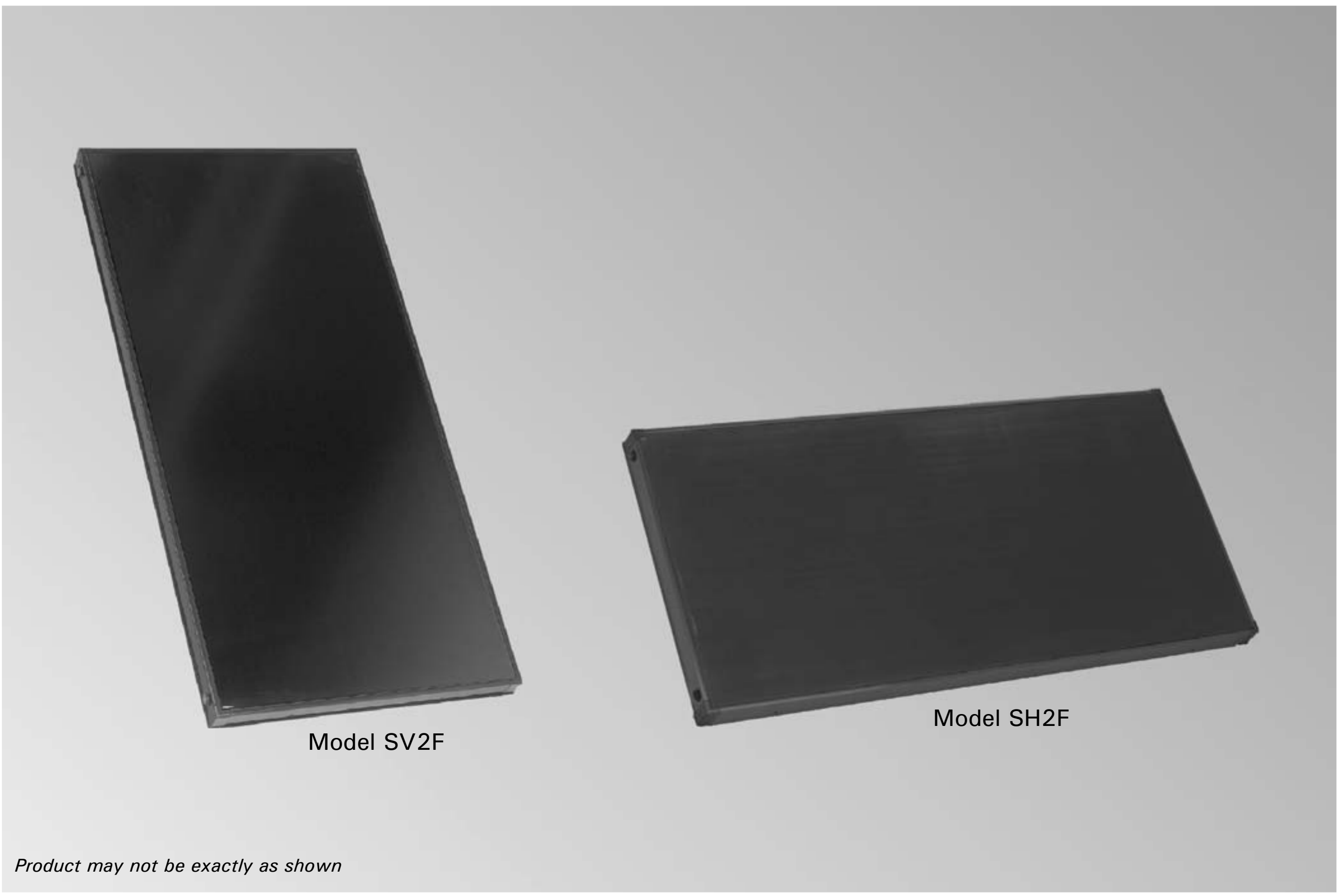
Solar System Design Guide

VITOSOL 200-FM



Product may not be exactly as shown

VITOSOL 200-FM Model SV2F and SH2F

Flat plate solar collectors

For vertical (model SV) or horizontal (model SH) installation on sloped and flat roofs. For integration on walls (model SH only).

To produce domestic hot water, or to supplement low-temperature heating systems or swimming pools via a heat exchanger.

6020 457 - 01 06/2019

Page

Solar Control

Page

Vitosol Installation Examples

Design and Operation

Solar Energy

Together with Viessmann heating systems, solar thermal systems create an optimum system solution for DHW and swimming pool heating, central heating backup and other applications.
This system guide includes a summary of all technical documents for the required components, as well as design and sizing information especially for systems for detached houses. You can obtain a printed Viessmann manuals from your Viessmann sales consultant or download it from the Viessmann website (www. viessmann.ca), where you will also find additional manuals regarding collector installation, service operation and maintenance of solar thermal systems.

Viessmann Collector Range

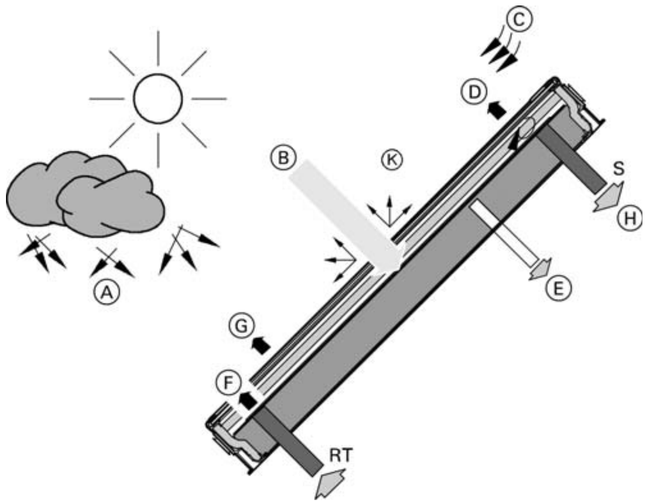
Viessmann Vitosol 200-FM Flat-plate collectors are suitable for DHW and swimming pool heating, for central heating backup, as well as for the generation of process heat. Our flat plate collectors efficiently convert light into heat at the absorber which is then used for heating one or multiple thermal loads.

Flat-plate collectors are easily and safely installed above and integrated into most residential or commercial roofs. Increasingly, collectors are also mounted on walls or as floor standing units (ground mount). Flat-plate collectors are more affordable than vacuum tube collectors. They are used for DHW heating systems, swimming pool heating and for central heating backup.

Flat-plate collectors cannot be mounted flush to flat roofs, as the glass cover cannot be kept clean simply through rain, and the venting of the collector would be more difficult. Vitosol 200-FM, type SH can also be installed on walls. When installed parallel to a wall (facing south), on an annual average, approximately 30% less radiation hits the collector than in installations on 45° supports. If the main period of use falls in spring, autumn or winter (central heating backup), higher yields may still be achieved from the collectors, subject to the prevailing conditions. It should be noted that installation of solar thermal collectors may be subject to certain legal requirements. For the rules regarding the implementation of collector systems, refer to local code requirements in your area.

Vitosol 200-FM collectors feature ThermProtect, a unique absorber coating. This coating changes its optical properties subject to temperature. In the standard temperature range of the solar thermal system, the collectors have the same performance values as conventional solar collectors. As soon as the solar tank has reached the required heat-up condition, an excess of solar energy causes the collector temperature to rise. If the collector absorber temperature exceeds the switching temperature of 167°F (75°C), the absorber will automatically adapt thus reducing heat draw-off. The maximum collector stagnation temperature of 293°F (145°C) can be reached when the system is at a standstill and exposed to full sun. When the collector temperature drops below 167°F (75°C), peak thermal output will resume as the absorber is no longer in switching mode. In a solar thermal system with switching flat-plate collectors, the formation of steam can be safely prevented with increased system pressures. This helps to protect the system components (pump, check valves, expansion vessel, etc.) including the heat transfer medium. ThermProtect absorber coating improves system reliability and service life. For economic reasons, the same sizing rules used for conventional flat-plate collectors apply to switching collectors. However, due to the reduced stagnation temperatures, the collector area may be oversized to achieve higher solar coverage.

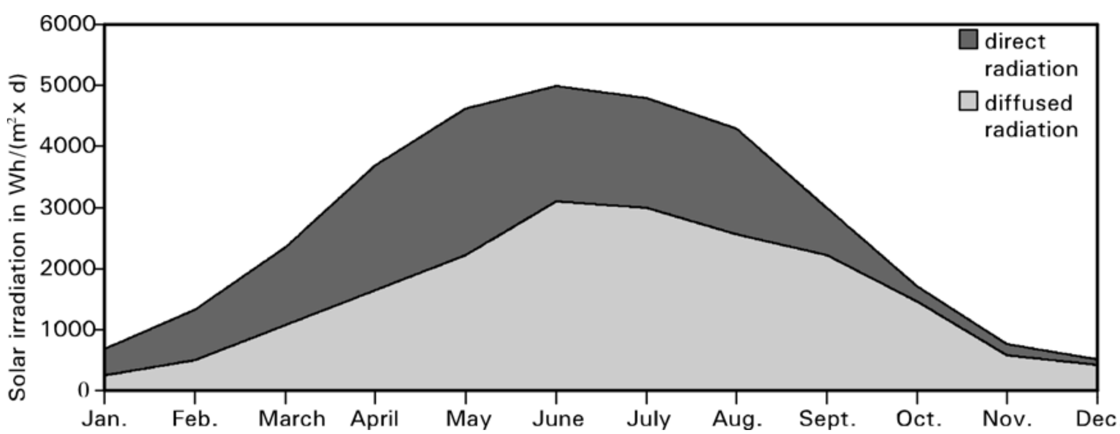
Solar Radiation



Solar radiation represents a flow of energy irradiated uniformly in all directions by the sun. Of that energy, an output of 429 Btuh/ft^2 (1.36 kW/m^2), the so-called solar constant, hits the outer earth's atmosphere.

Legend
Ⓐ Diffused celestial radiation
Ⓑ Direct solar radiation
Ⓒ Wind, rain, snow, convection
Ⓓ Convection losses
Ⓔ Conduction losses
Ⓕ Heat radiation of the absorber
Ⓖ Heat radiation of the glass cover
Ⓗ Useful collector output
Ⓚ Reflection
RT Return
S Supply

Global Radiation



After penetrating the earth's atmosphere, the solar radiation is reduced by reflection, dispersion and absorption by dust particles and gaseous molecules. That portion of this radiation which passes unimpeded through the atmosphere to strike the earth's surface is known as direct radiation.

The portion of the solar radiation which is reflected and/or absorbed by dust particles and gas molecules and irradiated back strikes the earth's surface indirectly is known as diffused radiation.

The total radiation striking the earth's surface is the global radiation. e.g. global radiation = direct radiation + diffused radiation.

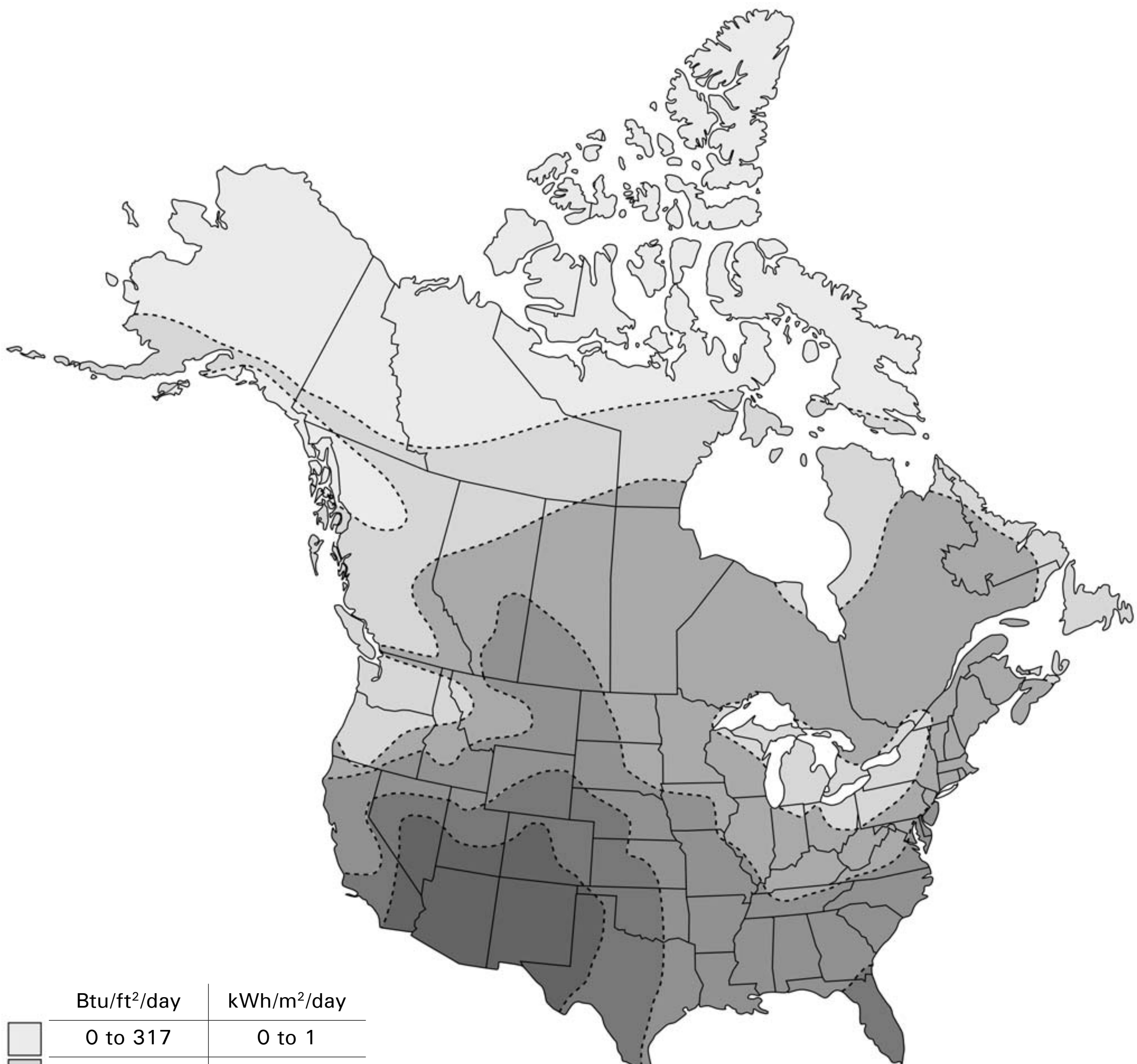
In the latitudes of North America, the typical global radiation under optimum conditions (clear, cloudless sky at midday) amounts to a maximum of 317 Btuh/ft^2 (1000 W/m^2).

