Failure of plastic pipe can lead to the release of high temperature closed circuit fluid and cause severe water damage and flooding.

Collectors **MUST BE** installed on an adequately supported area of roof.

Collectors are heavy. Improper lifting techniques could result in personal injury during installation. It is the installer's responsibility to use only approved lifting and safety devices and techniques when installing collectors.

The collector installation shall provide safe access for maintenance.



IMPORTANT:

The Rheem HS Series is suitable for frost prone locations due to the drain-back function. It is necessary that the pipes to and from the solar collectors fall back to the storage tank in a continuously downward direction and with no restrictions.

Ensure the collector sealing plugs are in place and that they remain in place until the collectors are in position and ready to be connected. This ensures no foreign matter enters the collectors or system pipe work.

The CSA2013 collector glass meets AS/NZS 2712 requirements for hail impact damage resistance. The fitment of glass guards for this purpose is not required. Stone Guards are available for protection against accidental damage or vandalism, if considered necessary. Contact Rheem for more information.

Note: The maximum gross weight of each CSA2013 collector when filled with water is around 33 kg.

Location of Solar Collectors

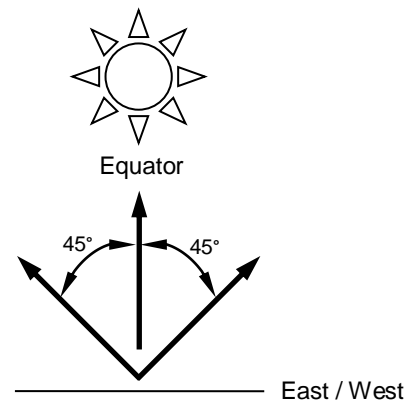
The base of the collectors **MUST** always be located a minimum of 1m **ABOVE** the top of the HS Series storage tank to enable the drain-back function.

Before commencing installing the solar collectors, inspect the roof structure to ensure that:

- The structural integrity of the roof is not compromised by the installation of the solar collector array, and;
- The solar collector array is installed in an area that is free from shade all year, particularly between the hours of 9:30 am and 4:00 pm. Tall trees and adjacent buildings may cast a shadow on the collectors during winter.

Orientation of Solar Collectors

For optimum performance, the solar collectors should be installed facing towards the equator (facing north in the southern hemisphere, facing south in the northern hemisphere). **ALWAYS USE A COMPASS TO CHECK THE ORIENTATION.** Deviation from the equator up to 45° east or west has little effect on the total annual solar output from the collectors (approximately 5%).

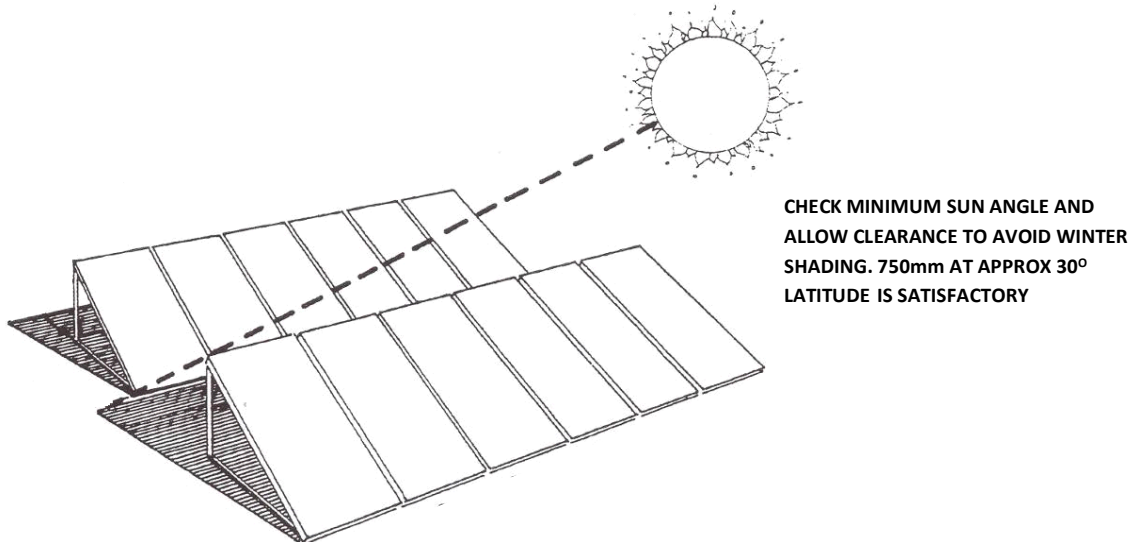


Inclination (Angle) of Solar Collectors

The angle of inclination of the collectors should be the same as the geographic latitude angle of the location or within $\pm 20^\circ$ of the latitude angle. Deviations from latitude angle up to $\pm 20^\circ$ will have little effect on the total annual solar output from the collectors (approximately 5%). To ensure correct water run-off, glass self-cleaning, and collector case venting, the minimum permissible angle is 10°.

Collector Bank Spacing

Where the collectors are mounted on variable pitch frames in multiple banks, maintain a distance of at least 750mm between each bank of collectors to prevent shading and allow access for servicing.



IMPORTANT:

When installing collectors on all roof types, it is important that connections are made loosely to allow for adjustment while the other collectors are located. With all collectors positioned as indicated on page 37 the connections shall be made tight and the collectors finally clamped. Failure to follow this procedure may cause difficulties during assembly.

Do not remove the solar collector packaging completely prior to the installation as the solar collector surface can become very hot. Remove only sufficient packaging material to enable the installation of the solar collectors.

Upon completion of the installation of the solar collectors with conetite fittings the packaging material may be removed whether or not the solar circuit is connected to the solar storage tank and / or the solar water heater is commissioned, without damage to the solar collectors.

The solar collector packaging must be removed completely prior to the permanent operation of the water heater.

Collector Installation on Pitched Tiled Roofs

Select a suitable area of roof sufficient to install all the collectors required. Each collector rail is supplied with 2 collector straps which are required to be fixed to the roof rafters. Expose the roof rafters so that the collector straps are evenly spaced as much as possible on each collector rail across the roof for the bottom of the first row. Then repeat the procedure 1,940 mm up the slope of the roof to complete the top of the first row. Then leaving approximately 750 mm in between rows, repeat the procedure for each subsequent row. A maximum of 8 collectors per bank can be interconnected together using the collector connector assembly supplied.

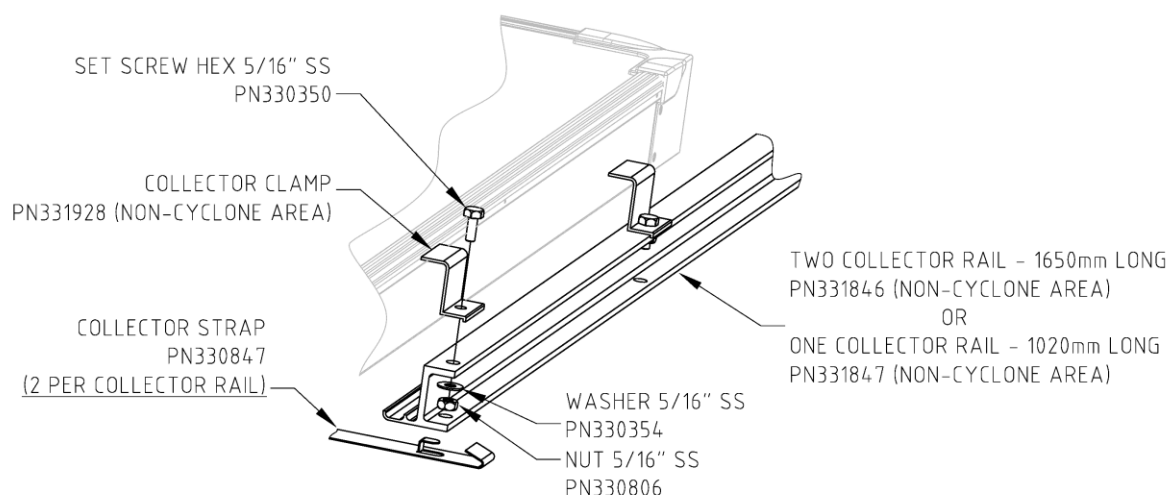
Fasten the stainless steel straps to the roof rafters and fix the collector bottom and top mounting rails into the straps. Maintain a gap between the top and bottom rails sufficient to fit the collectors. Ensure that each parallel bank in the collector array slopes towards the bottom collector connection pipe. A minimum slope of 2.5 mm per collector (20 mm per bank of 8 collectors) is recommended. Replace the roof tiles and position the collectors on the mounting rails, allowing approximately 100 mm between adjacent collectors for the collector connector assy.

Collector Installation on Pitched Metal Deck Roofs

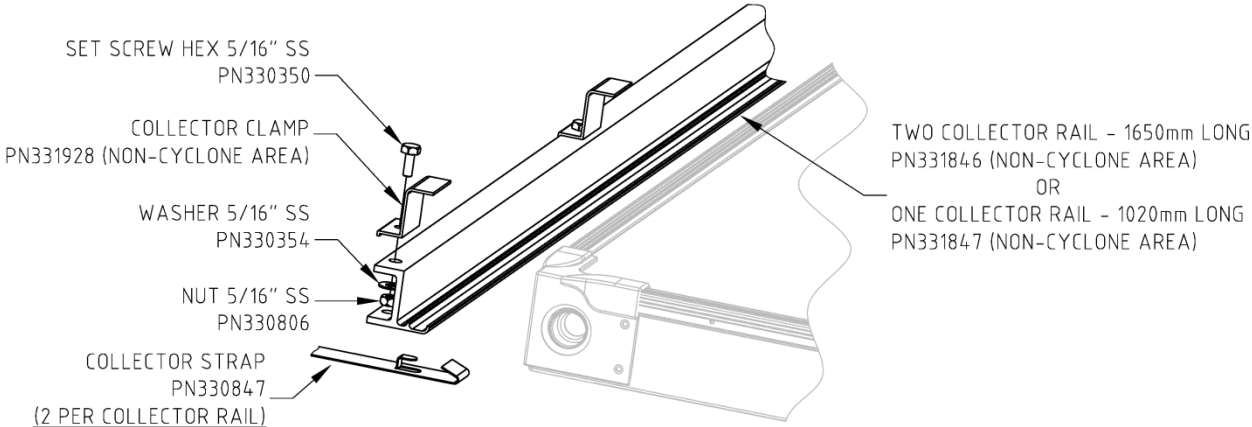
Fasten the stainless steel straps to the high points of the metal deck using stainless steel metal thread screws with weatherproof seals, so that the collector straps are evenly spaced as much as possible on each collector rail across the roof and fix the collector bottom and top mounting rails into the straps. Maintain a gap between the top and bottom rails sufficient to fit the collectors. Ensure that each parallel bank in the collector array slopes towards the bottom collector connection pipe. A minimum slope of 2.5 mm per collector (20 mm per bank of 8 collectors) is recommended. Position the collectors on the mounting rails, allowing approximately 100 mm between adjacent collectors for the collector connector assy.

Then leaving approximately 750 mm in between rows, repeat the procedure for each subsequent row. A maximum of 8 collectors per bank can be interconnected together using the collector connector assembly supplied.

Care should be taken to not mark metal roof sheet with a marking pen and to remove all swarf from the metal roof as these can cause deterioration of the metal roofing material.



DETAIL 'F'
COLLECTOR RAIL - BOTTOM



DETAIL 'G'
COLLECTOR RAIL - TOP

Collector Installation on Flat Roofs

Variable pitch frames are available from Rheem to suit collector only installations on flat or near flat structures. The variable pitch frames can be set at 15°, 20° or 25° inclination. Care **MUST BE** taken when spacing out the collector arrays to ensure no occurrences of self-shading between collector banks, particularly in the winter months.

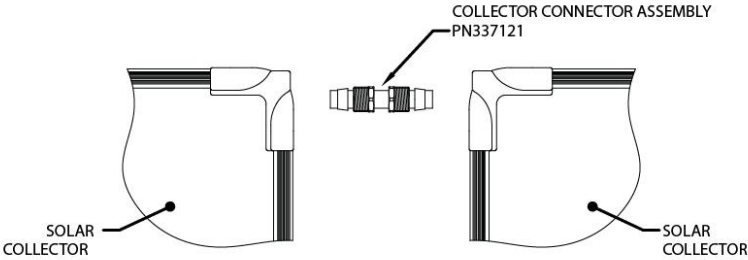
Determine the location of the Variable Pitch frame(s). Assemble and fix the frame(s) to the roof, following the installation instructions provided with the frames(s).

Position the collectors on the mounting rails, allowing approximately 100 mm between adjacent collectors for the collector connector assy.

Collector Connector

Insert the collector connector assembly at the top and bottom between each of the collectors and slide into place before fitting the collector clamps, to complete the installation.

Hint: To aid with fit up, loosely join all collectors in an array before final tightening of connector nuts.



Detail 'B'
Collector Connector Assembly (between collectors)

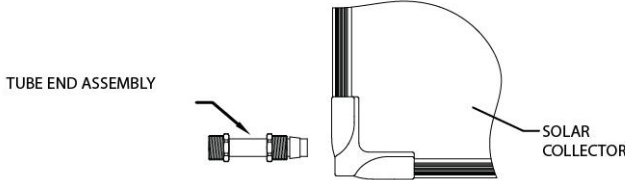
Collector Pipe Work

A maximum of 8 collectors per bank can be interconnected together using the collector connector assembly supplied. Each bank is to be installed to ensure Equa-flow between banks. Refer to diagram on page 36.

Tube End Assembly

The solar cold connection (inlet) to the collector array **SHALL BE** at the lowest corner of the collector array and the solar hot connection (outlet) at the diagonally opposite highest corner to ensure all banks have equal flow resistance.

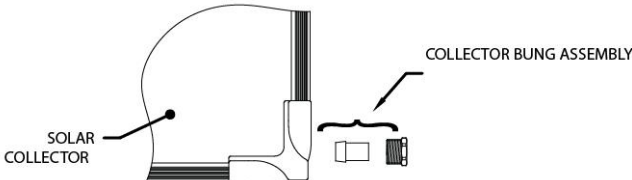
Fit a Tube End Assembly to the inlet and outlet of each bank.



Detail 'A'
Tube End Assembly (Inlet and Outlet)

Collector Bung Assembly

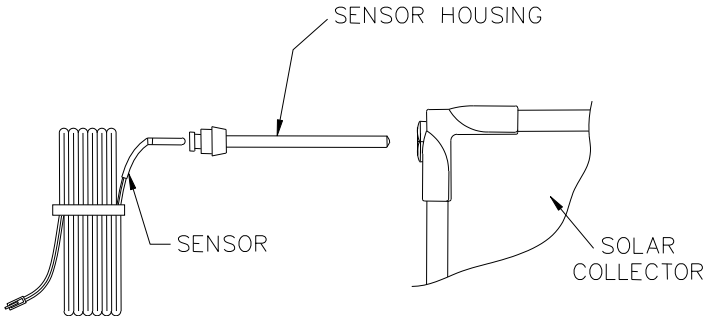
Fit the Collector Bung Assembly to the remaining two fittings on each bank of collectors.



Detail 'C'
Collector Bung Assembly

Collector Sensor Assembly

Fit the collector sensor housing (supplied with the Solar Pump Skid) into the fitting above the cold water inlet of one of the banks. It will be necessary to remove one of the collector bungs. It is necessary to ensure the hot sensor probe receives similar radiation to that of the main collector array and that it is not shaded at any time, either by adjacent buildings or other collectors. Insert the Collector Sensor all the way into the sensor housing and secure with the clip. Run the Collector Sensor cable to the Solar Pump Skid and connect at the terminal labelled "Collector". 20m extension leads are available from Rheem. Join these to create the required length of run from the collector array to the Solar Pump Skid.



Detail 'E'
Hot Sensor Assembly

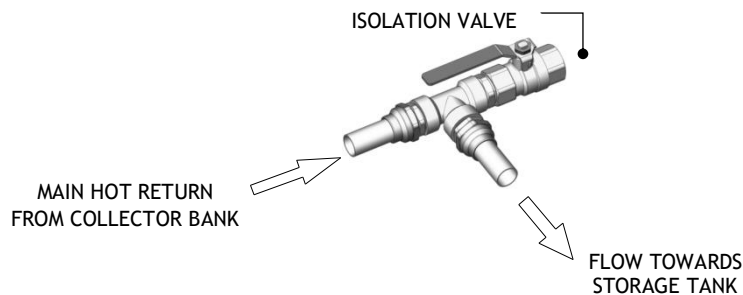
Plumbing Between Collector Banks

Connect each bank of collectors into a parallel group using reverse return connections on the hot outlet to ensure equal flow through each bank. If the plumbing between arrays is not in Equi-flow/Tichelmann, then fit a balancing valve at the inlet of each bank **ONLY** to facilitate balancing. Isolating a bank by fitting an isolation valve to the inlet and outlet may lead to catastrophic failure of the solar circuit.

