Duda Solar Water Heating Systems

Operation and Maintenance Manual

Duda Energy LLC

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www.DudaEnergy.com

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General Information

Please read this manual in its entirety prior to installing your Duda Solar water heater. This manual covers the general installation of the solar water heater but may not be a complete resource for the full installation or safety requirements for performing an installation. These systems should be installed in accordance with all local building codes.

Local Standards

This installation must be done in accordance with all local, state and federal regulations. Check with your local building code and code enforcement prior to installing a solar water heater. Local codes/regulations take precedence over the guidelines in this manual.

Qualified Installer

Duda Energy LLC does not take responsibility for improper installation of its Solar Water Heaters. Only people with plumbing, roofing and electrical knowledge should install a solar water heater. Duda Energy LLC recommends that a qualified/certified plumber or solar installer who holds a license required for such industry should install this product.

This water heater should be installed in accordance with the local code authority which has such jurisdictions over the installation, the utility company and this installation manual. If there are no local code requirements, follow the regulations found in the latest edition of The National Electric Code, NFPA 70. This may be obtained from the following organizations:

National Fire Protection Agency
1 Batterymarch Park
Quincy, MA 02269

American National Standards Institute
1430 Broadway
New York, NY 1001

Use your phonebook listings for the local authorities having jurisdiction over your installation.

Warnings and Cautions

When the term "**Warning**" is used it means that a person could be injured or killed if the procedure is not adhered to. The term "**Caution**" means that a person has a chance of being injured or worse if the procedure is not adhered to. "**Notes**" signify something regarding general tips for operation of the unit.

Pressure Release & Relief Valve

- **Caution**: The closed system solar loop **must operate at less than 87 psi** and have an expansion tank installed to accommodate expansion from the working fluid.
- **Caution**: The closed loop system design must eject fluid at **no more than 113 psi**. It is recommended that the pressure relief valve be operated every 6 months to ensure reliability and operation. Please raise and lower the release lever gently and carefully as the working fluid of the system can be extremely hot.
- **Caution**: The solar water tank must be equipped with a temperature/pressure relief valve. It must relieve pressure at no higher than 99°C / 100 psi. The T/P valve should be operated every 6 months to ensure reliability and operation. Please raise and lower the release lever gently and carefully as the working fluid of the system can be extremely hot.
- **Warning**: Failure to operate the pressure temperature relief valves on a regular basis could lead to failure of the component or possible solar storage tank explosion and damage to the solar system.

Water Quality

- Water needs to be added to propylene glycol for the working fluid of the system. It is recommended that distilled water be used to help prevent corrosion to the plumbing and system parts and to also ensure efficient heat transfer. The water quality must meet the following requirements:

Chloride	< 250 ppm
Hardness	< 200 ppm
Magnesium	< 10 ppm
Dissolved Solids	< 600 ppm
Chlorine	< 5 ppm

- Caution: Only food grade propylene glycol mixed with water may be used to make an antifreeze solution in the solar loop. The Duda Energy Inhibited Propylene Glycol has special corrosion inhibitors which will coat the inside of the piping in the solar loop. This helps prevent corrosion within the closed loop system, especially in the case of the propylene glycol becoming acidic over time.
- **Warning**: Do not use ethylene glycol (automotive antifreeze) for your solar loop. This chemical is toxic and may cause death should failure occur within the system causing it to mix in with the water in the tank. Only Food Grade Propylene glycol may be used in a solar water heater system.

- When mixing the propylene glycol with water, do not use a solution of more than 60% propylene glycol to 40% water by volume unless otherwise instructed by the manufacturer. The propylene glycol solution should only be concentrated enough to avoid the coldest possible temperatures in the region. Higher propylene glycol concentrations will reduce the heat transfer and pumping efficiency.
- Propylene glycol solutions will gradually become more acidic over time and should be changed out every 3 to 5 years to prevent excessive corrosion to the pipes. If the propylene glycol solution exceeds 250ºF on a regular basis, it should be changed more frequently as propylene glycol will become rapidly acidic when kept above this temperature.
- You should obtain a water quality analysis of your water supply prior to installing the solar water tank. Most of the time, these tests can be obtained from your water authority as they are required to perform this test and keep the results on record. If the water comes from a well, a water quality test should still be performed.
- If your location has "hard" water, the inside of the solar tank will become coated with lime scale, thus reducing the efficiency and life expectancy of the tank. It is recommended that a sufficient softening device be utilized for effective long term operation of the tank.
- The anode rod in the solar water tank is used to protect the inner walls of the tank from corrosion by use of the phenomenon known as galvanic corrosion. The anode rod, which is less noble than stainless steel, will corrode first before the stainless steel walls can corrode. Regular replacement of the rod will greatly extend the life of the tank. This rod should be checked every few years or replaced according to the below anode replacement schedule.

Dissolved Solids in Water (ppm)	Replacement Interval of Anode
0 – 600	5 Years
600 – 1000	3 Years
➢ 1000	2 Year or Less

- The Duda Solar water heating tank is initially equipped with a magnesium anode rod. Magnesium anode rods dissolve into the water as they corrode and provide healthy minerals to the water supply. Alternatives to the magnesium rods are aluminum or zinc-aluminum combinations. The aluminum-type rods are nobler than magnesium rods and will last a little bit longer than magnesium rods. Aluminum anode rods are preferred if your water supply contains very hard water. Zinc-aluminum (10% zinc, 90% Aluminum) rods can be used if the water has a sulfur dioxide odor. The zinc can help remove this order.

Metallic Corrosion

Duda Energy does not warrant the solar collector or solar water heater tank against corrosion related damage. Always use high grade copper or Duda's Flex tubing (corrugated stainless steel tubing) in the solar loop. The heat generated by the solar collectors can leach impurities into the working fluid of the system.

Warning: Do not use iron or PEX tubing in the closed loop section of the solar system. Iron piping fails easily due to corrosion effects of the working fluid and the ambient air. PEX tubing or any kind of plastic piping will melt from the extreme temperatures of the solar water collector.

Connection of Piping

Copper must be soldered using high temperature silver solder. The use of compression fittings or such equivalent fittings are acceptable for connecting copper pipes. Flexible stainless steel tubing must be attached using the threads and a high temperature gasket.

Freeze Protection of the Closed Loop System

The manifold and piping could become damaged from cold temperatures due to expansion of the working fluid in the case of freezing. A Food Grade Propylene Glycol solution should be used for maximum freeze protection in the closed solar loop. Refer to the temperature chart below for the appropriate mixture ratio based on your location. It is best to recognize that solar collectors on a roof will experience the coldest parts of the night and should have a solution able to withstand the coldest possible climate in your area. While the highest concentration may seem the best for the highest freeze protection, the lowest concentration permissible by weather should be used as heat transfer and pumping is more efficient with higher concentrations of water.

Note: No more than 60% propylene glycol should be used as higher concentrations have low heat conduction and high viscosity which may hinder performance of the circulation pump.

Solution (% by *mass)	10	20	30	40	50	60
Freeze Temp (°F)	26	18	7	-8	-29	-55
Boiling Temp (°F)	212	213	216	219	222	225

*The density of propylene glycol is very similar to that of water so a volume/volume ratio may be used in substitute to mass/mass.

Note: Duda Energy's Special Inhibited Food Grade Propylene Glycol is highly recommended. It will coat the inner parts of the metal piping with corrosion inhibitors. This will help prevent corrosion to the pipes as the glycol solution becomes acidic over time.

Freeze Protection of the Copper Heat Pipes

The evacuated tubes and heat pipes are not normally susceptible to damage in mild cold climates. The standard Duda Solar copper heat pipes (0.6mm thickness) are rated for -10°C (14°F) operating temperatures. It is generally acceptable for the heat pipes to endure 5–10°C (9-18°F) lower than their rated minimum operating temperatures for intermediate periods. However, if cold temperatures are expected to normally exceed this minimum temperature requirement, Duda Solar freeze resistant heat pipes should be considered to avoid cracking of the heat pipes. Use the below chart as a guide for Duda Solar Freeze Resistant Heat Pipes.

Model	Low Temperature	High Temperature	Heat Pipe	Condenser

	Rating	Rating	Thickness	Cover
Standard	-10°C (14°F)	230°C (446°F)	0.6mm	No
Freeze Resistant	-25°C (-13°F)	250°C (482°F)	0.7mm	No
Super Freeze Resistant	-50°C (-58°F)	250°C (482°F)	0.8mm	Yes

SRCC Certification & collector specifications

The Duda Solar Water Heater Collectors are OG-100 SRCC Certified. They are one of the most efficient solar water heaters in the market. They have a very high performance in both warm and cold weather due to its excellent design in manifold technology and quality evacuated tubes.

OG-100 certified collectors are eligible for the 30% Federal Tax Rebate for alternative energy. All components involved in the installation and labor may be considered for the tax rebate.

Following are copies of the SRCC report for each collector offered by Duda Energy LLC. To view the full pages of the SRCC report, please visit www.solar-rating.org and go to Ratings and search by entering the corresponding SRCC certification number into the appropriate field for search Duda Energy LLC by company name.

Duda Solar 15 Tube Solar Collector SRCC Certification

CERTIFIED SOLAR COLLECTOR

SUPPLIER:
Duda Energy
7055A Greenbrier Rd
Madison, AL 35756 USA

In Accordance with:
SRCC Standard 100-2010-08

BRAND:	Duda Solar
MODEL:	SC5815
COLLECTOR TYPE:	Tubular
CERTIFICATION #:	10001877
Original Certification:	September 19, 2013
Expiration Date:	July 13, 2023

The solar collector listed below has been evaluated by the Solar Rating & Certification Corporation™ (SRCC™), an ANSI accredited and EPA recognized Certification Body, 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. This document must be reproduced in its entirety.

COLLECTOR THERMAL PERFORMANCE RATING

Kilowatt-hours (thermal) Per Panel Per Day				Thousands of Btu Per Panel Per Day			
Climate -> Category (Ti-Ta)	High Radiation (6.3 kWh/m².day)	Medium Radiation (4.7 kWh/m².day)	Low Radiation (3.1 kWh/m².day)	Climate -> Category (Ti-Ta)	High Radiation (2000 Btu/ft².day)	Medium Radiation (1500 Btu/ft².day)	Low Radiation (1000 Btu/ft².day)
A (-5 °C)	6.8	5.1	3.5	A (-9 °F)	23.3	17.5	11.8
B (5 °C)	6.6	5.0	3.3	B (9 °F)	22.7	17.0	11.2
C (20 °C)	6.4	4.7	3.0	C (36 °F)	21.7	16.0	10.3
D (50 °C)	5.7	4.0	2.4	D (90 °F)	19.4	13.7	8.1
E (80 °C)	5.0	3.4	1.7	E (144 °F)	17.0	11.5	5.9

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:	2.342 m²	25.21 ft²	**Dry Weight:**	48 kg	106 lb
Net Aperture Area:	1.417 m²	15.25 ft²	**Fluid Capacity:**	0.9 liter	0.2 gal
Absorber Area:	1.219 m²	13.12 ft²	**Test Pressure:**	900 kPa	131 psi

TECHNICAL INFORMATION						
			Tested in accordance with: ISO 9806			
ISO Efficiency Equation [NOTE: Based on gross area and (P)=Ti-Ta]						
SI UNITS:	η= 0.420 - 0.65440(P/G) - 0.00310(P²/G)		**Y Intercept:**	0.420	**Slope:**	-0.786 W/m².°C
IP UNITS:	η= 0.420 - 0.11533(P/G) - 0.00030(P²/G)		**Y Intercept:**	0.420	**Slope:**	-0.139 Btu/hr.ft².°F

Transverse Incident Angle Modifier								Longitudinal Incident Angle Modifier at 50°:		0.90
θ	10	20	30	40	50	60	70	Test Fluid:	Water	
Κτα	1.02	1.06	1.14	1.25	1.40	1.55	1.35	Test Mass Flow Rate:	0.0118 kg/(s m²)	8.67 lb/(hr ft²)

REMARKS:

Jeni Huggins
Technical Director

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Duda Solar 20 Tube Solar Collector SRCC Certification

CERTIFIED SOLAR COLLECTOR

SUPPLIER:
Duda Energy
7055A Greenbrier Rd
Madison, AL 35756 USA

In Accordance with:
SRCC Standard 100-2010-08

BRAND:	Duda Solar
MODEL:	SC5820
COLLECTOR TYPE:	Tubular
CERTIFICATION #:	10001878
Original Certification:	September 19, 2013
Expiration Date:	July 13, 2023

The solar collector listed below has been evaluated by the Solar Rating & Certification Corporation™ (SRCC™), an ANSI accredited and EPA recognized Certification Body, 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. This document must be reproduced in its entirety.