With most high quality solar thermal collectors, as much as 75% of this global radiation can be utilized, depending on the type of collector (flat plate or evacuated tube).

Harnessing Solar Energy Using Solar Collectors

The useful energy which a collector can absorb depends on several factors. The main factor is the total solar energy available.
The amount of global energy varies from location to location (see maps below).

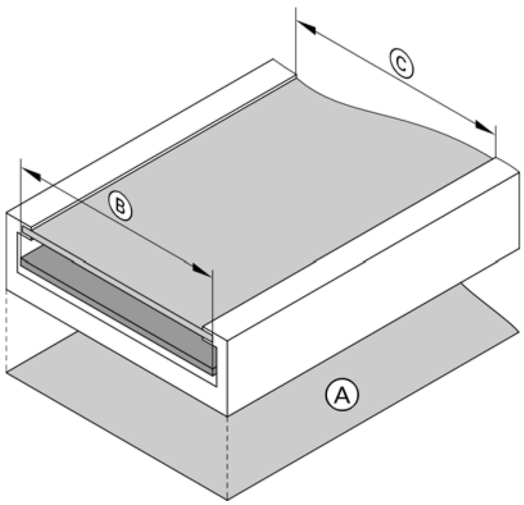
The type of collector, as well as its inclination and orientation, are also very important (see page 12).
If the solar installation is to be operated economically, careful dimensioning of the system components is also essential.



	Btu/ft²/day	kWh/m²/day
	0 to 317	0 to 1
	317 to 634	1 to 2
	634 to 951	2 to 3
	951 to 1268	3 to 4
	1268 to 1585	4 to 5
	> 1585	> 5

Note: Average mean daily global radiation on a south-facing surface tilted at an angle equal to the latitude of the location.

Parameters for Collectors



Flat-plate collector

Area designations

– Gross area Ⓐ
Describes the external dimensions (length x width) of a collector. It is important when planning the installation and when calculating the required installation area, as well as when applying for subsidies.

– Absorber area Ⓑ
The area of the collector that is selectively coated and is set into the collector. This is where the sun's energy is captured and turned/converted into heat.

– Aperture area Ⓒ
This is the opening or the area in the collector which solar energy can pass through such that it reaches the absorber sheet.

Flat-plate collector aperture area:
Area of collector cover through which solar rays can enter.

Collector Efficiency

The efficiency of a collector (see chapter "Specification" for the relevant collector) specifies the proportion of insolation hitting the absorber area that can be converted into usable heat. The efficiency depends, among other things, on the operating conditions of the collector. The calculation method is the same for all collector types. Some of the insolation striking the collectors is "lost" through reflection and absorption at the glass pane and through absorber reflection. The ratio between the insolation striking the collector and the radiation that is converted into heat on the absorber is used to calculate the optical efficiency η_0.

When the collector heats up, it transfers some of that heat to the ambient area through thermal conduction of the collector material, thermal radiation and convection. These losses are calculated by means of the heat loss factors k_1 and k_2 and the temperature differential ΔT (given in Kelvin) between the absorber and the surroundings:

Efficiency curves (based on collector absorber areas)

The optical efficiency η_0 and the heat loss factors k_1 and k_2 together with temperature differential ΔT and the irradiance E_g are sufficient to determine the efficiency curve. Maximum efficiency is achieved when the differential between the absorber and ambient temperature ΔT and the thermal losses are zero. The higher the collector temperature, the higher the thermal losses and the lower the efficiency.

Collector Thermal Efficiency Calculation

Example for Vitosol 200-FM SV2F:
*Calculate the efficiency (based on absorber area)

$$\eta = \eta_0 - \frac{k_1 \cdot \Delta T}{E_g} - \frac{k_2 \cdot \Delta T^2}{E_g}$$

Where:
η_0 = 82.3%
k_1 = 4.421 W/(m² K)
k_2 = 0.022 W/(m² K²)
E_g = 1000 W/m²
ΔT = (40°C - 20°C) = 20°C

$$\eta = 0.823 - \frac{4.421 \cdot 20}{1000} - \frac{0.022 \cdot (20)^2}{1000}$$

η = 0.7258 or 72.6% Efficient

Vitosol 200-FM Collector Efficiency (%)
(based on absorber area)

	Solar Irradiance (W/m²)				
ΔT	200	400	600	800	1000
0°K	82.3%	82.3%	82.3%	82.3%	82.3%
20°K	33.7%	58.0%	66.1%	70.1%	72.6%
40°K	-	29.3%	47.0%	55.8%	61.1%
60°K	-	-	24.9%	39.2%	47.9%
80°K	-	-	-	20.5%	32.9%
100°K	-	-	-	-	16.1%

Collector Thermal Output Calculation

Example for 1x Vitosol 200-FM SV2F collector:
*Calculate the output (based on absorber area)

$$Q_t = E_g \cdot A_c \cdot \left(\eta_0 - \frac{k_1 \cdot \Delta T}{E_g} - \frac{k_2 \cdot \Delta T^2}{E_g}\right)$$

Where:
η_0 = 82.3%
k_1 = 4.421 W/(m² K)
k_2 = 0.022 W/(m² K²)
A_c = 2.32 m²
E_g = 1000 W/m²
ΔT = (40°C - 20°C) = 20°C

$$Q_t = 1000 \cdot 2.32 \cdot \left(0.823 - \frac{4.421 \cdot 20}{1000} - \frac{0.022 \cdot (20)^2}{1000}\right)$$

Q_t = 1684 Watts

Vitosol 200-FM Thermal Output (Watts)
(based on absorber area of one collector)

	Solar Irradiance (W/m²)				
ΔT	200	400	600	800	1000
0°K	382 W	764 W	1146 W	1527 W	1909 W
20°K	156 W	538 W	920 W	1302 W	1684 W
40°K	-	272 W	654 W	1036 W	1417 W
60°K	-	-	346 W	728 W	1110 W
80°K	-	-	-	380 W	762 W
100°K	-	-	-	-	373 W

Thermal Capacity

The thermal capacity in kJ/(m^2 · K) indicates the amount of heat absorbed by the collector per m^2 and degree Kelvin. This heat is only available to the system to a limited extent.

Stagnation Temperature

The stagnation temperature is the maximum temperature that the collector can reach during insolation of 317 Btuh/ft² (1000 W/m²).

- Vitosol 200-FM, with ThermProtect: Up to 293°F (145°C)

If no heat is drawn from the collector, it will heat up until it reaches the stagnation temperature. In this state, the thermal losses are of the same magnitude as the radiation absorbed (energy in = energy out).

System Filling Pressure and Steam-Producing Power

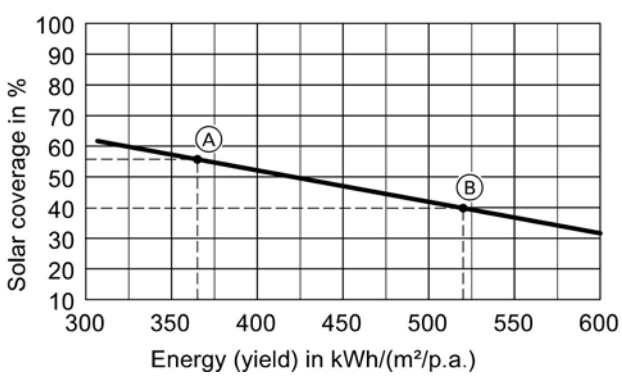
Steam-producing power
The steam-producing power in Btuh/ft² (W/m²) indicates the maximum power level at which a collector produces steam during stagnation and transfers it to the system, when evaporation occurs.

ThermProtect switching flat-plate collectors in solar thermal systems with higher system pressures will no longer produce steam. The steam producing power of such these collectors becomes 0 Btuh/ft² (0 W/m²).

System filling pressure for Vitosol 200-FM
To prevent steam creation of the solar heat transfer medium, the system filling pressure of the solar thermal system must be increased. At the highest point of the solar thermal system, a pressure of 44 psi (3.0 bar) must be present (see page 83). The static head of the solar thermal system, the pressure reserve for ventilation and the supplement for the difference in height between the expansion vessel and the safety valve must also be taken into account when filling the system.

Adjust the pre-charge pressure of the expansion vessel to match the relevant system configuration. Always adjust the pre-charge pressure of the expansion vessel before filling the solar thermal system.

Solar Coverage



Legend
Ⓐ Conventional sizing for DHW systems in detached houses
Ⓑ Conventional sizing for large solar thermal systems

The solar coverage rate indicates what percentage of the energy required annually for DHW applications can be covered by the solar thermal system.

Designing a solar thermal system always entails finding a good compromise between yield and solar coverage. The higher the selected solar coverage, the more conventional energy is saved.

However, high solar coverage is linked to an excess of heat in summer. This means a lower average collector efficiency and consequently lower yields energy in Btuh/ft² (kWh/m^2) absorber area.

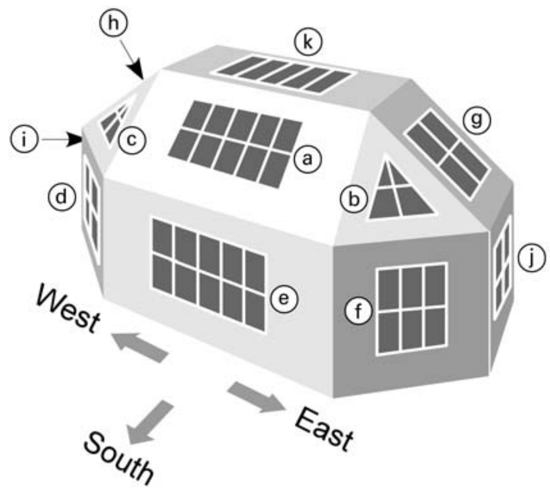
Most residential solar DHW systems are sized to achieve 55 to 60% solar coverage.

Most larger commercial solar DHW systems are sized to achieve 30 to 50% solar coverage.

The maximum solar coverage recommended to avoid overheating in most DHW systems and pool systems is 60%.

6020 457 - 01

Orientation of the Receiver Surface

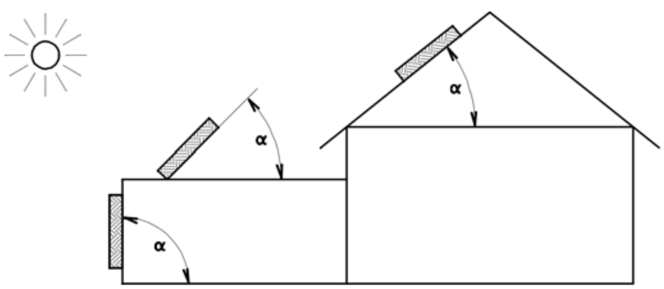


Optimum alignment and inclination
The solar collector provides the highest solar yield over an annual average when facing due South with an inclination of approximately 30° to 45° from the horizontal plane. However, the installation of a solar heating system is still viable even when the installation deviates quite significantly from the above (+/- 45° of due South alignment or with an inclination of 25° to 55° from the horizontal plane). Greater deviations, for example, for installation on walls, can be compensated for by a correspondingly larger collector area.