The solar cold pipe to and solar hot pipe from the collectors **MUST HAVE** a continuous fall back to the storage tank to ensure the drain back of the closed circuit fluid. The pipe work must have a continuous grade of 1 in 10 or 5°. This will prevent the closed circuit fluid collecting in dips in pipe runs, which may cause the pipes to fatigue and split on freezing. The water treatment used in the closed circuit is not an antifreeze agent. Its function is to act as a corrosion inhibitor only.

Install an appropriately sized Tee piece and isolation valve (not supplied), as shown below, at the highest point of the main solar return pipe work to facilitate collector array pressure test during commissioning and servicing. This will be referred to as the 'Bleed Valve'.

Note: if the collector arrays are not plumbed in Equi-flow / Tichelmann, then a bleed valve may be required at the highest point of multiple arrays.



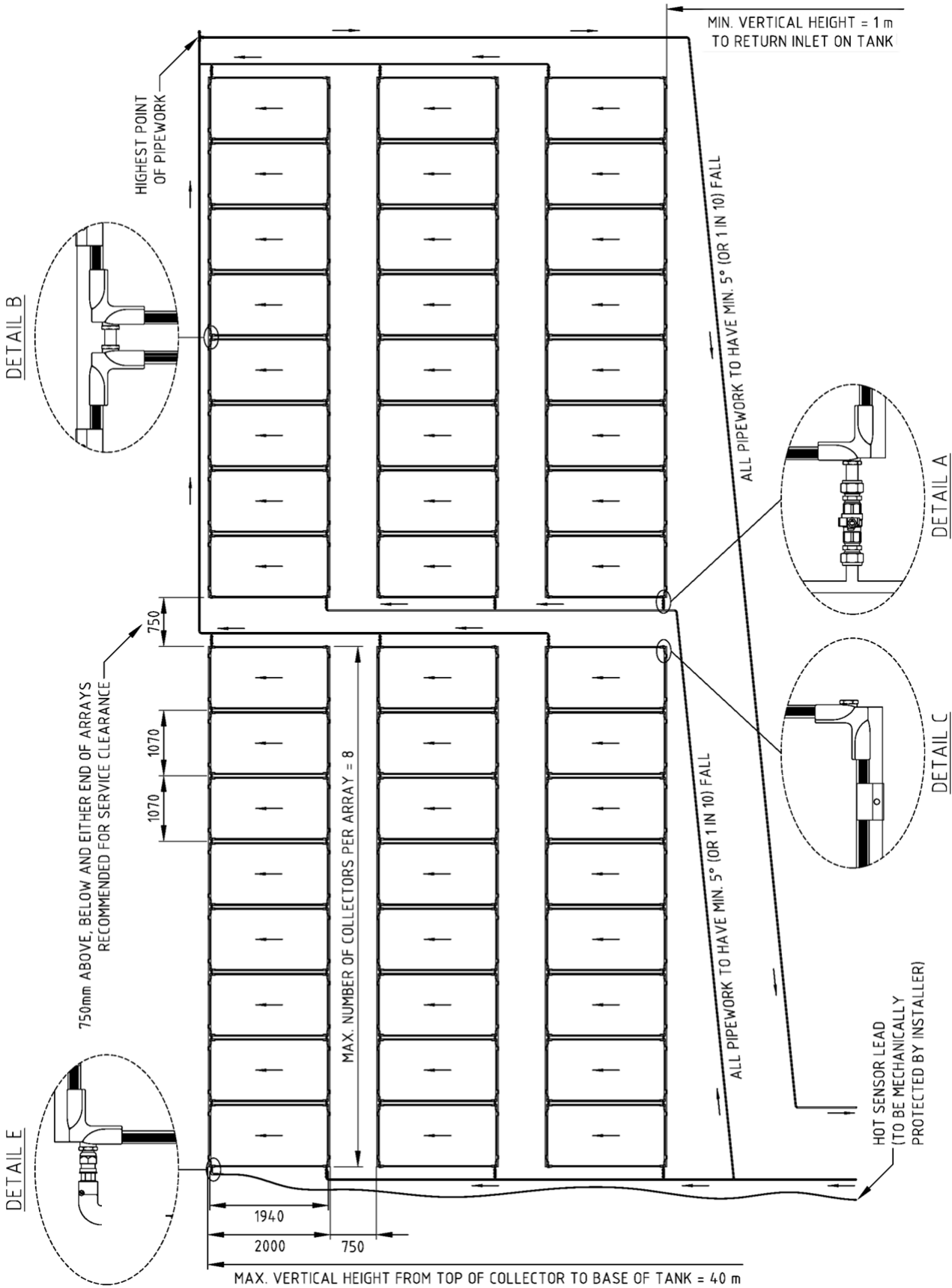
Collector Array Hot Outlet

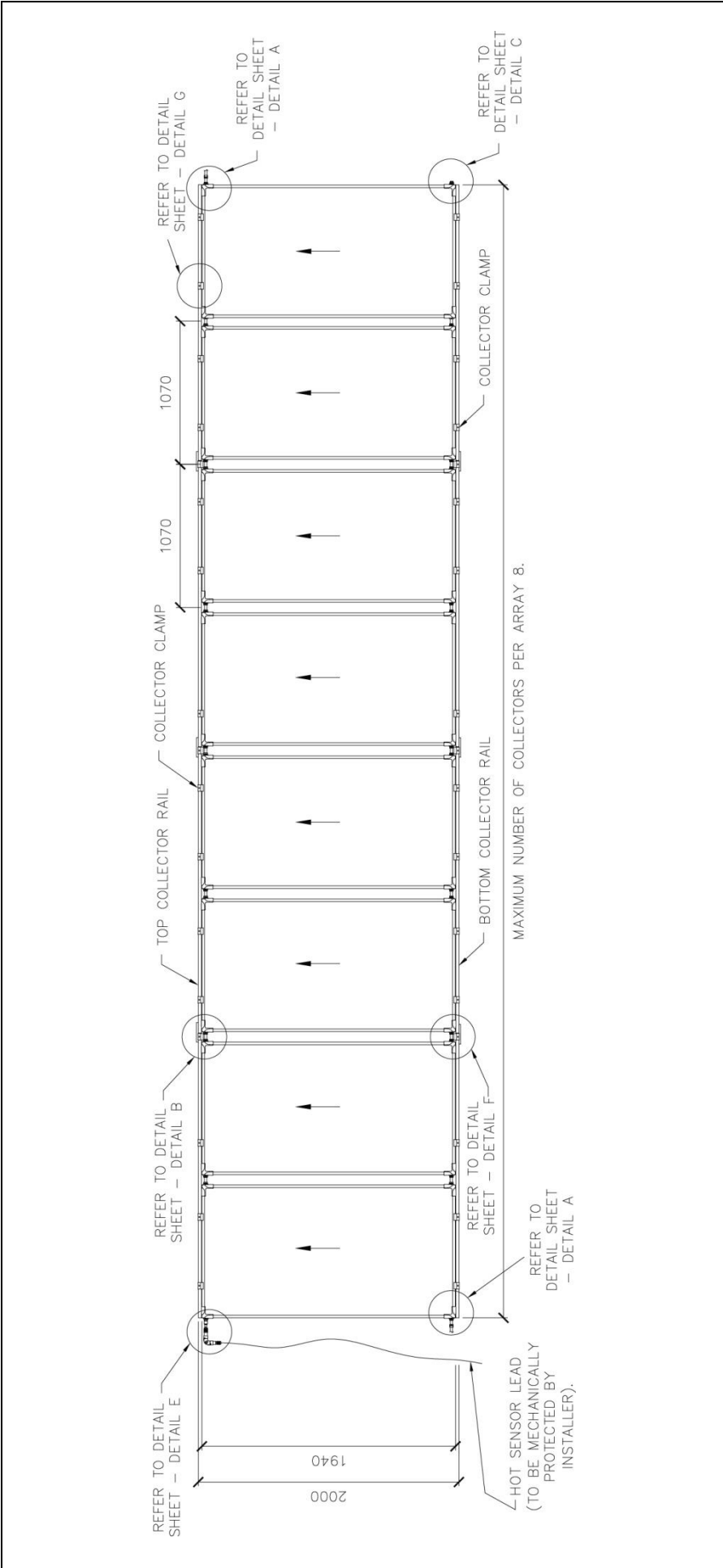
Pipe Insulation

All pipe work **MUST BE** insulated with a minimum of 13 mm thick fibreglass insulation or similar. Thicker insulation may be required to comply with the requirements of AS/NZS 3500.4. The insulation **MUST BE** weatherproof and UV resistant if exposed. The insulation offers corrosion protection to a metal roof against water runoff over the copper pipe, reduces pipe heat losses, and also assists in avoiding accidental contact with the solar pipe work. The insulation **MUST BE** fitted up to the fitting connections, as very high temperature water can flow from the solar collectors to the Heat Store Series 2 under certain conditions.

Closed cell polymer insulation should not be used as it may not be able to withstand the temperature of the water generated by the solar collectors under stagnation conditions.

Typical Multiple Collector Array Arrangement





Collector Array Installation Schematic

Electrical Connections

Solar Pump Skid

The Solar Pump Skid is suitable for indoor or outdoor installation. In extreme climatic regions where ambient temperatures regularly exceed 40°C, it is recommended to install the Solar Pump Skid out of direct sunlight. The Solar Pump Skid should be located within 5 lineal metres of the storage tank to enable sensor lead connections to the storage tank without the need for extension leads.

The Solar Pump Skid is supplied pre-assembled and wired, however, requires connection of a correctly sized single phase or three phase power supply depending on the model (including neutral 'N' and protective earth 'PE'). This power supply **SHALL BE** supplied from a distribution board (not supplied) that contains a circuit breaker and a main isolation switch to cut power to the control unit for servicing purposes. If the distribution board is not located close to the Solar Pump Skid, then a separate isolation switch **SHALL BE** installed in the power supply directly before it.

Table 11 - Solar Pump Skid Electrical Requirements

Model	Power Supply	Max Current (Amps)	Min Circuit Size (Amps)
RP013	220 -240V AC / 50-60Hz	10	16
RP015			
RP033			
RP035			
RP055	380 - 415V AC / 50-60Hz	10	16
RP103		15	20
RP153			

Consult your Rheem Distributor for pumps other than those shown above.

Connections

[Refer to the diagrams on page 39 and 40](#) for connection plugs and terminals.

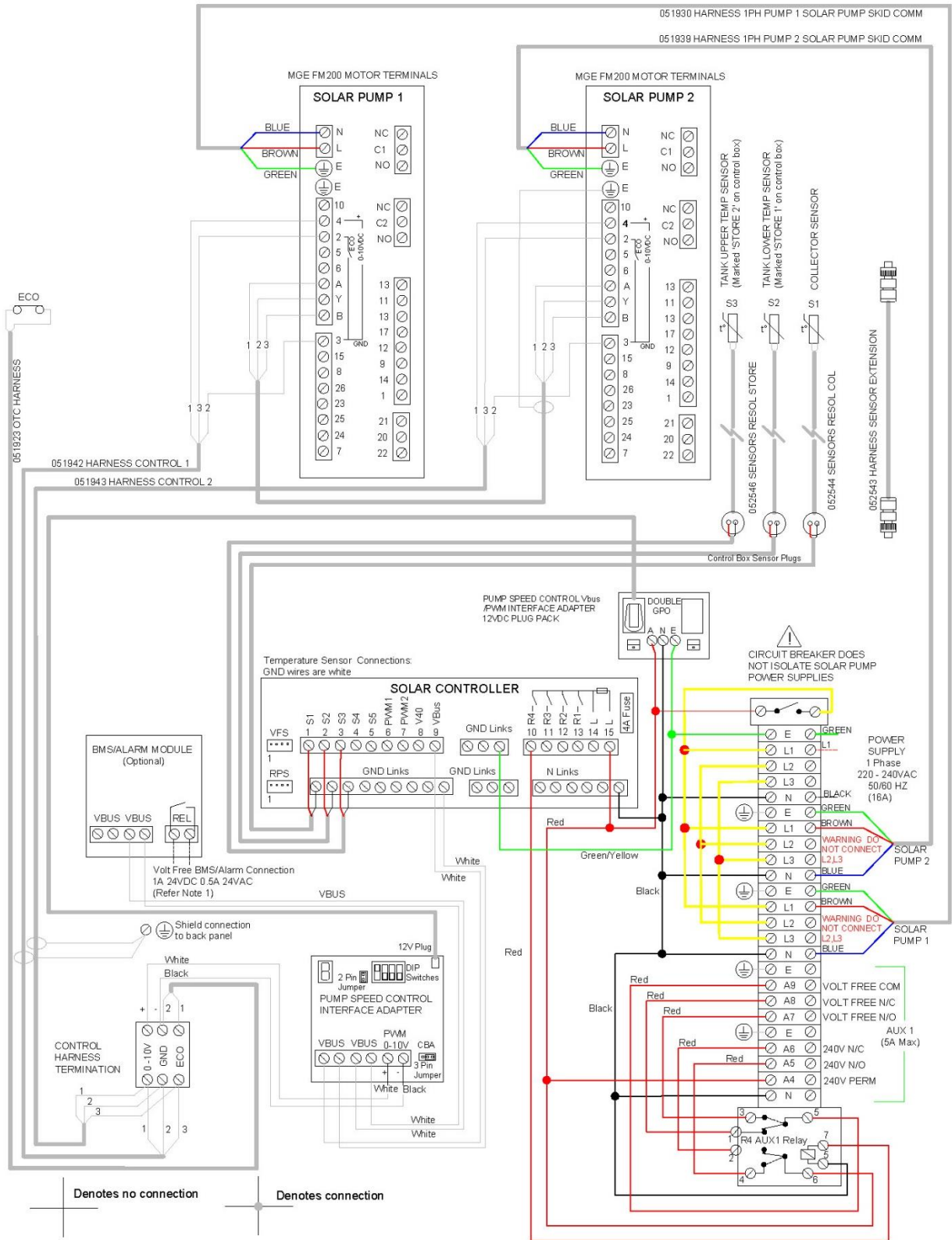
Power Supply

Single Phase

Wire the power supply to terminals L1, N, E within the Solar Pump Skid cabinet. **DO NOT** connect to terminals L2 or L3.

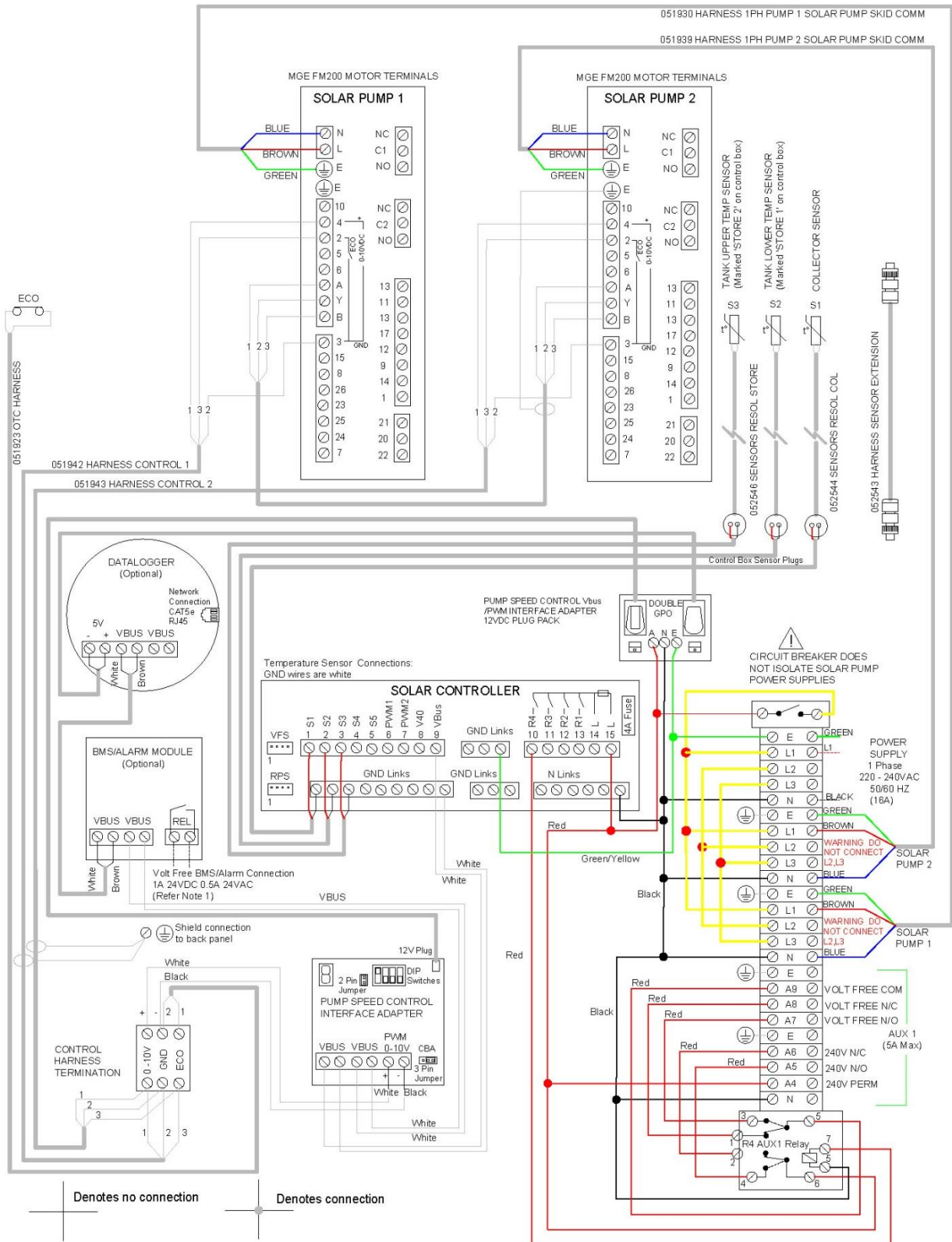
Three Phase

Wire the power supply to terminals L1, L2, L3, N, E within the Solar Pump Skid cabinet. Ensure phase rotation is correct.