COLLECTOR THERMAL PERFORMANCE RATING

Kilowatt-hours (thermal) Per Panel Per Day				Thousands of Btu Per Panel Per Day			
Climate -> Category (Ti-Ta)	High Radiation (6.3 kWh/m².day)	Medium Radiation (4.7 kWh/m².day)	Low Radiation (3.1 kWh/m².day)	Climate -> Category (Ti-Ta)	High Radiation (2000 Btu/ft².day)	Medium Radiation (1500 Btu/ft².day)	Low Radiation (1000 Btu/ft².day)
A (-5 °C)	9.0	6.8	4.6	A (-9 °F)	30.6	23.1	15.5
B (5 °C)	8.7	6.5	4.3	B (9 °F)	29.8	22.3	14.8
C (20 °C)	8.4	6.2	4.0	C (36 °F)	28.6	21.1	13.5
D (50 °C)	7.5	5.3	3.1	D (90 °F)	25.5	18.1	10.7
E (80 °C)	6.6	4.4	2.3	E (144 °F)	22.4	15.1	7.7

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:	3.083 m²	33.19 ft²	**Dry Weight:**	64 kg	141 lb
Net Aperture Area:	1.889 m²	20.33 ft²	**Fluid Capacity:**	1.2 liter	0.3 gal
Absorber Area:	1.625 m²	17.49 ft²	**Test Pressure:**	900 kPa	131 psi

TECHNICAL INFORMATION						
			Tested in accordance with: ISO 9806			
ISO Efficiency Equation [NOTE: Based on gross area and (P)=Ti-Ta]						
SI UNITS:	η= 0.420 - 0.65440(P/G) - 0.00310(P²/G)		**Y Intercept:**	0.420	**Slope:**	-0.786 W/m².°C
IP UNITS:	η= 0.420 - 0.11533(P/G) - 0.00030(P²/G)		**Y Intercept:**	0.420	**Slope:**	-0.139 Btu/hr.ft².°F

Transverse Incident Angle Modifier								Longitudinal Incident Angle Modifier at 50°:	0.90
θ	10	20	30	40	50	60	70	Test Fluid:	Water
Κτα	1.02	1.06	1.14	1.25	1.40	1.55	1.35	Test Mass Flow Rate:	0.0118 kg/(s m²) / 8.67 lb/(hr ft²)

REMARKS:

Jeni Huggins
Technical Director

www.solar-rating.org ♦ 400 High Point Drive, Suite 400 ♦ Cocoa, Florida 32926 ♦ (321) 213-6037 ♦ Fax (321) 821-0910

Duda Solar 25 Tube Solar Collector SRCC Certification

CERTIFIED SOLAR COLLECTOR

SUPPLIER:
Duda Energy
7055A Greenbrier Rd
Madison, AL 35756 USA

In Accordance with:
SRCC Standard 100-2010-08

BRAND:	Duda Solar
MODEL:	SC5825
COLLECTOR TYPE:	Tubular
CERTIFICATION #:	10001879
Original Certification:	September 19, 2013
Expiration Date:	July 13, 2023

The solar collector listed below has been evaluated by the Solar Rating & Certification Corporation™ (SRCC™), an ANSI accredited and EPA recognized Certification Body, 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. This document must be reproduced in its entirety.

COLLECTOR THERMAL PERFORMANCE RATING

Kilowatt-hours (thermal) Per Panel Per Day				Thousands of Btu Per Panel Per Day			
Climate -> Category (Ti-Ta)	High Radiation (6.3 kWh/m².day)	Medium Radiation (4.7 kWh/m².day)	Low Radiation (3.1 kWh/m².day)	Climate -> Category (Ti-Ta)	High Radiation (2000 Btu/ft².day)	Medium Radiation (1500 Btu/ft².day)	Low Radiation (1000 Btu/ft².day)
A (-5 °C)	11.1	8.4	5.6	A (-9 °F)	38.0	28.6	19.3
B (5 °C)	10.8	8.1	5.4	B (9 °F)	37.0	27.7	18.3
C (20 °C)	10.4	7.7	4.9	C (36 °F)	35.4	26.1	16.8
D (50 °C)	9.3	6.6	3.9	D (90 °F)	31.7	22.4	13.3
E (80 °C)	8.2	5.5	2.8	E (144 °F)	27.8	18.7	9.6

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:	3.824 m²	41.16 ft²	**Dry Weight:**	80 kg	176 lb
Net Aperture Area:	2.361 m²	25.41 ft²	**Fluid Capacity:**	1.5 liter	0.4 gal
Absorber Area:	2.032 m²	21.87 ft²	**Test Pressure:**	900 kPa	131 psi

TECHNICAL INFORMATION						
			Tested in accordance with: ISO 9806			
ISO Efficiency Equation [NOTE: Based on gross area and (P)=Ti-Ta]						
SI UNITS:	η= 0.420 - 0.65440(P/G) - 0.00310(P²/G)		**Y Intercept:**	0.420	**Slope:**	-0.786 W/m².°C
IP UNITS:	η= 0.420 - 0.11533(P/G) - 0.00030(P²/G)		**Y Intercept:**	0.420	**Slope:**	-0.139 Btu/hr.ft².°F

Transverse Incident Angle Modifier								Longitudinal Incident Angle Modifier at 50°:		0.90
θ	10	20	30	40	50	60	70	Test Fluid:	Water	
Κτα	1.02	1.06	1.14	1.25	1.40	1.55	1.35	Test Mass Flow Rate:	0.0118 kg/(s m²)	8.67 lb/(hr ft²)

REMARKS:

Jeni Huggins
Technical Director

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Duda Solar 30 Tube Solar Collector SRCC Certification

CERTIFIED SOLAR COLLECTOR

SUPPLIER:
Duda Energy
7055A Greenbrier Rd
Madison, AL 35756 USA

In Accordance with:
SRCC Standard 100-2010-08

BRAND:	Duda Solar
MODEL:	SC5830
COLLECTOR TYPE:	Tubular
CERTIFICATION #:	10001880
Original Certification:	September 19, 2013
Expiration Date:	July 13, 2023

The solar collector listed below has been evaluated by the Solar Rating & Certification Corporation™ (SRCC™), an ANSI accredited and EPA recognized Certification Body, 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. This document must be reproduced in its entirety.

COLLECTOR THERMAL PERFORMANCE RATING

Kilowatt-hours (thermal) Per Panel Per Day				Thousands of Btu Per Panel Per Day			
Climate -> / Category (Ti-Ta)	High Radiation (6.3 kWh/m².day)	Medium Radiation (4.7 kWh/m².day)	Low Radiation (3.1 kWh/m².day)	Climate -> / Category (Ti-Ta)	High Radiation (2000 Btu/ft².day)	Medium Radiation (1500 Btu/ft².day)	Low Radiation (1000 Btu/ft².day)
A (-5 °C)	13.3	10.0	6.7	A (-9 °F)	45.3	34.2	23.0
B (5 °C)	13.0	9.7	6.4	B (9 °F)	44.2	33.1	21.9
C (20 °C)	12.4	9.1	5.9	C (36 °F)	42.3	31.2	20.0
D (50 °C)	11.1	7.9	4.7	D (90 °F)	37.8	26.8	15.9
E (80 °C)	9.7	6.5	3.3	E (144 °F)	33.2	22.3	11.4

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:	4.565 m²	49.14 ft²	**Dry Weight:**	96 kg	212 lb
Net Aperture Area:	2.833 m²	30.49 ft²	**Fluid Capacity:**	1.7 liter	0.5 gal
Absorber Area:	2.438 m²	26.24 ft²	**Test Pressure:**	900 kPa	131 psi

TECHNICAL INFORMATION						**Tested in accordance with:** ISO 9806
ISO Efficiency Equation [NOTE: Based on gross area and (P)=Ti-Ta]						
SI UNITS:	η= 0.420 - 0.65440(P/G) - 0.00310(P²/G)		**Y Intercept:**	0.420	**Slope:**	-0.786 W/m².°C
IP UNITS:	η= 0.420 - 0.11533(P/G) - 0.00030(P²/G)		**Y Intercept:**	0.420	**Slope:**	-0.139 Btu/hr.ft².°F

Transverse Incident Angle Modifier								Longitudinal Incident Angle Modifier at 50°:	0.90
θ	10	20	30	40	50	60	70	**Test Fluid:**	Water
Kτα	1.02	1.06	1.14	1.25	1.40	1.55	1.35	**Test Mass Flow Rate:**	0.0118 kg/(s m²) / 8.67 lb/(hr ft²)

REMARKS:

Jeni Huggins
Technical Director

www.solar-rating.org ♦ 400 High Point Drive, Suite 400 ♦ Cocoa, Florida 32926 ♦ (321) 213-6037 ♦ Fax (321) 821-0910

Manifold Connections

There are two connections on the manifold, an inlet and an outlet. The fluid can flow in either direction. The flow of the fluid should be oriented so that the outlet of the manifold is also where the solar collector temperature sensor is installed. This is especially important for systems which have many collectors linked together since there can be great temperature differences between the inlet of the collectors and the outlet of the collectors.

Note: The manifold must be elevated at a minimum of 5° above the vacuum tubes in order for rapid transfer of the heat from the tubes to the manifold to through the use of evaporation of the special fluid inside of the heat pipes.

The header pipes on the manifold are ¾" copper pipes. Pipe connections may be made by soldering with a high quality silver solder or with the use of compression fittings.

Warning: Only high quality silver solder should be used as the high temperature of the operating unit can cause failure in low temperature products.

Wind Stress

When installing the collector, consider orienting the collector for wind resistance and take notice to the stresses on the attachment points. The installation must be made according to building codes/regulations regarding the installation of the unit.

Caution: When installing in windy conditions take precautions as the unit can be caught by the wind and damage to the unit or persons can occur.

It is the responsibility of the installer to ensure that the frame mounting area is of suitable strength. When applicable, a building inspector or equivalent should authorize the location of the installation to ensure that it will be done within all relevant regulations. Proper safety techniques should be practiced when installing the unit. If there are any doubts, contact your building inspector.

Caution: Placement of the solar unit should consider the possibility of broken tubes and glass shards falling on people or animals from incidental contact.

Snow Loading

In areas where significant amounts of snow accumulation can occur, it is recommended that the solar collectors be elevated. Please refer to local and other regulations regarding snow loading precautions.

Storage Tanks

Tanks must be installed in accordance with local building codes. Use additional braces or straps when installing the tank in earthquake zones.

Warning: When solar storage tanks are operated for an extended period of time without any hot water use, there can be a buildup of hydrogen gas in the top of the tank. If the tank's water supply is not operated frequently, run the hot water for several minutes to drain out all of the hydrogen gas. Do not operate a dishwasher or other hot water appliance until this gas has been discharged to avoid a potential ignition of the gas. When draining this gas from the tank, it will sound like air in the pipelines.

Hail Resistance

The solar water heater vacuum tube is extremely tough against hard impacts. The tubes are tested to withstand impact from hail up to 25mm in diameter (about one inch diameter). Even larger hail bombardment can be tolerated if the collector is oriented at an angle greater than 45°. If you live in an area where storms often generate hail greater than 25mm in diameter, it is highly recommended to orient the solar collector greater than 45°.

Pipe Sealant

High quality Teflon tape should be used for all NPT threaded fitting connections. We offer a yellow "gas line" Teflon tape which meets Mil SPEC T27730A, a military specification. Use of this Teflon tape will ensure a leak-free connection for years to come.

Scope of Manual

This manual is written for the reference of a qualified plumber or solar installer. This manual is not a full encompassing manual. Other resources should be gathered prior to installing the system. If conflicting information is found, the owner's manual takes president. Duda Energy LLC is not responsible for damages to property or persons due to solar water heater installations.

Definitions

- **Automatic Air Vent** – A vent installed at the highest point of the system to ensure the closed-loop system remains free of air.
- **Closed Loop Pressurized System** - A solar system which uses a separate fluid to transfer heat to a solar tank. The system is closed from other fluids and pressurized.

- **Tank Coil** – Coils or heat exchangers are immersed inside of the solar tank which permits transfer of heat from the closed loop pressurized system to the water. These coils are ½" or ¾" OD copper tubing coils which keep the solar loop working fluid from mixing with the domestic water.
- **Heat Dissipater** – Similar to a car radiator. A devise used to radiate off excess heat from the solar system.
- **Heat Pipe** – A high grade copper pipe which transfers heat to the manifold. The pipe contains a fluid which rapidly transfers heat to the manifold through evaporation in the bottom of the pipe and condensation in the top of the pipe. The top of this heat pipe is called the condenser. The condenser is inserted directly into the manifold.
- **Solar Panel or Solar Collector** – A complete unit which mounts to the roof or ground consisting of a manifold and vacuum tubes.
- **Solar Tank** – The water storage tank which the solar collector delivers heat to through the use of the closed loop.
- **Solenoid Valve** – An electrically controlled valve which is used to control flow through the heat dissipater when the solar loop reaches maximum working temperature.
- **Temperature Pressure Relief Valve (T/P Valve)** – This is a safety valve which ejects water if the temperature or pressure inside the solar tank exceeds maximum specifications.
- **Thermostatic Mixing Valve** – A mechanical valve which automatically mixes cold and hot water to an adjustable temperature.
- **Working Station** – The assembled unit containing the circulation pump, pressure gauge, tempering valve, pressure relief valve and flow meter.