Solar Energy Yield

ⓐ 100%	ⓓ 65%	ⓖ 80%	ⓙ 50%
ⓑ 95%	ⓔ 70%	ⓗ 80%	ⓚ 90%
ⓒ 95%	ⓕ 65%	ⓘ 50%	

Inclination of the Receiver Surface



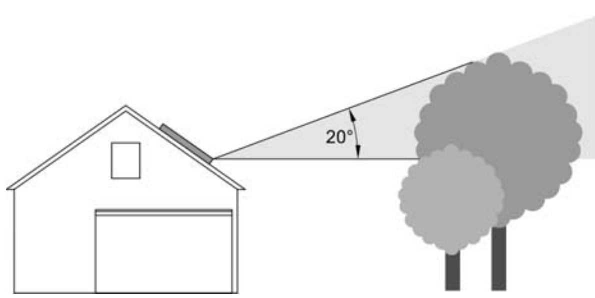
Collector Inclination Angles:
Summer biased installation = latitude of location -15°
Optimum, year round performance = latitude of location
Winter biased installation = latitude of location +15°

Inclination of the receiver surface
The yield of a solar thermal system varies depending on the inclination and orientation of the collector area. If the collector installation surface is angled, the angle of incidence changes, as does the irradiance, and consequently the amount of energy. This is greatest when the radiation hits the collector installation surface at right angles. In our latitudes, this case never arises relative to the horizontal. Consequently, the inclination of the receiver surface can optimize the yield. In North America, a collector installation surface oriented facing South and angled 35° receives approximately 12% more energy when compared with a horizontal position.

A common rule of thumb is used when designing a solar DHW heating system to optimize the year round production of energy:
Collector inclination = latitude of location.

For combination DHW + space heating supplement systems, the collectors should be installed at a steeper angle of inclination to take advantage of lower winter sun angles and to more effectively shed snow. The rule of thumb to optimize combination systems:
Collector inclination = latitude of location +15°.

Avoid Shading of the Receiver Surface



Avoid shading of the collector installation surface
Looking at the installation of a collector facing south, we recommend that the area between south-east and south-west is kept free of shading (at an angle towards the horizon of up to 20°). It should be noted that the solar system is to operate for longer than 20 years, and that during this time, for example, trees would grow substantially.

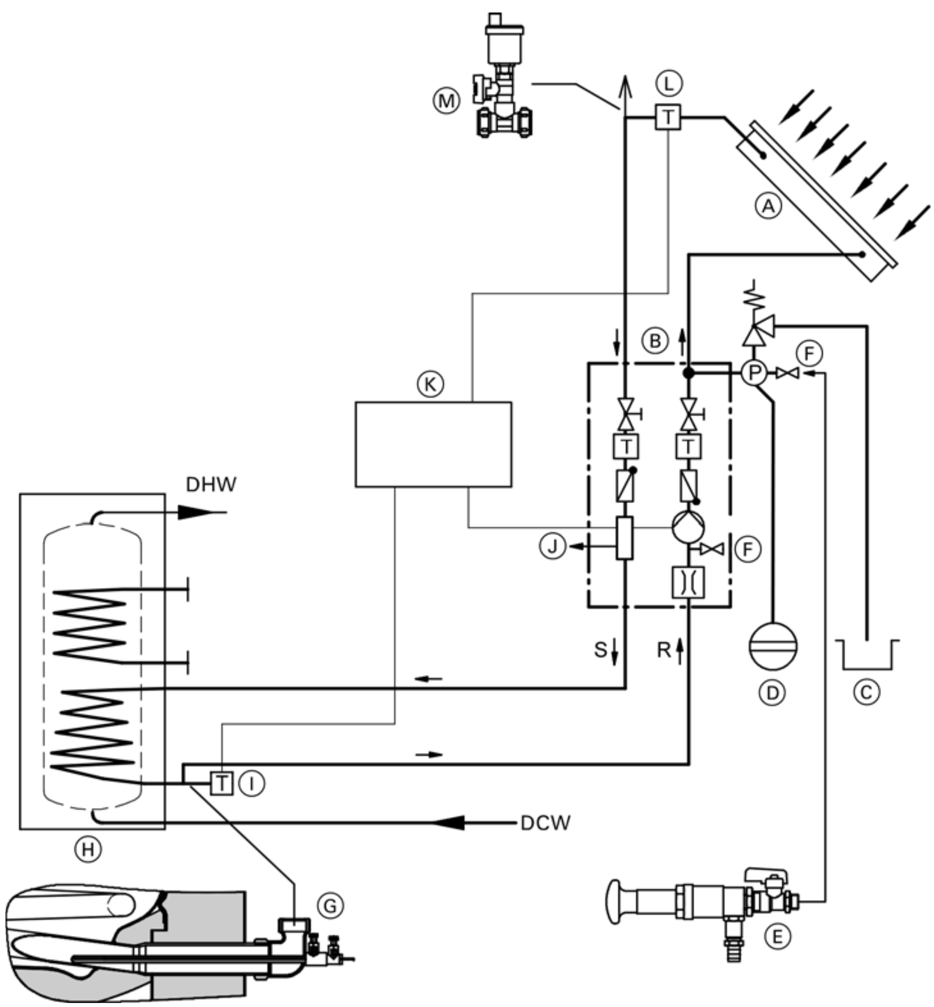
Overall System Optimization

A high-quality solar collector cannot by itself guarantee the optimum operation of a solar installation. This depends more on the complete system solution as a whole. Viessmann supplies all the components required for a solar heating system:

- a control unit that is tailored to the individual solar heating system,
- a DHW tank incorporating a solar heat exchanger inside the tank,
- a pre-assembled pump station with all necessary hydraulic components,design details aimed at achieving fast-responding control and therefore maximum yields from the solar heating system.

Correctly designed solar heating systems with well matched system components can cover 55 to 60% of the annual energy demand for DHW heating in detached and semi-detached houses.

Viessmann would be pleased to assist you with the design of solar heating system. The elements of a typical solar heating system are shown in the diagram below.



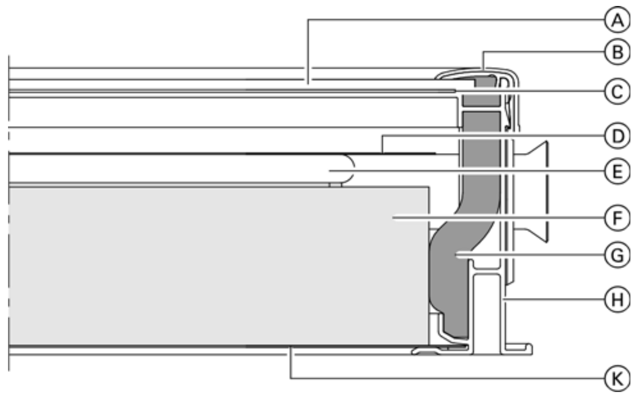
Legend

Ⓐ Solar collector
Ⓑ Solar-Divicon (pumping station)
Ⓒ Overflow container
Ⓓ Expansion tank
Ⓔ Solar manual filling pump (optional)
Ⓕ System fill manifold valve
Ⓖ Solar brass elbow comes with sensor well
Ⓗ Solar storage tank
Ⓘ Tank temperature sensor (field installed)
Ⓙ Air separator (Solar-Divicon)
Ⓚ Solar control unit
Ⓛ Collector temperature sensor (field installed)
Ⓜ Fast air vent, c/w shutoff valve *1
Ⓟ System pressure gauge
Ⓡ Return to collector
Ⓢ Supply from collector

*1 Install at least one air-vent valve (quick-acting air-vent valve or a manual vent valve, at the highest point of the system.

6020 457 - 01

Product Description



Legend
Ⓐ Solar glass cover, ⅛ in. (3.2 mm) thick
Ⓑ Aluminum cover strip in dark blue
Ⓒ Continuous flexible seal for solar glass cover
Ⓓ Aluminum absorber sheet with ThermProtect coating
Ⓔ Meander-shaped copper pipe
Ⓕ Melamine resin foam insulation
Ⓖ Melamine resin foam insulation
Ⓗ Aluminum frame in dark blue
Ⓚ Aluminum-zinc coated sheet steel back panel

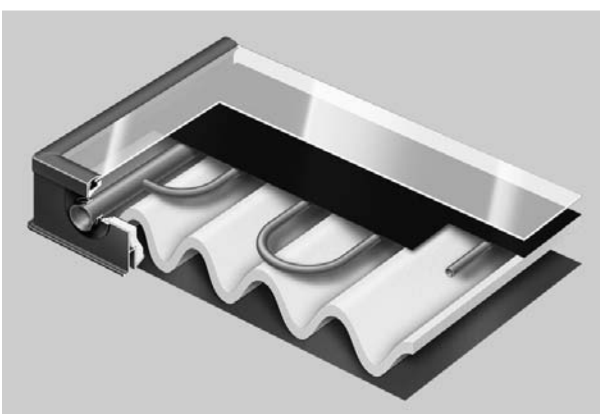
The main component of the Vitosol 200-FM is the ThermProtect switching absorber. It ensures high absorption of solar radiation and low emission of thermal radiation. When the collector temperature becomes elevated >167°F (>75°C) the absorber will switch or transition to a higher rate of thermal emission. The net result is that the collector will operate at a reduced temperature as the absorber will be rejecting excess thermal radiation. The ThermProtect switching absorber limits the maximum or stagnation temperature of the collector 293°F (145°C). A meander-shaped copper pipe, through which the heat transfer medium flows, is permanently embedded into the absorber.

The heat transfer medium channels the absorber heat through the copper pipe. The absorber is encased in a highly insulated collector housing, which minimizes collector heat losses. The high quality thermal insulation provides temperature stability and is free from gas emissions.

The cover consists of low iron tempered solar glass, thereby reducing reflection losses and making it very resistant to weather influences.

The glass is set into the one-piece powder-coated aluminum frame with a continuous profiled seal, preventing water from penetrating into the collector. This ensures a long and reliable service life for all internal components.

Benefits



Delivered condition
The Vitosol 200-FM is delivered fully assembled ready to connect.

- High performance, premium version flat plate collector, thanks to unique frame design and highly efficient ThermProtect coated aluminum absorbers.
- Suitable for many residential or commercial applications with vertical or horizontal versions available. Suitable for DHW or pool heating, space heating applications.
- Attractive appearance with powder coated dark blue frame, endless glass seal and minimal space between collectors. No screws or rivets used in frame for clean, neat finish.
- Rugged, high-quality construction using impact-resistant low-iron solar glass, copper piping, aluminum absorber and frame and non-degrading thermal insulation.
- Permanently sealed and high stability through all-around folded aluminum frame and endless glass seal.
- Universal application on flat, sloped roofs or freestanding, vertical (model SV) or horizontal (model SH) orientation. Model SH is suitable for installations on walls. Connect up to 12 collectors in one array for commercial or residential systems.
- Fast installation with flexible connection pipes and quick-connect fittings. Prefabricated collector mounting hardware ensures easy connection to roofs.
- Maximum system performance and reliability with a full range of solar system components designed to integrate seamlessly.
- Quality tested to Solar Keymark testing requirements.
- Certified to the Solar Rating and Certification Corporation (SRCC) OG-100 Standard.

