SunDrum Solar SDM300 Series Hybrid Solar Water Heating and Energy System Installation Manual

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Document Revision History

Revision	Description	Date	Author	Approval
2.0	Update to 2013 standards	11/17/14	MI	

Table of Contents

OG-300 Certification Page

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The solar system installer is to indicate (circle, check, etc.) the system that was actually installed.

	This product certified by: Solar Rating & Certification Corporation™ www.Solar-Rating.org	SunDrum Solar, LLC 15 Hillside Road Northborough, MA 01532 USA
Solar Energy Factor (SEF_D)	SRCC Cert. No.	Model No.
0.9	30003919	SDM300-10-B
0.9	30003918	SDM300-9-B
0.9	30003917	SDM300-8-B
0.9	30003916	SDM300-6-B
1.2	30003915	SDM300-9-E
1.2	30003914	SDM300-8-E
1.2	30003913	SDM300-4-E
1.2	30003912	SDM300-6-E
The installed system is marked above		

System Overview

The SunDrum Solar SDM300 Series Hybrid Solar Water Heating and Energy System uses from four to ten SDM100 collector panels, connected in series of two to five panels that are then connected in parallel rows to form a collector array of adequate size to transfer sufficient solar (thermal) energy to a Heat Transfer Fluid (HTF). The HTF used in the SunDrum SDM300 Series systems is Cryotek-100AL. The use of a HTF allows the system to operate at higher temperatures and provides greater freeze protection than water. The HTF is pumped through a closed solar loop; it does not come in direct contact with the potable water supply. The HTF in the closed solar loop is pumped up through the collector array, then down to the double-walled heat exchanger that is wrapped around the solar water heating tank. This results in the heating of the tank and water in the tank, while the HTF itself is cooled before being cycled back to the collector array.

The pump operations are controlled by a Differential Temperature Controller that uses the temperature difference between two sensors, one located in the solar tank and a second sensor at the collector array return port to turn the pump on or off as needed. During this process the HTF is cooling the Photo Voltaic panels mounted under the SDM100 Collectors. SunDrum® Solar SDM300 Series Hybrid Solar Water Heating and Energy Systems provide the unique capability of capturing both electrical and thermal energy in a single system.

Photovoltaic (PV) panels are very good at converting solar radiation into thermal and electrical energy. An example would be 1000 watts of solar radiation striking the PV panel would be converted into approximately 150 watts of electrical energy and 750 watts of thermal energy while 100 watts is reflected away. By capturing a majority of this thermal energy and transporting it to storage the PV panel will be cooled. Cooling the PV (photovoltaic) panels allow them to operate more efficiently – capturing more electrical power from the sun than a traditional PV only installation. Under standard test conditions the electrical output can increase to 165watts of electrical energy plus 480watts of thermal energy for 645 watts of total energy without increasing roof space. Thus by implementing a SunDrum Solar SDM300 hybrid system one dramatically improves the efficiency of converting the suns energy into useful energy.

This manual describes how to install a SDM300 system along with maintenance and troubleshooting guidelines..

Since the sun is not always out due to planetary rotation or weather patterns, solar energy is a dependent source of energy. Thus solar thermal systems should be considered a pre-heat system and requires a back up water heater of adequate capacity to fully meet the home's thermal energy needs. This is also true for SunDrum Solar SDM300 systems where our goal is to always cool the PV panel. Thus back up water heating is required with SDM300 systems. This water heater must be listed and labeled by an accredited listing organization.

The solar energy system described by this manual, when properly installed and maintained, meets the minimum standards established by the Solar Rating & Certification Corporation (SRCC). This certification does not imply endorsement or warranty of this product by SRCC.

A copy of this Solar System Manual along with SDM100 technical data sheet will be kept at the system installation site.

SunDrum Solar Supplied Parts list

SunDrum Solar Hybrid systems maximum operational temperatures are designed to equal the temperature of a bare PV panel. Thus operational temperatures are typically less than 80F above ambient temperature. SDM100 collectors are specified at 6psi maximum. Therefore a typical system will operate between native head +1psi to native head +6psi, where native head pressure equals the column of heat transfer fluid from the pressure gauge to the lowest SDM100 collector. For example a typical system 16ft above the pressure gauge would have a native head of 6.7psi, we pressurize the system to 2psi the system when off would measure 8.7psi. When on the pressure gauge would measure ~10.7psi. The tandem of managed operational temperatures with low pressure improve long term reliability. Optimal system performance occurs with 0.5gpm flow rate per string.

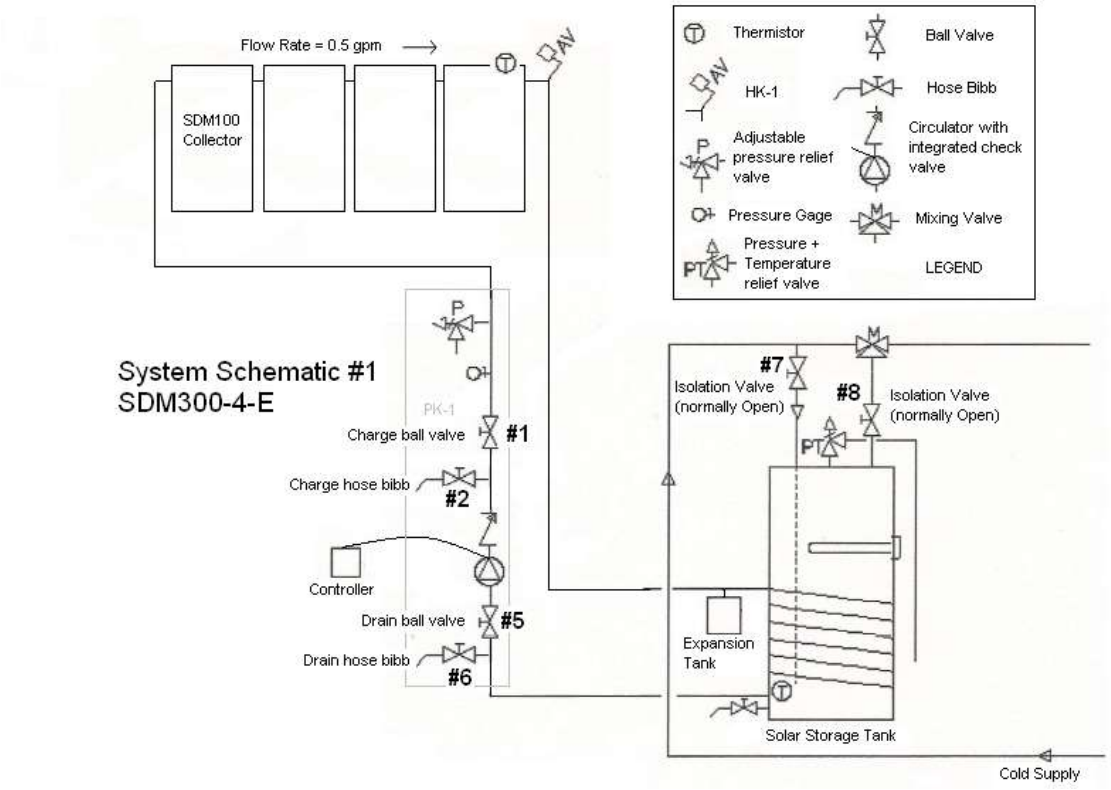
System Model	SDM100 Collectors (#)	SDM100 Connection Kits (#)	Header kit	Controller with Thermistor's + Sleeve	Pump Station	Propyelne Glycol (gal)
SDM300-4-E	4	4	HK-1	1	1	5
SDM300-6-E	6	6	HK-2	1	1	5
SDM300-6-B	6	6	HK-2	1	1	5
SDM300-8-E	8	8	HK-2	1	1	5
SDM300-8-B	8	8	HK-2	1	1	5
SDM300-9-E	9	9	HK-3	1	1	5
SDM300-9-B	9	9	HK-3	1	1	5
SDM300-10-B	10	10	HK-2	1	1	5

Note: Each SDM100 connection kit includes: 2 3/8" barbs, 2 plugs, 2 stainless steel hose clamps, 5' of industrial hose, and 5' of UV resistant insulation.

SunDrum Solar Replacement Parts

The following is a list references compatible replacement parts. Contact SunDrum Solar at (978) 562-5152 or techsupport@sundrumsolar.com to locate a local service agent and/or ordering parts.

Component	Manufacturer	Model
Controller	Steca	TR 0301
Circulator	Grundfos	UPS15-58FC
Solar Storage Tank	Rheem	81V80HE or 82V120HE
Heat Transfer Fluid	Hercules	Cryo-tek 100/AL
PEX with EVOH barrier	Watts	Radent PEX+
Insulation	Armacell	UT/Solaflex
Heater hose	Gates	4230-0129



(Basic SunDrum Solar System design)

Safety Considerations and Building Codes

WARNINGS:

Panel Assembly: SunDrum collectors are constructed with sheet metal and may have sharp edges. Gloves should be worn when handling the collector and assembling into the hybrid panel.

Installation Precautions: When connecting the SunDrum collector to the photovoltaic panel or into the array, ensure that electrical power is disconnected to avoid electrical shock. Use only UL-approved conductors, electrical connectors, and inverters for the solar PV installation. Keep in mind that multiple PV panels, wired in series, can generate dangerous or potentially lethal DC voltages when exposed to sunlight.

SunDrum collectors may be mounted on the roof or other elevated locations. Installers should wear adequate safety harnesses secured per manufacturer's guidelines.

Burns: SunDrum collectors are designed to gather thermal energy from the sun. They can heat fluid above 120°F, which can cause burns on unprotected skin. In addition, the collectors themselves will be hot when exposed to the sun. Take appropriate precautions to avoid burns.

 While SunDrum collectors are not electrical components, they are made from an electrically conductive material and must be grounded per specification.

 **Glare:** SunDrum collectors are made with materials that may reflect like a mirror and result in significant solar glare when assembled outside on sunny days. Adequate eye protection should be worn.

 **Building codes:** follow all state and local building codes including inspection and final hookup to the grid / building electrical system by a licensed electrician, and similarly for hookup to potable water supply by a licensed plumber.

Solar System must be located where it does not impair emergency movement of occupants.

 Combustible materials are to be kept away from high temperature components.

System Design and Configuration

Application Suitability

To determine the amount of energy a array will generate consult a qualified professional. There are a large number of factors that can determine performance.

Geographic Location and Environmental Considerations

Location – The amount of solar energy that can be captured and used is directly related to how much sun your part of the country receives. This is a function of weather (cloudiness, temperature), latitude, air quality, and other variables. Under ideal conditions (low latitude, desert air without clouds or pollution, noontime), the sun sends about 1,000 watts of power to Earth for each square meter illuminated. Using that as a standard, the National Renewable Energy Laboratory (NREL) maps the average amount of solar energy each region of our country receives (see Figure 1). For example, averaged over a year, a square-meter area in San Diego receives solar energy equivalent to 5 hours of 1,000-watt sunlight per day, whereas Nome Alaska receives the equivalent of 2.5 hours of 1,000-watt sunlight per day – half as much. Assuming the same system in both locations, the system in San Diego will capture twice the energy from the sun over the course of a year. Geography is one factor in sizing a system for a given application. Array tilt or slope is another factor. Depending upon the application load different slopes or pitch will be used to provide the best energy match.

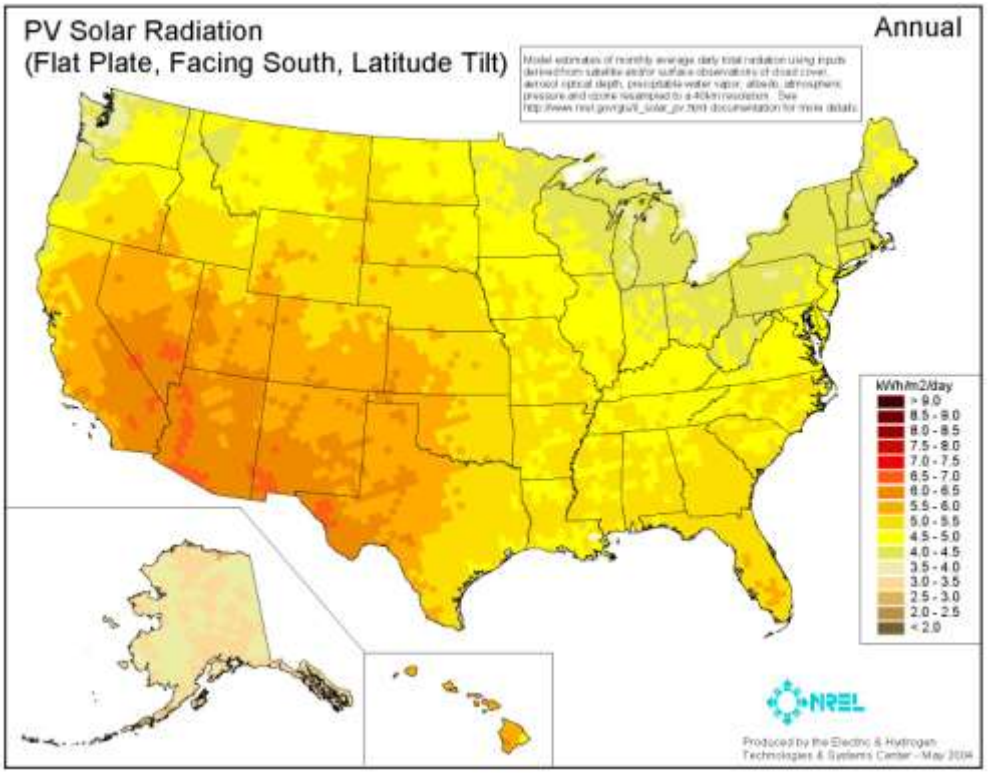


Figure 1: Solar insolation map for the United States (NREL)

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Shading – Because crystalline solar cells are normally wired in series to obtain the required DC voltage, solar PV installations are particularly sensitive to shading on any part of the panel. Even a small area of shading, covering a portion or all of a crystalline cell or wafer, will appreciably reduce the electrical power output of the panel. Perform a thorough inspection of the proposed site for potential shading at all times of year. Use of a site-assessment tool like the *Solar Pathfinder* or *Solar Site Selector* is recommended.