Equipment Supplied by Duda Energy for a Complete System

- Box with Manifold, mounting frame, optional back legs for stand, tube holders/end caps, mounting feet and thermal conducting compound
- Boxes of vacuum tubes with heat pipes and aluminum fines inserted
- Box of spare vacuum tubes for breakage insurance during freight
- Working Station (pump assembly and electronic controller)
- Solar Water Tank
- Inhibited food grade propylene glycol, automatic air vent, thermostatic mixing valve, submersible water pump for initial charging of the system

Note: Larger Systems may have more than one manifold with corresponding parts and also more vacuum tubes with and without heat pipes.

Additional Parts/Equipment Recommended From Duda Energy

- Flexible corrugated stainless steel tubing and corresponding fittings with fittings installation tool or copper pipe (stainless is preferred over copper for better corrosion resistance, less heat loss and easier installation) Enough pipe will be needed for connecting the solar collector to the working station and water tank.

- Nitrile/NBR/Buna/EPDM or other high temperature resistant pipe insulation
- Aluminum Pipe Wrap for protection of insulation exposed to weather
- Copper wire for extending connections to the solar collector temperature sensor
- Compression fittings for connecting the system components to the piping
- PVC tubing for connecting the
- High Quality Teflon Tape for NPT pipe connections
- 5 Gallon Pail for holding the working fluid during initial charging of the system

Note: Duda Energy offers most of the needed components in a turn-key option. Call for details.

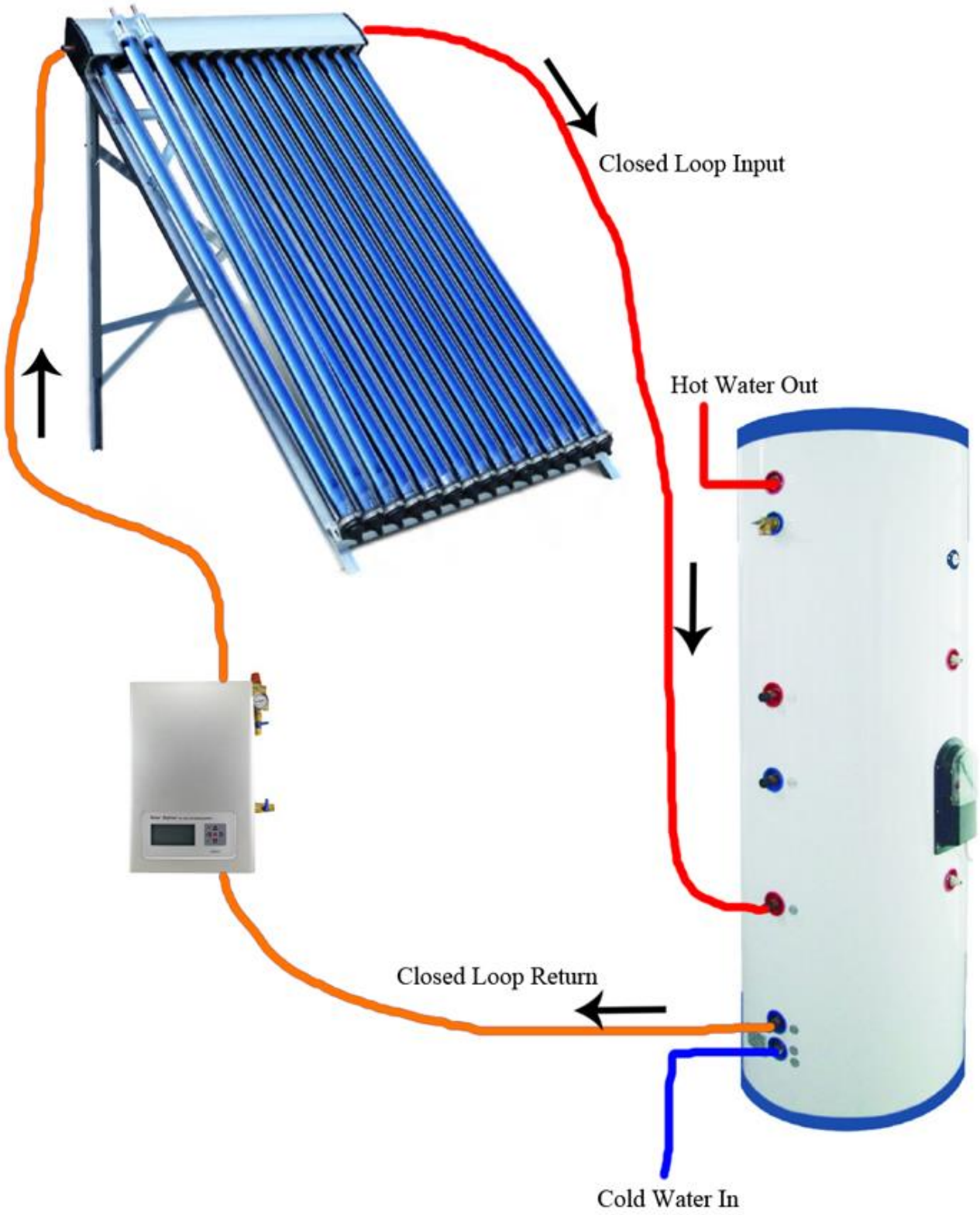
Tools & Materials Needed

- 2 Adjustable Crescent Wrenches
- 1 small pipe wrench
- High temperature lubricant
- Ladder(s) for access to roof and attic as needed
- Measuring tape, square, marking pencil or chalk (for marking rafters and holes on roof)
- ½" wood bit or a circular hole bit for roof penetration (for feed and return lines through the roof)
- 8 Bolts/washers/Screws/Nuts to mount unit to the roof (8 per collector)
- 2 rubber roof penetration boots and screws to mount
- Pipe clamps to hold pipes in place
- Caulking gun with a quality silicone roofing caulk (to fill lag holes and seal flashing to prevent leaks)
- Pipe cutters
- Drain pan for solar water tank
- Strapping for any part of the system (for earthquake zones or high wind areas)
- Small and Large Philips screwdrivers
- Small flat head screwdriver
- Hammer
- Plastic zip ties to hold wires in place
- Necessary copper connections for ¾" pipe on manifold to attach to stainless tubing or copper pipe
- Fittings to connect your water system to the tank and any necessary plugs if any ports will not be used
- Electric ring terminal for grounding the water heater element to thermostat housing screw
- Pipes for connecting water supply to the solar water tank

System Operation

The operation of the closed loop solar water heater system incorporates simple and reliable products which collect heat from the sun through the solar collector and transfer the heat using the working fluid (propylene glycol) to the solar water tank by use of the heat exchanger coil in the bottom of the tank.

Solar water heater vacuum tubes are a state of the art technology which were originally used only in commercial applications but have now become affordable as the ultimate use in energy conservation for both residential and commercial applications. The following diagram displays an overview of the system and how it operates:



Duda Energy Closed Loop Solar Water Heater System

Explanation of components

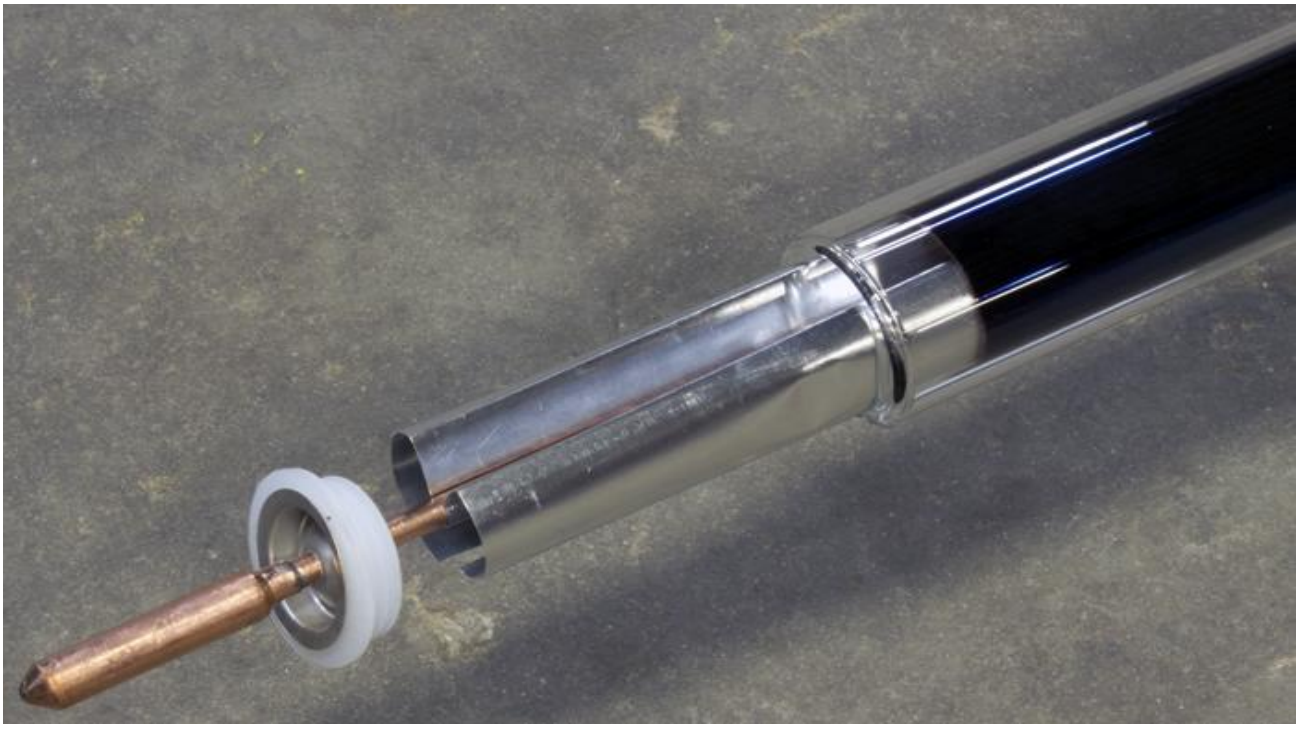
Solar collector

The solar collector consists of the manifold, vacuum tubes and frame.

Warning: Ensure the roof is structurally secure before installing the solar collector. If in doubt, consult an engineer or the local building inspector. The roof must be able to support the weight of the collector with tubes installed and able to withstand any additional weather loads such as snow and wind. Additional bracing may be required.

Caution: Do not install the vacuum tubes into the manifold until the unit is ready to operate with water in the solar tank and the closed loop is charged with the propylene glycol mix. The solar loop must be tested for leaks and proper pump operation must be confirmed. Keep the vacuum tubes out of the sunlight until they are ready to be installed into the manifold. The heat pipes will heat rapidly when the tubes are exposed to the sun and may cause serious burns to the installer. Perform the installation of the tubes in the late afternoon or early morning or wear temperature retardant gloves when inserting the heat pipes with tubes into the manifold.

See below for a photo of the heat pipe and aluminum fins which keep the heat pipe centered inside of the vacuum tube. The aluminum fins help heat rapidly transfer from the hot air to the heat pipe. The silicon gasket is used to seal the open end of the vacuum tube to the manifold to help contain the hot air within the tube and to prevent dust from entering the tube.



Copper Heat Pipe with Silicon Gasket Stopper and One-Piece Aluminum Fin

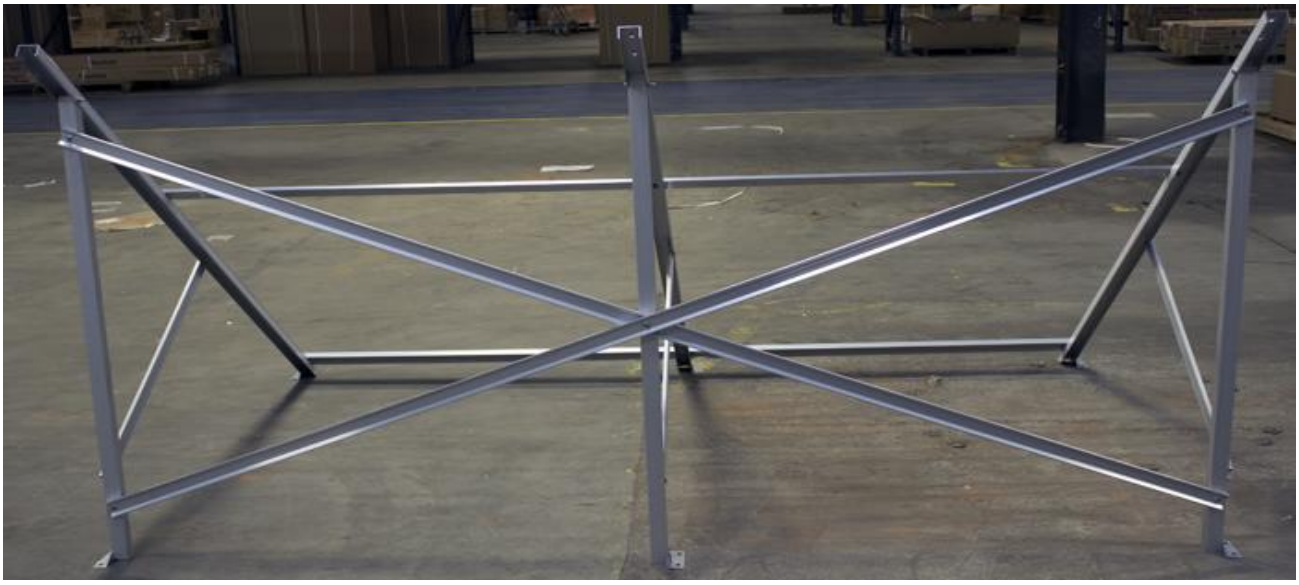
Accessory Frame Construction

Below are photos of the solar collector frame to reference when building the frame. For the flat roof stands, the back legs on the frame are optional and can be removed if you wish to mount the collector flush to the roof. Our slope roof frames may also be used for flush to the roof installations and also have the special ability of mounting underneath the tiles on a tile roof for a leak-proof design.