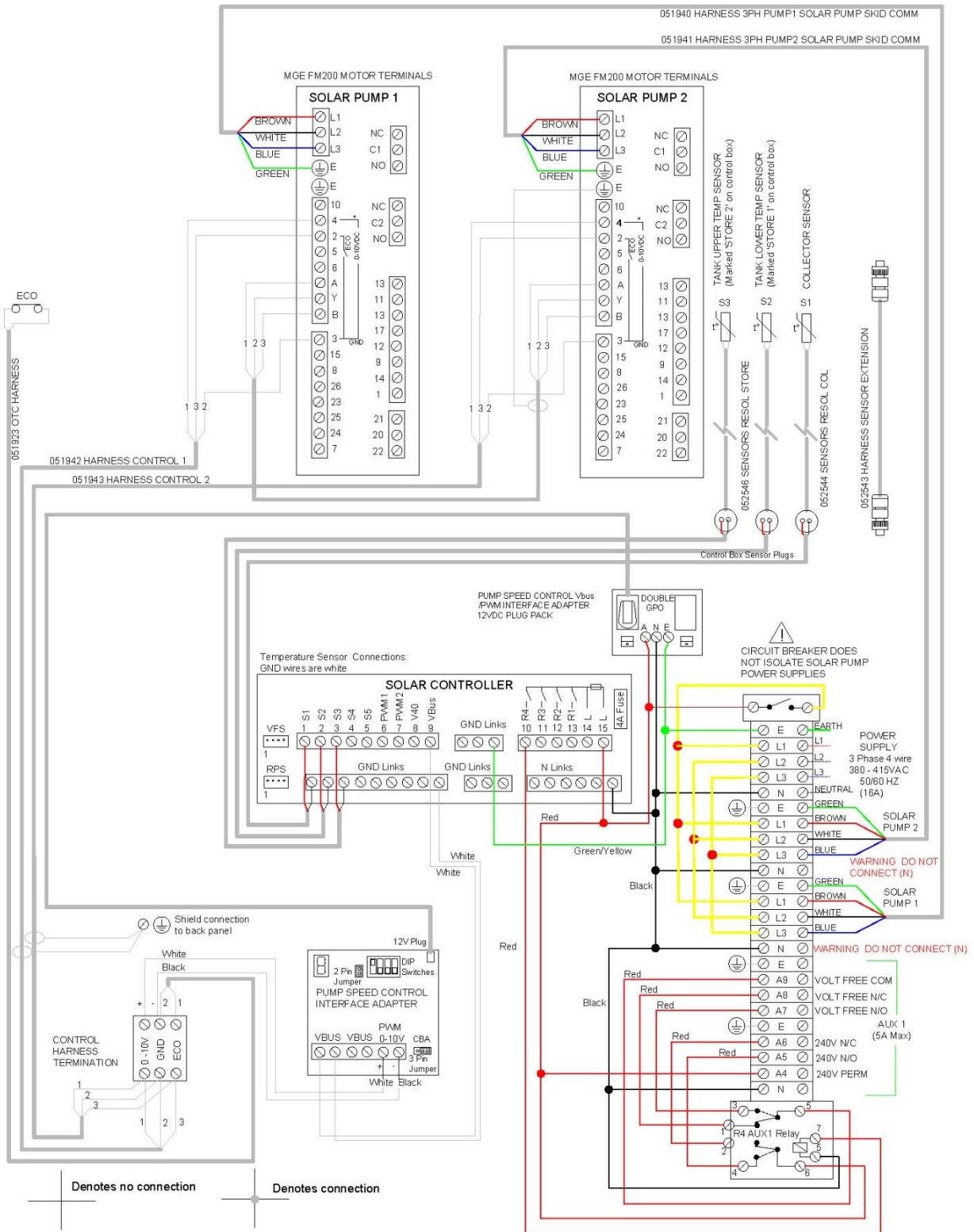
PART NO: 052541 WIRING DIAGRAM 1PH SOLAR PUMP SKID STANDARD REV BD

Wiring Diagram Solar Pump Skid – Single Phase Standard



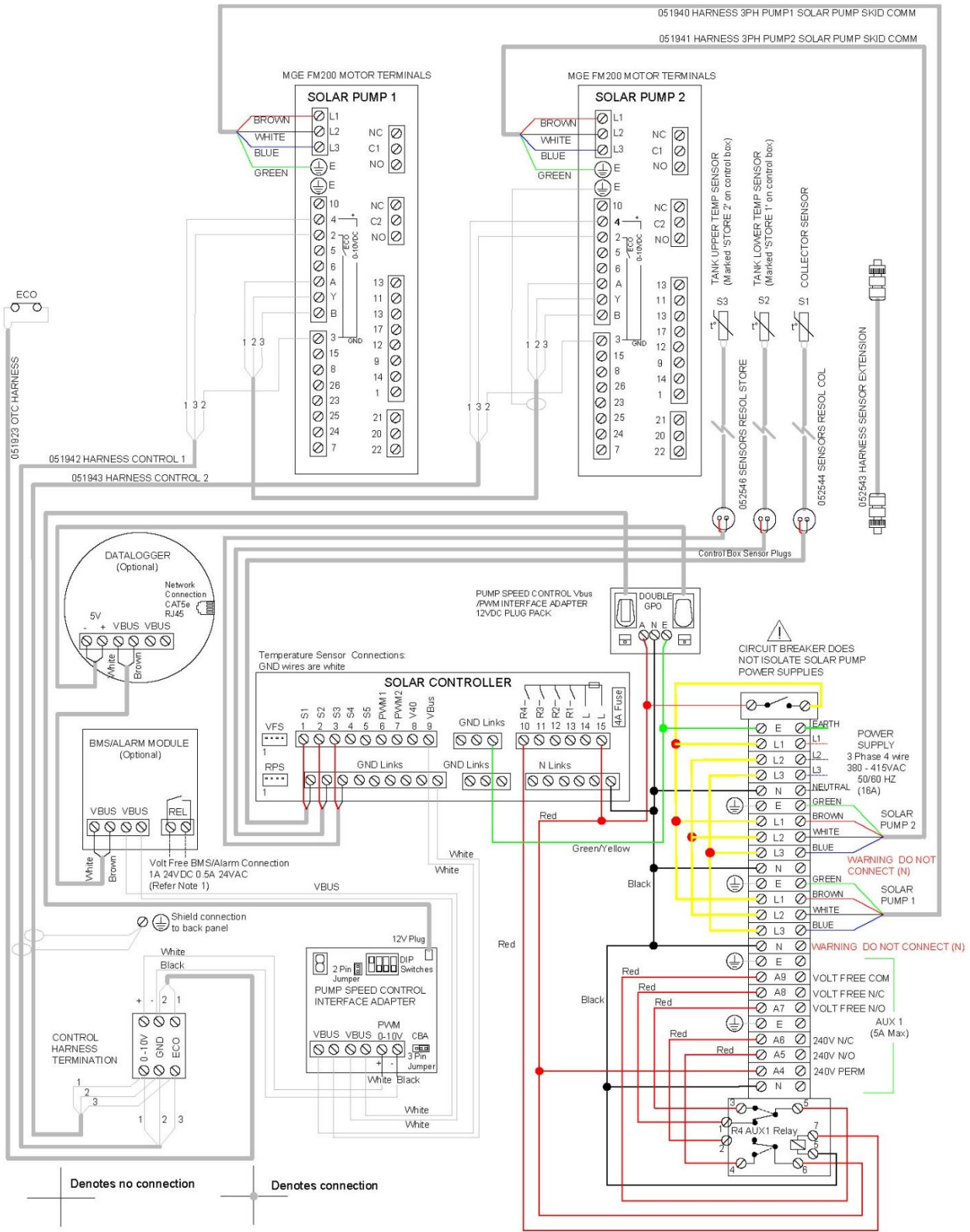
Note 1: A relay must be used if BMS/Alarm connection voltage/current rating exceeds values shown.
 PART NO: 052542 WIRING DIAGRAM 1PH SOLAR PUMP SKID DELUXE REV BD

Wiring Diagram Solar Pump Skid – Single Phase Deluxe



Note 1: A relay must be used if BMS/Alarm connection voltage/current rating exceeds values shown.
 PART NO: 052547 WIRING DIAGRAM 3PH SOLAR PUMP SKID STANDARD REV AD

Wiring Diagram Solar Pump Skid – Three Phase Standard



Note 1: A relay must be used if BMS/Alarm connection voltage/current rating exceeds values shown.
PART NO: 052548 WIRING DIAGRAM 3PH SOLAR PUMP SKID DELUXE REV AD

Wiring Diagram Solar Pump Skid – Three Phase Deluxe



IMPORTANT:

The temperature sensors are critical to the operation of this controller. They are sensitive devices and require careful handling. They should not be directly immersed in water or heated with a flame.

Sensors

All sensor connections are made at the back of the Solar Pump Skid. Run the sensor leads with their respective wells as per the table below:

Sensor ID	Sensor	Sensing location
S1	Collector Sensor	At collector array Hot Outlet
S2	Store 1	Tank fitting "J"
S3	Store 2 - auxiliary tank boost using remote heat source (optional)	Tank fitting "L"
S3	Store 2 - Solar Hot Water Secondary Return. 3 way valve is used to divert delivery skid return if HS tank being used to maintain building ring main heat losses (optional)	Positioned in delivery skid return line to HS tank

- 20m Extension leads are available for sensors S1 to S3.
- Fix the collector sensor lead to the adjacent building structure or pipe work insulation.
- Refer to Collector Sensor Assembly on page 34 for details on running and fitting the collector sensor to the collector array.
- Refer to the **Application Guide** for specific plumbing and wiring instructions to suit various configuration options.

3-Way Motorised Valve or Auxiliary Heating

The Solar Pump Skid has provision to connect either:

- a 3-way motorised valve (used for **Solar Hot Water Secondary Return**); or
- auxiliary pump (used to connect an auxiliary water heater for **Auxiliary Heating Using Remote Heat Source**) with or without timer control; or
- timer control (used for **In Tank Heating Using Electric Resistance Elements**)

These options are controlled via a DPDT relay with voltage free and 240V contacts contained within the Solar Pump Skid controller cabinet.

Solar Hot Water Secondary Return

The 3-way motorised valve is used if Solar Hot Water Secondary Return is to be employed. The Solar Pump Skid can support a 3 way valve motor drive which has its own internal relay or one with drive open/drive closed motor. Refer to the **Application Guide** for the most suitable plumbing and wiring arrangement.

3 Way Valve with Internal Relay Drive Motor

Connect the 3 way valve internal relay common contact to terminal A4 marked '240V PERM' in the Solar Pump Skid. Connect the 3 way valve internal relay coil active to terminal A5 marked '240V N/O' in the Solar Pump Skid. Connect the N/O and N/C contacts in the 3 way valve such that the port which diverts Delivery Skid return water to fitting 'C' in the HS Series storage tank is closed when the relay coil is energised. Connect neutral and earth to the terminals marked 'N' and 'E'.

3 Way Valve with Drive Open/Drive Closed Motor

Connect the 3 way valve such that the port which diverts Delivery Skid return water to fitting 'C' in the HS Series storage tank is connected to terminal A5 marked '240V N/O' and the port which diverts Delivery Skid return water to fitting 'A' in the HS Series storage tank is connected to terminal A6 marked '240V N/C' in the Solar Pump Skid. Connect neutral and earth to the terminals marked 'N' and 'E'.

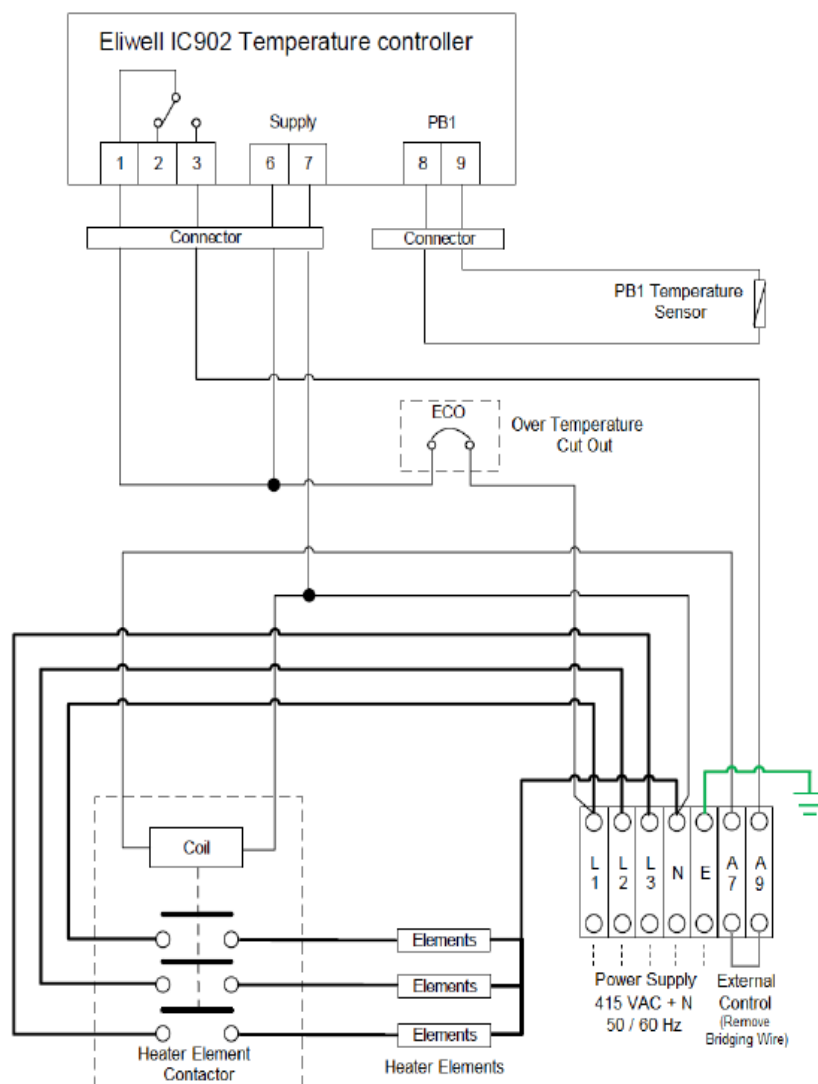
Auxiliary Heating - Remote Heat Source

An auxiliary pump is used if heating via a remote heat source is to be employed, for example a heat pump or gas water heater boosting within the top portion of the solar storage tank. Connect the pump to terminals A5 marked '240V N/O', neutral and earth marked 'N' and 'E' in the Solar Pump Skid. If a three-phase pump is employed, connect via a three-phase contactor.

Refer to the **Application Guide** for the most suitable plumbing and wiring arrangement depending on which product is being used for auxiliary heating.

In Tank Heating - Electric Resistance Heating Unit

If a Rheem supplied electric resistance heating unit is to be timer controlled via the solar controller, remove the bridging wire at the terminals marked 'A7 and A9' behind the element controller cover and connect the terminals to terminals A7 marked 'VOLT FREE N/O' and A9 marked 'VOLT FREE COMM' in the Solar Pump Skid. Refer to the **Application Guide** for the most suitable plumbing and wiring arrangement. Refer to the Heating Unit Installation instructions for details regarding the installation of the heating unit.