Note that some state and utility rebates are linked to site certification, where excessive shading and the angle/orientation of collectors are all factors determining the amount of rebate that will be granted to the system's owner. Check your state's latest rebate / tax-credit policy before finalizing an agreement to install a SunDrum system.

Freezing – Installers in most regions of the United States must consider the potential for freezing when designing and configuring solar thermal systems. The SunDrum collector is not designed to withstand the pressures of freezing fluid in the collector. In a region where there is any possibility of freezing, the installer must use a mixture of propylene glycol antifreeze and water, in the appropriate concentration for winter conditions at the site. Since low concentrations of propylene glycol can support bacteria growth the minimum acceptable concentration is 40%. Since the SDM100 collector includes anodized aluminum in its design, SDM300 systems include 5 gal of Hercules Cryo-tec-100/AL. This propylene glycol mixture is specially formulated for corrosion resistance.

% Concentration of cryo-tek-100/AL	Parts of cryo-tek-100	Parts of Distilled Water	Freeze Protection Down to
100%	undiluted	-	-70 °F/-57C
75%	3	1	-21 °F/-30C
60%	3	2	0 °F/-18C
50%	1	1	10 °F/-12C

Cryo-Tek 100/AL has HMIS Hazard warning of 0.0.0.A. Safety glasses are recommended when handling. If fluid makes eye contact rinse thoroughly with plenty of water, also under eyelids. If symptoms persist, call a physician. If ingested clean mouth with water and afterwards drink plenty of water. For skin contact, wash skin with soap and water. This material is not a hazardous waste according to Federal regulations (40 CFR 261)

Wind – The SunDrum collector fits completely within the profile of the PV panel and has no effect on wind loading calculations for correct PV panel mounting. Please consult local building codes for wind requirements and select appropriate PV mounting hardware.

Drainage – system design should ensure water flow off panels will not damage building.

Design Considerations

SDM100 operating pressure

SunDrum collectors are designed for 6 psi max operating pressure. Collectors may rupture or leak, voiding the warranty if they are exposed to higher pressures.

System Stagnation

Traditional solar thermal systems must be sized and designed to ensure that water does not reach boiling temperature in the collector or storage tank. A benefit of SunDrum's collector design is that it won't permit temperatures in excess of ambient temperature + 80° F. Systems normally will not exceed ambient temperature + 50° F. In geographies where the ambient temperature exceeds 120°, module slope must be restricted to avoid exceeding 200°F. For geographies with maximum temperatures 120° - 130° slope must be equal or greater than latitude. It is also important that the system is designed such that the cooling liquid (e.g. propylene glycol) does not exceed the maximum operating temperature of the photovoltaic (PV) module. Many PV panels have maximum temperature specification around 190°. In climates where the ambient temperature exceeds 110° F and there is a possibility of exceeding 190 ^{o}F requiring safeguard precautions. These precautions can include tilting the collectors where they do not receive maximum radiation during the hot months. SDM300 systems are also provided with a preprogrammed controller that will leave the system on over night when tank temperature exceeds 140° until the tank has dropped to 110°F. Building materials adjacent to solar components must be rated for elevated temperatures or suitably protected.

Recirculation Systems

Recirculation systems should be designed so they do not recirculate domestic hot water into the solar storage tank. SunDrum collectors are designed to cool PV panels to improve electrical performance. A recirculation system, which delivers hot water heated by the backup water heating system into the solar tank, would substantially reduce thermal energy collection efficiency and the PV panel cooling effect. Recirculation systems should be designed so that the recirculated water is isolated from the solar hot water tank and is only delivered to the backup water heater storage tank.

Component Selection

Roof-Mount System and Mounting Hardware

SunDrum collectors, once combined with a PV panel to form a hybrid PV/thermal collector, attach to a roof or ground-installed mount with standard PV panel mounting systems. The only unique requirement is ensuring that roof mounting rails and mounting hardware do not cover or come within 3" of the inlet/outlet couplings. This enables easier connections between collectors and to the plumbing / pipes connecting to the storage tank and pump.

Follow the mounting-equipment manufacturer's instructions for correctly installing and grounding the mounting system. Mounting must be capable of maintaining tilt and azimuth under local building codes.

Differential-Temp Controller

SDM300 systems include a preprogrammed controller that will turn the circulator on when it detects a collector temperature 8°F higher than tank temp and will shut the circulator off when collector temperature drops to within 2°F higher than tank temperature. It is also programmed with the holiday feature mentioned in the system stagnation section.

Pipe Size and Material

SDM300 systems can use cross linked PEX with oxygen barrier that are rated for 200F. SDM300-4, 6, 8, and 10 systems can used 1/2" piping. SDM300-9 systems should used 3/4" piping.

PEX tubing is not UV resistant and must be protected. SDM300 systems come with UV resistant insulation that will provide adequate protection. Where additional UV protection is desired two ½" PEX wrapped in 3/4" pipe insulation will slide easily into a false gutter drain for good ascetics. This provides inexpensive additional UV protection, structural support, and improved insulating value.

Select hangers specified for pipe and insulation. Hangers should not compress insulation.

Air Traps

To avoid binding the circulator, any air traps that are designed into the SDM300 system piping must be relieved by a air auto vent at their highest point. The SDM300 system comes with a air auto vent on the output header. Systems designed where piping continually rises to this point do not require additional air relief.

Plumbing Connectors

SDM300 systems provide a SunDrum connection and header kits. This includes two ½" NPT inlet/outlet couplings, two plugs, 5' industrial hose, 5' UT/Solarflex insulation, and two stainless steel hose couplings. The couplings are made from a material with excellent temperature, chemical resistance, and coefficient of expansion. However take extra care to ensure the connector is not cross-threaded when screwed into the aluminum collector coupling. Do not tighten coupling flush with the collector coupling since this will bottom out and prevent or constrain flow. All component s should be placed where they are accessible for maintenance and servicing.

WARNING: Do not tighten plug or barb couplings flush with SDM100 collector. Leave two threads exposed. Over tightening will result in bottoming against the back of the SDM100 and will restrict fluid flow.

SunDrum recommends that the connections from the collector array to the headers also be made with hose barbs connected with 25 year-life industrial hose. Additional stainless steel clamps are provided with each header. Connectors and caps threaded into the collector couplings should be wrapped with Teflon tape and coated with a thin layer of pipe-thread compound before installing.

Fluid connections and hose should be insulated with supplied insulation to minimize heat loss and UV degradation.

Auxiliary Heater

Auxiliary heater must be sized to handle the DHW load without solar and operate independently if needed.

Installation

Safety Considerations

 SunDrum collectors are constructed with sheet metal and may have sharp edges. Gloves should be worn when handling.

 SunDrum collectors may be attached on the roof or other elevated locations. Installers should wear an adequate safety harness secured per manufacturer's guidelines.

 Do not expose any building materials adjacent to solar components to elevated temperatures.

 Components that will be exposed to public traffic must be insulated or maintained below 140° F.

 When assembling the SunDrum collector onto the photovoltaic panel or into the array, electrical power must be disconnected to avoid electrical shock. Also PV panels generate electricity whenever the sun strikes them. Electrical shock can still occur when main power is disconnected requiring extra care.

Piping and sensor wire

A written plan with schematic drawings for collector placement should be completed before any work is started. Plan where the collectors and piping are to be installed vs. where the solar tank and plumbing will be located. Determine how the sensor wire and Thermistor sensor will be installed and protected. Sensor wires must be protected from degradation or false signals. Sensor wire must be rated for expected temperatures and UV conditions. The appendix of this manual has system schematics for OG300 approved system designs.

Building penetrations cannot impair enclosure function or allow vermin intrusion. Penetrations must meet applicable codes and National Roofing Contractors Association practices. Structural members penetrated by solar system components must meet code. Penetrations through fire-rated assemblies cannot reduce fire resistance below code.

 Provide appropriate pipe support and pitch to ensure that the insulation is not compressed.

Rooftop Rack Installation

For roof installation, horizontal rail spacing should be set so the lower horizontal rail is at least 3” from the SunDrum collector inlet port. This provides clear access to inlet ports at the bottom of the SunDrum collector (see figure below). Similarly, spacing between upper rail and upper outlet ports should be at least 3” to provide space for fastening and running insulated hose..

Racking system must meet local structural weight limits and is capable of maintaining tilt and azimuth position of the array.

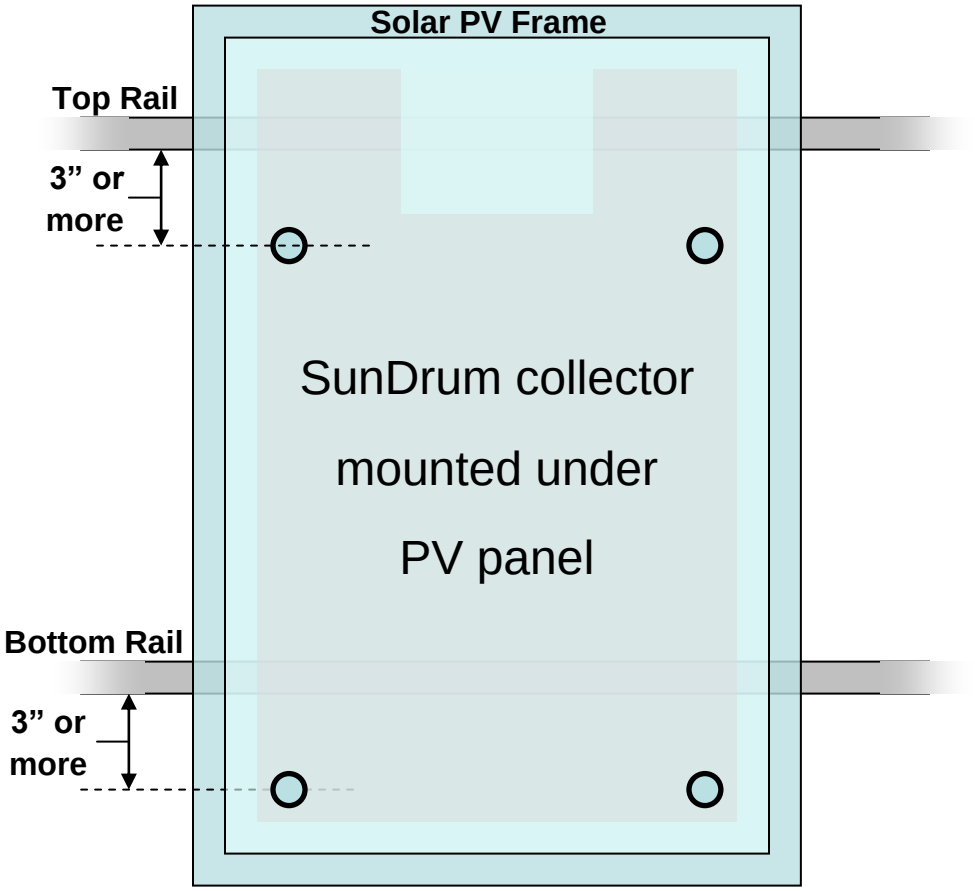


Figure 10: inlet- and outlet-port clearance to rails

Note that edge rack systems will not obstruct the inlets, and therefore only require clearance above roof to make final plumbing connections. Minimum clearance of 3” distance off roof is recommended, for access to inlet / outlet ports.

Double check dimensions of rack components, SunDrum collector input/output connections, and header locations for adequate clearance before installing racks on roof. Consult PV rack installation guide, and install racks according to directions.


Rails must not be located adjacent to the SDM100 bracket and fluid connections. Assemble a module to determine accurate locations for railing before mounting the rails to the roof.