6020 457 - 01

Specification

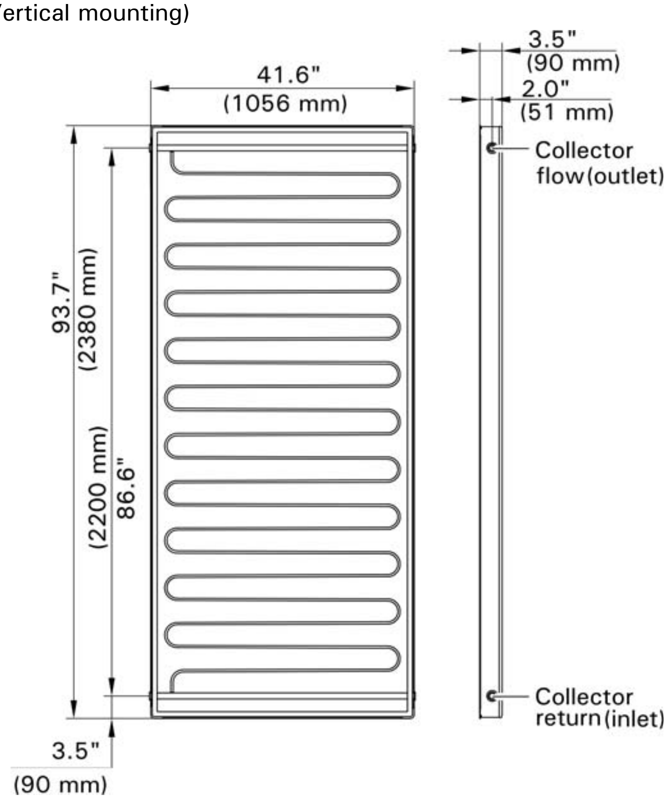
Vitosol 200-FM		SV2F	SH2F
Gross area	ft^2 (m^2)	27.0 (2.51)	27.0 (2.51)
Absorber area	ft^2 (m^2)	25.0 (2.32)	25.0 (2.32)
Aperture area *1	ft^2 (m^2)	25.1 (2.33)	25.1 (2.33)
Spacing between collectors	in. (mm)	¾ (21)	¾ (21)
Dimensions*2			
Width	in. (mm)	41¾ (1056)	93¾ (2380)
Height	in. (mm)	93¾ (2380)	41¾ (1056)
Depth	in. (mm)	3½ (90)	3½ (90)
Collector performance based on Absorber Area			
Optical efficiency	%	82.3	82.6
Heat loss coefficient U1	$W/(m^2 \cdot K)$	4.421	4.380
Heat loss coefficient U2	$W/(m^2 \cdot K^2)$	0.022	0.037
Collector performance based on Gross Area			
Optical efficiency	%	75.7	76.0
Heat loss coefficient U1	$W/(m^2 \cdot K)$	4.069	4.031
Heat loss coefficient U2	$W/(m^2 \cdot K^2)$	0.020	0.034
Thermal capacity	$kJ/(m^2 \cdot K)$	4.89	5.96
Weight (dry)	lb (kg)	86 (39)	88 (40)
Fluid capacity (heat transfer medium)	USG (L)	0.48 (1.83)	0.63 (2.40)
Maximum working pressure*3	psig (bar)	87 (6)	87 (6)
Maximum stagnation temperature*4	°F (°C)	293 (145)	293 (145)
Connection	in. (mm)	¾ (22)	¾ (22)
Requirements for installation surface and anchorage		Roof construction with adequate load capacity for prevailing wind forces	
Mechanical test load			
Max. tested positive load	lb/ft^2 (Pa)	73.1 (3500)	73.1 (3500)
Max. tested negative load	lb/ft^2 (Pa)	62.7 (3000)	62.7 (3000)

*1 Important for system design considerations.
*2 Dimensions rounded to the nearest ¼ inch.
*3 In sealed systems, operating pressure of at least 44 psig + 0.45 psig x static head (ft.) (3.0 bar + 0.1 bar x static head (m) must be present in the collectors in cold condition.
*4 The stagnation temperature is the temperature which applies to the hottest point of the collector at a global radiation intensity of 3412 Btu/h / 1000 W when no heat is conducted by the heat transfer medium.

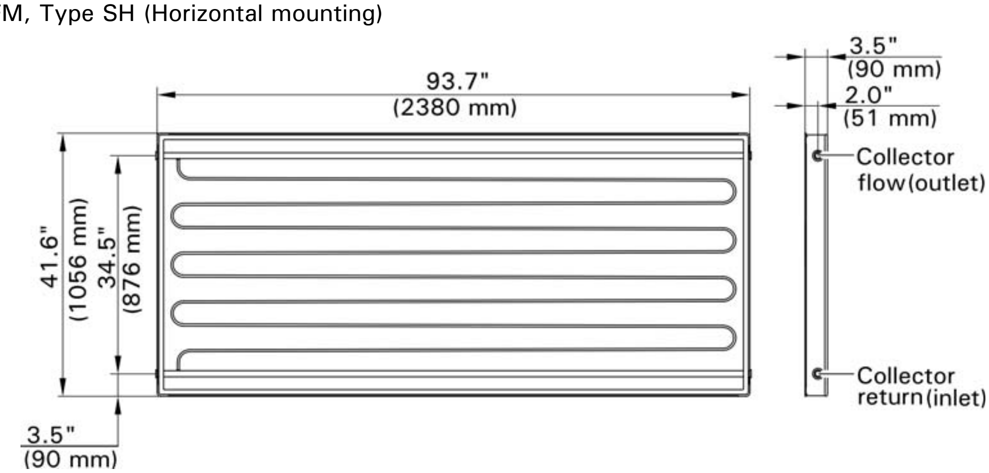
6020 457 - 01

Dimensions

Vitosol 200-FM, Type SV (Vertical mounting)



Vitosol 200-FM, Type SH (Horizontal mounting)



Approved Quality

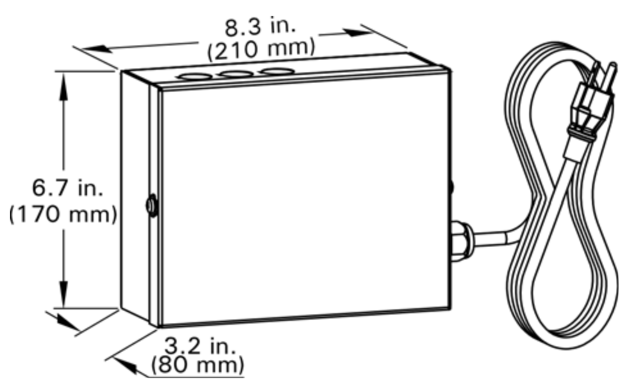
Tested in accordance with Solar KEYMARK, EN 12975, and SRCC 0G-100.

For a complete list of certified collectors and pre-engineered solar packages, please scan the QR code below or visit Solar Rating & Certification Corporation website at: www.solar-rating.org

Solar Control Units

Solar control module, type SM1	SCU 124 and 224	SCU 345
An external extension module for the Viessmann Vitotronic control based on a wall mountable casing. – Electronic temperature differential control for dual mode DHW heating and central heating backup from solar collectors in conjunction with a Viessmann boiler – Control and display via the Vitotronic boiler control unit	Electronic temperature differential controller for systems with dual mode DHW heating with solar collectors and boilers	Electronic temperature differential controller for up to three consumers for the following systems with solar collectors and boilers: – Dual mode DHW heating with dual mode DHW tanks or several tanks – Dual mode DHW and swimming pool heating – Dual mode DHW heating and central heating backup – Industrial/commercial heating systems

Solar Control Module SM1



Functions

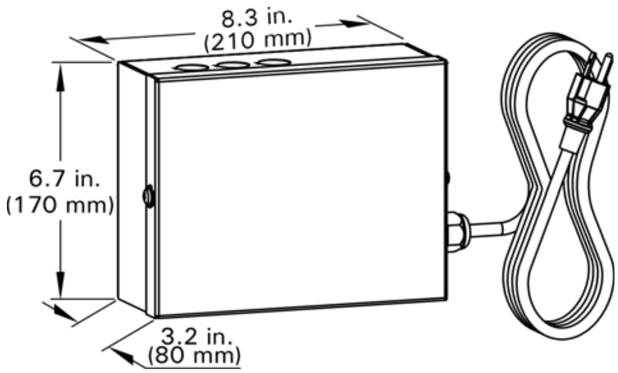
- With output statement and diagnostic system.
- Operation and display via the Viessmann Vitotronic boiler control unit.
- Switching the solar circuit pump.
- Heating of two consumers via a collector array.
- Second temperature differential controller.
- Thermostat function for reheating or utilizing excess heat.
- Suppression of DHW tank reheating by the boiler, subject to solar yield.
- Suppression of reheating for central heating by the heat source in the case of central heating backup.
- Heat-up of the solar preheating stage for 79 USG (300 L) or 119 USG (450 L) dual coil DHW tanks.
- Collector safety shutdown.
- Electronic temperature limitation in the DHW tank.
- Order extra immersion temperature sensors, if the following functions are required:
  - For DHW circulation diversion in systems with two DHW tanks.
  - For return changeover between the heat generator and the heating water buffer tank.
  - For heating additional thermal loads

Solar Control Module SM1 *(continued)*

Construction

The solar control module contains:

- PCB
- Terminals:
- 4 sensor inputs
- Solar circuit pump output
- 1 relay for switching an injection pump or motorized valve
- KM BUS connectivity
- Power supply (on-site ON/OFF switch)



Specification

Rated voltage	120 V~
Rated frequency	60 Hz
Rated current	2 A
Power consumption	1.5 W
Safety category	I

Permissible ambient temperature:

– During operation	32 to 104°F (0 to +40°C) use in the living space or boiler room (standard ambient conditions)
– During storage and transport	−4 to +150°F (−20 to +65°C)

Rated relay output breaking capacity:

– Semi-conductor relay	1 (1) A, 120 V~
– Relay 2	1 (1) A, 120 V~
– Total max.	2 A

Collector temperature sensor

For connection inside the module.
On-site extension of the connecting lead:

– 2-core copper lead, cable length up to 197 ft. (60 m) AWG 15-16 [cross-section of 0.00233 in^2 (1.5 mm^2)]
– Never route this lead immediately next to 120/240VAC cables

Cable length	8.2 ft. (2.5 m)
Sensor type	Viessmann NTC 20 kΩ, at 77°F (25°C)

Permissible ambient temperature:

– During operation	−4 to +392°F (−20 to +200°C)
– During storage and transport	−4 to +158°F (−20 to +70°C)

Tank temperature sensor

For connection inside the module.
On-site extension of the connecting lead:

– 2-core lead, length max. 197 ft. (60 m) AWG 15-16 [cross-section of 0.00233 in^2 (1.5 mm^2)]
– Never route this lead immediately next to 120/240VAC cables

Cable length	12.3 ft. (3.75 m)
Sensor type	Viessmann NTC 10 kΩ, at 77°F (25°C)

Permissible ambient temperature

– During operation	32 to +190°F (0 to +90°C)
– During storage and transport	−4 to +158°F (−20 to +70°C)

For systems with Viessmann DHW tanks, the SM1 tank temperature sensor is installed in the solar brass elbow (standard delivery or accessory for the respective DHW tank) in the heating water return.

Delivered Condition

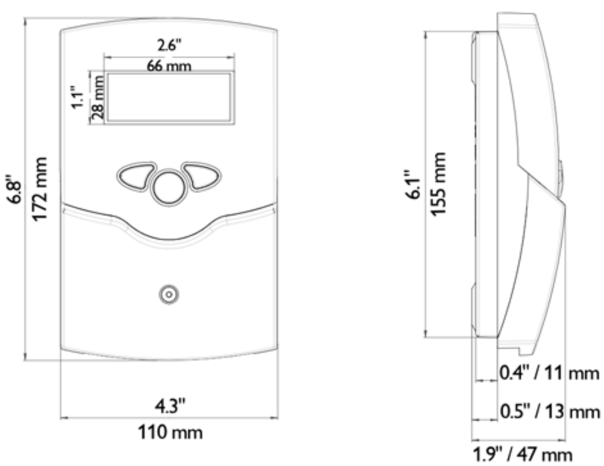
– Solar control module, type SM1
– 1 x collector temperature sensor (NTC 20 KΩ)
– 1 x tank temperature sensor (NTC 10 KΩ)

Solar Control Unit SCU 124

Construction

The control unit comprises:
- PCB
- LCD
- Selector keys
- Connection terminals:
  - 4x Sensor inputs
  - 2x Relay outputs for actuating pumps and valves
  - VBus connectivity
  - Power supply (on-site ON/OFF switch)
- 2x Variable speed outputs for controlling the solar circuit pump

The standard delivery includes 1x collector temperature sensor, 2x tank temperature sensors



Functions

- 3 basic system layouts
- Switching the solar circuit pump for DHW and/or swimming pool heating or space heating
- Electronic limiter for the temperature in the DHW tank (safety shutdown at 194°F (90°C)
- Collector safety shutdown and collector cooling
- Control of 1 storage tank/thermal load
- Operating hour counter for relays
- Energy metering
- Thermostat function
- Heat dump function

For further functions, see page 22.

For systems with Viessmann DHW tanks, the tank temperature sensor is installed in the solar brass elbow located in the heating water return (see page 35).