Electric Heating Unit – Wiring Diagram

BMS - Fault (deluxe solar pump skid models only)

A set of voltage free contacts are supplied within the Solar Pump Skid to allow solar system faults to be remotely monitored. Remove the AM1 module red cover located within the Solar Pump Skid and connect to the relay terminals. The switching capacity of the BMS is 1A @ 30V (DC); 0.5A @ 125V (AC).

BMS - Energy Monitoring (deluxe solar pump skid models only)

Refer to the manuals supplied with the Solar Pump Skid for BMS energy monitoring.

Delivery Skid

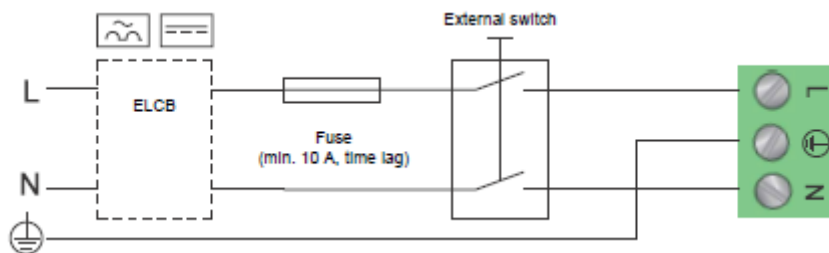
The Delivery Skid is suitable for indoor or outdoor installation. In extreme climatic regions where ambient temperatures regularly exceed 40°C, it is recommended to install the Delivery Skid out of direct sunlight.

The Delivery Skid is supplied pre-assembled and wired, however, requires connection of a correctly sized single phase power supply (including neutral 'N' and protective earth 'PE'). This power supply **SHALL BE** supplied from a distribution board (not supplied) that contains a circuit breaker and a main isolation switch to cut power to the control unit for servicing purposes. If the distribution board is not located close to the Delivery Skid, then a separate isolation switch **SHALL BE** installed in the power supply directly before it.

Table 12 - Delivery Skid Electrical Requirements

Model	Power Supply	Max Current (Amps)	Min Circuit Size (Amps)
RD200	220 -240V AC / 50-60Hz	5	10
RD400			
RD600			
RD800			

Wire the power supply to terminals L, N, Earth within the Delivery Skid pump controller housing. Each pump must be individually wired.



Delivery Skid Wiring

Chapter 3 - Commissioning Procedures

Commissioning Overview

- Commissioning of the HS-Series involves:
- Treating the storage tank pg 46
- Filling and pressure testing of the primary circuit including the Solar Pump Skid, collector array, storage tank, Delivery Skid and interconnecting piping pg 47
- Flushing treatment and adding corrosion inhibitor pg 46
- Programming of the solar controller pg 52
- Simulating and testing the solar circuit pg 67
- Setting the solar globe valve pg 68
- Balancing the collector array pg 68
- Setting the electric heating unit temperature (if installed) pg 70
- Commissioning of the Delivery Skid pg 70

Treating the Storage Tank- Part 1

The HS Series system must be treated to prevent corrosion. The system has either been supplied with the amount of preparation chemicals and corrosion inhibitor required or alternatively can be sourced locally. These are to be applied in accordance with the manufacturers' instructions. Refer to SDS sheets supplied with pre-treatment and corrosion inhibitor.



WARNING:

Protective clothing (gloves, glasses, face mask) should be worn when mixing and applying pre-treatment chemicals and corrosion inhibitor.

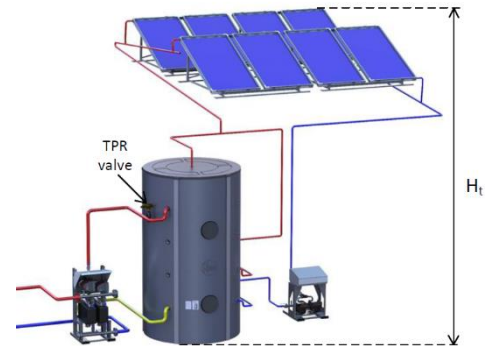
The system will need to be prepared using Nalprep IV prior to treating with corrosion inhibitor. Nalprep IV must be added to the system before filling and testing.

1. Open the spare isolation valve (shown on [page 48](#) at tank fitting 'G' as example) on the storage tank, and add a quantity of water to ensure there is sufficient dilution of the sulphuric acid that will be added in step 3.
2. Using a funnel, pour Nalprep IV at a dose of 2.7L per 1000L of total storage tank volume into the storage tank.
3. Add 15% of the weight of Nalprep IV of sulphuric acid (30%w/w) to the storage tank (0.4L/1000L of total storage tank volume). This ratio can be factored if different strengths of sulphuric acid are used. This is required to lower the pH of the water to 6.5 - 6.7.
4. Close the isolation valve on the tank.
5. Fill the system with clean water. Refer to [Filling and Testing of Primary Circuit on page 47](#) for the method to fill and pressure test the system and follow that procedure fully before following '[Treating the Storage Tank-Part 2](#)' on [page 50](#).

Filling and Pressure Testing of Primary Circuit

For best results, pressure testing of the collector array should be conducted late in the evening when there is little solar radiation, or to leave the collectors covered, and the collector array can remain flooded under pressure for around 60 minutes. The maximum

pressure for testing of the tank and collectors is 450 kPa (4.5 bar). If the total height of the collector array from the base of the storage tank is greater than 45m, a pressure equal to the total height plus 250kPa ($H_t+250\text{kPa}$) will be required to test the piping circuit to ensure all parts of the system are adequately sealed. The tank will need to be isolated from the collector circuit to avoid exposing the tank to a pressure greater than 450kPa. When pressure testing is to be conducted using mains pressure, ensure the mains pressure is reduced to 450 kPa (4.5 bar) before it enters the tank/s. Where the mains pressure is lower than 250 kPa (2.5 bar), a pressure testing pump (not supplied) shall be used for this purpose.



WARNING:

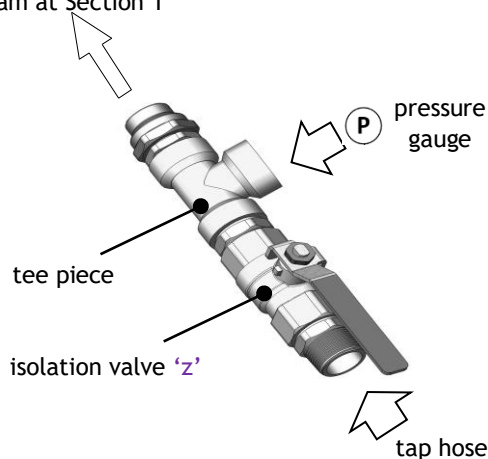
At no stage in the filling of the closed circuit should mains pressure greater than 450kPa be applied to the storage tank without a pressure reducing valve.

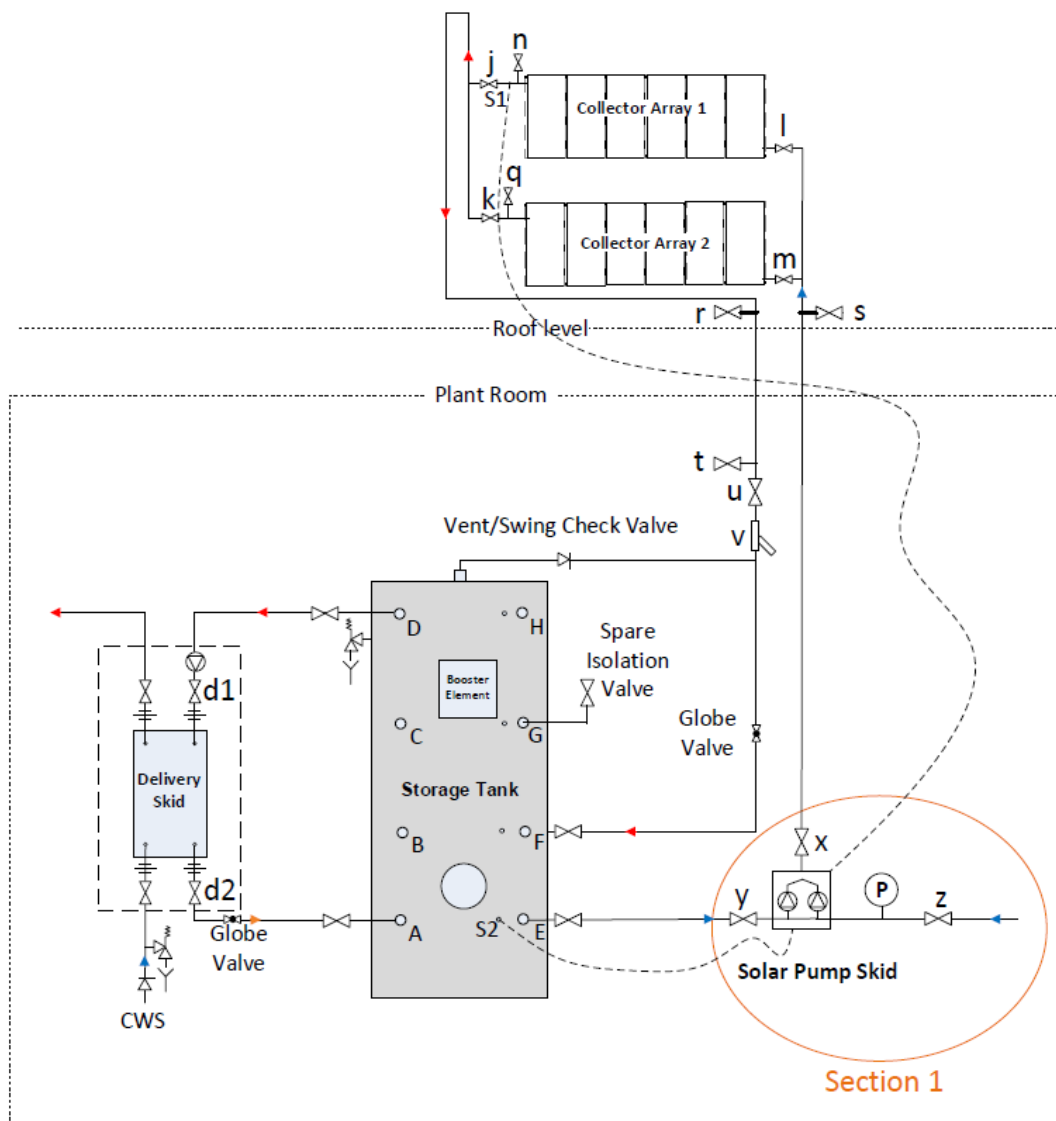
Note: The TPR valve on the storage tank is designed to relieve at around 517kPa and close at 413kPa. Pressure testing the circuit where the total height exceeds 45m may cause the valve to open. Where total height exceeds 45m, the tank/s and Delivery Skid must be pressure tested first, by isolating the solar circuit, then the solar circuit tested by isolating the tank/s and Delivery Skid, or vice versa.

Strict adherence to the following steps will ensure a successful pressure test is accomplished:

1. Fit a pressure gauge (capable of measuring more than 450kPa, or 250kPa over the height of the collector array above the measuring point, whichever is the greater, not supplied) at the tee piece on the Solar Pump Skid inlet manifold.

connect to Solar Pump Skid inlet manifold as shown on page 48 in diagram at Section 1

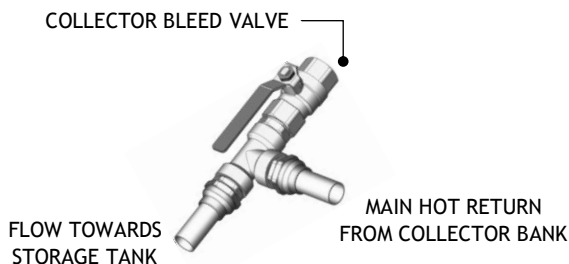




Commissioning Overview Diagram

Note: This Commissioning Overview diagram is stated as an example for ease of understanding the commissioning process. The actual commissioning may vary depending on site specific design and layout.

- Open all isolation valves fitted at the inlet and outlet of each bank of collectors (j,k,l,m), including the bleed valves installed at the highest point of each collector array (n,q). Ensure the hot (r) and cold (s) drain valves at roof level are closed.



3. Open all isolation valves on the Solar Pump Skid (x,y,z), solar hot line (u) and tank/s (valves at E,F fittings) including the tank bleed valve (t) in the solar hot line. Ensure the globe valve on the solar hot line is fully open.
4. Open all isolation valves on the primary side of the Delivery Skid (d1, d2), ie between the storage tank/s and the Delivery Skid (valves at A, D fittings).

Pressure Testing the Storage Tank and Delivery Skid

5. Connect water supply to the fill/drain valve (z) on the Solar Pump Skid inlet manifold 'B' and begin to fill the system.
6. When water overflows from the tank bleed valve (t), reduce the incoming water flow rate by slightly closing the fill/drain valve (z).
7. Close the fill/drain valve (z) fully to stop the incoming water, and then close the tank bleed valve (t) and isolation valve (u) in the solar hot line. Close the isolation valve (x) on the Solar Pump Skid outlet line (solar cold line)
8. Now, slowly open the fill/drain valve (z) and continue filling. Check the pressure gauge \textcircled{P} attached. When the pressure reaches 200kPa (2 bar), close the fill/drain valve (z) and allow the pressure to stabilise.
9. Repeat pressurising in steps of 10kPa and allow stabilising until 450kPa (4.5 bar) is reached.
10. Close the fill/drain valve (z) and observe the pressure.
11. Check for leaks at all the connections on the storage tank and Delivery Skid closed circuit. Should a leak be observed at any one of the connections, immediately release the pressure by gently releasing the lever on the TPR valve in the storage tank. Rectify any leak that is observed and repeat the pressure test as described above.
12. Hold the pressure in the system until the pressure remains steady for around 60 minutes.

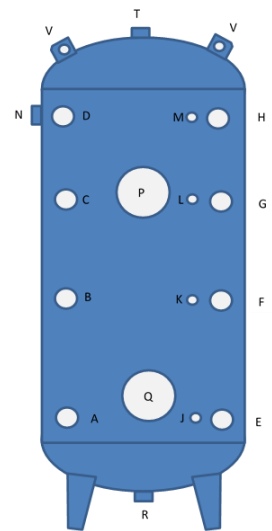
Pressure Testing the Collector Circuit

13. Relieve tank pressure by opening the tank TPR valve. Close the storage tank isolation valves at the solar cold and solar hot connection (At E, F fittings). Open the tank bleed valve (t) and open the Solar Pump Skid outlet isolation valve (x). Open the fill/drain valve (z) and fluid will begin to fill the collector circuit.
14. When water overflows from the collector bleed valve (n, q) and tank bleed valve (t), close the tank bleed valve (t), then reduce the incoming water flow rate by slightly closing the fill/drain valve (z).
15. Close the fill/drain valve (z) fully to stop the incoming water, and then close the collector bleed valve (n, q).
16. Now, slowly open the fill/drain valve (z) and continue filling. Check the pressure gauge \textcircled{P} attached. When the pressure reaches 200kPa (2 bar) or the pressure equivalent to the height of the collectors if greater than 45m, close the fill/drain valve (z) and allow the pressure to stabilise.
17. Repeat pressurising in steps of 10kPa and allow stabilising until 250kPa (2.5 bar) or 250kPa above the equivalent height of the collectors is reached.
18. Close the fill/drain valve (z) and observe the pressure.
19. Check for leaks at all the connections on the closed circuit. Should a leak be observed at any one of the connections, immediately release the pressure by slowly opening the collector bleed valve. Rectify any leak that is observed and repeat the pressure test as described above.
20. Hold the pressure in the system until the pressure remains steady for around 60 minutes.
21. After the pressure test, circulate the fluid. Follow the steps in Treating the Storage Tank - Part 2.

Note: Upon first full heat up cycle to the set temperature, or if the roof level is more than 45m above the storage tank, excess pressure in the solar heating circuit will be relieved by the TPR valve. This is normal, and once completed the system will be at its natural fluid level and excess fluid should no longer be released. It is important the TPR valve is drained in accordance with the [instructions on page 22](#).

Treating the Storage Tank- Part 2

- 1) Once the system is filled and pressure tested with no leaks, ensure that the entire primary circuit is open to water-flow (no isolated dead-legs) and circulate under no load (ie ambient water temperature). Refer to [Programming the Solar Controller on page 52](#) and [Manual Mode on page 63](#) for procedure to set solar pumps to manual operation. Set controller MAN 1 to nHI (high pump speed).
- 2) Circulate for an absolute minimum of 8 hours, preferably 8-12 hours or overnight. During this time any strainers should be checked for blockage and cleaned. This time can be used to program the solar controller. Refer to [Programming the Solar Controller on page 52](#).
- 3) Drain the system. First release the pressure by gently releasing the lever on the TPR Valve. Observe the pressure gauge and wait until pressure is completely released.
- 4) Open the collector bleed valves (n,q) and the drain fitting 'R' on each storage tank.
- 5) When completely drained, close the drain/s. Clean any line strainers installed in the solar (v) and Delivery Skid circuit.
- 6) Add TRAC107PLUS to one of the storage tanks at a dose of 2 to 3L per 1000L of total storage tank volume. Close the isolation valve (at G fitting).
- 7) Open the high level hot and cold drain valves (r, s) located just below the collectors and refill the system until fluid flows from these valves. Close the fill/drain valve (z).
- 8) It will be required to drain 25L/1000L of storage tank volume from the system to account for thermal expansion. Ensure the correct amount is removed by draining into a graduated vessel.