Note: It is best to make the bolts hand-tight on initial building of the frame. Secure the bolts tightly using a wrench when everything is pieced together and verified to fit correctly.

Note: The Flat Roof / Ground Stand has holes drilled specifically for the left and holes drilled specifically for the right side of the frame. Be sure to check where the holes are drilled for the cross-members to ensure that each piece is connected to the proper side of the frame, otherwise the cross-members will not have holes to mount to properly

37°/45° Flat Roof/Ground Stand

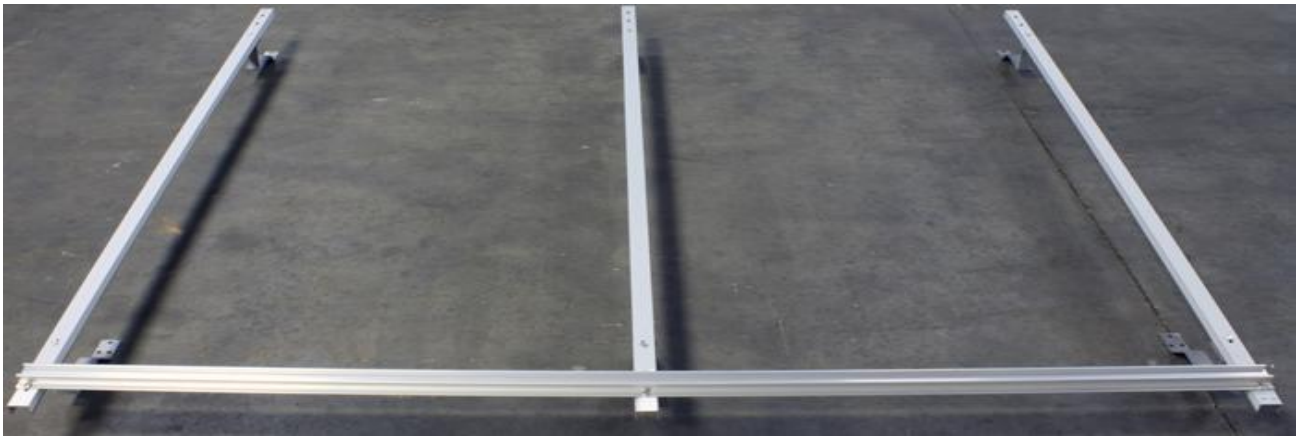


Rear view of Flat Roof / Ground Stand

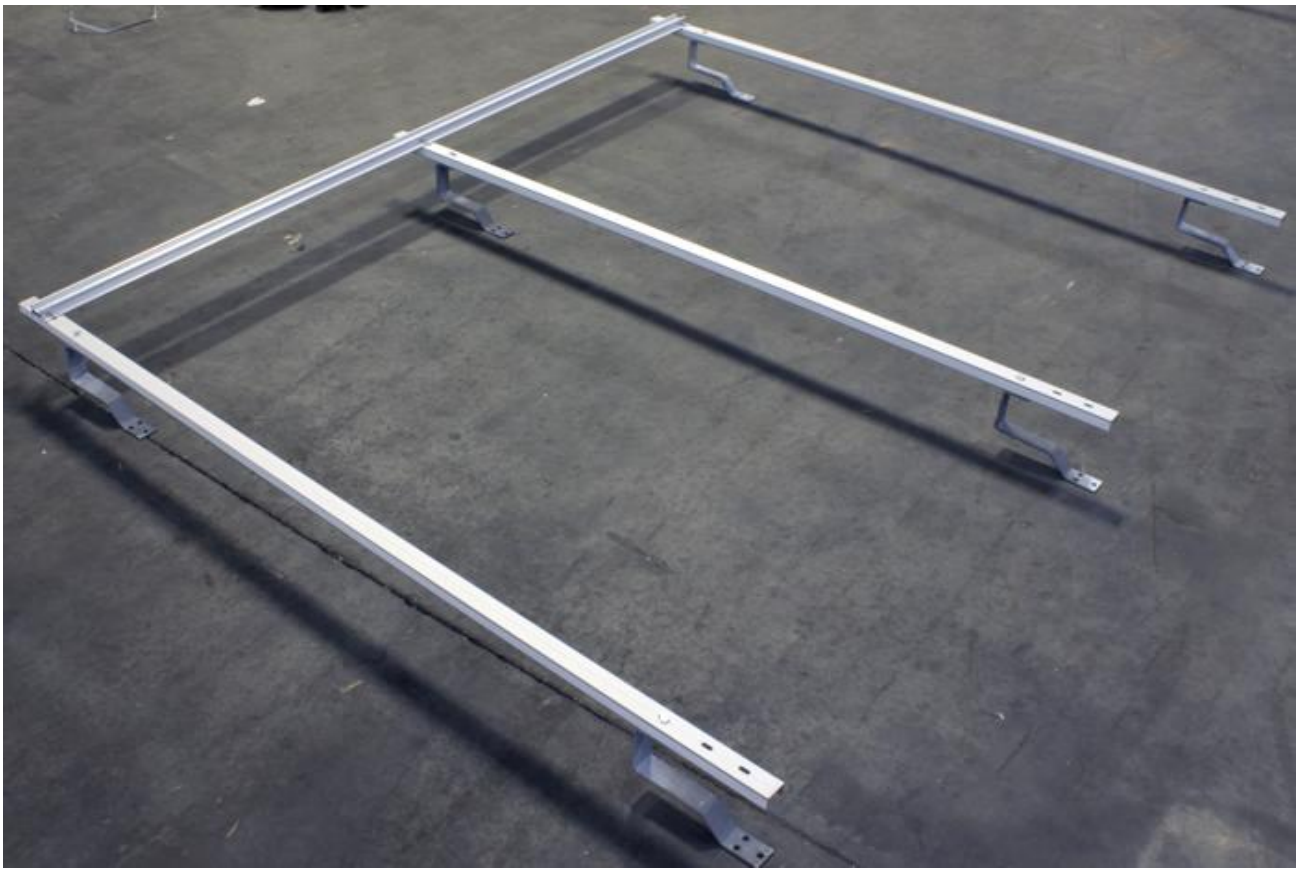
Side Angle of Flat Roof / Ground Stand

Flat Roof / Ground Stand with manifold mounted and tube holders in place (ready for tubes)

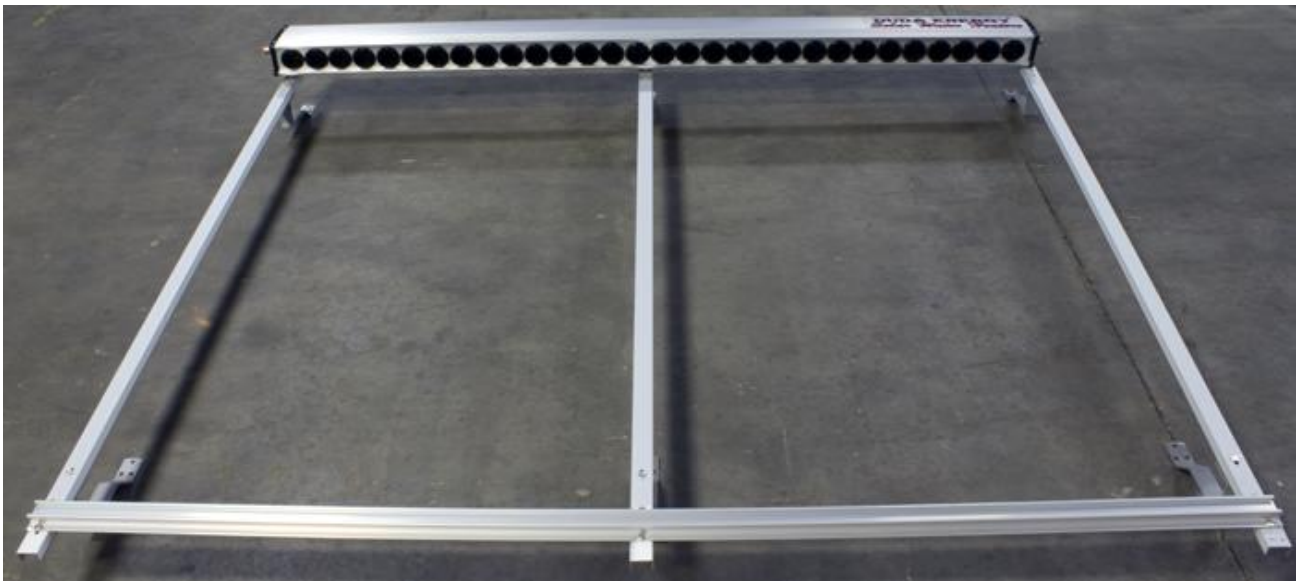
Slope Roof Frame



Front View of Slope Roof Frame



Back-Side View of Slope Roof Frame



Slope Roof Frame with Manifold Mounted

Caution: Care should be used when attaching the manifold to the frame to ensure proper bolt tightness. Supplemental strapping should be used in high wind and hurricane areas.

Working Station

The Duda Solar Water Heater System comes with the SR961s working station or its equivalent. The SR961s working station is an advanced device which circulates the working fluid of the closed loop with a varying flow rate from the collector to the tank based on collector, tank and return temperature coming from the tank. It has higher performance in heat gathering and is energy efficient in operation.

SR961s Working Station

A 3–speed German WILO star RS high temperature fluid pump with pressure gauge, pressure relief valve, flow meter, shut-off valve(s), check valve and charging valves are incorporated into the system. The pump station is encased with a foam insulation that helps retain heat. The metal casing helps protect electronic components from getting damaged by external forces.

Long screws or bolts may be used for mounting the working station to a wall. It should be mounted in the lower part of the closed loop system, preferably near the water tank for easy access to sensor ports. Be sure to mount the working station without obstruction to the charging valves, pressure relief valve and expansion tank port.

Electrical Installation

Please refer to the working station manual for instructions on wiring the device and connecting the temperature RTD sensors.

Caution: Prior to operating the pump, ensure that any shut-off valves in the closed loop are on the on position. If the pump operates with a closed shut-off valve, it can cause excessive heat build-up and burn out the pump. The SR961s and similar models have a pump protection mode where if it cannot achieve flow within 3 minutes of operation, it will shut down the circulation mode.

Pressure relief Valve

The pressure relief valve is located at the top right of the working station enclosure. It has a knob which is used to test its functionality and for manual draining. A drain hose or pipe should be attached to this valve so that if the valve opens, fluid can be directly to an appropriate container.

Pressure Relief Valve for Closed Loop

Mounting the Electronic Controller

The controller is integrated into the SR961s working station and does not require additional mounting. Other working stations may be separate from the controller. In this case, the controller should be installed somewhere near the working station. It is best to install it above the working station. Ideally, the pump should be located as low as possible, ideally at the bottom of the solar loop and the controller display above the working station at eye level for easy operation of the owner.

Flow Meter

The SR961s working station has an integrated flow meter with digital display. The flow rate is shown on the bottom portion of the display screen. It will measure the flow in liters per minute when the pump is operating and when flow is occurring.

Other controllers may use a mechanical flow meter which utilities a float inside of a pipe. The flow meter shows the flow of the solar loop in liters per minute. A white washer floats up to the appropriate level indicator to show the approximate flow when the pump turns on. The bottom of the flow meter (inlet to the working station) should be connected to the outlet of the coil on the solar tank so that the colder glycol solution enters the working station (after heat transfer to the tank).

On these mechanical flow meters is typically a tempering valve which can be used to restrict the flow of the fluid to the suction side of the pump. This valve should normally be set to full open (vertical position) by use of a flat head screwdriver unless the application requires higher temperature fluid to approach the tank (not normal).

Tubing

Copper pipe or Duda's Flex Tubing (corrugated stainless steel tubing) may be used for the solar loop. The latter is preferred as it conducts less heat, resists corrosion better and is very flexible and easy to run through an installation. This tubing, fittings and the necessary tools can be found on www.DudaEnergy.com

The piping used should be ½" for most installations. If several solar collectors are connected in series or more flow is required for the particular installation, ¾" piping may be used. Generally speaking, the smaller the pipe, the less heat loss and the less fluid that needs to be added or heated up on each day in operation of the water heater system.

Electronic Controller

Follow the installation instructions supplied with the controller. The following information and photos will help with the installation procedure.