Specifications

Rated voltage	100 – 240 VAC
Rated frequency	50 – 60 Hz
Rated current	4A
Power consumption	2W (in standby mode 0.7 W)
Safety category	II

Permissible ambient temperature:

– during operation	32 to 104°F (0 to +40°C) for use in the living space or boiler room
– during storage and transport	–4 to +150°F (–20 to +65°C)

Rated relay output breaking capacity:

– Semi-conductor relay 1	1 A 100 – 240 VAC
– Semi-conductor relay 2	1 A 100 – 240 VAC
– Total	max. 2A

Collector temperature sensor (FKP6)

For connection inside the control.
On-site extension of the connecting lead:
- 2-core copper lead, cable length up to 197 ft. (60 m) AWG 15-16 [cross-section of 0.00233 in^2 (1.5 mm^2)]
- Never route this lead immediately next to 120/240V cables

Cable length	5 ft. (1.5 m)
Sensor type	PT1000

Permissible ambient temperature

– during operation	–58 to 356°F (–50 to +180°C)
– during storage and transport	–4 to +158°F (–20 to +70°C)

Tank temperature sensor (FRP6)

For connection inside the control.
On-site extension of the connecting lead:
- 2-core lead, cable length up to 197 ft. (60 m) AWG 15-16 [cross-section of 0.00233 in^2 (1.5 mm^2)]
- Never route this lead immediately next to 120/240V cables

Cable length	8.2 ft. (2.5 m)
Sensor type	PT1000

Permissible ambient temperature:

– during operation	23 to +176°F (–5 to +80°C)
– during storage and transport	–4 to +158°F (–20 to +70°C)

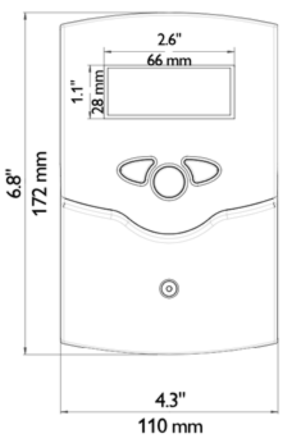
Delivered Condition

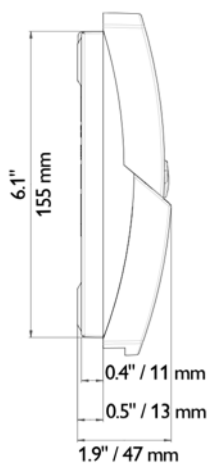
- SCU 124
- 1x collector temperature sensor (FKP6)
- 2x tank temperature sensors (FRP6)

Solar Control Unit SCU 224

Construction
The control unit comprises:
- PCB
- LCD
- Selector keys
- Connection terminals:
  - 4x Sensor inputs
  - 2x Relay outputs for actuating pumps and valves
  - VBus connectivity
  - Power supply (on-site ON/OFF switch)
- 2x Variable speed outputs for controlling the solar circuit pump and auxiliary pump or valve

The standard delivery includes 2x collector temperature sensors, 2x tank temperature sensors





Functions
- 10 basic system layouts
- Control of 2 collector fields
- Control of 2 storage tanks (thermal loads)
- Heat dump function
- Switching the solar circuit pump for DHW and/or swimming pool heating
- Electronic limiter for the temperature in the DHW tank (safety shutdown at 194°F (90°C)
- Collector safety shutdown and collector coding
- Operating hour counter for relays
- Energy metering
- Thermostat function

For further functions, see page 22.

For systems with Viessmann DHW tanks, the tank temperature sensor is installed in the solar brass elbow located in the heating water return (see page 35).

Specifications

Rated voltage	100 – 240 VAC
Rated frequency	50 – 60 Hz
Rated current	4A
Power consumption	2W (in standby mode 0.7 W)
Safety category	II

Permissible ambient temperature:

– during operation	32 to 104°F (0 to +40°C) for use in the living space or boiler room
– during storage and transport	−4 to 150°F (−20 to +65°C)

Rated relay output breaking capacity:

– Semi-conductor relay 1	1 A 100 – 240 VAC
– Semi-conductor relay 2	1 A 100 – 240 VAC
– Total	max. 2A

Collector temperature sensor (FKP6)
For connection inside the control.
On-site extension of the connecting lead:
- 2-core copper lead, cable length up to 197 ft. (60 m) AWG 15-16 [cross-section of 0.00233 in^2 (1.5 mm^2)]
- Never route this lead immediately next to 120/240V cables

Cable length	5 ft. (1.5 m)
Sensor type	PT1000

Permissible ambient temperature

– during operation	−58 to 356°F (−50 to +180°C)
– during storage and transport	−4 to +158°F (−20 to +70°C)

Tank temperature sensor (FRP6)
For connection inside the control.
On-site extension of the connecting lead:
- 2-core lead, cable length up to 197 ft. (60 m) AWG 15-16 [cross-section of 0.00233 in^2 (1.5 mm^2)]
- Never route this lead immediately next to 120/240V cables

Cable length	8.2 ft. (2.5 m)
Sensor type	PT1000

Permissible ambient temperature:

– during operation	23 to +176°F (−5 to +80°C)
– during storage and transport	−4 to +158°F (−20 to +70°C)

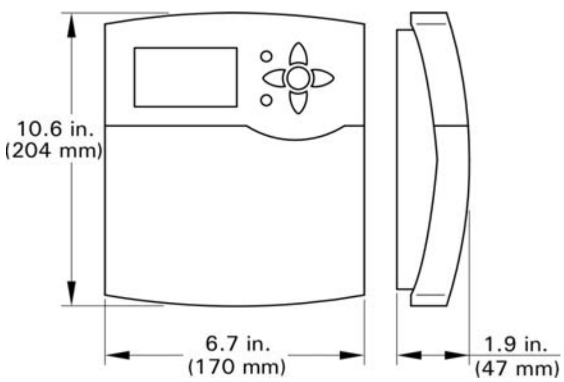
Delivered Condition

- SCU 224
- 2x collector temperature sensors (FKP6)
- 2x tank temperature sensors (FRP6)

Solar Control Unit SCU 345

Construction
The control unit comprises:
- PCB
- LCD
- Selector keys
- Connection terminals:
  - 5x Sensor inputs
  - 3x Variable speed outputs for controlling the solar circuit pumps
  - 1x Mechanical relay for actuating the pumps and valves
  - Pulse counter input for connection of flow meters
  - VBus connectivity
  - Power supply (on-site ON/OFF switch)
- SD card slot for data logging

The standard delivery includes 2x collector temperature sensor 2x tank temperature sensor (swimming pool water/ heating water buffer tank).



Functions
- Switching the solar circuit pumps for DHW and/or swimming pool heating or other consumers
- Electronic limiter for the temperature in the DHW tank (safety shutdown at 194°F (90°C)
- Collector safety shutdown and collector cooling
- 9 basic system layouts
- Up to 3 storage tanks (thermal loads)
- Operating hour counter for relays
- Energy metering
- Heat dump function
- Time controlled thermostat function

For further functions, see page 22.

For systems with Viessmann DHW tanks, the tank temperature sensor is installed in the solar brass elbow located in the heating water return (see page 35).

Specification

Rated voltage	100 – 240 VAC
Rated frequency	50 – 60 Hz
Rated current	4A
Power consumption	2W (in standby mode 0.9 W)
Safety category	II

Permissible ambient temperature:

– During operation	32 to 104°F (0 to +40°C) use in the living space or boiler room
– During storage and transport	–4 to +150°F (–20 to +65°C)

Rated relay output breaking capacity

– Semi-conductor relay 1 to 3	1A, 100 – 240 VAC
– Mechanical relay 4	2A, 100 – 240 VAC
– Total	max. 4 A

Collector temperature sensor (FKP6)
For connection inside the control.
On-site extension of the connecting lead:
- 2-core copper lead, cable length up to 197 ft. (60 m) AWG 15-16 [cross-section of 0.00233 in^2 (1.5 mm^2)]
- Never route this lead immediately next to 120/240V cables

Cable length	5 ft. (1.5 m)
Sensor type	PT1000

Permissible ambient temperature

– during operation	–58 to 356°F (–50 to +180°C)
– during storage and transport	–4 to +158°F (–20 to +70°C)

Tank temperature sensor (FRP6)
For connection inside the control.
On-site extension of the connecting lead:
- 2-core lead, cable length up to 197 ft. (60 m) AWG 15-16 [cross-section of 0.00233 in^2 (1.5 mm^2)]
- Never route this lead immediately next to 120/240V cables

Cable length	8.2 ft. (2.5 m)
Sensor type	PT1000

Permissible ambient temperature:

– during operation	23 to +176°F (–5 to +80°C)
– during storage and transport	–4 to +158°F (–20 to +70°C)

Delivered Condition

- SCU 345
- 2x collector temperature sensors (FKP6)
- 2x tank temperature sensors (FRP6)

Allocation to Solar Control Units

Function	Solar control module SM1	SCU 124	SCU 224	SCU 345
Tank temperature limit	x	x	x	x
Collector cooling function	--	x	x	x
Tank cooling function	--	x	x	x
Collector emergency shutdown	x	x	x	x
Minimum collector temperature limit	x	x	x	x
Evacuated tube collector function	x	x	x	x
Frost protection function	x	x	x	x
Thermostat function	x	x	x	x
Variable speed pump operation via PWM	--	--	--	x
Energy metering	x	x	x	x
Suppression of reheating by the boiler – DHW tank	x	--	--	--
– Central heating backup	x	--	--	--
External heat exchanger	x	--	x	x
Parallel relay	--	--	--	x
Tank 2 ON	--	--	x	x
Tank 2 to 3 ON	--	--	--	x
Tank priority control	--	x	x	x
Utilisation of excess heat (heat dump)	--	x	x	x
Cyclical heating	x	x	x	x
Relay kick	x	--	--	x
SD Card (data logging)	--	--	--	x

Tank Temperature Limit

The solar circuit pump will be switched OFF if the set tank temperature is exceeded.

Collector Emergency Shutdown

In order to protect the system components, the solar circuit pump is switched off if the adjustable collector maximum limit temperature is exceeded. The pump is kept off until the collector cools below the limit.

Minimum Collector Temperature Limit

The solar circuit pump will be blocked if the minimum collector array temperature is not achieved.

Collector Cooling Function with SCU 124 / 224 / 345

The solar circuit pump will be switched off when the maximum tank temperature is reached. The control will allow the collector temperature to increase until it reaches a user defined temperature. Then the solar circuit pump will be switched on long enough to enable the collector temperature to fall by 9ºRa (5ºK). This process will continue until the solar tank temperature increases to a maximum of 203ºF (95ºC).

Tank Cooling Function with SCU 124 / 224 / 345

This function is only available if the collector cooling function has been enabled. If the maximum tank temperature has been exceeded, the solar circuit pump will be enabled once the collectors are cooler than the solar tank. The pump will run for as long as required to cool the solar tank, to the selected maximum tank temperature. The reduction in tank temperature will come from the thermal losses via the collector array and piping (works best with flat plate collectors).

Information Regarding the Collector Cooling and Tank Cooling Functions

Ensure the intrinsic safety of the solar thermal system, even if the collector temperature continues to rise after the system has reached all limit temperatures, by accurately sizing the diaphragm expansion vessel. Where stagnation occurs or for collector temperatures that rise further, the solar circuit pump will be blocked or stopped (emergency collector shutdown) to avoid thermal overloading of the connected components.

Evacuated Tube Collector Function

This function is used for systems where the collector temperature sensor is not able to directly sense the internal fluids temperature or when the collector sensor is improperly located. The solar control will switch on the solar circuit pump for a defined amount of time then it will turn off the pump for another period of time.

This pump oscillation will operate between a time frame specified upon commissioning. This feature allows the fluid to be forced past the collector sensor thus allowing it to measure the interior collector temperature and make the required operational decisions.

Activate this interval function in systems where the collector temperature sensor is not in an ideal location to prevent a time delay in capturing the collector temperature. This function can be used for any collector type with improperly located collector sensor.

Frost Protection

If Viessmann collectors are filled with Tyfocor HTL heat transfer medium, this feature may not need to be enabled. Activate the frost protection feature if one of the following situations is applicable:

- when using water as heat transfer medium
- when there is an isolated chance of extreme cold which exceeds the freeze point of the heat transfer medium

■ Solar control module SM1
With a collector temperature below 41°F (5°C), the solar circuit pump will be started to avoid damage to the collectors. The pump will be stopped when a collector temperature of 45°F (7°C) has been reached.

■ SCU 124 / 224 / 345
With a collector temperature below 39°F (4°C), the solar circuit pump will be started to avoid damage to the collectors. The pump will be stopped when a temperature of 41°F (5°C) has been reached or when the solar tank temperature drops below 41°F (5°C).

Thermostat Function with Time Switches Solar Control Module SM1 and SCU 124, 224 and 345

The thermostat function can be used independent of the solar operation.
Different effects can be achieved by determining the thermostat start and stop temperatures:
– Start temperature < stop temperature:
  e.g. reheating
– Start temperature > stop temperature:
  e.g. utilization of excess heat

The factory default start temperature 104°F (40°C) and stop temperature 113°F (45°C) can be changed.

Start temperature setting range: 30 to 200°F (0 to 95°C)
Stop temperature setting range: 30 to 200°F (0 to 95°C)

■ Time switch with 3 periods that can be enabled
The functions within a function block are linked so that the conditions for all enabled functions must be met.