Ensure that all structural member and building penetrations meet all applicable codes and National Roofing Contractors Assoc. practices. Ensure that all penetrations through fire-rated assemblies do not reduce fire resistance below code. Do not impair enclosure function or allow vermin intrusion. Building materials adjacent to solar components are not exposed to elevated temperature.

Hybrid Module Installation – Prepare an installation diagram for the planned SunDrum collector array, showing the number the collector modules, the ***fluid inlet*** and ***fluid outlet*** couplings for each collector, the plug locations, barb locations, input and output header, and the Thermistor location. Always connect the Fluid outlet coupling at the highest connector so natural convection aids thermal collection and maximizes the collector's performance.

Header installation – Install headers per SDM300 system schematics 1-8. Inlet header can be located under the module so long as it is below the highest inlet. Output header air auto vent must be located above the highest module in the array. Headers are designed to provide balanced flow through each array string.

Hybrid Module Assembly

Assemble modules per SunDrum SDM100 Assembly guide.

For each numbered collector module, follow steps 1 through 6 before moving assembled modules to the roof.


NOTE: SunDrum collectors are oriented **face down** (fluid connectors down) when installed on the roof. When attaching connectors, plugs, and hoses at ground level, collectors are **face up**, so attachment points will be mirror-imaged relative to their installed position.

Remove the inlet/outlet protective covers before plumbing collectors into the system. These covers are installed temporarily to prevent foreign objects from falling into the collector during shipment and assembly.

Figure 12: Protective cover removed from SunDrum collector inlet

1. Apply Teflon tape and pipe thread compound to threads before screwing in. **CAUTION**: coupling thread will easily strip if threads are not lined up correctly. Take care to align threads correctly – if a thread is not aligned it will strip, and barb thread or plug will have to be discarded. Each SDM300 system kit provides two spares.

WARNING: Do not tighten plugs or barb flush with SDM100. Leave two threads exposed. Over tightening will result in bottoming and restrict liquid flow.

2. Connect hose barbs and plugs, in the pattern determined by system configuration, while panels are on the ground.

3. Align barbs per appendix schematics. Note by allowing a modest hose loop between couplings it is much easier to interconnect the array. Loop should not be long enough to touch the roof else it will need to be secured.

WARNING: It is critical to have barbs in the correct orientation when installing them for the first time. If a barb is loosened after initially been tightened, the likelihood of a leak is much greater.

4. Cut the connection hose to slightly longer than expected length, and connect one end to the panel while on the ground. Tighten hose clamp.

5. Slide min R 2.6 UV-resistant insulation over hose and attach hose clamp to unattached end.

6. Stacking completed SDM100 hybrid modules:

Before beginning the assembly of another module it is important to store the completed modules(s) in such a way as to not damage the PV front surface. The following procedure is recommended:

a. Use two pieces of cardboard the length of the modules (lids from shipping boxes work great). Rest one length against a stable vertical surface (side of a building, for example), to protect the back of the assembled module. Rest the other cardboard on the horizontal surface to protect the bottom of the assembled module.

b. Rest the assembled module against the vertical cardboard taking care to protect the front PV surface from abrasion.

c. After assembling a second module, and before stacking the module against the first, use pieces of foam from the SDM100 packing material to separate the two modules. This will prevent any protrusions from the modules from abrading each other.

d. Repeat step (c) until no more than 6 modules are stacked.

e. For more than 6 modules go back to step (a) and start a new stack.

7. Repeat for each hybrid panel before mounting on roof

System Installation

After module assembly, while the assembled panels are still on the ground, **plan the complete sequence of installing panels in advance**, with all connectors and plugs attached to inlet / outlet connectors before raising panels to the roof. One end of each hose, with hose clamps and insulation, should also be attached before raising panels to the roof. Determine location of fluid headers on the roof and pre-cut hoses, insulation, and UV protection covering if necessary before bringing them up for installation.

For configurations where fluid input and output lines run through the building, the roof penetration location of pipes coming from inside the building play a large role in determining how SunDrum collectors will be arrayed within the PV array. Pipes and tubing should be insulated with minimum R2.6 and kept as short as possible to minimize thermal losses.

Rafter location also plays a role in determining header position. Ideally, inlet and outlet headers are located between rafters and between the split for two parallel strings of collectors. If there is adequate space between roof and collectors, the inlet header may be located under the panels and hidden from view.

 NOTE: When locating the inlet header under the bottom panel, avoid interference between the inlet hose and the rail If the inlet header is located 12” higher than the highest inlet this creates a air trap and will require an additional air auto vent on the inlet line..

 NOTE: All components will be installed so as to be accessible for maintenance.

Thermistor – Before bringing the SunDrum hybrid collectors to the roof select which module will have the thermal sensor (thermistor) attached and the best location for connecting the thermistor to signal wiring when installed on the roof. The thermal sensor will provide the most accurate data when it is mounted on the last (warmest) collector in a string. Once location is determined, attach the thermistor T-Sleeve to the assigned collector while it's still on the ground. The sensor itself will be installed once that panel is on the roof. Insure sensor wire has been run from the controller to the selected module location on the roof.

8. Mount panels to roof mounts following PV panel and rack installation guide. Complete interconnect to adjacent panels while mounting.

 **NOTE**: Having a small hose loop with barbs pointing down will ease installation.

 *NOTE Grounding* ***– SunDrum Collectors must be grounded for shock protection and safety. Follow grounding requirements for the PV panel you are installing. SunDrum collectors are themselves grounded through the PV panel frame – see the SunDrum collector*** Assembly Guide ***for correct grounding procedure when assembling SunDrum collector to PV panels.***

9. Loop hose over mount or fix to panels or rack rails so that hose does not touch roof.
10. Connect the hose to opposite barb and tighten hose clamp.
11. Measure hose and insulation, and connect array to the output header.
12. Attach the thermal sensor to the selected panel by sliding the thermistor into the T-sleeve, and secure the signal wires.
13. Measure hose and insulation and connect array to the input header
14. Follow Local plumbing codes and licensing requirements for installing the solar storage tank, pump station, controller, and anti scald valve. Note: Drip pan must be used if tank is located in or above the living space.
15. All components that can exceed 140^{o} F must be insulated or isolated from public traffic with warning label.
16. Test the systems for leaks:
    a. Shut off air auto vent/s by tightening the cap or set screw.
    b. Using either drain or charge valve pressurize the system to 5 psi. Pressure should not drop over a 15 minute interval.

c. Re-open the air auto vent once the test is complete

System Startup and Shutdown

Solar Thermal

 WARNING: Before initial system start up, the system should be checked for leaks by pressurizing the system to 5 PSI with air. **DO NOT PRESSURIZE WITH GREATER THAN 5psi** to avoid voiding warranty.

Charging the System

Typically the circulator pump in a closed loop system is not powerful enough to charge a system (raise fluid to highest point in the system). Therefore, an external pump must be used to charge the system.

 **WARNING:** The traditional solar thermal charging process of forcing air out system by running the heat transfer fluid at a high flow rate for an extended period time **will not work**. The SunDrum collector design doesn't allow for the purging of air by simply cycling fluid through the system**. The steps below must be followed closely to guarantee a successful system charge.**

 **WARNING:** Closed-loop systems need to slowly purge the air from the system through the air auto vent placed at the highest point in the system. This can be done with a positive-displacement pump at low flow rate or with an impeller-based pump gated to a low flow rate.

The charging procedure has four steps. In all steps, it is important to monitor pressure closely and control flow rate using the specified valves in each step, so that the maximum pressure limits are not exceeded. Familiarize yourself with the labeled valves and hose bibs before you begin.

1. ***System cleaning:*** It is recommended that any system, whether new or existing, be thoroughly cleaned prior to being charged with Cryo-tek products. This can be done by following the instructions in "charge the source side" with clean distilled water.

2. ***Charge the source side:*** This step fills the pipes, hoses, and collectors from the normal pumped side of the circulator pump – i.e. the fluid fills the system, moving in the normal direction of flow;

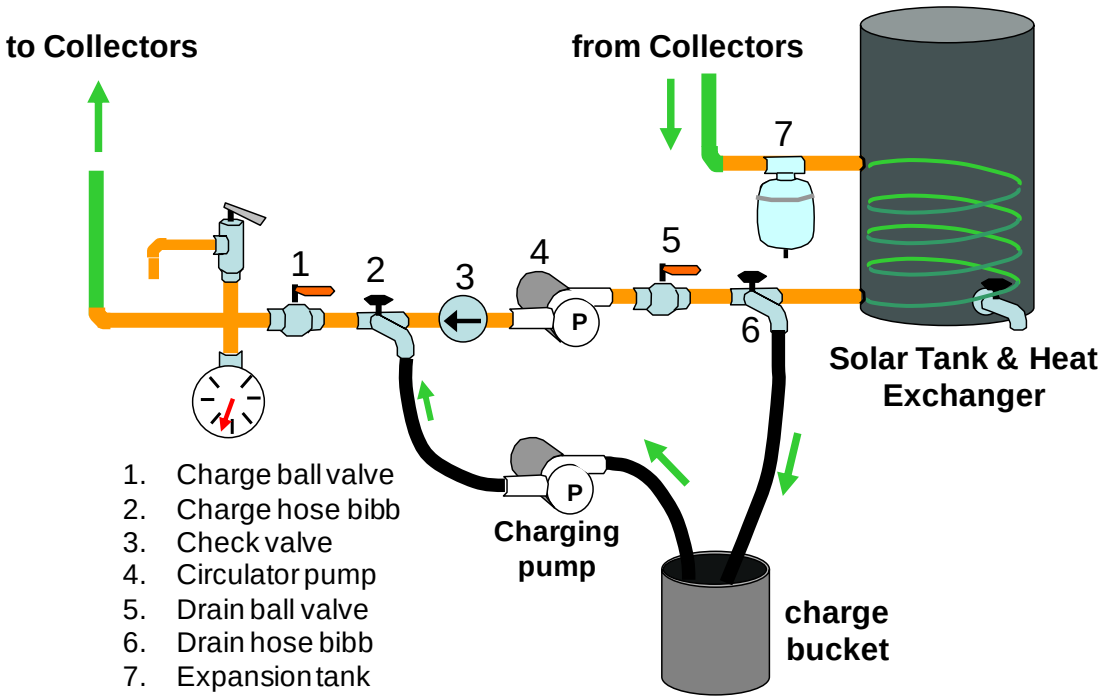
3. ***Prime the circulator pump:*** This step removes all the air from the circulator pump so that it is ready to take over and pump fluid after the charging steps are completed;

4. ***Charge the drain side:*** This step fills the pipes, hoses, and collectors by pumping fluid in the direction opposite to "normal" flow when the circulator pump is operating. Note this step must bypass the check valve.

When all three steps are completed correctly, the system will be filled with water/glycol mix, all of the air will be vented from the system, and the circulator pump will be moving fluid through the collectors, pipes, and hoses in the normal direction.

Charging the Source Side

Charging Source Side



1. Ensure that the air auto vent is in the open position to allow air to vent from the system when charging.
2. If necessary, prime the charge pump.
3. Connect the output end of the charge pump to the charge bibb (#2). The supply line to the charge pump should be inserted in a 5-gallon bucket filled with the thermal fluid mixture intended for system. (Use appropriate propylene glycol/water mix in freeze-prone zones.)
4. Open the drain bibb (#6) and connect one end of the discharge hose to the drain bibb (#6) and place the other end of the hose into the bucket.
5. Close both ball valves

Initial Valve Setup: Charge source side			
Drain Bibb #6 in Figure above	Drain Ball Valve #5 in Figure above	Charge Bibb # 2 in Figure above	Charge Ball Valve #1 in Figure above
Open	**Closed**	**Open**	**Closed**

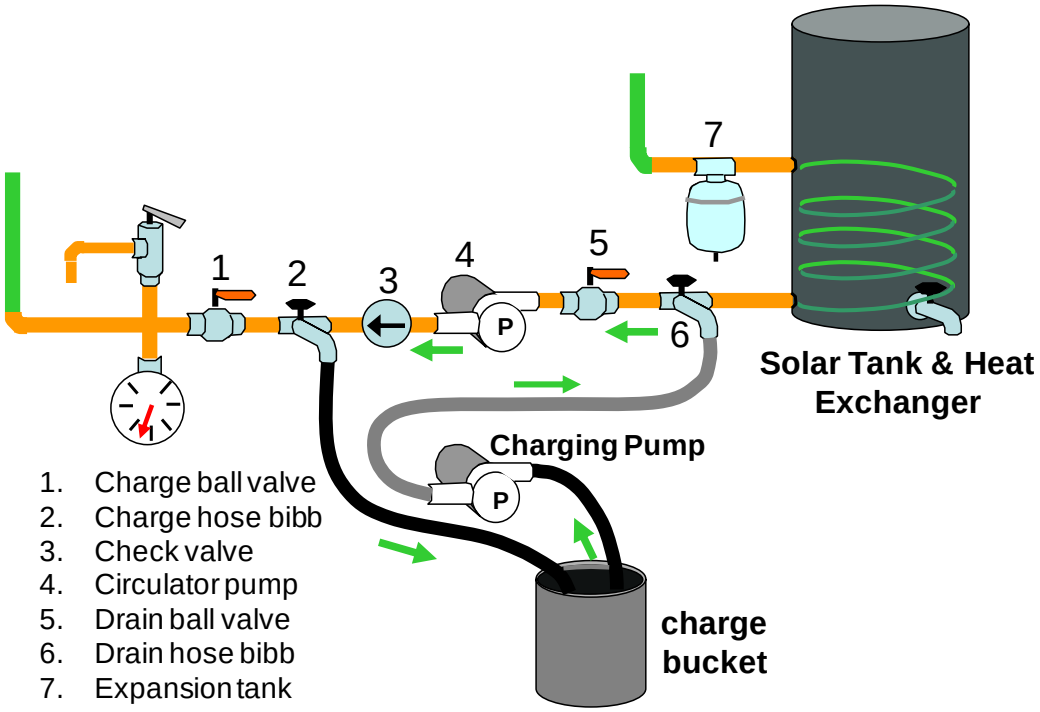
6. Turn the charge pump on and adjust the charge ball valve (valve #1) to fill the system at no more than 0.5 gpm flow rate (fluid will drop at approx 1.25 inches per minute in 5 gallon bucket).