Controller display

The display is used for setting various parameters, controls and shows operation of the unit. It connects to the controller

Controller

Three sensors are provided with the controller.

The black wire sensor is the pt1000. This high temperature sensor is to be used for the solar collector temperature detection and must be connected to T1 on the solar controller / working station. It withstands the high temperatures of the collector and works differently from the 10k sensors and cannot be interchanged.

Note: Be sure to put the pt1000 sensor into the side of the manifold which is also the outlet for the closed loop. Secure the wire appropriately so that there is no risk of the sensor falling out of the sensor port during operation due to external forces such as wind.

Note: Apply some thermal conducting paste to the tip of the probe to aid in rapid temperature detection with the sensor.

Properly Secured pt1000 sensor

The 2 gray wire sensors are to be installed into the top and bottom ports on the solar tank. T2 is the bottom sensor; T3 is the top sensor.

One of the various options of the controller is to circulate water from the tank, through the piping in the house and back to the tank. This keeps the water hot at all times so there is no waiting period for hot water when the tap is opened. This function can also be set with time intervals so that hot water is not wasted during non-use hours (while sleeping or gone to work).

In order to use this feature, a 2nd circulation pump is required. A 3rd 10k (gray) sensor and a thermowell will be required (must be purchased separately). Install the 3rd sensor into the thermowell and put the thermowell into the return hot water pipe. The thermowell is typically installed into the pipeline just before returning to the tank using a

tee to allow insertion into the pipeline. The controller can then sense when the pipe has cooled off in order to operate the circulation pump to provide the pipes with more hot water.

Copper Thermowell

Backup Heating function

Our tanks come with a manual thermostat for electric water heating backup. The controller has a backup heating function as well which can be used for this electric water heating element or another backup source such as an external gas heater. The advantage to using the controller for electric backup heating is it can be set with a timed function so that it will not activate the backup heating during times when water is not used i.e.: 4am. This can help save electricity by allowing the sun to continue the heating on the next day rather than relying on the element when the hot water is not even needed.

Caution: The controller will have a limited amount of output current which can activate a water heating element. For any high power applications which the controller cannot handle, a high power relay must be utilized. The controller will activate the relay so that high current passes through the relay to the element without passing through the controller. Duda Energy sells the SR802 High Power Relay for this application.

System Set-up

The controller out of the box is ready to go for the solar water heater system with the exception of the maximum tank temperature protection mode. This mode is highly recommended for the case where the solar water tank is overheated and the system needs to stop transferring heat to the tank. There are two functions which can be used for maximum temperature protection.

System shut down

If overheating is unlikely, it is best to use the function which shuts down the pump when the tank reaches max temperature. Once the tank temperature reaches the set maximum temperature, the controller discontinues operation of the pump. The fluid in the solar loop will boil off into a vapor and push all of the remaining liquid into the expansion tank connected to the working station. The solar water system will resume as normal after the system

cools down and the solar water tank drops 2°C below the set maximum temperature (for the SR961s). For instructions on how to set up this feature, please refer to the working station manual.

This method may not be preferred if tank overheating is likely to occur often, such as with an oversized collector or during the summer in southern locations when hot water consumption is not high. This method may also not be preferred if water usage may be spontaneously high and resumed system heating is desired as soon as cold water enters the tank.

Heat Dump Function

Propylene glycol becomes rapidly acidic if kept above 280°F. If it is kept at high temperatures for extended periods of time, it will need to be changed more often than normal to prevent excessive corrosion to the pipes and heat exchanger coil(s). If over-heating is likely to happen often, it is best to use a heat dissipater (sold separately) with electronic solenoid valves for controlled use of the heat dissipater when needed. When overheat protection mode occurs on the controller, the electronic valves open to allow flow of the glycol solution through the heat dissipater, thus cooling the working fluid and preventing additional overheating of the tank. When the tank temperature drops below the maximum again, the system will resume heating. Please refer to the working station / controller manual for activating this function.

Another method for utilizing a heat dump is to use a diverting mixing valve. Diverting mixing valves are usually set for a high operating temperature such as 95°C (203°F). When the working fluid reaches this temperature, the diverting valve mechanically diverts the fluid to pass through the heat dissipater prior to returning to the tank. This method allows for minimal electrical consumption, but has a little less control than with the use of solenoid valves. For example, if you desire to heat the tank close to 95°C, the diverting valve will begin dumping heat before the tank temperature reaches the maximum desired temperature.

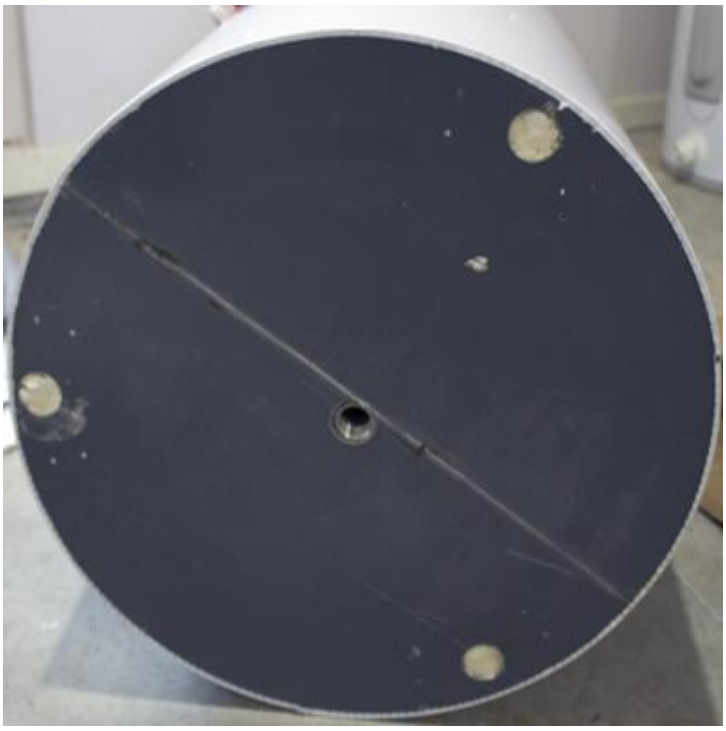
Solar water Tank

Caution: Ensure that the solar water tank is installed in an area where the weight of the tank full of water can be supported. Be sure to install a drain pain under the tank. Duda Energy will not be responsible for water or structural damage due to improper placement or plumbing techniques.

Caution: Do not turn on the water heating element until the tank is filled with water or damage to the heating element will result.

Mounting Feet

Attach the bottom plastic or rubber feet to the tank so it stands a few inches from the floor. Screws are provided in the tank packaging.



Bottom of Duda Solar Tank with Threaded Holes for Mounting Feet & Drain Port

Temperature/Pressure Relief

The T/P valve should be installed into the T/P port or top of the tank. Connect piping to the outlet of the T/P valve to direct ejected fluid to the drain pan or directly to the sewer. Test functionality of the valve when the tank is initially filled with water prior to operation and also every 6 months. Replace with a 100 psi maximum T/P valve if it is found not to function correctly.

Cold water Inlet Port

The cold water inlet port is for your city or well water supply to the tank. This enters in through the bottom side of the tank. Above this port is the solar loop inlet and outlet. The recommended cold water supply pressure is 60 psi. The cold water inlet pressure should not exceed 100 psi. Test your water pressure to be sure it does not exceed the maximum. Use a pressure regulation device to control the water inlet pressure if needed.

Lower Circulation Loop Ports

The solar loop is to be connected so that the return from the collector passes through the hot circulation inlet and out the hot circulation outlet to the working station.

Caution: Do not over-tighten the nut that holds the upper and lower coils in place. Doing so can twist the copper coil which will restrict fluid flow within the coil. Over-tightening can also crush the seal between the coil and the tank resulting in domestic water leakage through the port.

Note: It is best to connect to the coils with an elbow traveling downward to prevent a thermo siphon phenomenon from cooling the tank during no sun hours. The hot fluid inside of the coil will be unable to exit the coil beyond the downward bend of the elbow where cooler fluid will be resting since higher density/colder fluids sink while the hotter/lower density fluids rise to the top.

Elbows used on Solar Loop Connections to Tank to Prevent Thermo Siphon Effects

Bottom temperature Sensor Port

The bottom temperature sensor port is for detecting the temperature of the water which the bottom coil heats via the solar loop. This is recognized as T2 on the controller. Apply a little bit of the thermal conducting compound supplied with the manifold and slide it into this port.

Electric Water Heating Backup

The part you will find is the thermostat housing for the backup water heating element. Remove the screws to the panel to access the water heating element, wiring and thermostat sensor. Make sure that the thermostat sensor is installed inside of the temperature sensing port that is covered by the thermostat housing.

There is a water heating element pre-installed into the tank. It is usually a 3000w/220 VAC element. A 220v/240v AC power source should be used to activate this element for proper usage. This element can be easily removed and replaced with any element of your choosing from a local plumbing store which utilizes a 1" screw thread type connection. The port is 1" and uses an O-ring gasket to seal into the port, which is common for most standard water heating elements. The thermostat is capable of handling 110 VAC heating elements if desired.

Caution: The maximum power rating on the thermostat housing is 25 amps. Do not use water heating elements that will draw more than 25 amps or it can burn out the on/off switch and destroy the thermostat housing.

Wire your power source through the electrical housing and connect to the thermostat and then to the water heating element. Only one wire needs to go to the thermostat while the other can go directly to the element. The circuit on both wires must have full continuity in order for the element to operate (when the thermostat engages). The element should be grounded to the tank by one of the screws which connects to the tank.

Note: If you prefer to control the water heating element with the electronic controller, a high power relay must be used. Be sure that the relay matches the appropriate output voltage of the controller. The Duda Energy store carries the SR802 relay for these applications.

Caution: Do no exceed the rated amperage capacity of the relay.

Upper Circulation Loop Ports (Optional)

The upper coil of the tank can be used for a variety of applications. It can be used for alternate backup heating methods such as a boiler or external gas heater. It can also be used for retrieving heat for other systems such as radiant floor heating. Connect to this coil the same as the lower coil. Depending on the application, it may be advisable to use elbows on the top coil to prevent a thermo siphon from occurring.

Note: While dual coil tanks are useful for some applications, it is best to use a single coil tank for general water heating applications. Most single coil tanks have a longer bottom coil than do the dual coil tanks. Use of a dual coil tank for a single coil tank application may result in some minor thermal efficiency losses in the circulation loop. See the Duda Energy website for specifications on coil lengths for different size tanks.

Magnesium Rod / Anode rod

The anode rod port already has a new magnesium rod pre-installed. This rod should be checked regularly for corrosion and be replaced as needed to ensure a long lasting life to the tank. The rod can be replaced with an aluminum rod if the water supply is very hard water or with a zinc-aluminum rod if the water has a sulfur dioxide smell.

Hot Water Outlet

There is a hot water outlet port on the top side of the tank and also on the top of the tank. Use a plug to block off flow from one of the unused ports if applicable. Connect piping from the hot water outlet to your hot water supply to the building.

Note: It is strongly recommended to connect an elbow facing downward to the hot water outlet prior to connecting to the piping of the building to avoid a thermo siphon which will cause significant heat loss to the tank, especially through the night when water is not used. An alternative way to prevent the thermo siphon phenomenon is to install a spring loaded (vertical) check valve directly to the hot water outlet.

Hot Water Outlet with Elbow to Prevent Unnecessary Thermo Siphon

Drain port (Bottom side of the tank)

On the very bottom of the tank there is a drain port. It is recommended that piping and a ball valve be installed to this port for when the tank needs to be drained. This can be very useful when checking the anode rod or

when the tank needs to be serviced. Connect an elbow directly to the drain port, run piping far enough out from under the tank and install a valve for easy draining access. The valve should be able to eject water to the drain pan or have a garden hose fitting attached so that a garden hose can be used to direct draining water outside. In order for the tank to fully drain, the exit point for the water must be lower than the bottom of the tank.

Note: It is best to open the T/P valve when draining the tank to allow adequate air flow into the tank.

Thermostatic Mixing valve

WARNING: Solar water heaters heat whenever the sun is out. If the hot water is not used, it will continue heating the water to the point of boiling and may cause scalding or serious burns. Extremely hot water may damage appliances such as dish washers or laundry machines if a thermostatic mixing valve is not installed.

CAUTION: Adults may suffer slight burns from hot water from open taps. Children and elderly people may not have the proper reaction time to remove hands from a tap before severe scalding may occur. Households with children and elderly people should take additional precautions against scalding, such as installing thermostatic mixing faucets and showers.

Maximum temperatures for the tank can be set by the controller. But when the sun is available with free heat, it is normally not desirable to shut the heating down for the day. To combat the risk of scalding from extra hot water or damage to appliances, a thermostatic mixing valve must be installed to the hot water outlet.

1” Thermostatic Mixing Valve Connected to Hot Water Outlet and Cold Water Inlet

The thermostatic mixing valve must be used in a solar water heater to prevent scalding at the faucet. Since the sun can vary based on weather and time of year, solar systems will experience anywhere from mild to extreme hot water. Install the thermostatic mixing valve on the hot water outlet in conjunction with a cold water source so that it will mix in cold water automatically. This will ensure that the water exiting from the solar water tank will not exceed the maximum temperature set by the valve.