NOTES:

- Failure to observe this procedure properly will void any warranty for frost or stagnation issues.
 - If the system total height is greater than 45m, the T&PR valve on the storage tank(s) may open and discharge fluid before fluid reaches the high level cold and hot drain valves. If this occurs, step 8 is not required.
- 9) When fluid is drained or the T&PR valve closes, close the high level hot and cold drain valves (r, s).
 - 10) Close the isolation valve at the inlet and outlet of the Solar Pump Skid (y, x) and remove the pressure gauge. Cap the gauge spigot and reopen the Solar Pump Skid inlet and outlet isolation valve (y, x).
 - 11) Remove the mains water supply from the Solar Pump Skid.
 - 12) The closed circuit of the system is at ambient condition and the system is now ready for simulation and testing. Refer to [Programming the Solar Controller on page 52](#).

Notes:

- It is absolutely imperative that all of the Nalprep IV cleaning solution is purged from the system prior to the introduction of corrosion inhibitor. Residual Nalprep IV means the system has not been adequately drained/flushed and still contains suspended material/corrosion product. Residual Nalprep IV may also negatively impact the performance of the corrosion inhibitor subsequently applied as well as act as potential food source for bacteria leading to microbiological control issues in the future.
- The waste produced by the cleaning procedure will contain approximately up to 500ppm of o-PO4 and have a pH 6.5. The waste may also be turbid and contain much suspended iron. If the volume of the system is large, the fate of the waste needs to be considered and a once-off discharge permit obtained from the sewer provider.

If required, the waste generated may have the pH increased to pH 7.0 by the addition of a caustic product once the waste is out of the system.

- When a system has been left idle during works, there exists the potential for some microbiological contamination to be retained through the cleaning process.

Therefore, a heightened level of microbiological monitoring is often required up to a few months after inhibitor has been added to ensure that bacterial populations are not allowed to develop.

- Please check with local EPA with regards to the disposal of the passivation chemicals. Contact local Nalco representative.

Programming the Solar Controller

The following information will assist in setting up and troubleshooting the SHCX Solar Controller.

1.0 System Configuration

The SHCX Solar Controller supplied with the Solar Pump Skid can be configured to perform many varied functions, depending on system design. Refer to the **Application Guide** to select the most appropriate configuration.

Rheem typically uses Arrangement 1 or 3 or 9. One of these arrangements must be selected before testing and commissioning the system. **Important note: The subsequent selection of a different arrangement (at any stage during the operation of the controller) will reset all other adjustments to the factory settings, and thus all parameter settings will need to be verified and re-adjusted if required.**

2.0 Controller Operation and Function

2.1 Push Buttons for Adjustment

The SCHX Solar Controller is operated by 7 pushbuttons to the side of the display. They have the following functions:

Button (1) - scrolling upwards

Button (3) - scrolling downwards

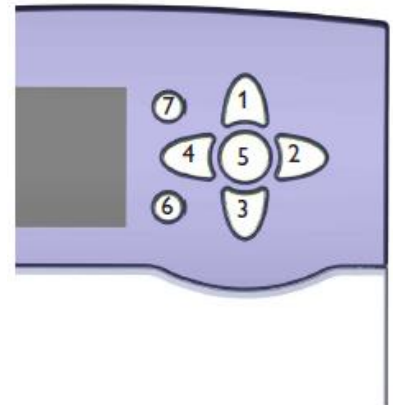
Button (2) - increasing adjustment values

Button (4) - reducing adjustment values

Button (5) - confirming

Button (6) - menu button for changing between the status and the menu level

Button (7) - escape button for changing into the previous menu



3.0 Initial Commissioning

When the hydraulic system is filled and ready for operation, connect the controller to the mains.

The controller may run an initialisation phase in which all symbols are indicated in the display. The directional pad flashes red.

When the controller is commissioned for the first time or when it is reset, it will run a commissioning menu after the initialisation phase. The commissioning menu leads the user through the most important adjustment channels needed for operation of the system and starts with the indication of the SHCX version number.

3.1 Commissioning Menu

The commissioning menu consists of the channels described in the following. In order to make adjustment, push button (5). ■ flashes and the adjustment can be made using side buttons (2) and (4). Confirm the adjustment with button (5). Push down button (3), the next channel will appear in the display.

1. Language:

Adjust the desired menu language.
Options include English, German

2. Unit:

Adjust the desired unit of measure.

3. Time:

Adjust the clock time. First of all adjust the hours, then the minutes. 24 hour time is used.

4. Date:

Adjust the date. First of all adjust the year, then the month, then the day.

5. System (Arrangement):

Adjust the desired system.
Refer to Application Guide for most appropriate arrangement.
Rheem promotes Arr 1, 3 and 9

6. Maximum store temperature:

Adjust the maximum store temperature.
Adjust setting to 85°C

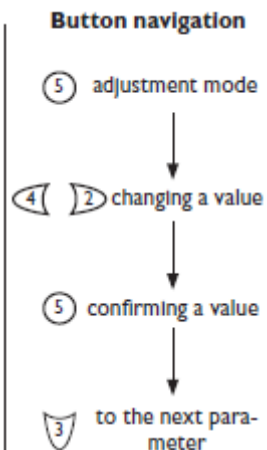
7. Loading store 2:

Switch off the “loading store 2” option.
(Not required for use with the HS Series system).

8. Pump control type:

Adjust the type of pump control for PUMP1
- PWM A: for Wilo PWM control pump (Wilo Stratos TEC 15/11.5)
- PWM b: for Grundfos PWM control pump (Grundfos PM2 15-145 130)

Select PWM b



9. Minimum speed:

Note: Speed can only be adjusted if pulse control (PULS) or PWM control (A, b, C) has been selected in the sub channel PUMP1. **Adjust setting to 30%**



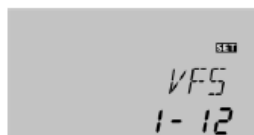
10. Maximum speed:

Adjustment for PUMP2 not required for use with the HS-Series system. **Adjust setting to 100%**



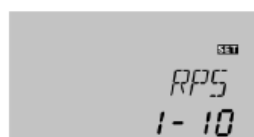
11. Range of the flow rate sensor:

Only required if installing a flow rate sensor for heat quantity measurement. Consult Rheem.



12. Range of the pressure sensor:

(Not required for use with the HS-Series system).

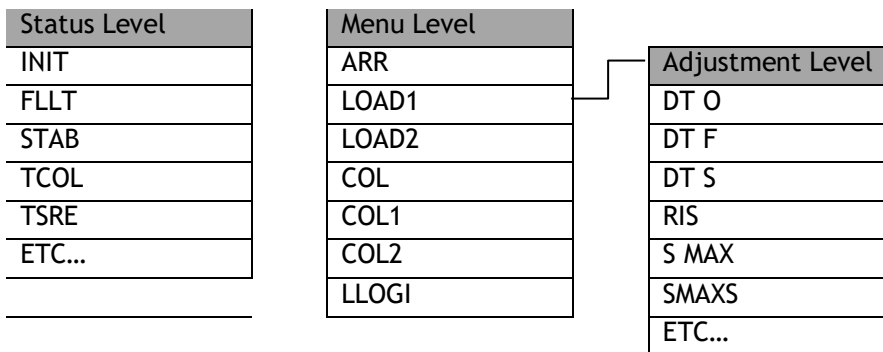


Complete the commissioning menu by pressing button 5



4.0 Menu Structure

The menu structure of the controller consists of 3 levels: The **STATUS** level, the **MENU** level and the **ADJUSTMENT** level.



The **Status** level consists of different display channels which indicate display values and messages. The **Menu** level consists of different menu items each of which is divided into sub-menus and **Adjustment** channels.

Each of these menu items represents a function or option which can be selected. If a function or option is selected, the controller changes to the **Adjustment** level in which the corresponding parameters of the function or option are available.

In order to activate or deactivate a function, it must be selected in the **Menu** level. The display changes to the **Adjustment** menu in which all adjustments required can be carried out. During normal operation, the display is in the **Status** level.

Notes:

Some of the **Menu** items depend on the selected system and the adjusted options. Therefore, they are only displayed if they are available.

The abstract from the menu structure shown above is for information on the structure of the controller menu and is therefore not complete.

4.1 Status Menu

During normal operation, the display is in the **Status** level. This level indicates the measurement values shown in the table.

In addition to the adjustment values, possible error messages are indicated in the **Status** level.

The following parameters can be viewed within the **Status** level of the controller menu:

Initialisation

Indicates the time adjusted in tDTO, running backwards.

INIT

Initialisation active

**Filling time**

Indicates the time adjusted in tFLL, running backwards.

FLLT

Filling time active

**Stabilisation**

Indicates the time adjusted in tSTB, running backwards.

STAB

Stabilisation

**Display of collector temperature**

Displays the current temperature measured in the solar collector.

TCOL

Collector temperature

Display range: -40 ... +260 °C

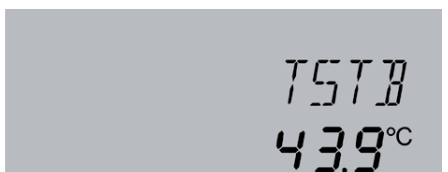
**Display of storage temperature**

Displays the current temperature measured at the appropriate sensor in the storage tank.

Display range: -40 ... +260 °C

TSTB: Store temperature base

TSTT: Store temperature top



Display of temperature at S3, S4 and S5

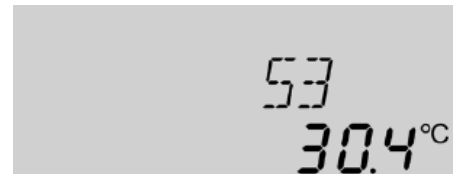
Indicates the current temperature at the corresponding sensor (without control function).

Display range: -40 ... +260 °C

S3: Temperature sensor S3

S4: Temperature sensor S4

S5: Temperature sensor S5

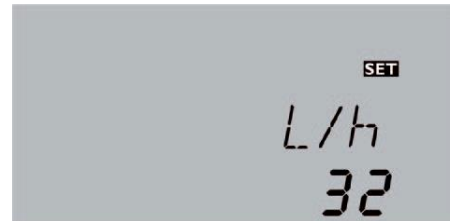
**Display of flow rate**

Indicates the measured current flow rate in the solar system.

L/h

Flow rate

Display range: 0 ... 9999 L/h

**Display of speed**

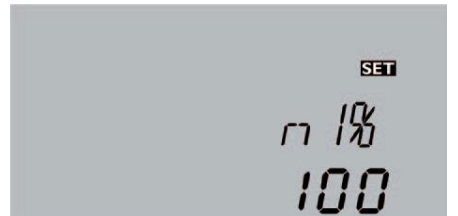
Indicates the current speed of the solar pump.

n1%

Current pump speed

Display range: 30 ... 100% standard pump

20 ... 100% HE pump

**Operating hours counter**

The operating hours counter accumulates the solar operating hours of the pump relay (h R1).

h R1

Operating hours counter



Note: The accumulated operating hours can be set back to 0 if required:

- In order to access the RESET-mode of the counter, press the set button 5.
- The display symbol **SET** will flash and the operating hours will be set to 0.
- Confirm the reset with the set button 5 in order to finish the reset.
- In order to interrupt the RESET-process, do not press any button for approximately 5 seconds. The display returns to the display mode.

Display of heat quantity

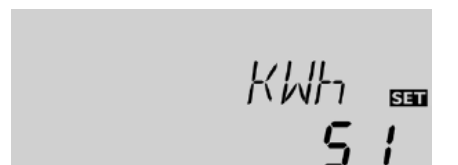
Indicates the heat quantity produced in the system. For this purpose, the heat quantity measurement option has to be enabled.

The flow rate as well as the values of the reference sensors S1 (flow)

and S4 (return) are used for calculating the heat quantity supplied. It is shown in kWh in the channel **KWh** and in MWh in the channel **MWh**. The overall heat quantity results from the sum of both values.

The accumulated heat quantity can be set back to 0. As soon as one of the display channels of the heat quantity is selected, the symbol **■** is displayed.

In order to access the RESET-mode of the counter, press the set button 5 for approx. 2 seconds. Confirm the reset with the set button in order to finish the reset.



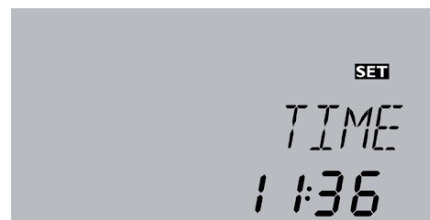
In order to interrupt the RESET process, no button should be pressed for about 5 seconds. The display returns to the display mode.

Display of time

The current clock time can be displayed.

TIME

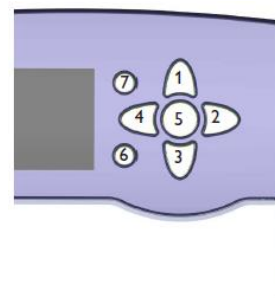
Displays the current time



4.2 Selecting Menu Points and Adjusting Values

During normal operation, the display is in the **Status** level. To leave the status level and access the **Menu** level press button (6).

The display indicates the level with the selectable menus. In order to change the parameters of a menu item, select the menu item and press button (5). The display changes to the **Adjustment** level. The adjustment channels are characterised by the indication ■■■.



- Select the desired channel by pressing the buttons (1) and (3)
- Confirm the selection with button (5). ■■■ flashes (adjustment mode)
- Adjust the value, the function or the option using the buttons (2) and (4)
- Confirm the selection with button (5). ■■■ permanently appears, the adjustment has been saved.
- If no button is pressed within a couple of minutes, the adjustment is cancelled and the previous value retained.

The SHCX solar controller has many functions. Rheem promotes systems using Arrangements 1, 3 and 9, refer to the **Application Guide** for appropriate systems. The relevant parameters are shown here. Items marked with strike through eg ~~C~~MAX are not relevant to the promoted system arrangements. For further information on all possible system settings refer to the separate SHCX manual.