 **NOTE:** To avoid losing prime on the charge pump, make sure the bucket always has enough fluid so that the end of the charge hose is always submerged and won't pull air into the system.

7. Fill the system until you see a steady flow from the drain hose into the bucket for 2 minutes.
8. Close the charge bibb (#2) and then shut off the charge pump. Let the system settle for 30 seconds and then note the head pressure.
9. Turn the charge pump back on and then open the charge bibb (#2). Slowly open the flow control valve (#1) until the pressure increases to 3 psi above noted head pressure from step 10. Run the charge pump for 1 minute at this rate.
10. Slowly shut the charge bibb (#2) and then shut off the charge pump.
11. Wait until fluid stops exiting the drain hose into the bucket. This could take several minutes, but will ensure an accurate measurement of the unpressurized head pressure. Measure the head pressure when stabilized. Unpressurized Head Pressure = _____ psi. Also note the unpressurized head on the supplied pressure gauge label.
12. Close the drain bibb (#6).

Priming the Circulator Pump

Priming Circulator Pump



13. Disconnect the drain hose from the drain bibb (#6). Disconnect the charge pump hose from the charge bibb (#2) and then connect the charge pump hose to the drain bibb (#6). Connect the drain hose to the charge bibb (#2).

Initial Valve Setup: Prime Circulator			
Drain Bibb #6 in Figure above	Drain Ball Valve # 5 in Figure above	Charge Bibb #2 in Figure above	Charge Ball Valve #1 in Figure above
Close	**Open**	**Open**	**Closed**

14. Turn the charge pump on and slowly open the drain bibb (#6) only enough to allow the fluid to steadily exit the drain hose into the bucket used to prime the circulator.

WARNING: *Once fluid begins to steadily exit the drain hose, it is very important to allow the fluid to steadily exit the drain hose for at least 5 seconds. At this point close the charge bibb (#2), close the drain ball valve, and then shut off the charge pump within 10 seconds (step 17, below).*

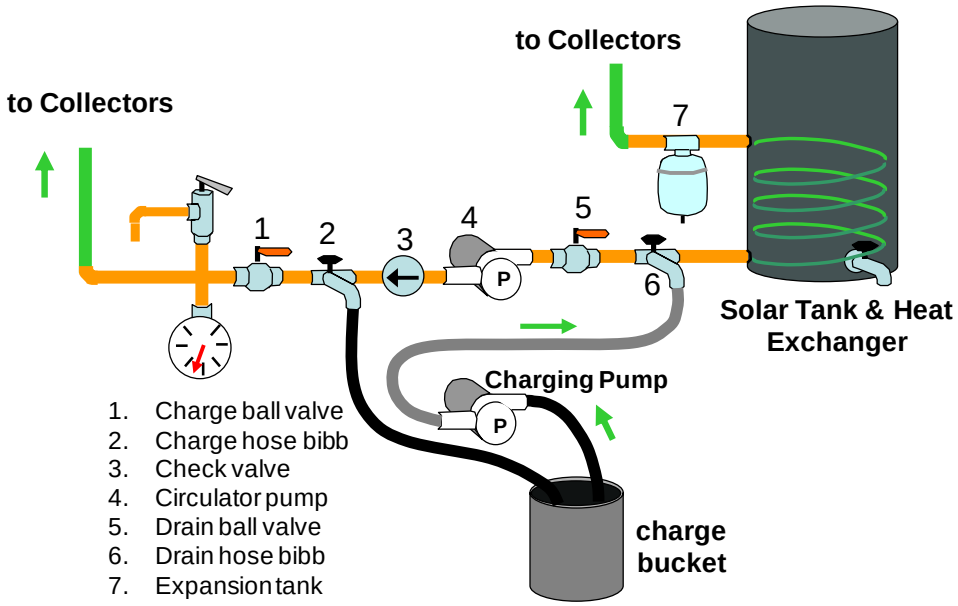
15. Close the charge bibb (#2), then drain ball valve (#5), and then shut off the charge pump.

    NOTE: If the charge pump is left on too long, this may damage the SunDrum collectors by exceeding the collectors' maximum pressure specification.

Charging Drain Side (Reverse-Charging Setup)

In this step the system is charged in the other direction (pumping into the "drain side" of the system), to purge additional air from system.

Charging Drain Side (reverse-charging setup)



16. Allow fluid to drain from the drain side through the charge pump until the pressure gauge redisplays head pressure, then close drain bibb (#6).

Initial Valve Setup: Charge Drain Side			
Drain Bibb #6 in Figure above	Drain Ball Valve #5 in Figure above	Charge Bibb #2 in Figure above	Charge Ball Valve #1 in Figure above
Closed	**Closed**	**Closed**	**Closed**

17. Turn the charge pump on and slowly open the drain valve #6. When the pressure increases by 1.00 psi. immediately open the drain ball valve (#5), wait a few seconds, and then fully open the flow control valve (#1). Slowly increase the pressure at 1 psi per minute using the drain bibb (#6) to limit pressure.

18. When the pressure gauge reads 3 psi above the head pressure, close the drain bibb (#6) and then shut off the charge pump and wait 10 minutes.

19. Set the expansion tank pressure by evacuating any gas from the expansion tank until the pressure gage drops to within 1 psi of the unpressurized head pressure measured in step 11. This allows the expansion tank to absorb changes in fluid volume to maintain reliable system operation.

 **Warning:** *If the expansion tank is not set properly, the system pressure can exceed the 6 psi panel specification and could damage the collectors.*

20. Return system pressure to 3psi above head by adding more fluid, being sure to close drain bibb (#6) and then shut off charge pump.

 **NOTE:** *If the circulator does not achieve prime see the troubleshooting section for useful tips to achieve prime.*

21. Adjust the circulator to its lowest power setting, then turn the circulator on and adjust the flow to the head pressure measured in step 16 + the pressure in the following table using the flow control valve (#1). If the flow is unable to be achieved shut off circulator, adjust to next highest power setting and repeat. Once flow is set, system charging is complete. Record normal off pressure on the pressure label.

System Model Number	System Configuration (# of Collectors)
SDM300-6,9	2 psi
SDM100-4,8	2.5 psi
SDM100-10	3 psi

22. Adjust the pressure relief valve to (head pressure + 9 psi). With supplied pressure relief valve this is three complete tighten rotations of the adjustment bolt from where the valve starts to leak. Record normal on pressure on the pressure label.

 Note: System is designed to minimize noise and vibration in piping and pumps. Only a quite hum should be audible during system operation.

Troubleshooting – Frequently-Asked Questions (FAQs)

1. If the circulator pump does not achieve prime, repeat the circulator pump priming sequence (steps 14-16).

2. If you are having trouble charging the source side, the charge pump may not have enough power to achieve the necessary head. Two charge pumps in series will increase the head height.

3. If the circulator pump is unable to start or maintain fluid flow, there is most likely an air pocket in the system. Connect the charge pump in parallel to the circulator taking care to introduce as little air into the system as possible. Open hose bibb #6, turn on charge pump, and slowly open bibb #2 until desired flow rate is attained. Since the charge pump is more powerful than the circulator it will move the air pocket to a location it can be vented. After 5 minutes of operation shut off the charge pump and close the hose bibbs. Turn on the circulator and validate correct operation.

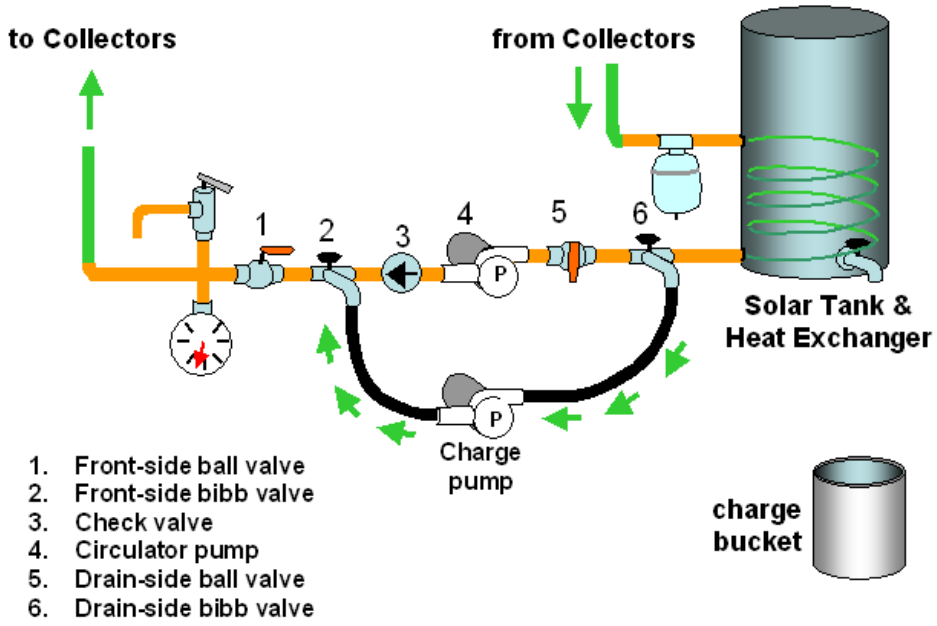
    **NOTE:** *It is very important to fill the hoses of the charge pump with the heat transfer fluid before hooking up to bibb.*

4. If pressure gauge swings erratically when shutting off the circulator pump, too much air remains in the system. Close drain ball valve (#5), drain fluid from drain side of system, and then repeat the charging drain side procedure (steps 15 – 18)

   a. If the pressure gauge continues to swing erratically there is a designed air trap in the system than needs to be found and eliminated or relieved with a air auto vent

5. If unable to determine accurate Native Head pressure reading, which may be due to the Drain Hose Bibb (#6) being located above the heat exchanger that may create a vacuum in step 11 that invalidates the pressure reading. Then use the following alternate method to calculate the Native head. Measure the height from the pressure gauge to the top of the system in feet and multiply by 0.433psi/ft. this is the system's Native Head pressure.

Charge Pump Parallel Operation



6. If the circulator pump does not achieve prime, repeat circulator pump priming sequence (steps 14-16).

Operation, Maintenance, and Inspection Schedule

Maintenance Schedule

We recommend the system owner purchase a maintenance contract from the system dealer or installer. Periodic inspection and maintenance is important to ensure best performance from your SunDrum system.

Name of Repair Company: _____

Address of Repair Company: _____

_____

SunDrum Collectors - require no preventative or scheduled maintenance.

Propylene Glycol Solution – The system should be tested each autumn to ensure the propylene glycol mixture will not freeze at the site's coldest winter temperatures or has become acidic. Use Hercule's C ryo-tek Test Kit (35271). Add additional Cryo-tek 100 /AL product if freeze protection is inadequate. Add C ryo-tek Inhibitor (35276) if pH is below 8.5. Test kits can be purchased from plumbing distributors or SunDrum Solar.

Hoses – Hoses should be inspected annual to insure they are not rubbing against the roof or exposed to direct sunlight without UV protection.

Couplings- Couplings should be inspected annually and tightened if they have become loose.

Insulation - insulation, and UV protection should be inspected annually and repaired when necessary.

Circulator pump – manufacturers manual will be given to the owner during installation which includes recommended maintenance instructions.

Storage Tank – manufacturers manual will be given to the owner during installation which includes recommended maintenance instructions.

Emergency Valve-Off – In the event of an emergency shut the valve off that allows cold water to enter the solar storage tank and contact dealer/installer

Projected Equipment replacement time – Even though they are not warranted for this duration, the majority of components used in a SDM300 system are expected to last 25 years. However, the Circulator, Solar Storage Tank, expansion tank, may not last this long. It can be projected that each of these components may need to be replaced every 10 years.