To adjust the temperature on the valve: turn the knob clockwise to decrease the maximum output temperature or counter-clockwise to increase the maximum temperature. The Markings show the approximate mixed temperature output in degrees Celsius.

The consumer product safety commission recommends a maximum of 120°F output temperature. This is approximately 50°C. Some appliances such as dishwashers may require higher input temperatures. In this case, it may be preferred to add a tee to the hot water outlet on the tank and use a secondary thermostatic mixing valve for supplying such appliances. Alternatively, the thermostatic mixing valve on the tank can be set to the maximum appliance temperature while thermostatic faucets and showers are used to regulate the water temperature to lower temperatures when coming in contact with humans. Thermostatic mixing valve faucets and showers can also be quite convenient as the exact desired temperature can be selected every time and the user does not need to spend time adjusting the water accordingly each time of use.

Example of Thermostatic Mixing Faucet

Example of Thermostatic Mixing Shower

Duda's Flex Tubing / Corrugated Stainless Steel Tubing

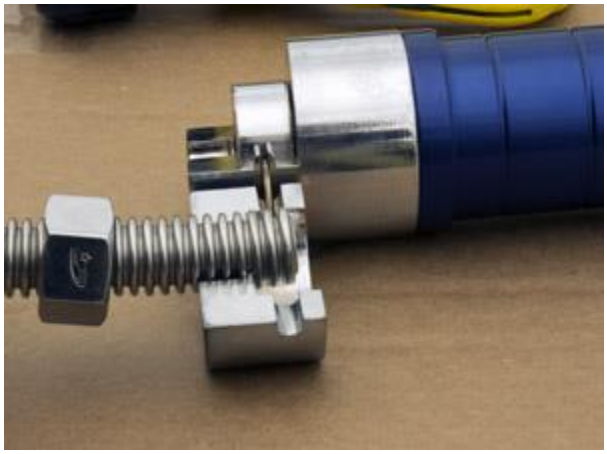
A special tool is required to flatten the corrugations on the end of the tubing. There are a few different types of tools available. There is an economical tool which can be used for flattening the corrugations by striking it with a hammer. There is also more expensive tools or toolboxes which are capable of performing the flattening by hand and they can also do multiple sizes of piping installs. We recommend the economical tool for anyone installing fittings to a single size of tubing who will not be doing many fitting installs and the professional kit for multiple tube sizings or when many fitting installations are to be performed.

Note: Take special care when cutting the stainless tubing. The tubing should be cut as clean as possible with no burs left on the edges or it could make it difficult to make a good seal with the fitting.

Step 1: Slide the fitting over the tubing

Slide the fitting you will use over the end of the tubing with the threads facing the end of the fitting. Leave enough room so you can clamp the tubing.

Step 2: Flatten the corrugations using the special fitting tool



Place the tubing into the clamp which holds the tubing in place in the special tool for flattening the corrugations. We recommend clamping down on 2-3 corrugations. You can clamp one corrugation, but if there is an error in the flattening, there's a chance of leakage, and the durability will be lower. We usually use 2 corrugations as it seems to be enough for most applications. In the photo, the professional tool is shown with only 1 corrugation setting into place for clamping. Once the tubing is in place, use the tool to flatten the corrugations. 2-3 hits may be necessary to make it perfectly flat.

Step 3: Apply the c-ring to the tubing

Once the ending corrugations are flattened as shown in the above photo, apply the c-ring between the last flattened corrugation and the first unflattened corrugation as shown in the above photo. Once in place, crimp the c-ring closed. This C-ring will prevent the fitting from coming off the tubing.

Step 4: Pull the fitting forward

Pull the fitting forward so it is against the c-ring. You will notice that the fitting can no longer be pulled from the tubing.

Step 5: Apply the washer

Apply the washer to the inside of the fitting. The photo shows a Teflon washer which is generally acceptable for most solar installations.

Step 6: Attach to your piping

Thread the fitting end onto the pipe you are attaching to. Do not use Teflon tape or any pipe dope. The seal is made by the washer. It can connect to both NPT and straight thread fittings. The washer will need to seal against the end of the fitting which the stainless tubing is attaching to in order to prevent leaks. Thread by hand until the fitting is hand tight. Once hand tight, use a wrench to turn it no more than 1/4-1/2 a turn. You should be able to bend the tubing back and forth without the back end of the fitting allowing the tubing to flex at all. When it is stiff on the back side of the fitting, it is tight enough.

Pressurize the tubing and checking for leaks. If there are slight leaks, you can try tightening a little bit more. Avoid over tightening the fitting as it can cause the washer to compress too much and the tubing could shred it against the pipe fitting. If leaks still persist after the fitting is tightened, remove and check for problems in the installation of the c-ring and flattening of the corrugations.

Installation

Transport Unpacking and Inspection

The system will arrive on a pallet. Before signing for delivery, inspect each box to be sure that there is no damage. If there is any damage, have it noted on the bill of lading. Signing for the bill of lading without noting any damage waives the consignee's right to a damage claim with the carrier.

Note: Delivery truck drivers may be impatient and try to rush you through the process. As you unload each box of tubes, give it a little shake. If there is a broken tube, you will be able to hear it. If there is evidence of breakage, open the box to find how much damage there is to note it. Do not let a pushy driver con you out of your right to replacement of merchandise. Duda Energy LLC cannot replace broken by transit merchandise if the bill of lading is signed as goods received in good condition.

- Check each box to make sure that all parts were included. If any parts are missing, contact Duda Energy and the parts will be replaced as soon as possible.
- Open the boxes to the vacuum tubes away from the sun and inspect for damage. Inspect the bottoms of the tubes and check for silver color. If any of the bottoms appear clear, the vacuum has been lost and the tube will not function efficiently. If a tube with a heat pipe is broken, remove the heat pipe and aluminum fins and place it into one of the spare tubes sent in the shipment.
  Note: Spare tubes are provided for freight insurance purposes only. We will not replace broken spare tubes. As long as you have enough tubes to complete the solar water collectors, there is no need for replacements. Any extras are yours to keep for future replacements as needed.
  Caution: Do not expose the tubes to sunlight until ready to install. The heat pipes will heat rapidly and cause serious burns. The outside of the vacuum tubes will remain cold to the touch since heat cannot travel through the vacuum between the two glass tubes.

Location Requirements

Select a location near the center of your water supply piping system or where water is most commonly used. If the tank is too far from one tap, it will take a long time for hot water to reach it. The solar tank must be installed indoors and must stand in the vertical position on a level surface.

Caution: Solar water tanks are heavy when filled with water. The high weight can result in structural failure. Ensure the floor has adequate support. Contact a local building inspector or structural engineer for advice.

The solar water tank should be located in an area not subject to freezing temperatures. Water heaters located in unconditioned spaces (attics, basements etc.) may require piping to be insulated to protect against freezing. The drain and controls must be easily accessible for operation and service. Do not use this water tank in conjunction with a hot tub or pool. Chlorine rapidly corrodes metals.

Note: Local codes and requirements in your area may require the installation of your water heater be accomplished in a way that the bottom element is elevated from the floor at least 18 inches.

Important: the solar water tank should be located in an area where leakage of the tank or connections will not result in damage to the area adjacent to the water heater or to lower floors of the structure. Due to the normal corrosive action of the water, the tank will eventually leak after an extended period of time. It is recommended that a suitable drain pan be installed under the solar water tank. This pan protects the property from damage which may occur from normal condensate formation on the tank or leaks in the tank or pipe connections. The pan must limit the water level to a maximum depth of 2-1/2" and be 2" wider than the solar water tank and then the pan piped to a suitable drain of at least ¾" pipe. The drain pipe should be pitched for proper drainage and consideration should be made for the possibility of the drain pipe freezing which can cause blockage. Under no circumstances will the manufacturer or distributor be held liable for any fluid damage in connection with this solar water tank or solar collection unit.

Note on California: the water heater must be braced, anchored or strapped to avoid moving during an earthquake. Contact local utilities for code requirements in your area or call 1-800-999-9515 and request instructions.

Electrical Requirements

Warning: When making the electrical connections, always make sure:

- The electrical supply has the proper overload fuse or breaker protection
- Wire sizes and connections comply with all applicable codes
- Wiring enclosed in approved conduit (if required by local codes)
- The water heater and electrical supply are properly grounded

Warning: When installing the electrical wiring to the solar water tank:

- Ensure the tank is completely filled with water before making any electrical connections
- The power to the unit is shut off
- Connect the electrical supply to the water heater in accordance with local utility requirements and codes.
- Ground the solar water tank by connecting a grounding wire

Branch Circuit Sizing Guide

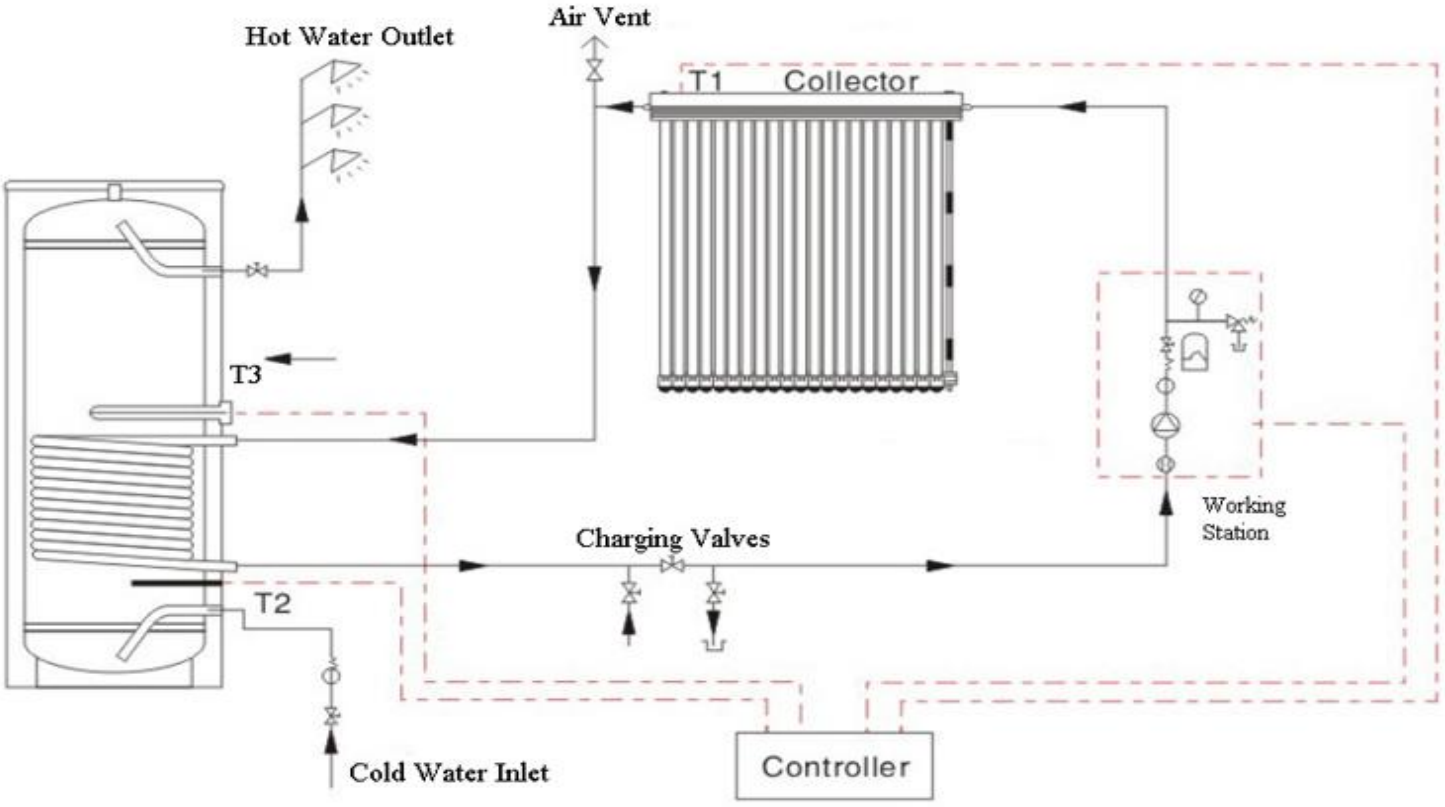
Power Load (watts)	Recommended Over Current Protection Rating (amps)			Copper wire Size (AWG) Based on N.E.C table 310-16 (60°C)		
	120v	208v	240v	120v	208v	240v
1500	15	15	15	12	14	14

2000	20	15	15	10	14	14
2500	30	15	15	10	14	14
3000	30	20	15	8	12	12
3500		20	20		10	12
4000		25	20		10	10
4500		30	25		10	10
5000		30	30		10	10
5500		35	30		8	10