SCU 224 and 345 ΔT Control with Temperature Limitations

This function is used for loading or unloading tanks. The control will monitor both tanks to see if there is usable heat that can be utilized. The control has 3 sets of criteria that must be achieved before the heat exchange will occur.

1. The heat source must be greater than the defined minimum temperature or Switch ON temperature setpoint.

2. The heat source must be greater than the heat sink as defined by the Switch ON temperature differential (or ΔT).

3. The heat sink must be lower than the defined maximum temperature or Switch OFF temperature setpoint.

Note: If the system temperature is within this criteria, the heat exchange will begin. It will continue until one or more sets of criteria have not been achieved.

- Upper and lower temperature limits
- Differential temperature control

ΔT controls
The corresponding relay switches ON if the ΔTon (startup) temperature differential is achieved and OFF when the thermal load maximum temperature is exceeded.

Speed Control with Solar Control Module SM1

The variable speed pump control is disabled in the factory default condition, during commissioning it can be enabled for relay output R1.

Possible pumps:
– High efficiency pumps (with optional module)
– Pumps with PWM input (only use solar pumps), e.g. Wilo or Grundfos pumps

Note: We recommend operating the solar circuit pump at maximum output while the solar thermal system is being commissioned and vented of air.

SCU 124/ 224 Speed Control

The variable speed control is disabled in the factory default condition.
It can be enabled for relay output R1 and R2.

Possible pumps:
– Standard solar pumps with and without their own speed control
– High efficiency pumps (with optional module)

Note: We recommend operating the solar circuit pump at maximum output while the solar thermal system is being commissioned and vented of air.

SCU 345 Speed Control

The variable speed control is disabled in the factory default condition.
It can be enabled for relay output R1, R2 and R3.

Possible pumps:
– Standard solar pumps with and without their own speed control
– High efficiency pumps (with optional module)
– Pumps with PWM input (only use solar pumps), e.g. Wilo or Grundfos pumps

Note: We recommend operating the solar circuit pump at maximum output while the solar thermal system is being commissioned and vented of air.

Energy Metering with Solar Control Module SM1 and SCU 124 and 224

When determining thermal yields, the difference between the collector and tank temperature, the calculated flow rate, the type of heat transfer medium and the operating time of the solar circuit pump are taken into account. The maximum flow rate is entered in the control at the time of commissioning and the energy production is calculated.

Note: The maximum flow rate as visually measured from the pump station flow meter must be manually entered into the control. This is to be done during commissioning and the control will calculate the energy produced by the solar system.

SCU 345 Energy Metering

The thermal yield statement can be produced with or without the use of a flow meter.

- Without V40 flow meter through the temperature differential between the heat supply and the return temperature sensors and the manually entered flow rate from the pump station flow meter.
- With V40 flow meter (accessory for the SCU 345) through the temperature differential between the heat supply and the heat return temperature sensors and the measured flow rate as captured by the flow meter.

  Note: Existing sensors can be used, without affecting their function in the relevant system scheme.

Verifying Solar Control Energy Calculation (SCU 124 / 224 / 345)

Long Hand Calculation Example:

Imperial Units

Solar Flow Rate (m) = 1 gpm
Solar Fluid Specific Heat (cp) = 1 Btu/lb°F (water)
0.83 Btu/lb°F (50% glycol)
Solar Fluid Density (P) = 8.33 lbs/gal (water)
8.73 lbs/gal (50% glycol)
Incoming fluid temperature (t_1) = 120°F
Leaving fluid temperature (t_2) = 100°F

Calculate energy gained by solar system (50% glycol)
Q = m(cp)(P) ΔT
Q = 1 gpm x (60 mins/hr. x 8.73 lbs/gal x 0.83 Btu/lb°F) x 20°F
Q = 8,695 Btuh

Metric Units

Solar Flow Rate (m) = 3.8 lpm
Solar Fluid Specific Heat (cp) = 1.163 Wh/kg°C (water)
0.96 Wh/kg°C (50% glycol)
Solar Fluid Density (P) = 1.000 kg/L (water)
1.047 kg/L (50% glycol)
Incoming fluid temperature (t_1) = 49°C
Leaving fluid temperature (t_2) = 38°C

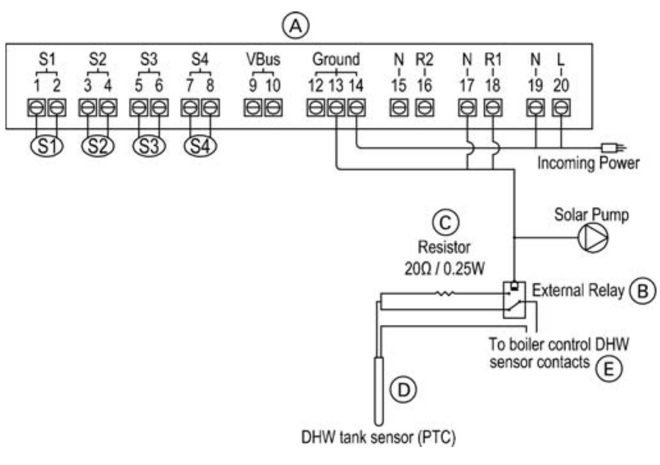
Calculate energy gained by solar system (50% glycol)
Q = m(cp)(P)ΔT
Q = 3.8 lpm x (60 min x 1.047 kg/L x 0.96 Wh/kg°C) x 11°C
Q = 2521 Wh or (2.5 kWh)

Fluid Properties for Standard Propylene Glycol Based Heat Transfer Medium

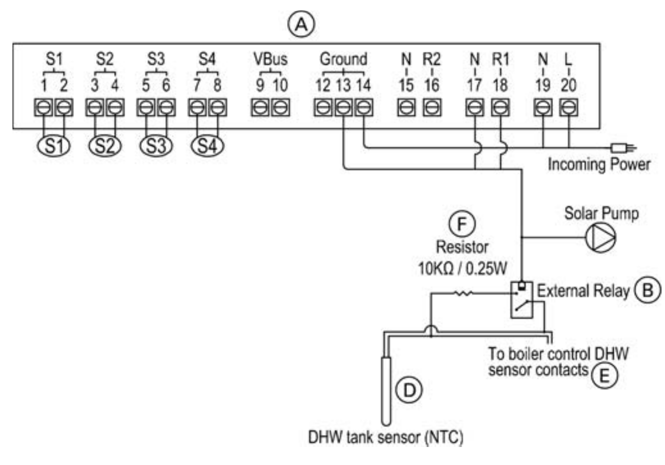
Concentration of Propylene Glycol	Freeze Protection		Specific Heat			Density	
	°C	°F	J/kg°K	Wh/kg°K	Btu/lb°F	kg/L	lb/gal
0% (water only)	0	32	4190	1.1638	1.000	1.000	8.33
25%	-10.7	12.7	3930	1.0917	0.939	1.024	8.53
30%	-14.0	6.8	3850	1.0694	0.920	1.029	8.58
35%	-17.6	0.3	3770	1.0472	0.900	1.034	8.62
40%	-21.5	-6.7	3680	1.0222	0.879	1.039	8.66
45%	-26.0	-14.8	3580	0.9944	0.855	1.043	8.69
50%	-32.4	-26.3	3480	0.9667	0.831	1.047	8.73
55%	-40.4	-40.7	3380	0.9389	0.807	1.050	8.75
60%	-48.4	-55.1	3280	0.9111	0.783	1.053	8.78

Suppression of DHW Tank Reheating by the Boiler with SCU 124, 224 and 345

PTC – DHW Tank Sensors



NTC – DHW Tank Sensors



Legend
Ⓐ Solar control unit wiring terminals
Ⓑ External Relay (field supplied)
Ⓒ Resistor 20 Ω, 0.25 W (field supplied)
Ⓓ Tank temperature sensor of the boiler control unit
Ⓔ To the boiler control unit; connection for tank temperature sensor
Ⓕ Resistor 10 kΩ, 0.25 W (field supplied)

Systems with Viessmann Solar Control Units SCU 124, SCU 224 & SCU 345

Reheating of the DHW tank by the boiler will be suppressed by the solar control unit if the DHW tank (thermal load #1) is being heated. A resistor simulates an DHW temperature that is 5°K or 9°Ra higher than the actual temperature. The DHW tank is only heated by the boiler if the set DHW temperature cannot be maintained by the solar thermal system.

Suppression of DHW Tank Reheating by the Boiler with Solar Control Module SM1

DHW tank reheating by the boiler is suppressed in two stages. While the DHW tank is being heated by the solar thermal system, the set DHW tank temperature is reduced. After the solar circuit pump has been switched off, suppression remains active for a certain time.

If solar heating is uninterrupted (> 2 h), reheating by the boiler only occurs when the temperature falls below the 3rd set DHW temperature, as set at the boiler control unit (at coding address “67”) [setting range 50 to 203°F (10 to 95ºC)]. This value must be below the first set DHW temperature.

The DHW tank will only be heated by the boiler, if this set value cannot be achieved by the solar thermal system.

If a sufficiently high temperature is available in the multi-mode heating water buffer cylinder to heat the heating circuits, reheating is suppressed.

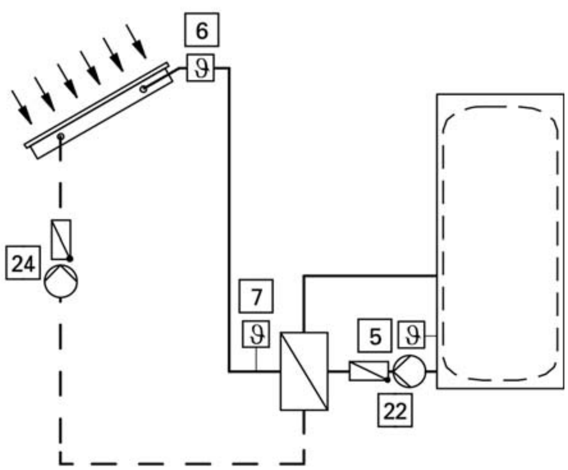
Auxiliary Function for DHW Heating with Solar Control Module SM1

For detailed information see chapter “Auxiliary function for DHW heating”. Only possible in conjunction with Vitotronic control units with KM BUS.
Control units from the current Viessmann product range are equipped with the necessary software.

Boiler control unit settings:

- The set DHW temperature 2 must be encoded
- The DHW phase 4 for DHW heating must be enabled Via KM BUS, this signal will be transferred to the SM1 control, and the transfer pump (relay #2) will be started.

External Heat Exchanger with Solar Control Module SM1



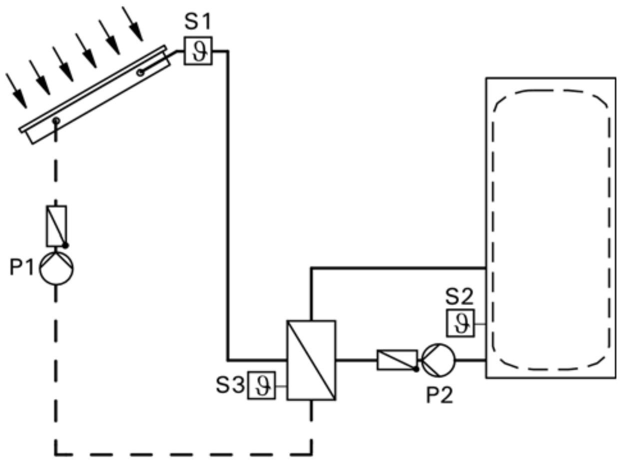
The DHW tank is heated via the heat exchanger. The secondary pump 22 starts in parallel with solar circuit pump 24. If an additional temperature sensor 7 is used, secondary pump 22 starts when solar circuit pump 24 is running and the required temperature differential between sensors 5 and 7 is given.

Option #1: The DHW tank is heated via an external heat exchanger. The control uses only 2 sensors to operate the primary and secondary pumps simultaneously. The control monitors the temperature differential between sensors 6 and 5, should there be usable heat, then pumps 24 and 22 will start at the same time or in parallel.

Option #2: The DHW tank is heated via external heat exchanger. The control uses 3 sensors to operate the primary and secondary pumps independently. The control monitors the temperature differential between sensors 6 and 5, should there be usable heat then pump 24 will start. The control will monitor the heat exchanger to see if it has usable heat. If the differential between sensors 7 and 5 is achieved then the control will start pump 22.

6020 457 - 01

External Heat Exchanger with SCU 224 and 345



Option #1: The DHW tank is heated via the heat exchanger. The primary pump P1 operates based on the temperature differential between S1 and S2. Secondary pump P2 starts in parallel with solar circuit pump P1. This is done by using the field supplied external relay connected to the glycol pump output of the control R1.

Option #2: The DHW tank is heated via the heat exchanger. The primary pump P1 operates based on the temperature differential between S1 and S2. The secondary pump P2 operates based on another temperature differential between sensors S3 and S2.