Appendix:

Document List and Description*SunDrum® Collector Assembly Guide*

Description: The *Collector Assembly Guides* show the installer how to attach the SunDrum collector to the back side of an off-the-shelf solar PV panel from one of SunDrum's supported PV panel manufacturers. This includes placement of the panel, attachment of brackets and clamps, and installation of insulating panels over the SunDrum collector. The target audience is system installers.

Limited Warranty

SunDrum® Solar ("SunDrum") SDM100 collector is warranted to be free from defects in materials and workmanship for 10 years from the date of warranty activation, when installed by an Authorized SunDrum Dealer in accordance with SunDrum's installation instructions. Within this period, SunDrum will, at its sole option, either repair or replace any components which fail in normal use, subject to the limitations and exclusions set forth herein. Such repairs or replacement will be made at no charge to the customer for parts or labor; provided that the customer shall be responsible for transportation cost.

SunDrum® Solar accessories are warranted to be free from defects in materials and workmanship for 2 years from the date of warranty activation, when installed by an Authorized SunDrum Dealer in accordance with SunDrum's installation instructions. Within this period, SunDrum will, at its sole option, either repair or replace any components which fail in normal use, subject to the limitations and exclusions set forth herein. Such repairs or replacement will be made at no charge to the customer for parts or labor; provided that the customer shall be responsible for transportation cost.

Limitations and Exclusions

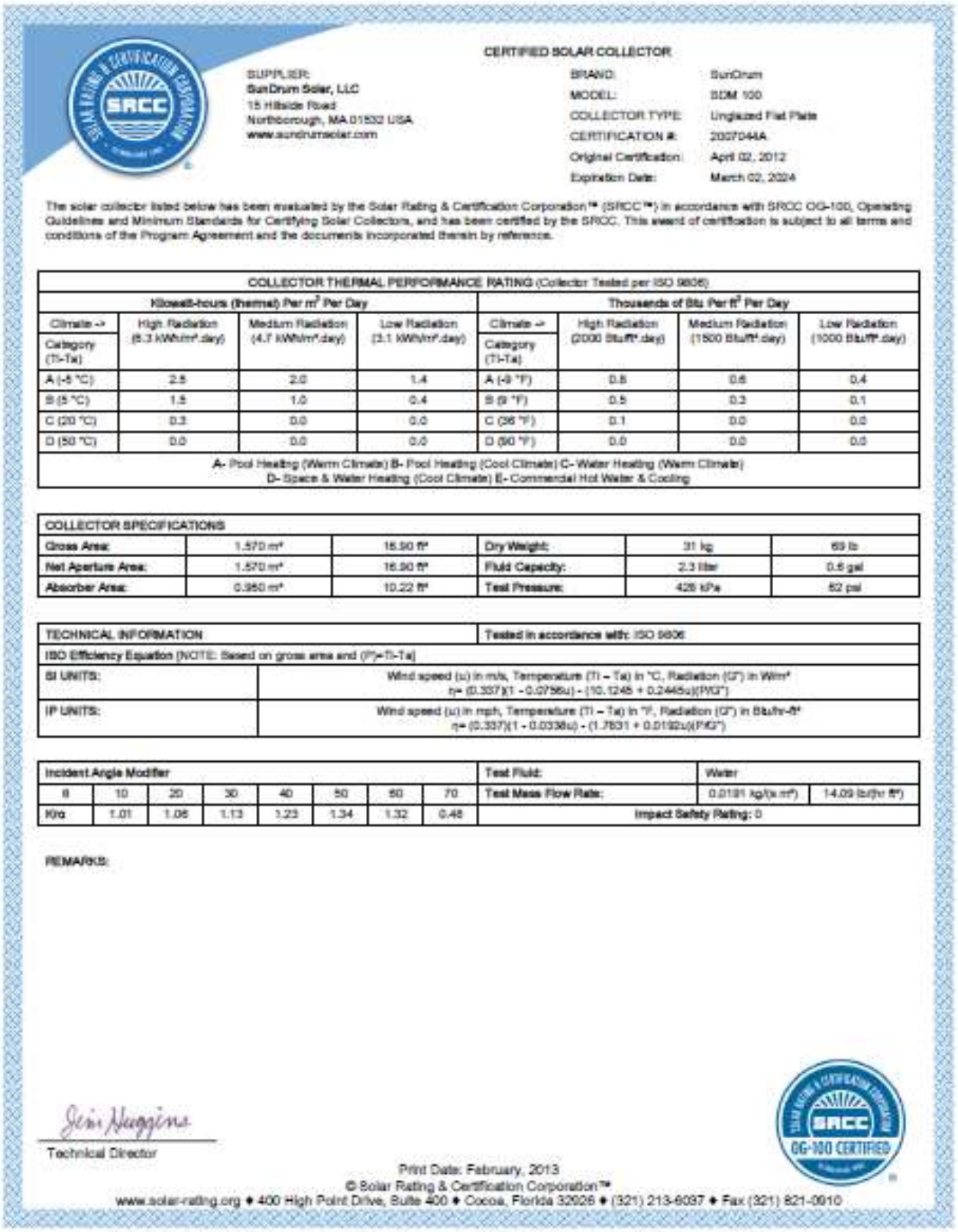
This warranty does not cover failures resulting from freeze damage, fire, flood, lightning, hurricane, tornado, hailstorm, windstorm, earthquake, or other acts of God, vandalism, explosions, exposure to harmful materials, including but not limited to acetic, caustic, or highly mineralized water or other fluids, operation of the collector under excessive pressure or excessive flow rates, abuse, negligence, accident, misuse, falling objects or unauthorized alterations or repairs or any other cause beyond the control of SunDrum Solar.

THE WARRANTIES AND REMEDIES CONTAINED HEREIN ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED OR STATUATORY, INCLUDING ANY LIABILITY ARISING UNDER ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, STATUATORY OR OTHERWISE. THIS WARRANTY GIVES YOU SPECIFIC RIGHTS, WHICH MAY VARY FROM STATE TO STATE.

IN NO EVENT SHALL SUNDRUM BE LAIBLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM THE USE, MISUES, OR INABILITY TO USE THIS PRODUCT OR FROM DEFECTS IN THE PRODUCT. SOME STATES DO NOT ALLOW THE EXCLUSION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU.

SunDrum retains the exclusive right to repair or replace the product or offer a full refund of the purchase price at its sole discretion. SUCH REMEDY SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY BREACH OF WARRANTY.

To obtain warranty service, contact your local SunDrum authorized dealer.



CERTIFIED SOLAR COLLECTOR

SUPPLIER:
SunDrum Solar, LLC
15 Hillside Road
Northborough, MA 01532 USA
www.sundrumsolar.com

BRAND:	SunDrum
MODEL:	SDM 100
COLLECTOR TYPE:	Unglazed Flat Plate
CERTIFICATION #:	20070444A
Original Certification:	April 02, 2012
Expiration Date:	March 02, 2024

The solar collector listed below has been evaluated by the Solar Rating & Certification Corporation™ (SRCC™) in accordance with SRCC OG-100, Operating Guidelines and Minimum Standards for Certifying Solar Collectors, and has been certified by the SRCC. This award of certification is subject to all terms and conditions of the Program Agreement and the documents incorporated therein by reference.

COLLECTOR THERMAL PERFORMANCE RATING (Collector Tested per ISO 9806)

Kilowatt-hours (thermal) Per m² Per Day				Thousands of Btu Per ft² Per Day			
Climate -->	High Radiation (6.3 kWh/m².day)	Medium Radiation (4.7 kWh/m².day)	Low Radiation (3.1 kWh/m².day)	Climate -->	High Radiation (2000 Btu/ft².day)	Medium Radiation (1500 Btu/ft².day)	Low Radiation (1000 Btu/ft².day)
Category (Ti-Ta)				Category (Ti-Ta)			
A (-5 °C)	2.5	2.0	1.4	A (-9 °F)	0.8	0.6	0.4
B (5 °C)	1.5	1.0	0.4	B (9 °F)	0.5	0.3	0.1
C (20 °C)	0.3	0.0	0.0	C (36 °F)	0.1	0.0	0.0
D (50 °C)	0.0	0.0	0.0	D (90 °F)	0.0	0.0	0.0

A- Pool Heating (Warm Climate) B- Pool Heating (Cool Climate) C- Water Heating (Warm Climate)
D- Space & Water Heating (Cool Climate) E- Commercial Hot Water & Cooling

COLLECTOR SPECIFICATIONS					
Gross Area:	1.570 m²	16.90 ft²	Dry Weight:	31 kg	69 lb
Net Aperture Area:	1.570 m²	16.90 ft²	Fluid Capacity:	2.3 liter	0.6 gal
Absorber Area:	0.950 m²	10.22 ft²	Test Pressure:	428 kPa	62 psi

TECHNICAL INFORMATION	Tested in accordance with: ISO 9806
ISO Efficiency Equation (NOTE: Based on gross area and (Ti-Ta)/G)	
SI UNITS:	Wind speed (u) in m/s, Temperature (Ti – Ta) in °C, Radiation (G) in W/m² η= (0.337)(1 - 0.0756u) - (10.1245 + 0.2445u)(Ti/G)
IP UNITS:	Wind speed (u) in mph, Temperature (Ti – Ta) in °F, Radiation (G) in Btu/hr-ft² η= (0.337)(1 - 0.0336u) - (1.7831 + 0.0192u)(Ti/G)

Incident Angle Modifier								Test Fluid:	Water	
θ	10	20	30	40	50	60	70	Test Mass Flow Rate:	0.0191 kg/(s·m²)	14.09 lb/(hr·ft²)
K(τα)	1.01	1.06	1.13	1.23	1.34	1.32	0.48	Impact Safety Rating: 0		

REMARKS:

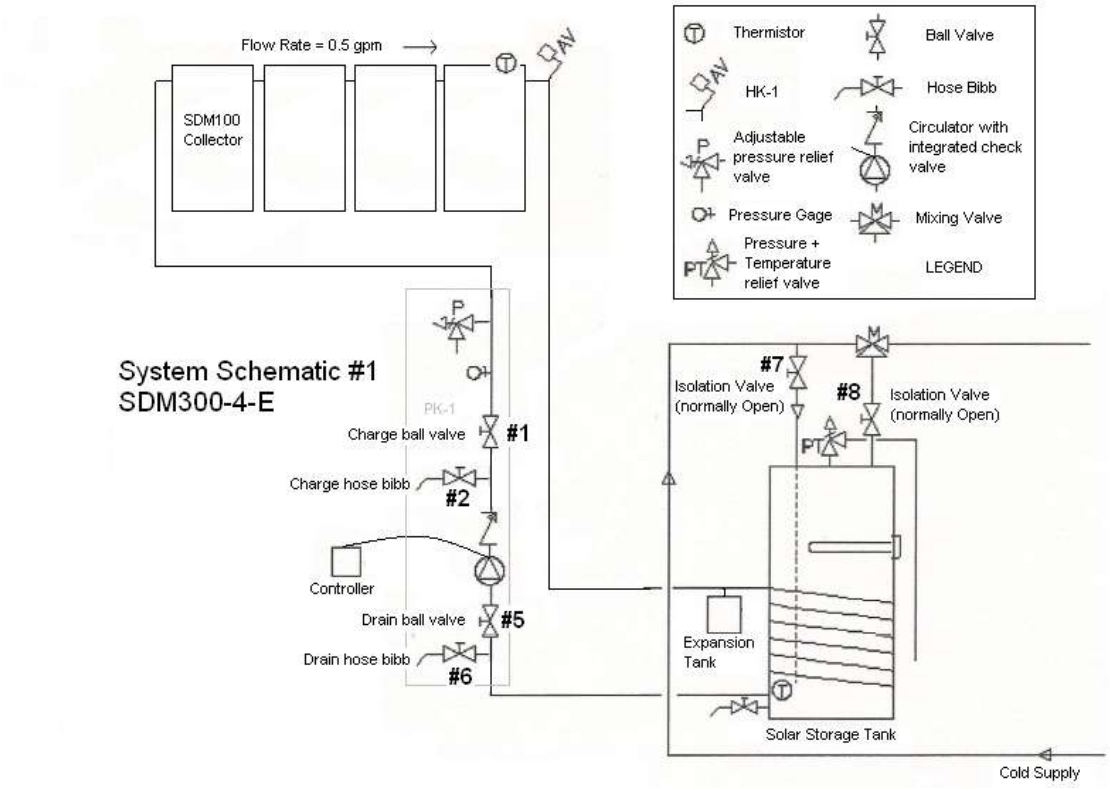
Jean Huggins
Technical Director

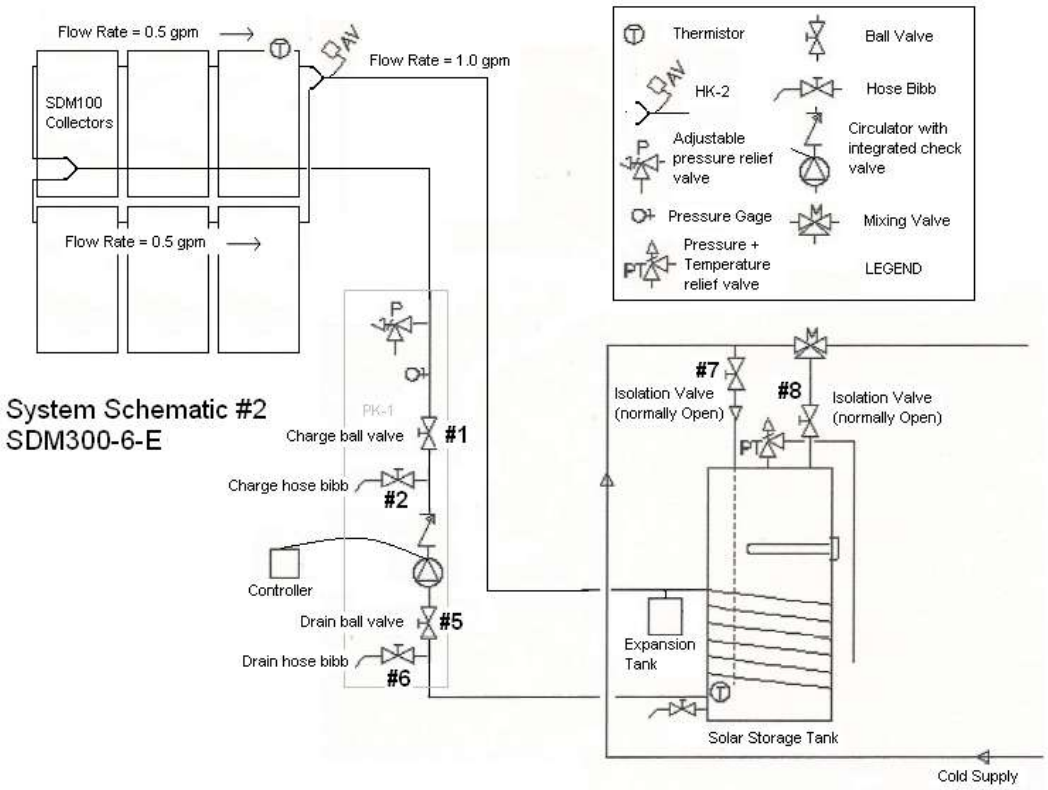
Print Date: February, 2013
© Solar Rating & Certification Corporation™
www.solar-rating.org ♦ 400 High Point Drive, Suite 400 ♦ Cocoa, Florida 32926 ♦ (321) 213-6037 ♦ Fax (321) 821-0910

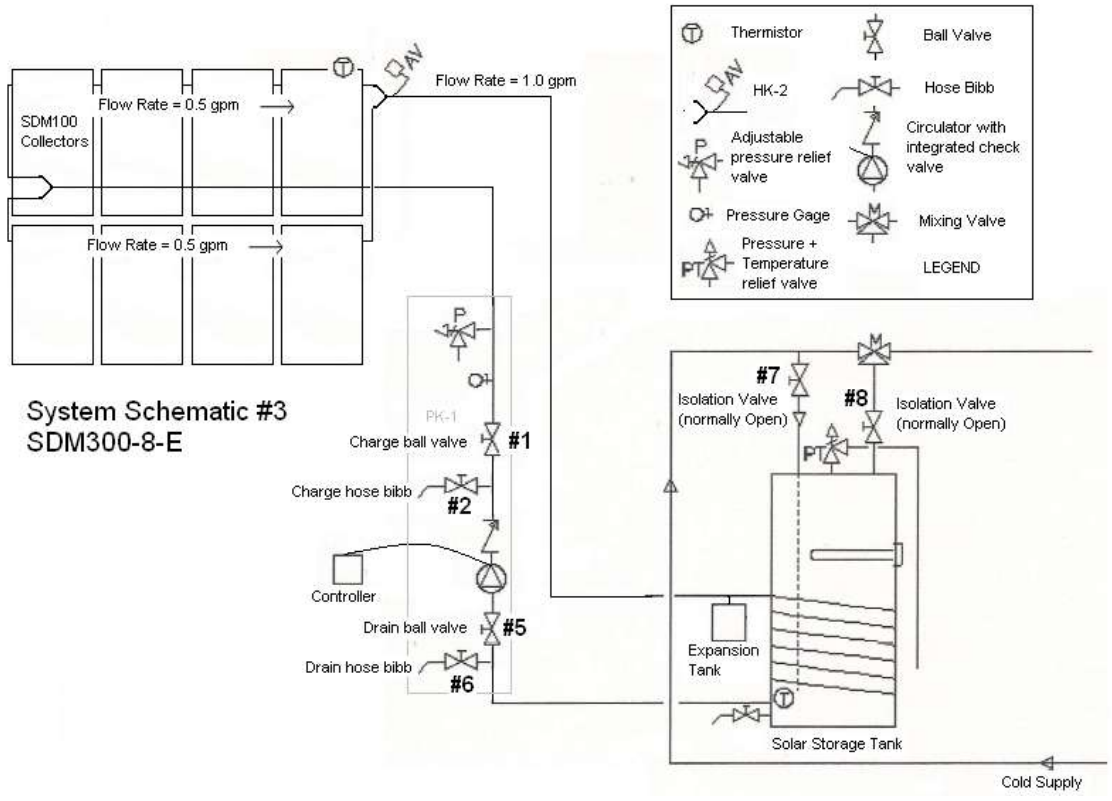
Page 1 of 1

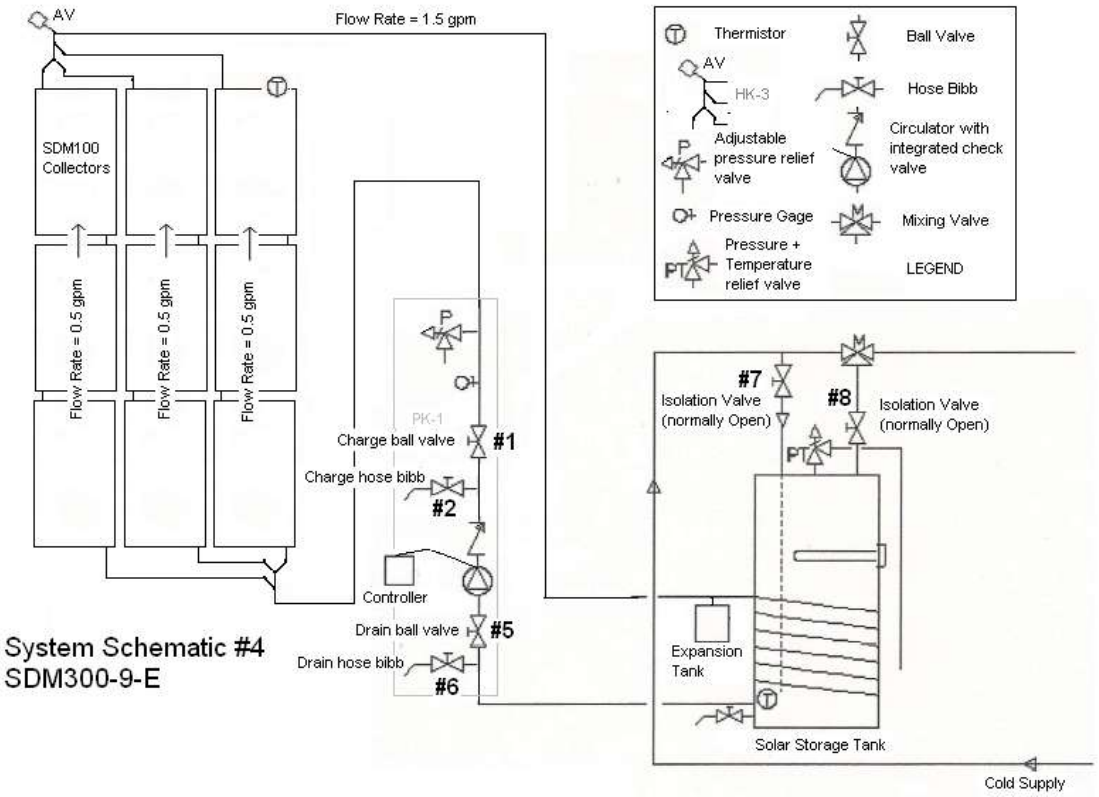
Controller Manual

Description: The *Controller Manual* provides the controller operating instructions. Including preset delta T on/off limits and safety features.

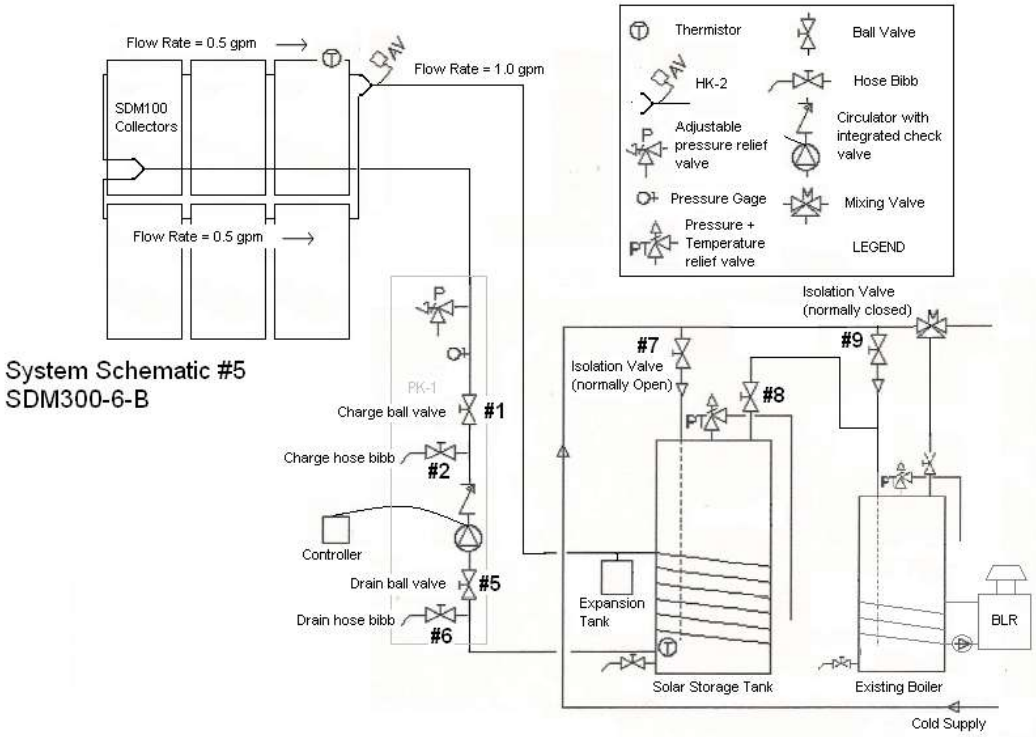



Flow Rate = 0.5 gpm
Flow Rate = 1.0 gpm
SDM100
Collectors
Flow Rate = 0.5 gpm
Thermistor
Ball Valve
HK-2
Hose Bibb
Adjustable
pressure relief
valve
Circulator with
integrated check
valve
Pressure Gage
Mixing Valve
Pressure +
Temperature
relief valve
LEGEND
System Schematic #2
SDM300-6-E
PK-1
Charge ball valve
#1
Charge hose bibb
#2
Controller
Drain ball valve
#5
Drain hose bibb
#6
#7
Isolation Valve
(normally Open)
#8
Isolation Valve
(normally Open)
Expansion
Tank
Solar Storage Tank
Cold Supply