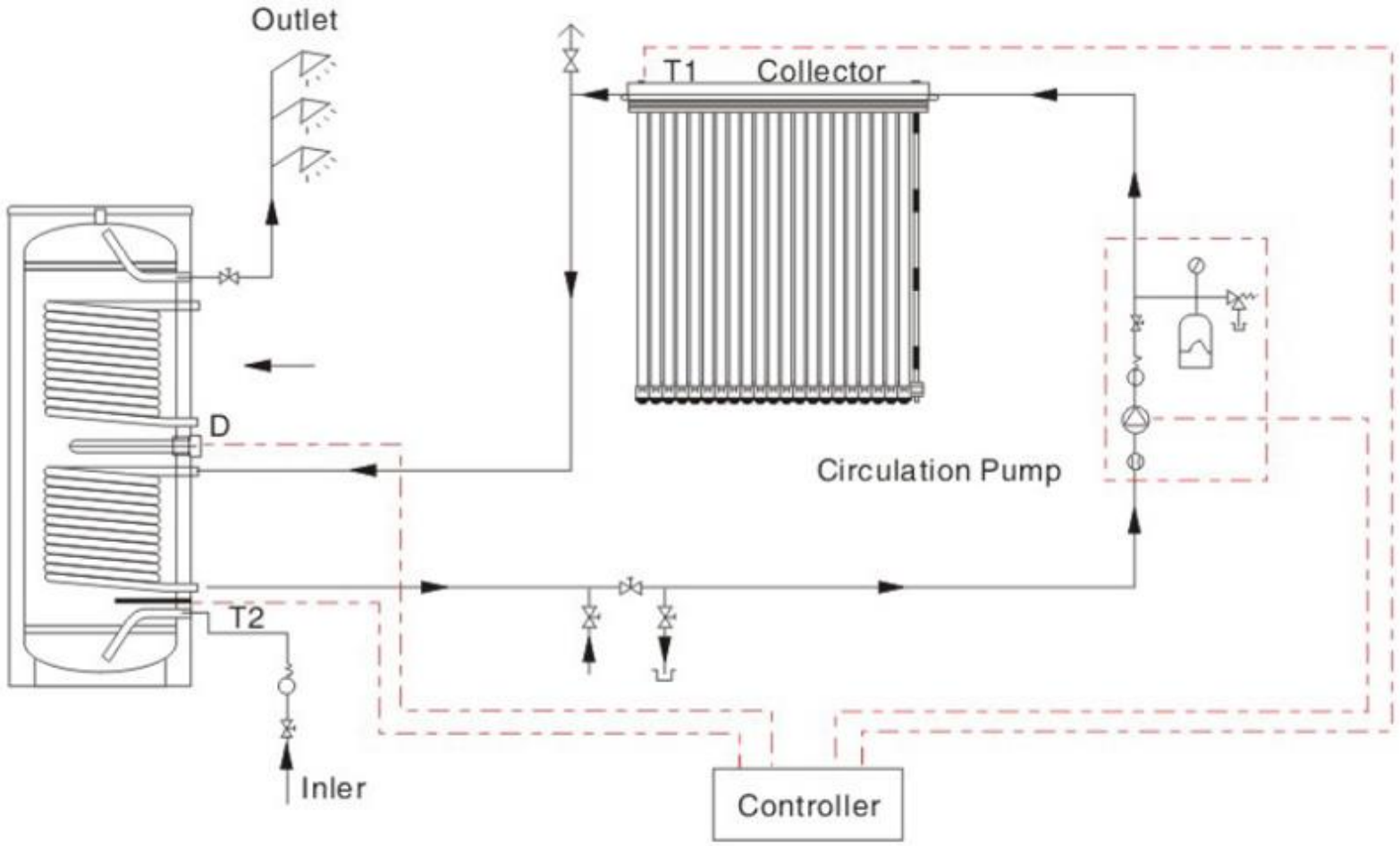
System Design

The Duda Energy split solar water heater is the most efficient design on the market which provides freeze protection in most climates. The design of the heat pipes allow for working ambient temperatures as low as -40°C (-40°F).

There are two options for the tank in our split solar systems. There are tanks with single coils and dual coils. The single coil tanks have maximum performance in solar heat transfer as the longest possible coil length is utilized for the solar loop. These tanks should be utilized if only solar water heating and the electrical heating backup element will be used.



Pressurized Split Solar System with Single Coil Tank



Pressurized Split Solar System with Dual Coil Tank

NOTE: Due to variances in types of controllers, working stations and system designs, the above system design should be observed as a baseline to follow during installation, and the final set-up of your system design may vary slightly such as the location of the charging valves, working station and ports used for the hot water outlet on the tank.

Direction and Angle of Installation

The angle of installation will affect the efficiency of your solar collector throughout the year. For a balanced system, the collector should be oriented so that it will receive the maximum amount of sunlight on average throughout the year.

In special cases, an installation may require more winter efficiency or more summer efficiency. Winter efficiency may be desired if a system is oversized, so as to avoid overheating in the summer, but minimal use of backup heating. Or it can be utilized for supplementing a home heating system. Summer efficiency pay be preferred for pool heating or solar absorption refrigeration systems (solar air conditioning).

For more winter efficiency, aim the collector at a higher angle towards the horizon. For more summer efficiency, aim the collector at a lower angle so it faces more towards the sky directly above.

Note: In the northern hemisphere, the collector should face south. In the southern hemisphere it should face north.

Note: The angle at which the solar collector is mounted should roughly correspond to the latitude of your location plus 5 to 15°. For example:

-Chicago, IL has latitude of 41° north. The collector should face south at approximately 46-56°.

-Jacksonville, FL has latitude of 30° north. The collector should face south at 35-45°.

-Sao Paulo, Brazil has latitude of 23° south. The collector should face North at 28-38°.

Note: In general, it is not necessary to over compensate for summer or winter efficiency. Duda Solar collectors lose only 10% of their efficiency when they are oriented 50° away from perpendicular with the sun. Since the sun's angle changes by ±23.5° throughout the year, it is advised not to orient the collector more than 26.5° from the latitude of the location to avoid significant efficiency loss during the parts of the year where the sun angle may vary by more than 50° from the collector orientation. Also, since the sun rises from the horizon, which is 90°, and rises to no more than 0° in non-tropical areas throughout the year, the standard Duda Solar 37° and 45° frames are considered ideal for efficient solar water heating.

For a list of US cities and their latitudes, go to: http://www.infoplease.com/ipa/A0001796.html

It is not necessary to have the exact angle of your latitude when mounting the solar water collector. Generally speaking, it is acceptable to be within +/-10° of the ideal angle. If the roof is within the range, the collector can be mounted flush to the roof. If the collector is put at a higher angle than your latitude, it will be more efficient in the winter. If less of an angle, more efficient in the summer. Also, if direct North/South is not possible because of the location, it is best to face somewhat westward as the temperatures during the evening are warmer than in the morning, and the system will be more efficient in the evening rather than in the morning due to less heat loss.

Note: to ensure optimum performance, place the solar collector in full sunlight and trim any trees that might shade the collector during daylight hours.

Mounting the Frame

Slope Roof Installation

WARNING: Ensure that the roof is structurally sound prior to installing the solar collectors to the roof. If in doubt, call an engineer or your local building inspector. Ensure that the unit will face in the correct direction of the sun (to the South in the Northern Hemisphere). Ensure that the location can support the load of the manifold, snow and wind load. Additional bracing may be required.

CAUTION: Do no install the vacuum tubes until the unit has been mounted properly, the pipes have been attached and system properly charged with fluid and tested for leaks. Be sure that the pump and valves operate properly. Keep the solar tubes away from exposure to sunlight until ready to install. Failure to do so will void warranty.

CAUTION: Install only in the late afternoon or early morning or wear protective gloves while installing the units. When the vacuum tubes are exposed to the sun, the heat pipes will become very hot rapidly and may cause serious burns if precaution is not taken during installation.

Bracing

Roofing lag screws or other bolts which can adequately penetrate a roof and seal properly to prevent leaks should be used for mounting the collector frame to the roof. Screws should penetrate the roof so that contact can be made with the most structurally secure part of the roof such as timber which is laid horizontally on the rafters or trusses to support the structure. If needed, you can add cross framing under the roof structure and screw that to the trusses of the house.

Prior to drilling holes for the braces, measure the system and lay out the frame components so that the unit will look square and level on the house. If multiple collectors are to be installed, please take those into account.

Once the location for the screws have been planned out, drill appropriate size holes into the supports for the roof. Next, apply a high grade silicone into the holes and where the feet to the frame will come into contact with the roof and then screw the frame for the collector to the roof, taking care not to apply too much torque to the screws to avoid stripping the wood underneath.

On a tile roof, the slope roof frame can be installed with the bottom portion of the hooks underneath the tile. Remove the tile and fasten the hook to the structure underneath. Once installation is completed, the tile can be placed back over the hook.

Collector on a tile roof

Hook under the tile

Additional bracing may be required. Contact an engineer or your local building inspector for advice.

Flat Roof or Ground Installation

If the frame is to be mounted on the ground it needs support from a concrete base. Affix the frame base to the concrete using appropriate concrete fasteners with stainless steel bolts or screws.

When attacking the frame to a flat roof use appropriate sized stainless steel bolts or screws to affix the unit to the surface. Rubber gaskets and silicone should be used between the roof and the foot of the base unit to help protect against water leakage. Use refer to section 4.6.1 for information on properly mounting to a roof.

Wall Mounting

When mounting to a wall, reverse the flat roof/ground stand so that you form a right triangle against the wall of the house. Mount the manifold on the top closest to the house and the bottom support rail on the bottom farthest away from the house.

CAUTION: Ensure the wall is structurally sound and can withstand the forces associated with the system (wind, snow, collector components, fluid and frame weight)

Ensure that you adequately secure the unit to the structure. You should consider shading from the eave of the house but remember that the higher the collector is located, the less chance of snow gathering and covering the collector.

CAUTION: Mounting a solar collector on the side of a house exposes the occupants to the hazard of being struck by broken glass should the unit be damaged during a storm or strong winds.

Installing the Components to the Frame

Mounting the Manifold

The manifold comes with bolts with the heads already inside of the manifold and nuts fastened on the outside. Place the manifold onto the frame so that the bolts line up with the holes. Slide the bolts slide through the holes and place the manifold onto the stand. Use the nuts to fasten the bolts to the frame securely.

Manifold mounted to 37° Flat Roof / Ground Stand

Piping & Automatic Air Vent

Install the piping which will connect the tank coils to the manifold. We recommend using Duda's Flex Tubing, which is stainless steel flexible tubing. This tubing has high temperature resistance, loses heat much slower than copper, and is very easy to install due to its flexible properties.

The manifold header pipe is ¾" copper pipe. When using stainless steel flex tubing instead of copper pipe, you may solder copper adapters to convert to threads, or use brass or stainless steel compression fittings to convert to a male thread. Most systems use ½" tubing, so a conversion to ½" threads will be necessary. If you have a larger system *(several 30 tube collectors in series) you may require ¾" tubing and can convert to ¾" pipe thread for that tubing.

On the inlet side of the manifold, convert the header pipe to the needed size and simply attach the stainless steel tubing, or solder copper pipe or coil to connect to the tank's coil. On the outlet side of the manifold, a tee should be installed prior to connecting the fittings for the piping so that an automatic air vent can be installed to the outlet of the manifold. This air vent is extremely useful for bleeding out air which may not be possible to purge on the initial charging. Simply loosen the thumb screw to let air bleed out after a few weeks of operation. It should be located at the top most point of the system which is typically on the exit of the manifold. You may also need to make additional connections with tees if you use an option heat dump loop with solenoid / thermostatic diverting valves.

Piping which passes through the roof should be installed so that no leaking can occur. We recommend using rubber "boots" for a good seal to the roof. These are cone shaped and seal to the roof with a lot of surface area contact and give plenty of room for the piping to pass through. Make sure to use silicon where the boot contacts with the roof to ensure a perfect leak-proof seal.

Rubber Boot for Connecting Pipes through Roof

Insulation

The piping in the closed loop system needs to be insulated for optimal efficiency. A high temperature insulation such as Nitrile Rubber or EPDM insulation should be used. **CAUTION:** Do not use foam insulation. Foam insulation has a low temperature resistance and will melt or catch on fire from the high temperatures of the solar water heater system.

Insulation which is exposed to the outside environment needs to be protected from rain and UV rays. Use aluminum tape to wrap the insulation and protect it from weather. Make sure to make a good seal and leave no areas uncovered so moisture cannot get inside.

NOTE: Our EPDM insulation has a protective layer on it already and does not need aluminum pipe wrap for protection.

Charging the System

Prior to installing the vacuum tubes, the system should be fully charged. The system should also be checked for leaks prior to charging. To check for leaks, apply 30 psi of air pressure and let the system sit overnight. If the pressure holds, then there are no leaks. If there are no leaks, the system can then be flushed with water to clean it of any debris prior to charging.