Parallel Relay with SCU 345

With this function, a further relay will be switched (subject to the system control layout) in addition to the relay (R1) which switches the circulation pump, e.g. to control a diverting valve or a second pump.

Multiple Tank Operation with SCU 224 and 345

In systems with several storage tanks or thermal loads. With this function, storage tanks or thermal loads can be excluded from solar heating.

Note: Only with the SCU 345 can the end-user deactivate a tank or load from the control layout. For the SCU 224, the system commissioning agent, must properly select the control layout which reflects the true hydraulic layout.

Tank Priority Control with SCU 224 and 345

In systems with several storage tanks or thermal loads. It is possible to determine the order in which the heating of the storage tanks or thermal loads will occur.

If the storage tank or thermal load cannot be heated with priority, the next storage tank or thermal load in line will be heated for an adjustable cycle time. After this time has expired, the solar control unit will stop the pump(s) and monitor the rise of the collector temperature during the adjustable cyclical pause. As soon as the start conditions for the storage tank or thermal load with priority have been met, that storage tank or thermal load will be heated again. Otherwise, the next-in-line storage tank or thermal load will continue to be heated.

Utilization of Excess Heat (Heat Dump) with SCU 124 / 224 / 345

In systems with several storage tanks or thermal loads. A heat dump can be selected to be heated only after all other storage tanks or thermal loads have reached their maximum set value. The selected heat dump will not be heated in cyclical operation.

Pump Exercise Function with Solar Control Module SM1

If the pumps and valves have been switched off for 24 hours, they are started for approximately 10 seconds to prevent them seizing up.

SD Card with SCU 345

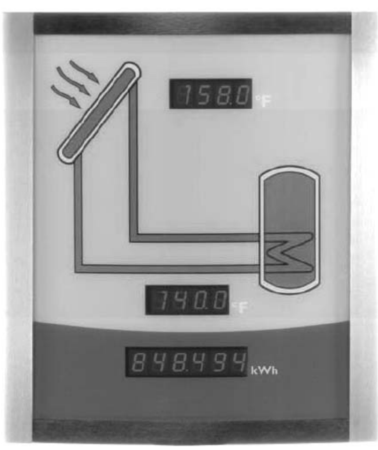
SD card to be provided on site with a memory capacity ≤ 2 GB and file system FAT16.

Note: Never use SD-HC modules.

The SD card is inserted into the SCU 345.

- To record the operating values of the solar thermal system.
- Saving the values to the SD card in a text file. This may, for example be opened in a tabular calculation program (e.g. Excel). The historical logged values can then be graphed for easy viewing.

Smart Display SD3

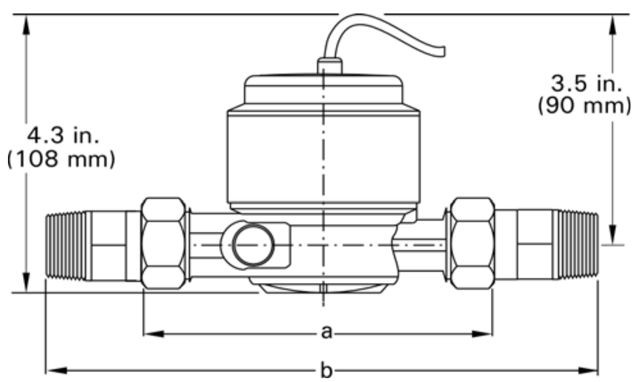


Used for visualizing live data issued by the controller: collector temperature, tank temperature and energy yield of the solar thermal system. For use with all SCU controls.

DL2 Datalogger

Enables the acquisition and storage of large amounts of data (solar sensors, relay outputs, energy metering) and storage over a long period of time. The DL2 can be configured and read out with a standard internet browser via integrated web interface. SD card slot for transmission of stored data. For use with all SCU controls.

V40 Flowmeter



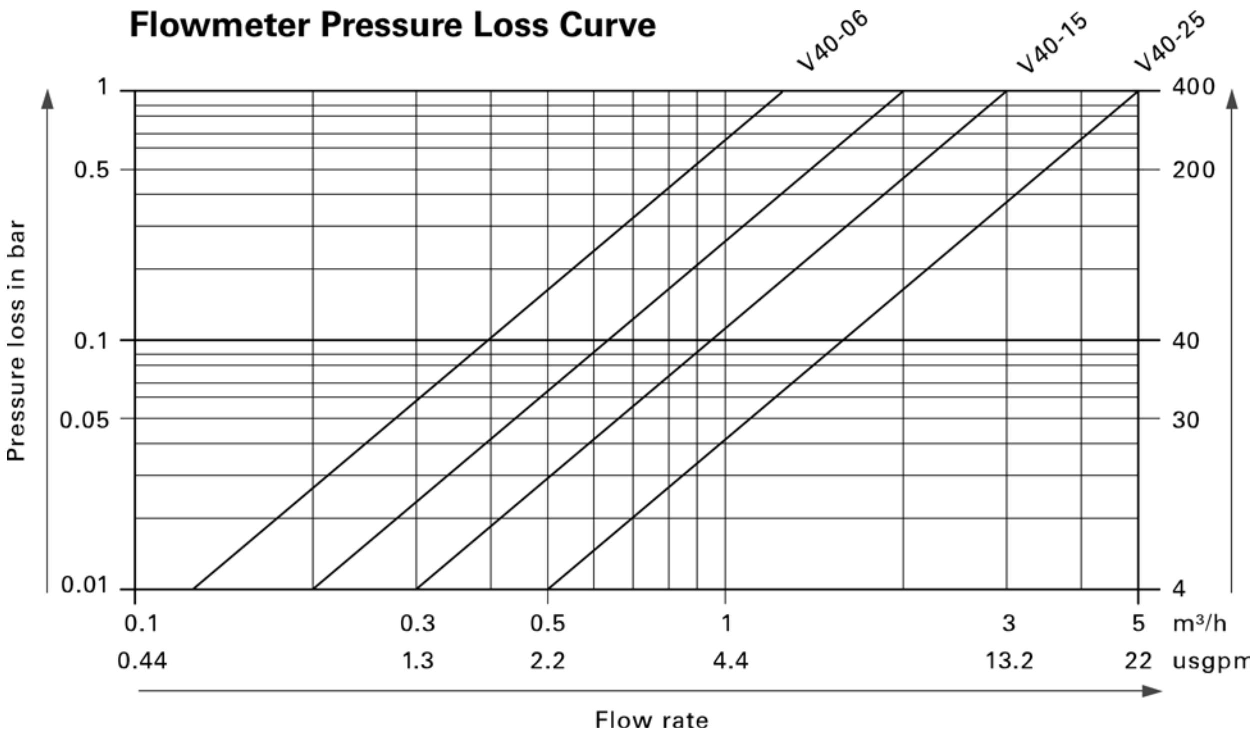
Used with SCU 345 control to measure the solar fluid flow rate to determine energy metering. Available in 3 flow ranges.

Single-jet impeller		V40-06	V40-15	V40-25
a	Mounting length without fittings	4.3 in. (110 mm)	4.3 in. (110 mm)	5.1 in. (130 mm)
b	Mounting length with fittings	8.3 in. (209 mm)	8.3 in. (209 mm)	8.9 in. (228 mm)
	Width of unit	2.8 in. (72 mm)		
	Weight without fittings	1.3 lb. (0.6 kg)	1.3 lb. (0.6 kg)	1.5 lb. (0.7 kg)
Vertical or horizontal mounting				

V40 Flow meter Kit
Components:

- V40 pulse flow meter with 3/4″ NPT connections
- 2 temperature sensors
- 2 sensor wells

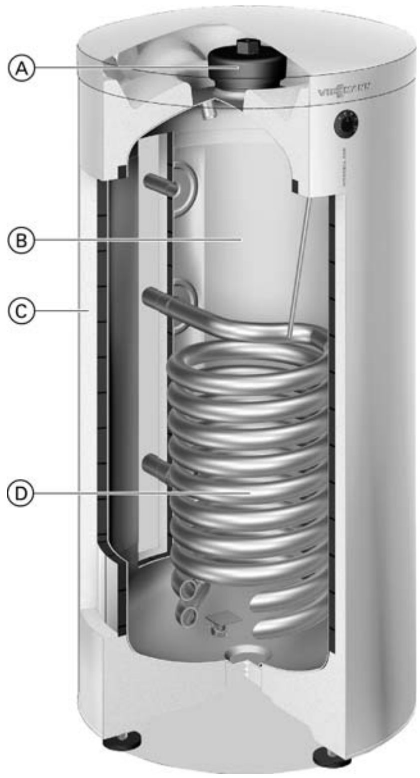
V40 Flowmeter Technical Data



Flowmeter Sizing
Three flowmeter kit sizes available; flow meter must be sized to match the maximum or peak flow rate of the solar thermal system.

Flowmeter Model	**V40-06**	**V40-15**	**V40-25**
Minimum flow rate	0.1 USG/min (0.38 L/min)	0.3 USG/min (1.14 L/min)	0.5 USG/min (1.89 L/min)
Maximum practical flow rate recommended	2.4 USG/min (9.08 L/min)	5.3 USG/min (20.06 L/min)	9.7 USG/min (36.71 L/min)
Maximum number of Vitosol 200-FM flat plate solar collectors	6	14	24
Pressure loss at maximum flow rate	80 “w.c. (0.199 bar)	80 “w.c. (0.199 bar)	80 “w.c. (0.199 bar)

Technical Data - Vitocell 300 Series



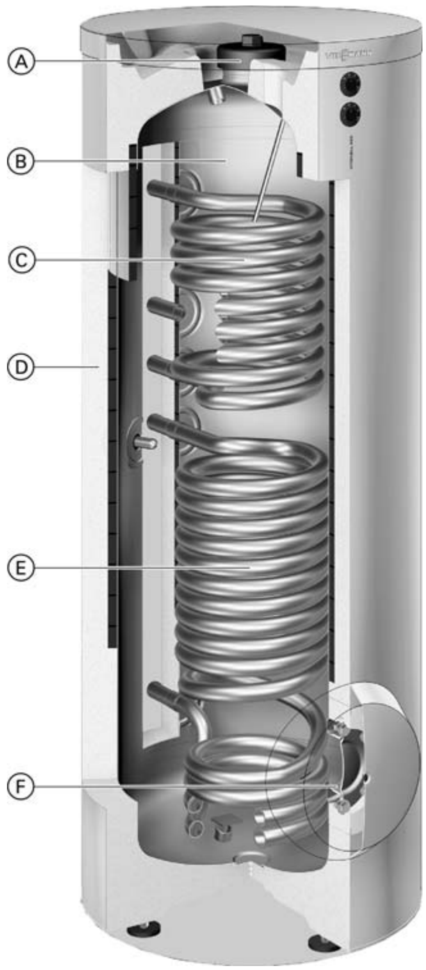
Legend
Ⓐ Inspection and cleaning opening
Ⓑ Stainless steel cylinder
Ⓒ Highly effective all-round thermal insulation
Ⓓ Indirect coil made from stainless steel

Refer to the Technical Data Manual for detailed information on sizing and performance parameters for the Vitocell domestic hot water storage tanks.

Model		**300-W EVIA**	**300-V EVIA**	**300-V EVIA**	**300-V EVIB**
Storage capacity	USG (L)	42 (160)	53 (200)	79 (300)	119 (450)
Insulation		PUR Foam			Soft PET
Standby heat loss	BTU/h (°F/h)	127 (0.7)	129 (0.6)	151 (0.5)	287 (0.3)
Dimensions					
Overall tank length with insulation	in. (mm)	23 (581)	23 (581)	26¼ (667)	32¾ (832)
Overall tank width with insulation	in. (mm)	24 (605)	24 (605)	29¼ (744)	35 (888)
Overall tank height with insulation	in. (mm)	47 (1191)	55½ (1409)	68¼ (1734)	77 (1960)
Weight					
Tank with insulation	lbs (kg)	132 (60)	154 (70)	231 (105)	187 (85)
Heat exchanger coil capacity	USG (L)	1.95 (7.4)	1.95 (7.4)	2.91 (11)	3.43 (13)
Heat exchanger surface area	ft.^{2} (m^2)	11 (1.0)	11 (1.0)	16 (1.5)	18.3 (1.7)
Connections					
Solar supply/return coils	∅ in. (male NPT thread)	1	1	1	1
Domestic cold/hot water	∅ in. (male NPT thread)	¾	¾	1	1¼
Recirculation	∅ in. (male NPT thread)	¾	¾	1	1

6020 457 - 01

Technical Data - Vitocell 300 Series



Refer to the Technical Data Manual for detailed information on sizing and performance parameters for the Vitocell domestic hot water storage tanks.