Sensor / Terminal	Designation	Description
S1	TCOL	Temperature collector
S2	TSTB	Temperature store base
S3	TSTT	Temperature store top or Delivery Skid return (see Application Guide)
S4		Optional sensor for measurement purposes or options
S5		
VFS		
RPS		
V40		

Relay	Description
R1	Solar pump
R2	Optional: Thermal disinfection Booster pump Parallel relay Heat dump
R3	
R4	Auxiliary heating with remote heat source, timer controlled heating, solar secondary return

Adjustment Channels						
Channel	Sub Channel 1	Sub Channel 2	Factory Setting	Change to	Description	Ref
ARR					System	
			1		For standard system with in-series boost	
			1	3	For timer controlled heating or auxiliary heating with remote heat source	
			1	9	For secondary flow and return circuit with diverter valve based on temperature difference	
LOAD>						
	DT O		6 K	10 K	Switch-on temperature difference	
	DT F		4 K	4 K	Switch-off temperature difference	
	DT S		10 K	10 K	Set temperature difference	
	RIS		2 K		Rise	
	SMAX		60 °C	85 °C	Store maximum limitation. Can store as high as 90°C	
	SMAXS		2		Sensor used to measure store max	
COL>					Collector	
	CEM		130 °C	150 °C	Collector emergency temperature	
	QCCO>		OFF		Option collector cooling	
		C MAX	110 °C		Maximum collector temperature	
	QCM1>		OFF		Option collector minimum limitation	
		C MIN	10 °C		Minimum collector temperature	
	QTCO>		OFF		Option tube collector function	
		T CST	07:00		Tube collector starting time	
		T CEN	19:00		Tube collector ending time	
		T CRU	30 s		Tube collector runtime	
		T CIN	30 min		Tube collector standstill interval	
	QCFR>		OFF		Option collector frost protection	
		GFR O	4 °C		Antifreeze temp collector on	
		GFR F	5 °C		Antifreeze temp collector off	
LLOGI>					Loading logic	
	QDB>		OFF		Drain back option	
		T DTO	60 s		Time period - switch on condition	
		T FLL	5.0 min		Filling time	
		T STB	2.0 min		Stabilisation	
		QBST	OFF		Booster function	
	QOVRU*		OFF			
COOL>					Cooling functions	
	QSYC**		OFF		System cooling	
	QSTC		OFF		Store cooling	
	QHDP**		OFF		Heat Dump	
DT3>				Refer to the Application Guide for the most appropriate settings depending on system configuration.	Used only if ARR 9 is selected. Differential temperature control with diverter valve	
	DT30		6K		Switch on difference	
	DT3F		4K		Switch off difference	
	S2DT3		3		Reference sensor heat store	
AH>					Used only if ARR 3 is selected. After heating option (timer controlled heating or auxiliary heating with remote heat source)	
	AHO		40°C	Refer to 4.2.7	Switch on temperature	
	AHF		45°C	Refer to 4.2.7	Switch off temperature	
	t1O		06:00	As req'd	Switch on time 1	
	t1F		22:00	As req'd	Switch off time 1	
	t2O		00:00	As req'd	Switch on time 2	
	t2F		00:00	As req'd	Switch off time 2	
	t3O		00:00	As req'd	Switch on time 3	
	t3F		00:00	As req'd	Switch off time 3	
PUMP>					Pump Speed	

Channel	Sub Channel 1	Sub Channel 2	Factory Setting	Change to	Description	Ref
	PUMP1>		OnOF	PWM b	Speed variant pump 1	
		n1LO	30%	30%	Minimum pump speed	
		n1HI	100%	100%	Maximum pump speed	
	PUMP2>					
	PUMP3>					
MAN>					Manual mode	
	MAN1		Auto		Manual mode 1	
	MAN2		Auto		Manual mode 2	
	MAN3		Auto		Manual mode 3	
	MAN4		Auto		Manual mode 4	
BLPR>			OFF		Blocking protection	
OTDIS>			OFF		Thermal disinfection option	
OPARR>			OFF		Parallel relay option	
OHQM>			OFF		Heat quantity measurement option. Used if data logging equipment is installed.	
GFDS>			OFF		Registration Grundfos sensors	
	VFS		OFF	OFF	Range of flow rate sensor	
	RPS		OFF	OFF	Range of pressure sensor	
	OFLOW		OFF	OFF	Flow rate monitoring option	
PRS>			OFF		Pressure monitoring option	
DATE>			OFF		Enter date	
LANG>			En		Language	
UNIT>			°C		Unit	
OSDC>			OFF		SD card option	
CODE>			0000		User code	
RESET>			OFF		Factory setting	
*This channel is only available if the Grundfos sensors have been registered in GFDS channel						
**Are blocked against each other						

4.2.1 Selecting the system

ARR

System

Adjustment range: 1 ... 26

Factory setting: 1

Arrangements 1, 3 and 9 promoted by Rheem



Important note: The subsequent selection of a different arrangement (at any stage during the operation of the controller) will reset all other adjustments to the factory settings, and thus all parameter settings will need to be verified and re-adjusted if required.

4.2.2 ΔT regulation

The controller works as a standard differential controller. If the switch-on difference is reached, the pump is activated. When the temperature difference reaches or falls below the adjusted switch-off temperature difference, the respective relay switches off.

LOAD / DT O

Switch-on temperature difference

Adjustment range: 1.0 ... 50.0 K in steps of 0.5 K

Factory setting: 6.0 K

Adjust to: 10.0 K

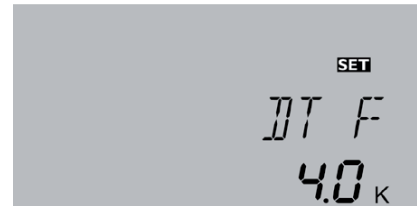


LOAD / DT F

Switch-off temperature difference

Adjustment range: 1.0 ... 49.5 K in steps of 0.5 K

Factory setting: 4.0 K

Confirm setting as: 4.0 K**4.2.3 Speed Control**

When the switch-on temperature difference is reached, the pump is activated at 100% speed for 10 s. Then, the speed is reduced to the minimum pump speed value.

If the temperature difference reaches the adjusted nominal value (DT S), the pump speed increases by one step (10%).

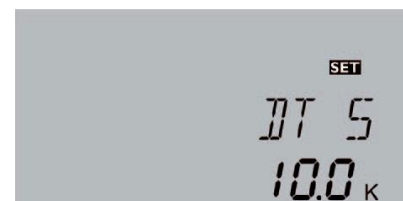
The response of the controller can be adapted via the parameter "Rise". If the difference increases by the adjustable rise value RIS, the pump speed increases by 10% until the maximum pump speed of 100% is reached. If, at decreasing temperatures, the temperature difference decreases by the adjustable rise value RIS, the pump speed decreases by 10%.

LOAD / DT S

Set temperature difference

Adjustment range: 1.5 ... 50.0 K in steps of 0.5 K

Factory setting: 10.0 K

Adjust to: 10.0 KLOAD / RIS

Rise

Adjustment range: 1 ... 20 K in steps of 1 K

Factory setting: 2 K

Confirm setting as: 2 K (adjust if required)

Note: To enable speed control, the corresponding relay has to be set to "Auto" (adjustment channel MAN) and the pump control type has to be set to PWM b (adjustment channel PUMP).

4.2.4 Maximum Store Temperature

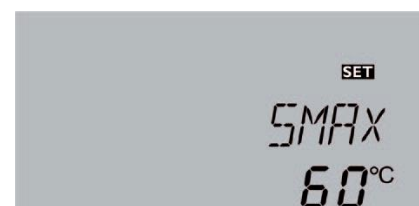
If the storage tank temperature reaches the adjusted maximum temperature, the solar pump will cease operation. If the maximum tank temperature is exceeded, ☀ is displayed (flashing).

LOAD / SMAX

Maximum store temperature

Adjustment range: 4 ... 95°C in steps of 1°C

Factory setting: 60°C

Adjust to: 85°C**4.2.5 Sensor Maximum Store Temperature**

Allocation of the sensor for store maximum limitation. The maximum limitation always refers to the sensor selected.

LOAD / SMAXS

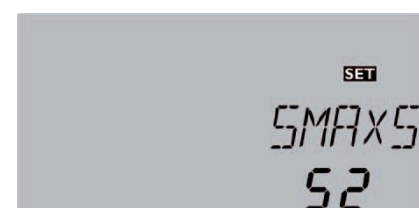
Sensor store maximum temp

Adjustment range: S2, S3

Factory setting: S2

Confirm setting as: S2

(This should be the lowest sensor position in the tank)



4.2.6 Collector Emergency Shutdown

When the collector temperature exceeds the adjusted collector emergency temperature (CEM), the solar pump (R1/R2) is switched off in order to protect the system components against overheating (collector emergency shutdown). If the maximum collector temperature is exceeded, “!” is displayed (flashing).

CEM

Collector emergency temperature

Adjustment range: 80 ... 200°C in steps of 1°C

Factory setting: 130°C

Switch-on hysteresis: -10 K

Adjust to: 150°C

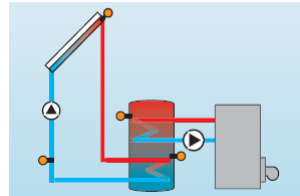
4.2.7 Thermostat Function

The thermostat function works independently from the solar operation and can be used for the use of surplus energy (solar hot water ring main) or after heating (Auxiliary Heating). Refer to the **Application Guide** for appropriate use of this function.

AHO < AHF

The thermostat function is used for after heating (Auxiliary Heating).

Refer to the Application Guide for the most appropriate settings depending on system configuration.

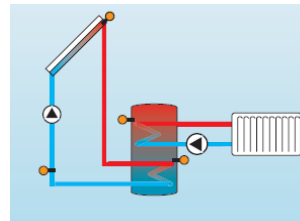


AHO > AHF

The thermostat function is used for use of surplus energy (Solar Hot Water Secondary Return).

Refer to the Application Guide for the most appropriate settings depending on system configuration.

Symbol II will be shown in the display if the second relay output is activated.



AHO: Thermostat switch on temperature

Adjustment range: 0.0 to 95.0°C

Factory setting: 40°C



AHF: Thermostat switch off temperature.

Adjustment range: 0.0 to 95.0°C

Factory setting: 45°C



In order to block the thermostat function for a certain time span, there are 3 time frames, t1-t3. The switch on and switch off times can be adjusted in steps of 15 minutes. If the switch on and switch off times are identical, the time frame is inactive.

If the thermostat function should run from e.g. 06:00 a.m. and 09:00 a.m. only, adjust t1O to 06:00 a.m. and t1F to 09:00 a.m.

The factory setting for the thermostat function is in continuous operation. The first time frame is factory set from 06:00 to 22:00. If all time frames are set at 00:00 o'clock, the thermostat function is solely temperature dependent.

4.2.8 Pump Control

As described during the initial Commissioning Menu steps, with this parameter the pump control type can be adjusted.

The following types can be selected:

- Adjustment for standard pump without speed control
- Adjustment for standard pump with speed control
 - OnOF (pump on / pump off)
- Adjustment for high efficiency pump (HE pump)
 - PULS (pulse packet control via semiconductor relay)
 - PWM A (Wilo)
 - **PWM b (Grundfos)**
 - PWM C (Laing)

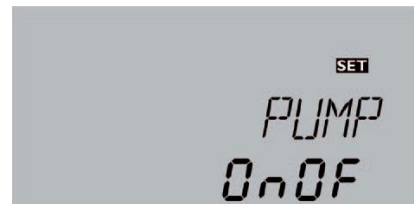
PUMP / PUMP 1

Pump control

Selection: OnOF, Puls, PWM A, PWM b, PWM C,

Factory setting: OnOF

Adjust to: PWM b (Grundfos pump)



4.2.9 Minimum Speed

As described during the initial Commissioning Menu steps, with this parameter the pump minimum speed is adjusted.

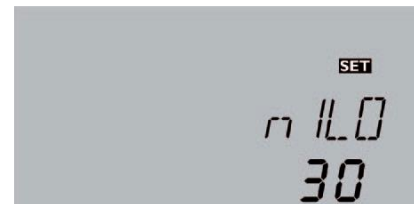
PUMP1 / n1LO

Speed control

Adjustment range: 20 ... 100% in steps of 5%

Factory setting: 30%

Confirm setting as: 30%



4.2.10 Maximum Speed

As described during the initial Commissioning Menu steps, with this parameter the pump maximum speed is adjusted.

PUMP1 / n1HI

Speed control

Adjustment range: 20 ... 100% in steps of 5%

Factory setting: 100%

Confirm setting as: 100% (adjust if required)



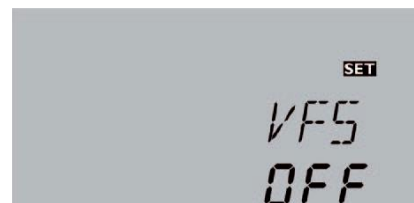
GFDS / VFS

Flow sensor

Adjustment range: OFF / 1-12 / 2-40

Factory setting: OFF

Leave off unless a flow sensor is to be used. Consult Rheem



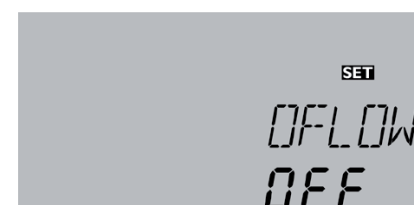
GFDS / OFLOW

Flow rate alarm activation

Adjustment range: ON / OFF

Factory setting: OFF

Adjust to: OFF



4.3 Additional Functions

These further functions and parameters can be accessed via the menu tree:

4.3.1 Manual Mode

For control and service work, the operating mode of the controller can be manually adjusted. For this purpose, select the adjustment value MAN.

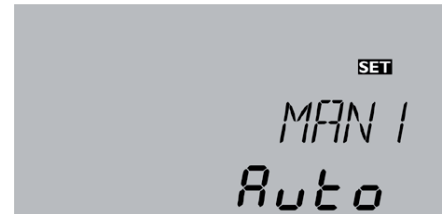
MAN / MAN1

Adjustment range: Auto, ON, OFF, nLO, nHI

Factory setting: Auto

The following adjustments can be carried out:

- Auto : relay in automatic mode
- ON : relay is switched on
- OFF : relay is switched off
- nLO : relay is switched with adjusted minimum speed
- nHI : relay is switched with adjusted maximum speed



Note: Always adjust the operating mode back to “Auto” when the control and service work is completed. Otherwise normal operation will not be possible.

Time and date

The date and time can be adjusted if required.

In the display, the upper line indicates the day followed by the month. The lower line indicates the year.

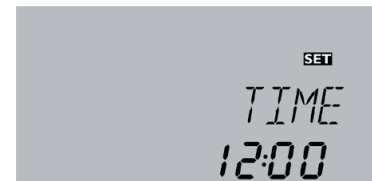
DATE/Time

Time

Adjustment range:

00:00 ... 23:59

Factory setting: 12:00



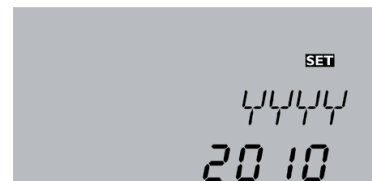
DATE / YYYY

Year

Adjustment range:

2010 ... 2099

Factory setting: 2010



DATE / MM

Month

Adjustment range: 01 ... 12

Factory setting: 03



DATE / DD

Day

Adjustment range: 01 ... 31

Factory setting: 15



Language

In this adjustment channel, the menu language can be chosen.

LANG

Language

Selection: dE (German), En (English)

Factory setting: En



4.3 User code and short menu

The access to some adjustment values can be restricted via a user code (customer). For safety reasons, the user code should **be set to the customer code before the controller is handed to the customer!**

1. Expert **0262** (Factory setting)

All menus and adjustment values are shown and all values can be altered.

2. Customer **0000**

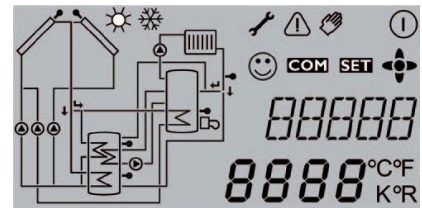
The expert level is not shown, adjustment values can be changed partly (see below)

- In order to restrict the access, enter 0000 in the menu item CODE.
The display changes to the **Status** level. If the adjustment channel is selected afterwards, the short menu shown below will be available. The short menu suits the selected system.
- In order to authorize access, enter 0262 in the menu item CODE.

Channel	Factory	Adjustment Range	Description
TIME	12:00	00:00 ... 23:59	Time
DT O	6	1.0 ... 50.0	Switch on temperature difference store
DT F	4	1.0 ... 49.5	Switch off temperature difference store
DT S	10	1.0 ... 50.0	Set temperature difference store
S MAX	60	4 ... 95	Store maximum limitation
MAN1	Auto	Auto / ON / OFF / n LO / n HI	Manual operation pump 1
CODE	0000	0000 / 0262	User code

5.0 Indications and System Monitoring Display

The system monitoring display consists of 3 area: **Channel Display**, **Tool Bar**, **System Screen**.



Full Monitoring Display

Channel Display

The channel display consists of two lines. The upper line is an alphanumeric 16-segment indication in which mainly the channel names and menu items are shown. In the lower 7-segment indication, the channel values and the adjustment parameters are indicated. Temperature and temperature differences are indicated with the unit (°C / °F or k / °R respectively).



Indication Channel Only

Tool Bar

The additional symbols of the tool bar indicate the current system status. Functions are listed below.



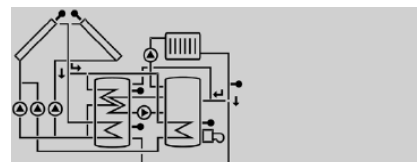
Tool Bar Only

Tool Bar Functions

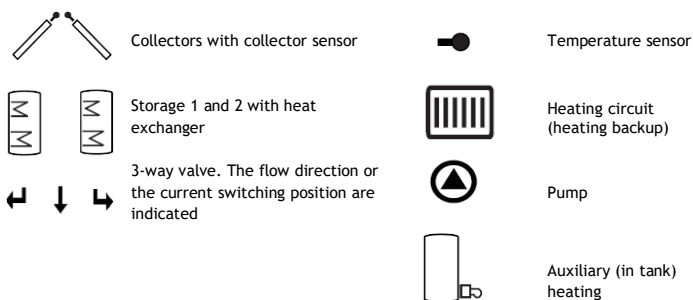
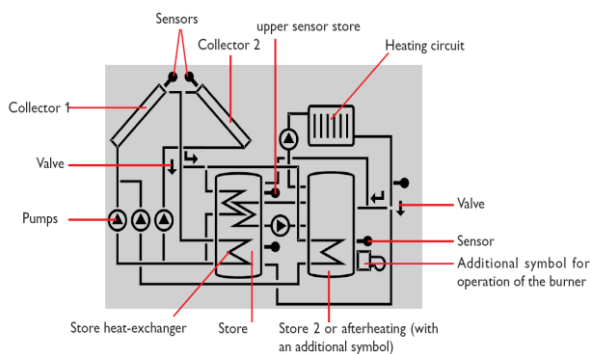
Symbol	Normal	Flashing
	Relay active	
	Maximum store limitation active / maximum store temperature exceeded	Collector cooling function active System cooling, store cooling active
	Antifreeze functions activated	Collector minimum limitation active / antifreeze function active
		Collector emergency shutdown
		Sensor fault
		Manual mode active
		Store emergency shutdown active
		Adjustment channel is being changed (SET mode)
	SD card is being used	SD card is full
	Indication of the buttons available in the menu item	
	Normal operation	

System Screen

The system selected is shown in the system monitoring display. It consists of several system component symbols, which are, depending on the current status of the system, either flashing, permanently shown or “hidden”.