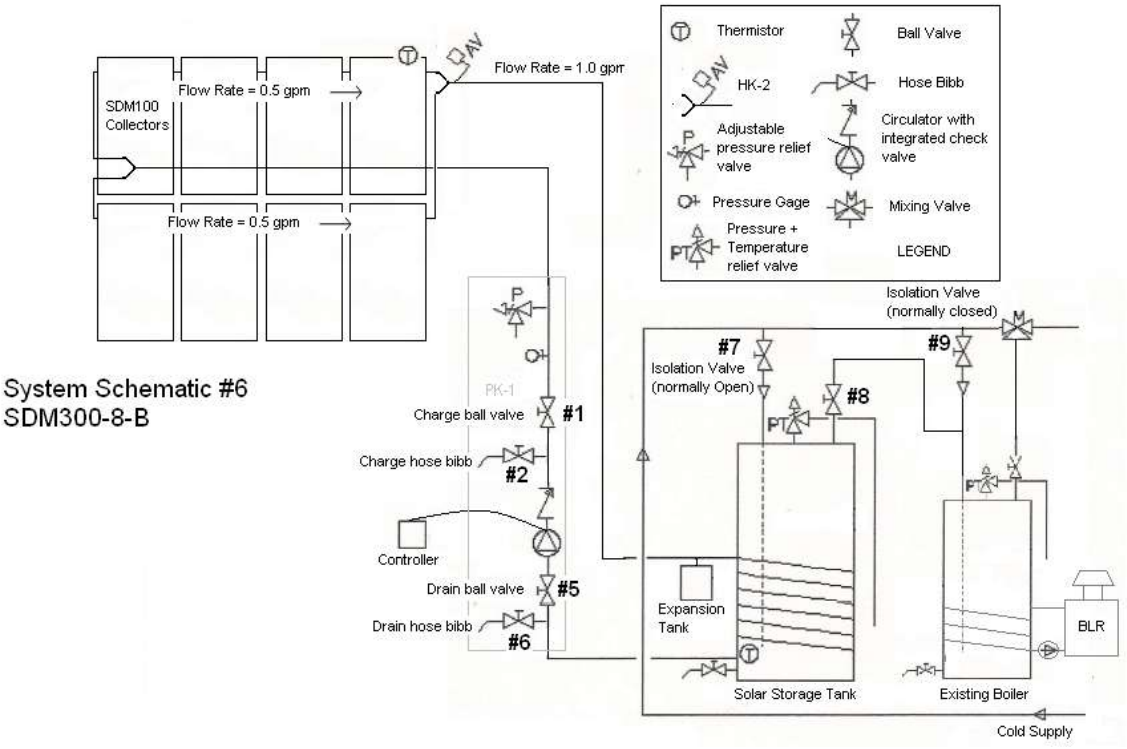

Flow Rate = 1.0 gpm
Flow Rate = 0.5 gpm
SDM100
Collectors
Flow Rate = 0.5 gpm
Thermistor
Ball Valve
HK-2
Hose Bibb
Adjustable
pressure relief
valve
Circulator with
integrated check
valve
Pressure Gage
Mixing Valve
Pressure +
Temperature
relief valve
LEGEND
System Schematic #3
SDM300-8-E
PK-1
Charge ball valve
#1
Charge hose bibb
#2
Controller
Drain ball valve
#5
Drain hose bibb
#6
#7
Isolation Valve
(normally Open)
#8
Isolation Valve
(normally Open)
Expansion
Tank
Solar Storage Tank
Cold Supply



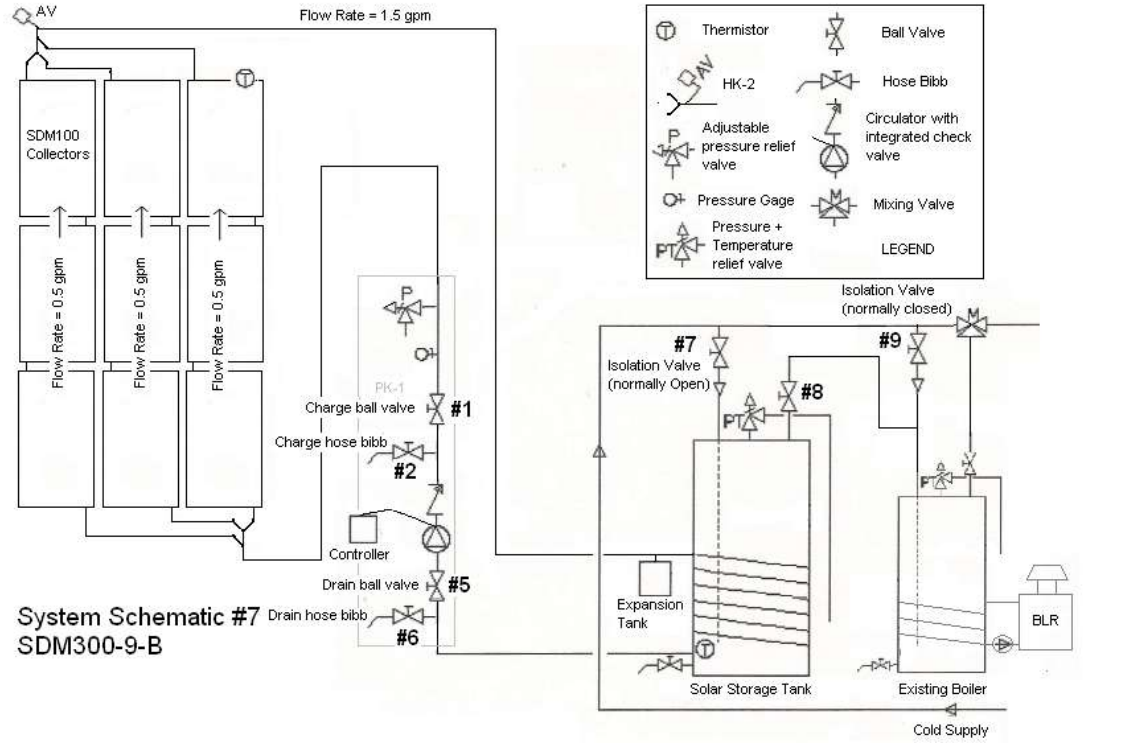
System Schematic #4
SDM300-9-E



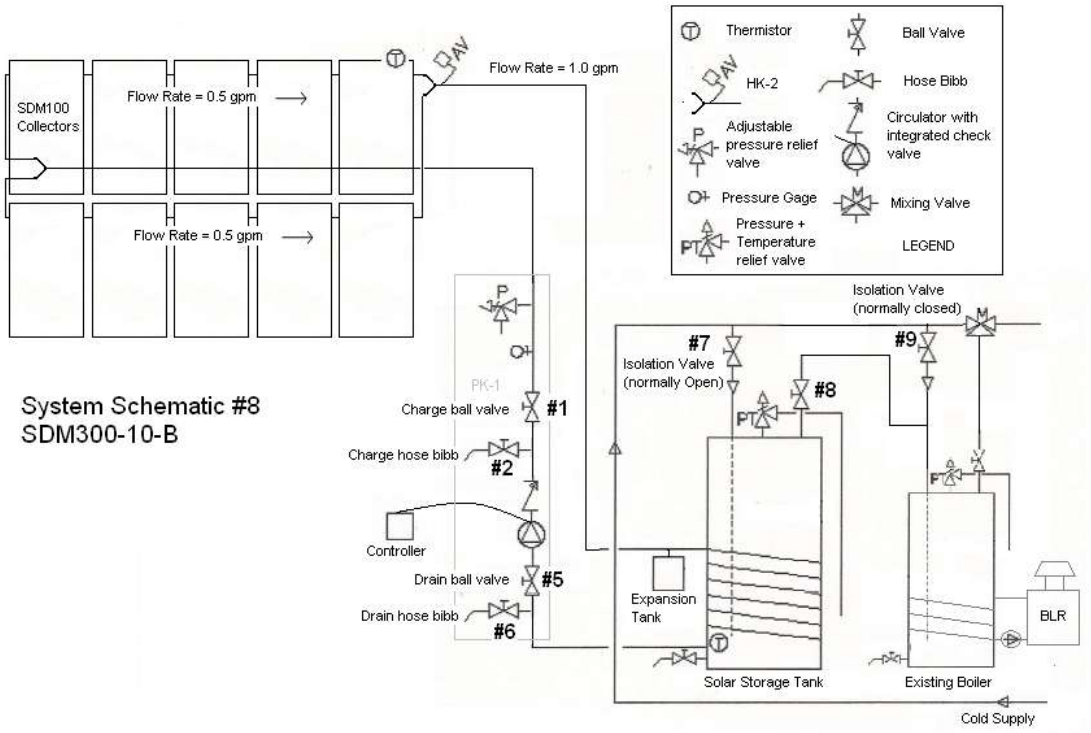
System Schematic #5
SDM300-6-B



System Schematic #6
SDM300-8-B



System Schematic #7
SDM300-9-B



System Schematic #8
SDM300-10-B

System Labels

SDM300 Pressure label is to be located close to the pressure gage and completed per steps 11 + 21.

SunDrum® Solar SDM300 Pressure Label

Native Head Pressure _____ psi.

Normal Off Pressure _____psi

Normal On Pressure _____psi

Temperature Warning labels should be installed on any uninsulated hot water pipes. The installer should insulate any hot water pipes to avoid burns.

Solar Storage Tank Label should be attached to the tank after final insulation or covering is installed.

Solar Storage Tank

Maximum Operating Temperature = 185° F

Maximum Operation Pressure = 50 PSI

SunDrum® Solar SDM300-___-___

____% Cryo-Tek-100/AL Propylene Glycol, Heat Transfer Fluid mixture ____ parts pg ____parts dw. AWWA Fluid Class II; HMIS rating of 0-0-0-A.

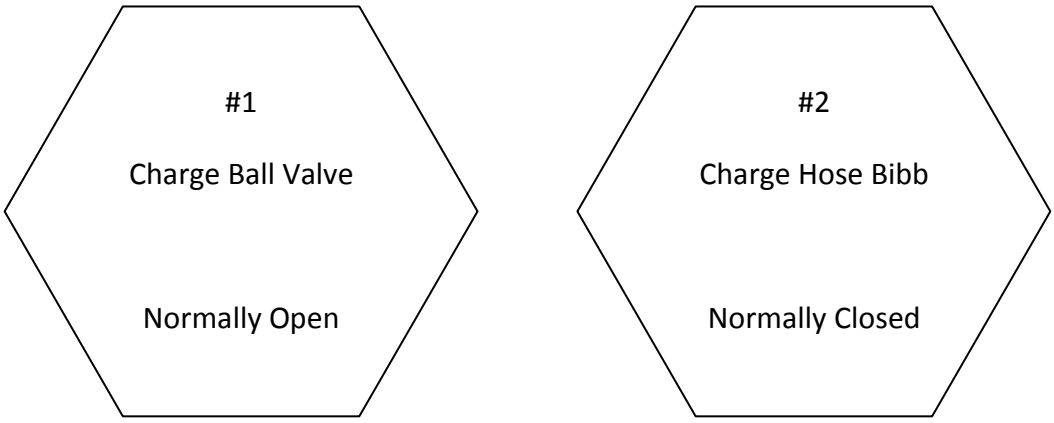
Minimum rated temperature _____

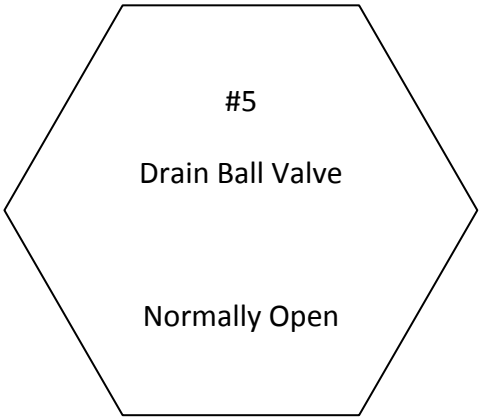
Freeze tolerance limits are based upon an assumed set of environmental conditions. At a 75% concentration freeze limit is -21F.

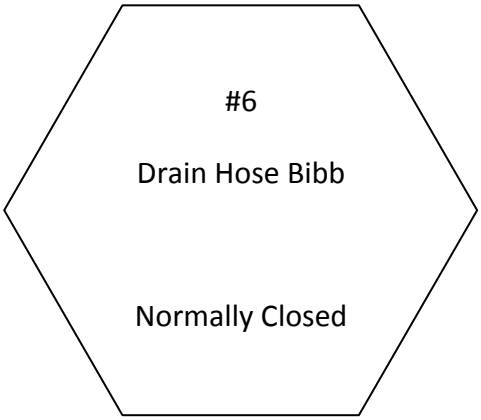
Heat exchanger type double-wall with leak protection. No other fluid shall be used that would change the original classification of this system. Unauthorized alterations to this system could result in a hazardous health condition. See Manual for handling instructions.

SunDrum Solar System Label should be located in a highly visible location either on the Solar Storage tank or by the Controller.

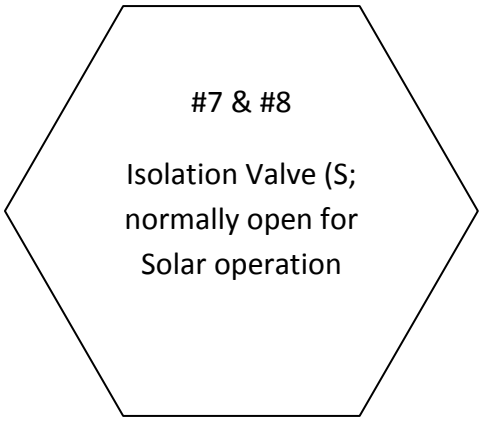
The following labels are attached during manufacturing on SunDrum Solar Pump stations

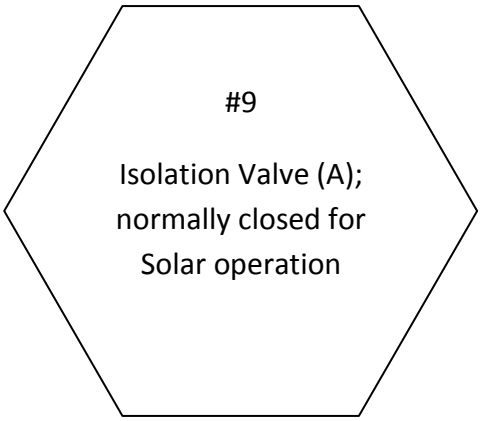






Labels #7,#8 and #9 are attached by the plumber and describe how to disable the solar system from the auxiliary hot water source.