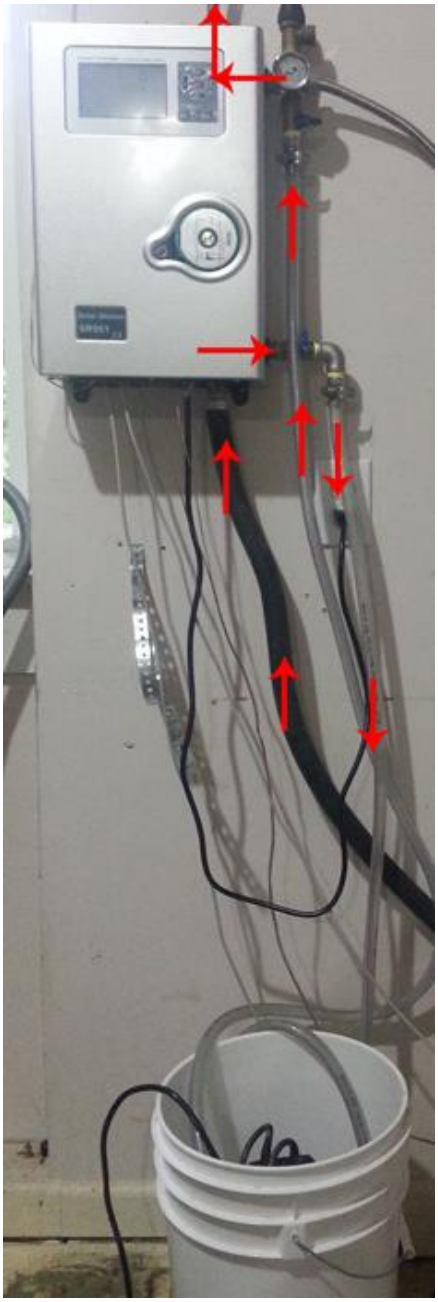
To charge the system, use a pump with pressure. A submersible pump is most convenient as it can be placed directly into a pail. It will suck fluid up into the system with high flow and pressure, forcing most of the air out of the piping.

The SR961s is the most common working station for Duda Solar Systems. It has a check valve after the pump and 2 charging valves. The top charging valve should be the inlet from the submersible pump and the bottom valve should be the outlet for discharging fluid/air.

To charge the system, open the 2 charging valves and turn on the submersible pump. Allow fluid to flow for about 5 minutes or until air stops coming out of the outlet. If the hose is submersed into the glycol solution in the pail, you will be able to see the bubbles from the air purging out. Once complete, close the discharge valve first, then close the inlet valve and then quickly turn off the pump so it does not build up too much pressure in the tubing.

The pressure of the system generally should be about 1-2 bar. It is perfectly fine to overcharge the pressure a little higher, shut off the pump and close the valves, and then slightly open the drain valve to allow pressure to bleed down to 1-2 bar.

The expansion tank's air pressure should be set to just above the pressure of the system pressure when it is cold, so that it will begin relieving pressure build up as soon as the system begins heating. To check the air pressure of the tank, remove the bottom cap to expose the inflator valve. Check the pressure with a pressure gauge. If there is too much pressure, relieve some of the pressure through the valve. If there is not enough pressure, use an air compressor to charge the tank to the needed pressure.



Direction of flow when charging the solar system with an SR961s Working Station

Installing the Vacuum Tubes

Ensure that the manifold holes for the heat pipes are clean. If there is any debris or rough edges, using a half round file to clean it and remove any foreign debris.

NOTE: Vacuum tubes will heat the heat pipes rapidly. If the installation is performed in the sun, only allow the tube to be exposed to the sun for minimal amounts of time. Wear protective gloves at all times and do not touch the heat pipe with bare hands.

Vacuum tubes are very strong against blunt forces. However, they have a weak point on the bottom of the tubes where the glass was sealed off after the vacuum was applied. Be careful not to hit this point as it can cause the tube to lose its vacuum. If the vacuum tube has lost its vacuum, it will appear white instead of having a metallic look.

Good Tube with Metallic Bottom (Existing Vacuum)

Bad Tube with White Bottom (Vacuum Lost)

Prior to installing the vacuum tube into the manifold, apply some thermal conducting paste to the sides and tip of the heat pipe. This will ensure full contact with the manifold (no air pockets) for optimum heat transfer and will also make removal of the heat pipes much easier in the future.

Coat the Condenser with Thermal Paste Prior to Insertion into the Manifold

What Condenser Looks like After Removing from Manifold with Applied Thermal Paste

To install the tube, pull the heat pipe about 6 inches out of the tube so that you can hold onto the heat pipe by hand without touching the condenser. Line the tube up with the hole and push the heat pipe into the manifold hole

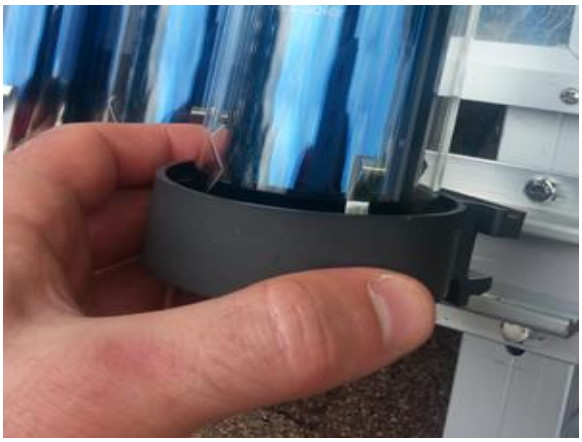
until it bottoms out. Once it bottoms out, slide the vacuum tube up so that the heat pipe goes back into the vacuum tube until the vacuum tube is flush against the manifold.

Pulling the copper heat pipe out of the tube so it can be pushed in by hand

Pushing the tube up against the manifold once copper heat pipe is inside the manifold hole

Once the tube is in place, unscrew a tube holder and slide it onto the bottom of the tube. Snap the tube holders into the bottom rail of the frame. This tube holder should be located so that the tube is perpendicular to the manifold. Use an angle iron to measure. Once snapped in place, thread the other part of the black plastic tube holder into position to tighten the tube against the holder. Tighten until the tube is very sturdy and does not move. It is important that the tube will no vibrate when wind loads hit the collector.

Your style of tube holders may vary. There is a screw on type which will require that you unthread it completely to put it onto the tube. Then snap it down to the bottom frame of the collector and then thread it back on until the tube is tight. The clamshell tube holders can open (like a clam shell) to accept the tube while it is already fastened to the frame. Once the tube is in place, the clamshell can be snapped closed. Then the bottom screw is tightened at the bottom threads to secure the tube against the manifold.



Place the top piece of the tube holder over the tube

Snap top piece of tube holder into the bottom rail of the frame

Screw bottom piece into tube holder to fasten tube tightly to manifold

Completely Fastened Tubes

Clamshell Style Tube Holder

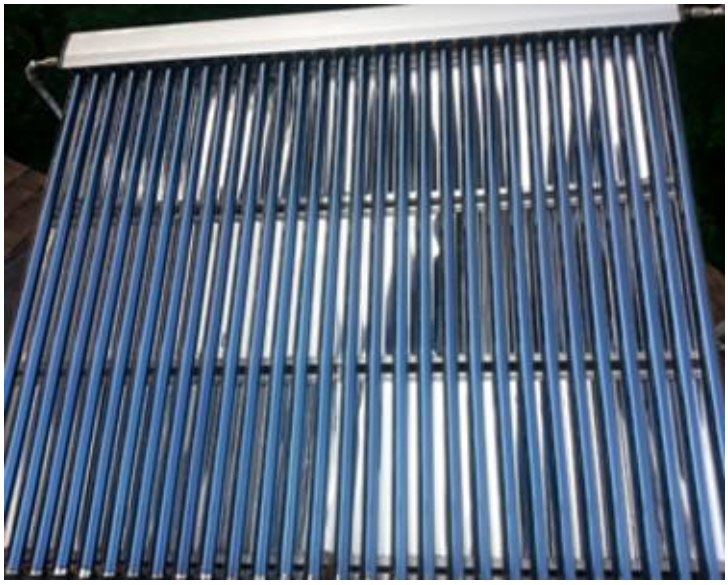
Reflectors

Reflectors are optional but provide increased sunlight absorption while the sun is directly overhead. Sunlight which normally passes in-between the tubes will bounce off the bevels on the reflector and into backs and sides of the tubes. Reflectors do not help as much when the sunlight is coming from an angle since they already capture most of the sun through passive tracking.

Overall, adding reflectors will boost sunlight absorption anywhere from 10-30%. Considering that their cost is low, the added gains are always worth the investment. The best part is that if overheating is a problem in the summertime, they can easily be removed and reinstalled when fall approaches and the amount of sunlight decreases.

It is best to install the reflectors after the tubes have been installed. Sometimes it can be difficult to install the tubes with reflectors on them. To install the reflectors, simply slide them between the tubes and the frame and align the holes in the reflector with the holes in the frame and bolt them down. If you do not have a “reflector compatible” frame which has pre-drilled holes, you will need to mark the position where the holes should be and drill them to accommodate the reflectors.

Normally, 2 reflectors are utilized per collector for the ease of installation and removal. However, it is possible to squeeze 3 reflector pieces per collector for maximum sunlight absorption as shown in the photos below.



30 tube collector with 3 reflector pieces

Side view of collector

Maintenance

Cleaning

Your Duda Solar water heater system should remain clean from occasional rainfall. The round vacuum tubes naturally resist collection of dust and debris that transfers through the atmosphere.

Leaves

Leaves and limbs should be removed when they accumulate on the system. The debris blocks the sun energy and causes a buildup of moisture that can cause decay of the roof surface.

Broken Evacuated Tubes

Your solar water collector can operate with broken tubes. If a tube breaks or loses vacuum, simply remove the defective tube from the collector and remove the copper heat pipe and aluminum fins from it. Insert the copper heat pipe and aluminum fins into a spare tube and install to the missing slot in the collector. Your system will operate normally with slightly reduced efficiency until broken tubes are replaced.

Flushing the System

The closed loop portion of the system should be flushed every 3 to 5 years.

Instructions for long periods of inactivity

The SR961s controller has a vacation mode. If you will be gone for a long period of time, it is advised to put the controller into vacation mode. This mode will circulate the closed loop at night to dissipate heat to the ambient air. This helps prevent excessive overheating and preserves the working fluid a little longer. Be sure to turn off vacation mode when you return home.

If the water heater tank is left unused for long periods of time (over two weeks) a small quantity of hydrogen gas will have built up in the top of the tank. **WARNING:** This gas is highly flammable and in order to dissipate it safely, we recommend that the hot water tap be opened for several minutes to allow the gas to pass safely through the pipes. Do not use the dishwasher, laundry machine, or other gas or electrical appliance for this purpose. Do not smoke or allow any open flames or electrical device operating nearby.

Anode Rod Maintenance

The solar water tank contains a sacrificial anode rod which helps preserve the life of the tank. This device should be checked periodically for corrosion and replaced as needed. The time it takes to corrode depends on the water quality. We recommend using our magnesium anode rods for soft water and aluminum anode rods for hard water.

Draining the Solar Water Tank

CAUTION: Cover the entire solar panel with cardboard or other material that will fully block the sunlight.

CAUTION: Water will be hot and extreme temperatures can be generated with solar water heaters which can scald body parts or cause severe burns.

1. Cover the solar panel
2. Turn off electricity and/or gas to the system
3. Flush cold water through the tank to cool off the closed loop portion
4. Turn off water from the main supply going to the tank
5. Open the drain valve located at the bottom of the solar tank
6. Open the temperature/pressure relief valve at the top of the solar tank to allow air into the tank to allow water to drain. Ensure that you close this release valve after you refill the tank.

Emergency Shutdown Procedures

To Turn off the solar system

Simply remove the power from the electronic controller.

To turn off the water

A shutoff valve should be replaced before the supply to the tank to allow you to shut off the main water supply to the system.

Troubleshooting

No Hot Water

-Check for power to the controller

-Check tank and closed loop pressures

-Check the pressure of the closed loop system. It should be approximately 25 psi or higher if the system is heating. If it has overheated, the pressure will be much higher and needs to be allowed to cool before normal operation may resume.
-Follow the recommendations of the controller manual and check the temperature of T1. If T1 is higher than T2 by the ΔT setting of the controller, ensure that the system pump is on.
-Check the backup heating source after prolonged periods of cloud cover.
-Check for flow of the closed loop at the working station. Some working stations use a float device to show flow. The SR961s displays the flow rate on the display screen.

Warranty

Duda Energy LLC guarantees the electronic components for one year, the collector manifold and solar water heater tank for 5 years, the vacuum tubes for 10 years and the heat pipes for 15 years after the date of purchase. Only products with manufacturer defects will be replaced. Duda Energy will not replace equipment which has been damaged, corroded or misused. Duda Energy will not be held liable for other damages associated with a fault or defect to include labor or other costs. Duda Energy will not pay for shipping costs associated with the return of defective merchandise but will cover shipment of replacement devices to the customers within the 48 contiguous states if original merchandise is deemed defective.

Disclaimer

This manual provides important information regarding the safe installation and operation of your system. It is not intended for this manual to be a complete resource for the installation and safe operating procedures for installing and operation of your system. For the reason of safety, Duda Energy LLC recommends that this system be installed by a professional installer only. Duda Energy LLC is in no way to be held responsible for failure to follow your local safety regulations and codes for your specific locality. Duda Energy LLC will only be held liable for product replacement.