System Screen in the System Monitoring Display



6.0 Flashing Codes

System Screen Flashing Codes

- Pumps are flashing during starting phase.
- Sensors are flashing if the respective sensor indication channel is selected.
- Sensors will flash rapidly if a defect is detected.
- Burner symbol will flash if auxiliary heating is activated.

7.0 Messages / Further Indications

If the controller operates faultlessly (normal operation) a smiley is displayed.

If the controller detects a malfunction, the directional pad flashes red and a message is indicated in the status display. A warning triangle and the wrench are additionally displayed.

If more than one error or fault condition has occurred, only the one with the highest priority will be displayed as a message in the status display.

In the case of a sensor error, the system is switched off, and a message appears on the display marked by an “E”. Additionally, a corresponding value for the error type assumed is indicated.

After the error has been removed, the error message disappears.

Error	Value	Description	Solution
FS1...5	-88.8	Short circuit at sensor 1...5	Check the cable
FS1...5	888.8	Broken cable at sensor 1...5	Check the cable
EVFS	9999	Error at VFS sensor	Sensor fault. Check, and if necessary, correct the connection of the sensor plugs. If a sensor signal does not appear, the sensor has to be replaced
EFLOW		Error flow rate - only if set to ON Threshold values for VFS1-10 sensor: 1.0-1.1 L/min Threshold value for VFS 2-40 sensor: 2.0-2.1 L/min	Check the pump. Check whether a flow rate exists.
PARAM		Remote parameterisation	Do not parameterise the controller via the push buttons during remote parameterisation.

Testing and Simulating the Solar Circuit

The commissioning of the solar circuit should be carried out on a sunny day where the temperature in the collectors will enable the solar pump to be activated.

Note: Refer to Programming the Solar Controller on page 52 to adjust user defined settings and prepare the system for simulation and testing.

- Remove both temperature sensors from their sensor housings in the collector and storage tank. Allow the sensors to cool down to ambient temperature.
- Switch on the electric power supply to the Solar Pump Skid. Observe that the controller display activates.
- Observe that the pump is not operating (with both temperature sensors at the same temperature, the controller should not operate the solar pump).
- Replace both temperature sensors into their respective sensor housings. At this point, if there is sufficient solar radiation, the solar collector sensor will measure a higher temperature than the storage tank sensor, indicating that there is energy to be collected.
- The controller should send a signal to the motor starter relay to activate the solar pump when the temperature differential between the solar collector sensor and the storage tank sensor is greater than the switch on temperature difference 'DTO'.
- Observe that the "Initialisation" countdown will be displayed before the controller sends power to the solar pump. The "Initialisation" period is a user defined time period before the pump starts once the temperature differential described above is met. Once the period of initialisation lapses, the pump will start operating.
- Remove the solar collector sensor from its sensor housing in the collector and allow the sensor to cool down to ambient temperature. Once the temperature differential between the solar collector sensor and the storage tank sensor falls below the user defined set point, the pump should stop operating.
- Should there be insufficient solar radiation, the desired conditions can be simulated as follows:

ENSURE THAT THE SENSORS DO NOT COME INTO DIRECT CONTACT WITH THE WATER.

- Get two plastic bags (no leaks) capable of withstanding hot water. One plastic bag will be used for the solar collector sensor and the other for the storage tank sensor.
- Two containers or flasks, such as an insulating thermos type, capable of holding hot water are required. Each container requires a thermometer with a range of 0 - 120°C.
- The temperature of water in "thermos 1" should be approximately 5°C greater than the maximum temperature set point of the storage tank (user defined 'SMAX'). The temperature of water in "thermos 2" should be approximately 5°C greater than the temperature of water in "thermos 1" plus the switch on temperature difference 'DTO'.
- To simulate the condition that there is enough solar energy to be collected, remove the solar collector sensor from the sensor pocket and insert the sensor into the plastic bag. Insert the plastic bag (with sensor) into "thermos 2". The solar pump should start operating.
- To simulate the condition that there is little solar energy to be collected, remove the solar collector sensor (with plastic bag) from "thermos 2" and allow the sensor to cool down to ambient temperature. The solar pump should stop operating.

- To simulate the condition that there is enough solar energy to be collected but the storage tank has reached the maximum set temperature, put the solar collector sensor (with plastic bag) into “thermos 2”. The solar pump should switch on. Remove the storage tank sensor from the sensor housing and place it into the second plastic bag. Place them into “thermos 1”. The solar pump should stop operating.
- Remove the tank sensor (with plastic bag) from “thermos 1” and the solar pump should restart after the sensor cools down below the maximum temperature set point of the storage tank (user defined 'SMAX').

Setting the Solar Globe Valve

- Fully close the globe valve then open the valve one full turn.
- Replace the solar collector sensor such that the pump activates.
- The pump will flood the circuit on maximum speed. Depending on the circuit, the pump should remain on maximum speed.
- Observe the collector temperature on the solar controller. If, after about 1 minute, the temperature is steady or begins to fall, the globe valve needs no further adjustment.
- If the temperature begins to increase, wind out the globe valve one full turn. Wait for the system to stabilise and observe the temperature.
- Repeat this process until the temperature remains steady or begins to fall.
- The globe valve is now set

Note: Upon first full heat up cycle to the set temperature, or if the roof level is more than 40m above the storage tank, excess pressure in the solar heating circuit will be relieved by the TPR valve. This is normal, and once completed the system will be at its natural fluid level and excess fluid should no longer be released.

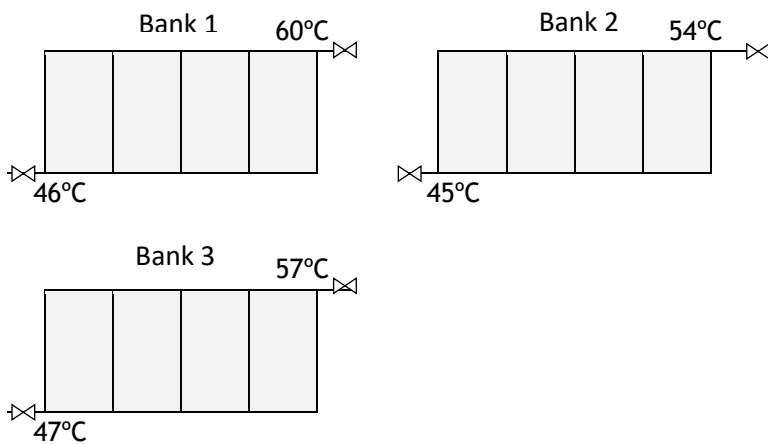
It is important the TPR valve is drained in accordance with the [instructions on page 22](#).

Balancing the Collector Array

If the solar collectors are arranged in multiple banks, in order to establish full flow through the collector array, each bank of the collector array **MUST BE** balanced. This will be especially required if the banks are not manifolded in Equa-flow or Tichelmann. This can be accomplished by installing a balancing valve (optional) at the inlet of each bank of collector and following the balancing instructions as follows:

- Ensure that all isolation valves at the inlet and outlet of each bank of collector are fully open.
- With the solar pump running, measure the temperature at the inlet and outlet of each bank of collectors by using a portable handheld thermometer (not supplied).
- Note down the temperature rise between the inlet and outlet of the bank of collectors.
- Repeat this measurement for all banks of the entire collector array.
- The temperature rise **SHALL BE** uniform for all banks of collectors.
- The temperature rise will depend on the level of solar radiation available.

If the temperature rise is not uniform across all the banks of collectors, it indicates that the flow is not uniform. A uniform flow across the banks can be achieved by adjusting the balancing valves as follows: For example, in a collector array of 12 collectors installed in 3 banks of 4 collectors, the following temperatures were recorded:



- The temperature rises across each bank are as follows:
(Bank 1 = 14°C) (Bank 2 = 9°C) (Bank 3 = 10°C)
- The above temperature rises indicate that Bank 1 is suffering from less than full flow.
- The average temperature rise for all the banks is 11°C and the objective is to obtain this temperature rise uniformly across all banks.
- Partially close the balancing valves to Banks 2 and 3. Allow stabilising for 10 minutes.
- Measure the temperatures once again as described above and record the temperature rises.
- The temperature rises across each bank is now as follows:
(Bank 1 = 13°C) (Bank 2 = 10°C) (Bank 3 = 11°C)
- Partially close the balancing valves to Banks 2 and 3. Allow stabilising for 10 minutes.
- Repeat the exercise until an equal temperature rise across each bank is obtained.

Setting the Electric Heating Unit Temperature

The parameters of the operating thermostat (Eliwell IC902) may need to be reprogrammed to achieve the desired system operating temperature. The boost element should be set at the minimum temperature that will meet the needs of the application to maximise solar contribution. The boost temperature should be set so that the minimum temperature is 5°C higher than the set temperature of the Delivery Skid in order for the Delivery Skid to perform to specification.

Note: if no buttons are pressed for 15 seconds, settings are not saved and the display will revert to show the previous page.

Set Point:

Press and release **set** key. '**Set**' will be displayed.

Press **set** key again to display the pre-programmed value.

Use ▲ and ▼ arrows to modify set point to the desired temperature. **Do not adjust greater than 83°C.**

Press **set** key again to confirm selection.

Press **fnC** key to return to normal operating mode. The current sensed temperature will be displayed.

Differential:

Press and hold **set** key for 5 seconds. '**CP**' will be displayed.

Press the **set** key, '**diF**' will be displayed.

Press **set** key again to display the current differential setting (default 2°C)

Use ▲ and ▼ arrows to adjust the value to the desired differential.

Press **set** key again to confirm selection. '**diF**' will be displayed.

Press '**fnC**' key **twice** to return to normal operating mode. The current sensed temperature will be displayed.

Heat/Cool Mode:

The thermostat should be factory set to heating mode, to check;

Press and hold **set** key for 5 seconds. '**CP**' will be displayed.

Press the **set** key, '**diF**' will be displayed.

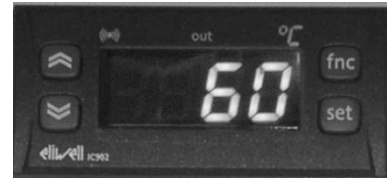
Press and release ▲ arrow **3** times. '**HC**' will be displayed.

Press and release **set** key. '**H**' should be displayed to denote that the thermostat is in heat mode.

If '**C**' is displayed, press and release the ▲ arrow to modify setting to '**H**'.

Press **set** key to confirm selection. '**HC**' will be displayed.

Press '**fnC**' key **twice** to return to normal operating mode. The current sensed temperature will be displayed.



Commissioning of the Delivery Skid

Potable Water Circuit

All lines must be flushed of debris prior to filling the system. Failure to observe this requirement may lead to system blockage and/or underperformance. If a line strainer has been fitted, check and clean after flushing.

Fill the potable water circuit by opening the isolation valve at the cold water inlet connection on the potable water side of the Delivery Skid. Open a hot tap so air may be purged from within the system whilst filling. Close hot tap when all air has been expelled.

When full operational pressure is reached, ensure that all connections on the potable circuit are free of leaks. The potable water circuit **MUST BE** full and pressurised before any other tests are conducted. Switch on the electrical power to the Delivery Skid and follow the instructions on [page 71](#) to set the temperature.

Setting the Delivery Temperature

The temperature entering the primary side of the Delivery Skid should be at least 5°C higher than the set temperature of the Delivery Skid in order for the Delivery Skid to perform to specification.

The Delivery Skid set point temperature should be at least 5°C below the ECO setting for the given model. Refer to table below for ECO temperature settings.

The Delivery skid is supplied from the factory at the temperature described in the table below. If adjustment is required:

- Go to Home screen on the pump.
- Press OK. The setpoint box will be highlighted.
- Press OK. The temperature will be highlighted
- Press OK. The first digit will be highlighted. Use the Up/Down and Side keys to select the desired setpoint.
- Press the Return key to go back through the pages or the Home key to return to the home page.



Adjust the ECO high limit thermostat temperature to match the Delivery Skid set point temperature:

- Undo the 4 screws on the ECO cover, and remove the cover. The screws are captive and will not fall out.
- Using a flat bladed screwdriver, adjust the thermostat dial to the required Crossflow set point temperature.
- Replace the cover and tighten the 4 screws.

Delivery Skid Temperature Settings

Factory Setting	Max Recommended Temp Setting	Recommended ECO Setting
70	60	60

Refer to Grundfos Magna manual supplied with Delivery Skid for other system options.

Setting the Delivery Skid Globe Valve

Before testing the system, the water heating plant must be at the set temperature.

If installed, and connected to the inlet of the Delivery Skid (refer to Application Guide), turn on the building recirculation pumps. If the Delivery Skid is connected on a dead leg circuit, open some taps to represent the design minimum flow rate. The Delivery Skid will automatically activate to heat the water in the secondary circuit to the set temperature.

If the pump does not activate, or shuts down soon afterwards, this is an indication the primary side flow rate is at the lower end of the Delivery Skid pump operating range. This will be the case typically with 200 to 600kW Delivery Skids, with a high heat store temperature and a high return water temperature (ie small temperature rise).

Adjusting the globe valve on the Delivery Skid primary side outlet towards the closed position will allow the Delivery Skid pump to operate at a lower flow rate and maintain better temperature control (not supplied with 800kW Delivery Skid).

Adjust the globe valve so that the pump remains on for a longer period of time

Delivery Skid Parameter Settings

The Deluxe Delivery Skid system is factory set to automatically switch pump operation in duty/standby mode and switch pumps in the event of pump failure. No further adjustments are required to the system.

The system is now completely commissioned. Explain operation and hand over to a responsible officer.

Chapter 4 - Troubleshooting & Maintenance

Troubleshooting

“Insufficient Hot Water”

Solar Input

- Confirm the temperature differential settings are operating as described in Chapter 3 -Commissioning Procedures ‘Testing/Simulating the Solar Circuit’.
- Ensure that all collectors are being completely filled with closed circuit fluid. This is achieved by recording flow and return temperatures at each bank of collectors. Adjustment, if necessary, **SHALL BE** conducted as described in Chapter 3 - Commissioning Procedures.
- Confirm closed circuit fluid level at the hot and cold drain valves located at the roof penetration level. If the level is low, check system for leakage, repair, and top up to the drain valve level. Check pump seals for leakage.
- Ensure the collectors are not being shaded by trees, adjacent structures or other collectors.
- Check for leakage of hot water plumbing circuit in the building.
- Re-check that the flow and return pipework to and from collectors are correctly connected.
- Ensure the Delivery Skid is switched on and the correct temperature has been set.

Electric, or Auxiliary Heat Pump / Gas Boost (if installed)

- Confirm the booster system is switched on and the electrical supply available.
- Check for blown fuses or tripped circuit breakers.
- Has over-temperature lock-out occurred on one or more of the operating thermostats?
- Thermostat setting incorrect.
- Thermostat faulty.
- Electrical heating element failure.
- Is the boost plant timer controlled?



WARNING:

Operation of the safety cut-out may indicate a dangerous fault.

“Insufficient Water Pressure”

- Check line strainers for blockage (if fitted).
- Check water pressure before and after pressure limiting valve (if fitted). If possible, adjust pressure setting if too low. Replace valve if necessary.
- Ensure pressure limiting valve is of sufficient capacity to meet the requirements of the application.
- Is pipe sizing adequate to suit the application?
- Check all valves, heat exchangers and pipework for fouling or blockage.

“Closed Circuit Relief Valve Discharging”

- After commissioning has been completed and the closed circuit stabilised, discharge from relief valves should not occur. Continual discharge may indicate a leak in the heat exchanger.
- The relief valve is set at 500kPa. If the static fluid level in the system at the hot and cold drain valves is greater than 40m, this may cause the valve to open. This should only occur once. If relief valve continues to discharge fluid, consult Rheem for remedy.