Spec Sheet #S00040
July 2008

cryo-tek™ -100/AL

ANTI-FREEZE for aluminum heat exchanger heating and cooling systems

HERCULES®

specifications

cryo-tek™ -100/AL

DESCRIPTION

A new generation of very efficient boilers utilizing ALUMINUM HEAT EXCHANGERS are becoming more popular in today's marketplace. These new boilers typically heat three times faster than traditional boilers and require a specific, unique blend of anti-freeze specific to protecting against acid corrosion.

Cryo-tek -100/AL is a blend of virgin (not recycled) propylene glycol and Hercules exclusive Triple Protection additives designed for use in hydronic heating and cooling closed loop piping systems (including PEX and radiant tube heating systems), ice melt and general heating systems where aluminum heat exchangers are installed.

Hercules Triple Protection additives provide outstanding protection against acid corrosion, scale and sedimentation formation in properly maintained systems containing recommended concentrations of **cryo-tek Anti-Freeze**.

- Acid neutralizing agent protects by neutralizing corrosive acids.
- Mineral Deposition Preventative eliminates scale formation on critical heat transfer surfaces, piping systems and equipment.
- Mineral Sediment Preventative keeps minerals in solution, resisting formation of clusters of mineral salts and preventing particles from precipitating out of solution.

Used at recommended levels, all three agents work together to prevent bio film (slime) build-up.

Cryo-tek -100/AL may be used in systems fabricated with metal, plastics (except CPVC) and rubber piping, fittings, seals, and other parts. Corrosion inhibitors in all **cryo-tek** products protect against corrosive build-up within the piping loop and are effective with most metals including steel, aluminum* and copper. **Cryo-tek** solutions have a high specific heat and are efficient at transferring heat.

As packaged, **cryo-tek** is non-flammable, odorless, non-irritating, and compatible with **Hercules boiler stop leaks**.

Formulated for the maximum propylene glycol protection directly out of the container. Certified Performance: Freeze Protection Down to -60°F / -51°C, Pumpable Down to** to -70°F / -57°C, and Burst Protection Down to -100°F / -73°C.

Cryo-tek -100/AL can be diluted with water for less severe conditions. (See Chart page 3.)

Test Kits and Accessories

Freeze protection levels and corrosion protection levels should be checked annually. Use **Hercules Refractometer** (35290) and **pH Meter** (35272) or, **cryo-tek Test Kit** (35271). Add additional **cryo-tek** product, if freeze protection is inadequate. Add **cryo-tek -100/AL Inhibitor** (35274), if pH is below 7.0. (see Maintenance section).

*Please check with equipment manufacturer of system to determine compatibility with this product.
**Minimum flow protection levels are estimated and are dependent on system and equipment.

cryo-tek™ -100/AL

ANTI-FREEZE for aluminum heat exchanger heating and cooling systems

SIZES AND PACKING

STOCK NO.	SIZE	PACKING	WEIGHT/CASE
35283 cryo-tek -100/AL	5 gal.	1	49.6 lbs.
35291 cryo-tek -100/AL	55 gal.	1	518.0 lbs.
35290 Refractometer	-	1	0.25 lbs.
35272 pH Meter	-	1	0.3 lbs.
35271 Test Kit	-	6-10 packs	0.3 lbs.

STOCK NO.	SIZE	PACKING	WEIGHT/CASE
35274 Inhibitor	8 oz.	6	5.3 lbs.
35279 Protection Tags	*Free available upon request*		

APPROVALS AND LISTINGS

The virgin propylene glycol used in **cryo-tek -100/AL** and all **cryo-tek** products is "GRAS" (Generally Recognized As Safe) for incidental contact with food.

SPECIFIC USES

Use any **cryo-tek Anti-Freeze** in hydronic closed loop heating and cooling systems, chillers, ice melt, solar heating systems, and general plumbing systems that require freeze protection. **Cryo-tek -100/AL** is specifically formulated for aluminum based heat exchangers.

SPECIFIC APPLICATIONS†

Add **cryo-tek** product to protect pipes from freezing and bursting. Although **cryo-tek -100/AL** is specifically designed for use in boilers with aluminum heat exchangers, it can be used in more traditional applications, such as chiller systems, recreational vehicles, seasonal homes, mobile homes, trailers, boats, sprinkler systems, and industrial use.

PHYSICAL PROPERTIES

cryo-tek -100/AL

pH	7.0 - 8.5
Density lb/gal. 60°F - 65°F	8.74 lb./ gallon
Specific Gravity 60°F - 65°F	1.050
Specific Heat BTU/lb°F @ 160°F	0.806
Boiling Point:	230°F / 110°C
Appearance and color:	Orange liquid. Odorless.

WARNINGS OR CAUTIONS

- Read all cautions and directions carefully before using this product.
- Not for use in steam systems.
- Not for use with CPVC pipe and fittings.
- Use **Hercules boiler liquid or base hit™ II** to stop leaks on system containing **cryo-tek** products.
- Do not use in internal combustion engines as a coolant.
- Do not use in water softeners. Disconnect all water softeners from system or provide back flow protection to prevent mineral contamination of minerals.
- **Cryo-tek** products are not recommended:

1. For use in systems containing galvanized components.
2. For open solar systems and systems where operating stagnation temperatures are regularly over 300°F / 150°C.
3. For systems with concentrating solar collectors or evacuated tube solar collectors.

(Please check with equipment manufacturer of system to determine compatibility with this product).

CAUTION REGARDING COMPETITIVE PRODUCTS:

Hercules cryo-tek products are formulated using virgin propylene glycol and high purity Triple Protection additives for assurance of materials compatibility and non-toxicity characteristics. Dilution or mixing of **cryo-tek** products with other manufacturers' product may compromise these critical requirements and is not recommended.

† For special applications which may not be covered on this or other Hercules literature, please contact Hercules Technical Services Department by phone at 1-800-221-9330 or send a fax to 1-800-333-3456.

INSTALLATION INSTRUCTIONS

1. CLEAN THE SYSTEM - It is recommended that any system, whether new or existing, be thoroughly cleaned prior to being charged with **cryo-tek -100/AL**. Any system contaminated with dirt and other materials reduces efficiency and wears the system prematurely. New systems need to be free of flux, solder residue, grease and any foreign particles. Existing systems need to be flushed and cleaned to eliminate any build-up of rust, scale, lime and other non-organic matter. All systems should be checked for leaks prior to installation of any **cryo-tek** product. Minor leaks can be sealed with **Hercules base hit II or Hercules boiler liquid**.

2. MEASURE THE TOTAL CAPACITY OF THE SYSTEM using one of the following methods:

DIRECT METHOD

A. Fill system completely, making sure all components of system are full.

B. Shut system down, let pressure drop to a safe level.

C. Drain out fluid into suitable container and record the number of gallons removed. This is TOTAL SYSTEM FLUID CAPACITY.

ESTIMATION METHOD

A. Determine system pipe sizes and amount of linear footage for each size. Using Table I, calculate the volume of the system piping.

B. Add this number to the gallon capacity of the boiler or equipment in the system to determine the TOTAL SYSTEM FLUID CAPACITY.

TABLE I (Note: 1 US Gallon = 3.785 Liters)

Description	Pipe Diameter Nominal Size	3/8"	1/2"	5/8"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"
Standard Steel Pipe	US Gallons of Fluid per 100 ft. pipe	1.0	1.6	-	2.8	4.5	7.8	10.5	17.5	24.9	38.5
Type "L" Copper Tubing	US Gallons of Fluid per 100 ft. pipe	0.76	1.22	1.81	2.52	4.30	6.55	9.27	16.12	24.86	35.48

3. SELECT DESIRED TEMPERATURE COVERAGE

Using Table II, determine protection level desired and match it to the appropriate **cryo-tek** product concentration.

TABLE II

cryo-tek -100/AL

	MIXING RATIO		PROTECTIONS		
% Concentration of cryo-tek -100/AL	Parts of cryo-tek -100/AL	Parts of Water	Freeze Protection Down to	Pumpable* Down to	Burst Protection Down to
100%	undiluted	–	-60°F / -51°C	-70°F / -57°C	-100°F / -73°C
75%	3	1	-18°F / -28°C	-32°F / -35°C	-75°F / -60°C
60%	3	2	+2°F / -17°C	-20°F / -29°C	-50°F / -45°C
50%	1	1	+12°F / -11°C	+5°F / -15°C	-20°F / -30°C

The above chart differs from cryo-tek -100. Cryo-tek -100 is based on actual freeze numbers developed at NJIT. The cryo-tek -100/AL chart above is based on using the Dow tables at 60% PG.

*Pumpable Down to protection levels are estimated and are dependent on system and equipment. Attempting to circulate fluid below freeze point may overload and/or cause pump failure.

4. DETERMINE AMOUNT OF cryo-tek PRODUCT REQUIRED IN SYSTEM

Determine the amount of **cryo-tek** product needed in system by multiplying total system capacity in gallons by the concentration factor of **cryo-tek -100/AL**, product (first column in each chart above).

Total System Capacity (gal) X Concentration Factor of cryo-tek product = Amount of cryo-tek product to be used (gal)

5. CHARGING THE SYSTEM

System should be completely empty with burner and pump shut off. All internal valves, including zone valves, should be open. THE ENTIRE SYSTEM SHOULD BE OPEN TO PREVENT ANY AREA OF IT FROM BEING ISOLATED. First, add the computed amount of **cryo-tek** product. Second, add water if necessary. The system can be filled using one of the following two alternatives. The main objective is to fill the system with little or no air trapped in it.

A. After providing for an air exit, pump solution into boiler through the boiler drain valve using a small pump.

B. Pour solution through a removed air vent at the HIGHEST point in the system.

6. PURGE THE AIR IN SYSTEM

Since air (which includes oxygen) trapped in a system not only results in inefficiencies in the operating of the system (wasted energy and excessive noise), it can also cause corrosion. To prevent this, the system, once filled, needs to be purged of all air.

7. TEST THE SYSTEM

Once installed and fully operational, use **Hercules Refractometer** and **pH Meter** or **Cryo-tek Test Strips** to test fluid to assure proper freeze and corrosion protection.

Note: An automotive coolant tester will not work with cryo-tek or other propylene glycol anti-freeze mixtures.

8. MAINTENANCE

Systems with **Cryo-tek -100/AL** installed should be tested annually for product concentration and inhibitor levels using Hercules Refractometer and pH Meter (or, less accurately Hercules Test Strips). If **Cryo-tek -100/AL** concentration levels are low, add **Cryo-tek -100/AL** using the following formula:

$$\text{TOTAL SYSTEM CAPACITY (gal) X } \frac{\text{(\% Cryo-tek desired - \% Cryo-tek in system)}}{\text{(100\% - \% Cryo-tek in system)}} = \text{Number of gallons of Cryo-tek to be added.}$$

Be sure to drain adequate fluid from system before adding the additional **Cryo-tek -100/AL**.

The proprietary inhibitor used in **Hercules Cryo-tek -100/AL** has an exceptionally long life expectancy.

The pH of the system solution should always be between 7.0 and 8.5.

If the corrosion inhibitor tests low, add one 8 oz. container of **Cryo-tek Inhibitor** in accordance with inhibitor label instructions for every 20 gallons of fluid capacity of the system. If the total system capacity is less than 20 gallons, add one 8 oz. container of **Cryo-tek -100/AL** inhibitor. If after inhibitor addition and thorough system mixing, the corrosion inhibitor pH still tests low, add another 8 oz. container of **Cryo-tek -100/AL** inhibitor for every 20 gallons of system capacity. If after this addition the inhibitor still tests low, the system should be drained, cleaned, and recharged with fresh **Cryo-tek -100/AL**.

MATERIAL SAFETY INFORMATION

FOR MORE INFORMATION ON THIS PRODUCT, REQUEST MATERIAL SAFETY DATA SHEET (MSDS) #40 cryo-tek -100/AL

For Delivery by Fax	Call 1-800-942-4636
Internet	See MSDS section of www.herchem.com
Mail	Contact Hercules at address below or any Hercules representative

HMIS Hazard Warning 0-0-0-A

INGREDIENTS	CAS#
PROPYLENE GLYCOL NJ-T.S.R. #81348300 5018P, 5002P	57-55-6

If you require additional information or have specific questions concerning **Hercules cryo-tek** products, call Hercules Technical Services department at 1-800-221-9330, send a fax to 1-800-333-3456, or e-mail to info@herchem.com

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4