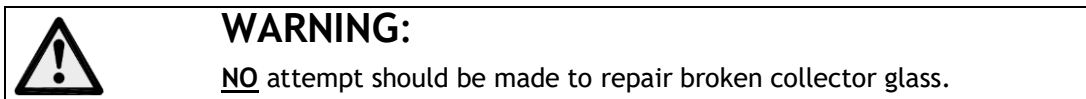
Maintenance**Collector Care**

Ensure the glass on your solar collectors is free of dust, salt spray or any other matter which may reduce the effectiveness of the solar collectors. Rainfall should keep the collectors adequately clean. It is recommended that the collector glass be washed clean at least every three months should adequate rain have not fallen in this period. Collector washing may be completed with water and a soft sponge. This should be undertaken at a time when the collectors are cool, such as early in the morning. In extremely dusty areas, such as mining towns and locations adjacent to dust forming plants, extra attention should be given to this matter.

Note: Ensure that any trees which may shade the solar collectors are regularly trimmed.

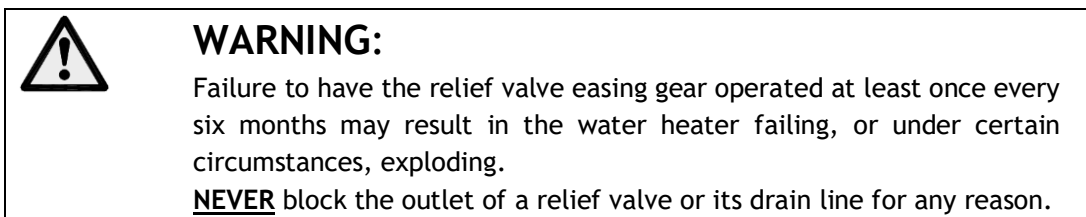
Collector Glass Breakage

Contact your Rheem dealer for assistance with this issue.

**Six Monthly Relief Valve Easing**

The easing gear of pressure or temperature relief valves fitted to the water heater system **MUST BE** operated every six months to assure their continuing function.

IT IS VERY IMPORTANT THAT THE LEVER IS RAISED AND LOWERED GENTLY. EXERCISE CARE TO AVOID ANY SPLASHING OF WATER, AS WATER DISCHARGED FROM THE DRAIN LINE WILL BE HOT.



Note: Continuous leakage of water from a relief valve or its drain line may indicate a problem with the water heater.

Operate the easing lever on the pressure relief valves once every six months. If fluid does not flow freely from the drain line when the lever is lifted, then the water heater should be checked by your Rheem dealer.

The temperature and pressure relief valve **SHALL BE** checked for performance, or replaced at intervals not exceeding 5 years, or more frequently in areas where there is a high incidence of water deposits.

Cleaning the Heat Exchanger

Should the heat exchanger require cleaning, e.g. due to operation in hard water at high temperatures, it is possible to clean the heat exchanger. Use a tank with weak acid, 5% phosphoric acid or, if the heat exchanger is frequently cleaned, 5% oxalic acid. Remove from the system and circulate cleaning fluid through the heat exchanger, ideally at 1.5 times the normal flow rate and in reverse flow.

Flush the heat exchanger water ways with clean water and then before the final rinse with water, rinse with a solution of 1-2% sodium hydroxide (NaOH) or sodium bicarbonate (NaHCO₃) to neutralise all acid.

Servicing the System

The HS Series should be serviced every 12 months to ensure the continued efficient operation of the system.

The service should include inspection of the following items:

- Temperature and pressure relief valves
- Automatic operation of controls
- Collector glazing and waterproofing
- Collector glass cleaning
- Insulation of the pipework
- Solar pump operation
- Water leakage in both the closed and potable water circuits
- Closed circuit fluid condition and level. The closed circuit may require a small volume of fluid to be added to account for the fluid discharged through the regular easing of the temperature relief valve.
- Checking balance of corrosion inhibitor.
- Cleaning line strainers.

Spare Parts

In areas where spare parts may not be readily available, it is recommended that a minimum range of spare parts be kept to carry out fast and effective repairs. This is particularly important if the HS Series system is the only source of hot water.

The following spare parts are recommended to be kept on site:

- Sensor and sensor lead wire
- Pump for solar circuit
- Solar collector
- Collector connector assembly x 4
- Collector bung assembly x 2
- Tube end assembly x 2
- Closed circuit Temperature Relief Valve 1¼" NPT x 75 PSI (93 - 97°C)
- Delivery Skid pump or pump head
- Delivery Skid heat exchanger
- Electric heating unit contactor, ECO and thermostat
- Complete spare heating unit
- Other boost water heater components, as required

HS Series Warranty

1. THE RHEEM WARRANTY - GENERAL

- 1.1. This warranty is given by Rheem Industries Pty Limited ABN 45 064 945 848 of 1 Alan Street, Rydalmere New South Wales, Australia.
- 1.2. Rheem offers service through its Distributor network. Rheem will repair or replace components at the address of the water heater subject to the terms of the Rheem warranty. Rheem, in addition can provide preventative maintenance and advice on the operation of your water heater.
- 1.3. For details about this warranty, you can contact your local Rheem Distributor.
- 1.4. The terms of this warranty are set out in section 2 and apply to water heaters manufactured after 1st June 2015.
- 1.5. If a subsequent version of this warranty is published, the terms of that warranty will apply to water heaters manufactured after the date specified in the subsequent version.

2. TERMS OF THE RHEEM WARRANTY AND EXCLUSIONS TO IT

- 2.1. The decision of whether to repair or replace a faulty component is at Rheem's sole discretion.
- 2.2. If you require a call out and we find that the fault is not covered by the Rheem warranty, you are responsible for our standard call out charge. If you wish to have the relevant component repaired or replaced by Rheem, that service will be at your cost.
- 2.3. Where a failed component or cylinder is replaced under this warranty, the balance of the original warranty period will remain effective. The replacement does not carry a new Rheem warranty.
- 2.4. Where the water heater is installed outside the boundaries of a metropolitan area as defined by Rheem, or further than 30 km from a regional Rheem Distributor, the cost of transport, insurance and travelling between the nearest Rheem Distributor's premises and the installed site shall be the owner's responsibility.
- 2.5. Where the water heater is installed in a position that does not allow safe or ready access, the cost of that access, including the cost of additional materials handling and/or safety equipment, shall be the owner's responsibility. In other words, the cost of dismantling or removing cupboards, doors or walls and the cost of any special equipment to bring the water heater to floor or ground level or to a serviceable position is not covered by this warranty.
- 2.6. This warranty only applies to the original and genuine Rheem water heater in its original installed location and any genuine Rheem replacement parts.
- 2.7. The Rheem warranty does not cover faults that are a result of:
 - 2.7.1. Accidental damage to the water heater or any component (for example: (i) Acts of God such as floods, storms, fires, lightning strikes and the like; and (ii) third party acts or omissions).
 - 2.7.2. Misuse or abnormal use of the water heater.
 - 2.7.3. Installation not in accordance with the Owner's Guide and Installation Instructions or with relevant statutory and local requirements in which the water heater is installed.
 - 2.7.4. Connection at any time to a water supply that does not comply with the water supply guidelines as outlined in the Owner's Guide and Installation Instructions.
 - 2.7.5. Repairs, attempts to repair or modifications to the water heater by a person other than the Rheem Distributor.
 - 2.7.6. Faulty plumbing or faulty power supply.
 - 2.7.7. Failure to maintain the water heater in accordance with the Owner's Guide and Installation Instructions.
 - 2.7.8. Transport damage.
 - 2.7.9. Fair wear and tear from adverse conditions (for example, corrosion).
 - 2.7.10. Cosmetic defects.
 - 2.7.11. Breakage of collector glass for any reason including hail damage.
 - 2.7.12. Subject to any statutory provisions to the contrary, this warranty excludes any and all claims for damage to furniture, carpet, walls, foundations or any other consequential loss either directly or indirectly due to leakage from the water heater, or due to leakage from fittings and/ or pipe work of metal, plastic or other materials caused by water temperature, workmanship or other modes of failure.

3. WHAT IS COVERED BY THE RHEEM WARRANTY FOR THE WATER HEATERS DETAILED IN THIS DOCUMENT

Installation	Model	Period	Warranty
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All Components (from date of the installation)

All installations	All models	Year 1	New component, solar collector or water heater (at Rheem's sole discretion), free of charge, including labour.
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Cylinder (from date of installation)

All installations	Storage vessel	Years 2 to 5	New storage tank, free of charge, with installation and labour costs being the responsibility of the owner.
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Major Parts (from date of installation)

All installations	Delivery Skid heat exchanger	Years 2 to 5	New parts, free of charge, with installation and labour costs being the responsibility of the owner.
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Solar Collector (from date of installation)

All installations	CSA2013	Years 2 to 5	New Solar collector, free of charge, with installation and labour costs being the responsibility of the owner.
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Notes:

- Rheem reserves the right to transfer fully functional components from the defective water heater to the replacement water heater if required.
- The term "water heater" used in the Warranty, Warranty Conditions and Warranty Exclusions means the Rheem supplied water heater(s), solar storage tank(s), solar collector(s), delivery skid(s), solar pump station(s), electric heating unit(s), kit(s) and components.

4. ENTITLEMENT TO MAKE A CLAIM UNDER THIS WARRANTY

- 4.1. To be entitled to make a claim under this warranty you need to:
- 4.1.1. Be the owner of the water heater or have consent of the owner to act on their behalf.
 - 4.1.2. Contact Rheem without undue delay after detection of the defect and, in any event, within the applicable warranty period.
- 4.2. You are not entitled to make a claim under this warranty if your water heater:
- 4.2.1. Does not have its original serial numbers or rating labels.

5. HOW TO MAKE A CLAIM UNDER THIS WARRANTY

- 5.1. If you wish to make a claim under this warranty, you need to:
- 5.1.1. Contact your local Rheem distributor and provide owner's details, address of the water heater, a contact number and date of installation of the water heater or if that's unavailable, the date of manufacture and serial number from the fresh water station and/or tank.
 - 5.1.2. Rheem will arrange for the water heater to be tested and assessed on-site.
 - 5.1.3. If Rheem determines that you have a valid warranty claim, Rheem will repair or replace the water heater in accordance with this warranty.
- 5.2. Any expenses incurred in the making of a claim under this warranty will be borne by the owner.

Commissioning Checklist

COMMISSIONING MAY ONLY BE DONE BY A QUALIFIED TRADESPERSON

The following information is to be completed by the installer at the time of installation:

System Model :	
Storage Tank Model :	Qty:
Storage Tank Serial :	
Element Rating (kW):	
Element Serial:	
Delivery Skid Model :	
Delivery Skid Serial :	
Solar Pump Skid Model :	
Solar Pump Skid Serial :	
Collector Qty :	
Collector Details :	Type: Manufacture Date:
Date of Installation :	
Installer :	
Address :	
Suburb/State/Country :	
Phone :	
Date of Commissioning :	
Commissioning Agent :	
Warranty Start Date :	

Pressures:

Closed circuit pressure test	_____ kPa	Pass <input type="checkbox"/>	Fail <input type="checkbox"/>
Potable circuit pressure test	_____ kPa	Pass <input type="checkbox"/>	Fail <input type="checkbox"/>

Temperatures:

Store max temperature setting	_____ °C	Pass <input type="checkbox"/>	Fail <input type="checkbox"/>
Booster temperature setting	_____ °C	Pass <input type="checkbox"/>	Fail <input type="checkbox"/>
Delivery skid temperature setting	_____ °C	Pass <input type="checkbox"/>	Fail <input type="checkbox"/>
Closed circuit temperature	_____ °C	Pass <input type="checkbox"/>	Fail <input type="checkbox"/>
Potable water-out temperature	_____ °C	Pass <input type="checkbox"/>	Fail <input type="checkbox"/>
Potable water-return temperature	_____ °C	Pass <input type="checkbox"/>	Fail <input type="checkbox"/>

**BEFORE ATTEMPTING TO OPERATE THE HS SERIES SYSTEM
ENSURE THAT THE CHECKLIST BELOW IS COMPLETED.**

Checks	Pass	Fail	Remarks
1. Water quality check			
2. Solar pump check			
3. All mechanical fixings are secured			
4. Collector array pipework is correct and as per diagram shown in the installation instructions			
5. Solar flow and return pipes have continuous fall to the storage tank to ensure all fluid drains back to the tank under gravity when pump is turned off			
6. Closed circuit is filled to the correct level with the correct concentration of inhibitor. No leaks detected			
7. Solar flow and return pipework is adequately insulated			
8. Closed circuit fluid flow through collector array is correctly balanced			
9. Potable water circuit is purged of air and fully flooded. No leaks detected			
10. Delivery Skid circuits are free of air (deaerated) as per instruction			
11. All isolation valves in the potable & closed circuit are opened			
12. Line strainers in closed circuit have been checked and cleaned			
13. Solar circuit globe valve is set			
14. Delivery skid globe valve (if required) has been set			
15. Controller parameters are adjusted to the desired settings			
16. Owner / Site Manager is correctly instructed on the system use			
17. Installation & Warranty Report at the end of this manual has been completed and signed			

For In-Tank Boosted Systems, the following checks are conducted in addition to the above

Checks	Pass	Fail	Remarks
1. Maximum energy input from all sources is less than 500kW			
2. ECO (Safety energy cut-out device) fitted			
3. Primary circuit maximum supply pressure must not exceed 400kPa			
4. All mechanical fixings are secured			
5. Flow and return pipework is adequately insulated			
6. All isolation valves connecting the booster are open			
7. Electrical supply is correctly sized to suit the load of the heating elements (if applicable)			
8. Gas supply pipework is adequately sized and at correct pressure (if applicable)			
9. Correct gas type is available to suit gas appliance (if applicable)			
10. All internal gas products are flued correctly (if applicable)			
11. Booster Controller parameters are adjusted to the desired settings			

Technician

Manager

Customer Representative

Reference Formulation

1. Energy Required To Heat Water:

$$\text{Energy (Input)} = \frac{\text{quantity} \times \text{specific heat} \times \text{temperature rise}}{3600}$$

= kilowatts (kW.h)

Quantity = litres
 Specific Heat = 4.19 kJ/kg.K (fresh water)
 Temperature Rise = °C
 3600 = constant

2. Rate At Which Energy Is Supplied To A Heater:

$$\text{Energy (output)} = \frac{\text{output} \times 3.6 \times 100}{\% \text{ efficiency of heater}}$$

= Megajoules (MJ/h)

Output = kW
 3.6 = constant
 100 = constant

3. Time Required To Heat Water:

$$\text{Time} = \frac{\text{energy required to heat water (see calc. 1)}}{\text{heater output}}$$

= hours

Energy Required = kW.h
 Heater Output = kW

4. Energy Required To Heat A Flow Of Water:

$$\text{Energy (input)} = \text{flow rate} \times \text{specific heat} \times \text{temp. rise}$$

= kilowatts (kW)

Flow Rate = l/s
 Specific Heat = 4.19 kJ/kg.K
 Temperature Rise = °C

5. Recovery Rate Of A Water Heater:

$$\text{Hourly Recovery} = \frac{\text{heater output} \times 3600}{\text{Specific heat} \times \text{temp. rise}}$$

Heater Output = kW
 3600 = constant
 Specific Heat = 4.19 kJ/kg.K
 Temperature Rise = °C

6. 1st Hour Water Availability Of A Heater:

$$\text{Quantity} = \text{heater delivery} + \text{recovery rate (see calc. 5)}$$

= litres (in 1st hour)

Note: Heater delivery is 84% for Edwards SS tanks & 70% for heat exchange tanks.

7. Quantity Of Mixed Water:

$$\text{Quantity} = \frac{\text{LH} \times (\text{T1} - \text{T2})}{\text{T3} - \text{T2}}$$

= litres

LH = litres of hot water
 T1 = temperature of hot water °C
 T2 = temperature of cold water °C
 T3 = temperature of mixed water °C

8. Temperature Of Mixed Water:

$$\text{Temperature} = \frac{\text{LH} \times (\text{T1} - \text{T2})}{\text{LM}} + \text{T2}$$

= °C

LH = litres of hot water
 T1 = temperature of hot water °C
 T2 = temperature of cold water °C
 LM = litres of mixed water

9. Amperage Drawn From Single Phase Electric Supply:

$$\text{Amperage} = \frac{\text{electrical energy draw of appliance}}{\text{power supply}}$$

= amps (A)

Electrical Energy = watts (W)
 Power Supply = volts (V) eg. 220V

10. Amperage Drawn From Three Phase Electric Supply:

$$\text{Amperage} = \frac{\text{electrical energy draw of appliance}}{1.732 \times \text{power supply}}$$

Electrical Energy = watts (W)
 1.732 = constant
 Power Supply = volts (V) eg. 440V

11. Storage Capacity Of A Tank:

$$\text{Capacity} = \text{area of base} \times \text{length of tank} \times 1000$$

= litres

Area of Base = sq.m
 Length of Tank = m
 1000 = constant

12. Area of A Circle:

$$\text{Area} = \text{radius}^2 \times 3.142$$

= sq.m

Radius = m
 3.142 = constant

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Note: Every care has been taken to ensure accuracy in preparation of this publication. No liability can be accepted for any consequences, which may arise as a result of its application

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