Legend

Ⓐ Upper inspection and cleaning opening
Ⓑ Stainless steel cylinder
Ⓒ Upper indirect coil – DHW is reheated via the boiler
Ⓓ Highly effective all-round thermal insulation
Ⓔ Lower indirect coil – connection for solar collectors
Ⓕ Front inspection and cleaning opening

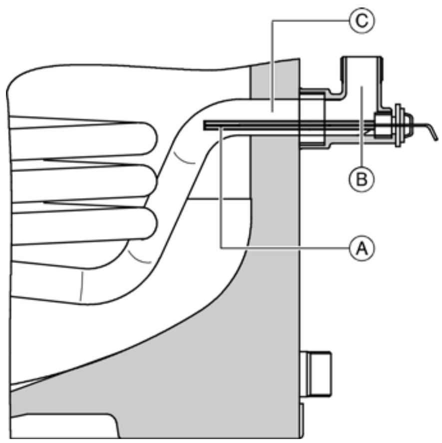
Model		**300-B, EVBA**		**300-B, EVBB**	
Storage capacity	**USG (L)**	**79 (300)**		**119 (450)**	
Insulation		PUR Foam		Soft PET insulation	
Standby heat loss	BTU/h (ºF/h)	151 (0.5)		287 (0.3)	
Dimensions					
Overall tank length with insulation	in. (mm)	26¼ (667)		32¾ (832)	
Overall tank width with insulation	in. (mm)	29 (744)		35 (888)	
Overall height with insulation	in. (mm)	68¼ (1734)		77(1960)	
Weight					
Tank with insulation	lbs (kg)	249 (113)		220 (100)	
Coil		**upper coil**	**lower coil**	**upper coil**	**lower coil**
Heat exchanger coil capacity	USG (L)	1.8 (6.7)	2.9 (11)	2.6 (10)	3.43 (13)
Heat exchanger surface area	ft.^{2} (m^2)	9.6 (0.9)	16 (1.5)	14 (1.3)	18.3 (1.7)
Connections					
Solar supply/return coils	∅ in. (male NPT thread)	1		1	
Domestic cold/hot water	∅ in. (male NPT thread)	1		1¼	
Recirculation	∅ in. (male NPT thread)	1		1	

6020 457 - 01

Vitocell Solar Brass Elbow

Vitocell tank temperature sensor installation location for solar heating applications 42 – 79 USG (160 – 300 L).

Position the solar brass elbow with integrated sensor well in the solar glycol return line (lower coil) which returns to the collector array.

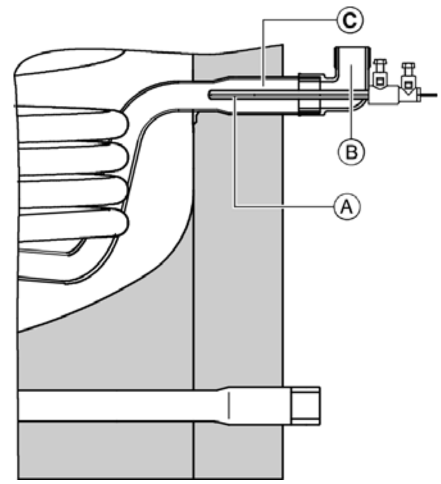


Legend

Ⓐ DHW tank temperature sensor for solar application (included with solar control unit)
Ⓑ Brass elbow with sensor well
Ⓒ Solar collector return connection.

Vitocell tank temperature sensor installation location for solar heating applications 119 USG (450 L).

Position the solar brass elbow with integrated sensor well in the solar glycol return line (lower coil) which returns to the collector array.

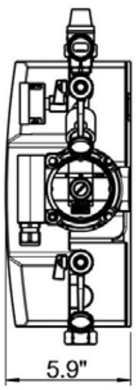


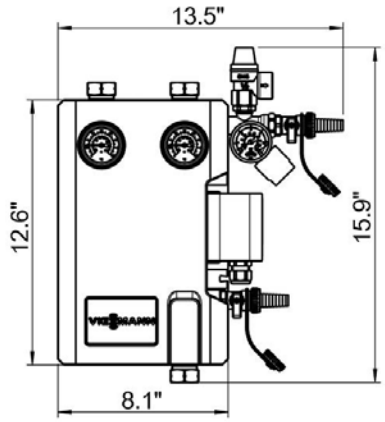
Legend

Ⓐ DHW tank temperature sensor for solar application (included with solar control unit)
Ⓑ Brass elbow with sensor well
Ⓒ Solar collector return connection.

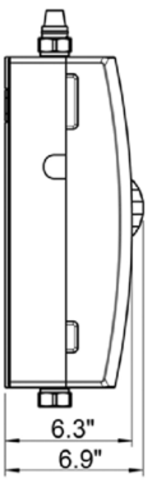
Solar-Divicon and Solar Pump Assembly

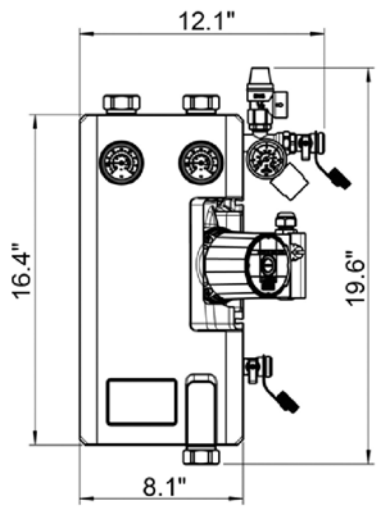
Solar-Divicon DN20B



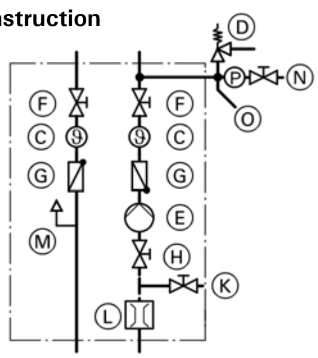


Solar-Divicon DN25B





Solar-Divicon Construction



Legend

Ⓒ Thermometer
Ⓓ Pressure relief valve
Ⓔ Circulation pump
Ⓕ Shut-off valves
Ⓖ Flow check valves
Ⓗ Shut-off valve (adjusting screw)
Ⓚ Drain valve
Ⓛ Flow indicator
Ⓜ Air separator
Ⓝ Fill valve
Ⓞ Expansion tank connection

Sizing the Circulation Pump

If the flow rate and pressure drop of the entire system are known, the pump is selected on the basis of the pump characteristics. Multiple-speed pumps which can be matched to the system are the most suitable.

To simplify the installation and selection of the pumps and safety equipment, Viessmann supplies the Solar-Divicon.

The Solar-Divicon comprises
- pre-assembled and sealed valves and safety assembly,
- 2 flow check valves,
- 3-speed system pump (2 sizes available),
- pressure gauge,
- 2 thermometers,
- 2 isolation valves,
- pressure relief valve, 87 psig (6 bar),
- flush and fill manifold.
- Air separator
- Flow meter

Two models of Solar-Divicon are available:

Model DN20B
- up to 6 USG/min (22.7 L/min)
- up to 8 Vitosol 200-FM collectors.

Model DN25B
- up to 10 USG/min (37.9 L/min)
- up to 18 Vitosol 200-FM collectors.

Note: Actual number of collectors will depend on system layout, type of collector, required flow rate, length of piping run and size of pipe used.

IMPORTANT

The Solar-Divicon and the solar pump line are not suitable for direct contact with swimming pool water or potable water.

IMPORTANT

Always install Solar-Divicon at a lower height than the collectors to prevent steam from entering the expansion vessel in the event of stagnation.

6020 457 - 01

Solar-Divicon Pump and Electrical Specification

Pump Electrical Details	**Solar-Divicon DN20B**	**Solar-Divicon DN25B**
Model	Wilo Star S21 U-15-130	Wilo Star S30 U-25-180
Voltage	115 Vac	115 Vac
Phase	1 Ph	1 Ph
Frequency	60 Hz	60 Hz
Speed #1	42 Watts	92 Watts
Speed #2	65 Watts	142 Watts
Speed #3	90 Watts	180 Watts
Maximum Amperage Draw	0.8 Amps	1.5 Amps
Connection Types		
Solar Supply Return Circuit	Ø 3/4” Copper Type-L (Locking Ring)	Ø 1” Copper Type-L (Locking Ring)
Solar Expansion Tank	3/4” NPT (Female)	3/4” NPT (Female)
Safety Relief Valve	3/4” NPT (Female)	3/4” NPT (Female)
Flow Meter Range		
Minimum Flow Rate	0.8 USG/min (3.0 L/min)	1.0 USG/min (3.8 L/min)
Maximum Recommended System Flow Rate	4.4 USG/min (16.7 L/min)	6.6 USG/min (25.0 L/min)
Maximum Flow Rate	6.0 USG/min (22.7 L/min)	10 USG/min (37.9 L/min)
Pump Head Capacity		
Maximum Head	20 ft (6.1 m)	29 ft (8.8 m)
Operating Conditions		
Maximum Operating Temperature	230ºF (110ºC)	230ºF (110ºC)
Maximum Operating Pressure	6 Bar (87 psi)	6 Bar (87 psi)
Fluid Content		
Internal Fluid Content	0.11 USG (0.40 L)	0.20 USG (0.75 L)
Maximum Collector Surface Area		
Low Flow = 0.5 gal/ft^2/hr (20 l/m^2/hr)	85,300 Btuh (25 kW)	119,400 Btuh (35 kW)
High Flow = 1.0 gal/ft^2/hr (40 l/m^2/hr)	42,650 Btuh (12.5 kW)	59,700 Btuh (17.5 kW)
Maximum Recommended Number of Vitosol 200-FM Collectors		
Low Flow = 0.5 gal/ft^2/hr (20 l/m^2/hr)	14	20
High Flow = 1.0 gal/ft^2/hr (40 l/m^2/hr)	7	10

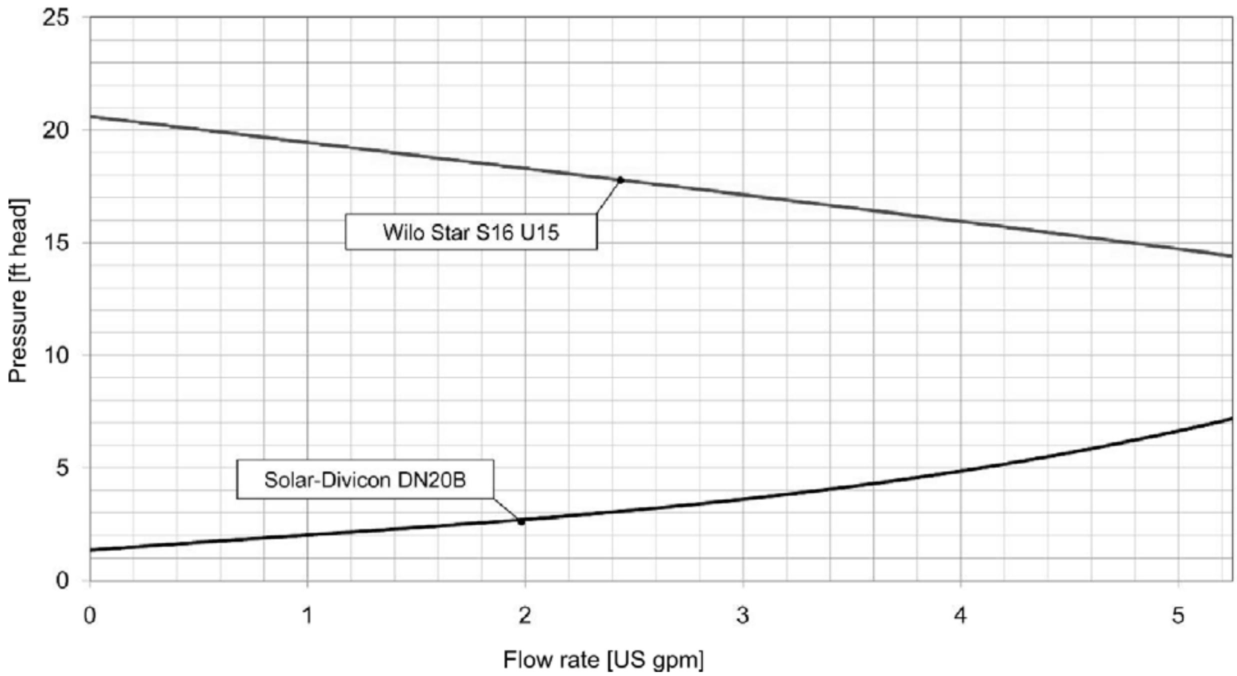
Combination brass temperature gauge, flow check valve and isolation valves are located in the solar supply and solar return lines.

- Unload the check valves using a wrench, manually rotate valve assembly clockwise 45 degrees
- Close or isolate the system using a wrench, manually rotate valve assembly clockwise 90 degrees

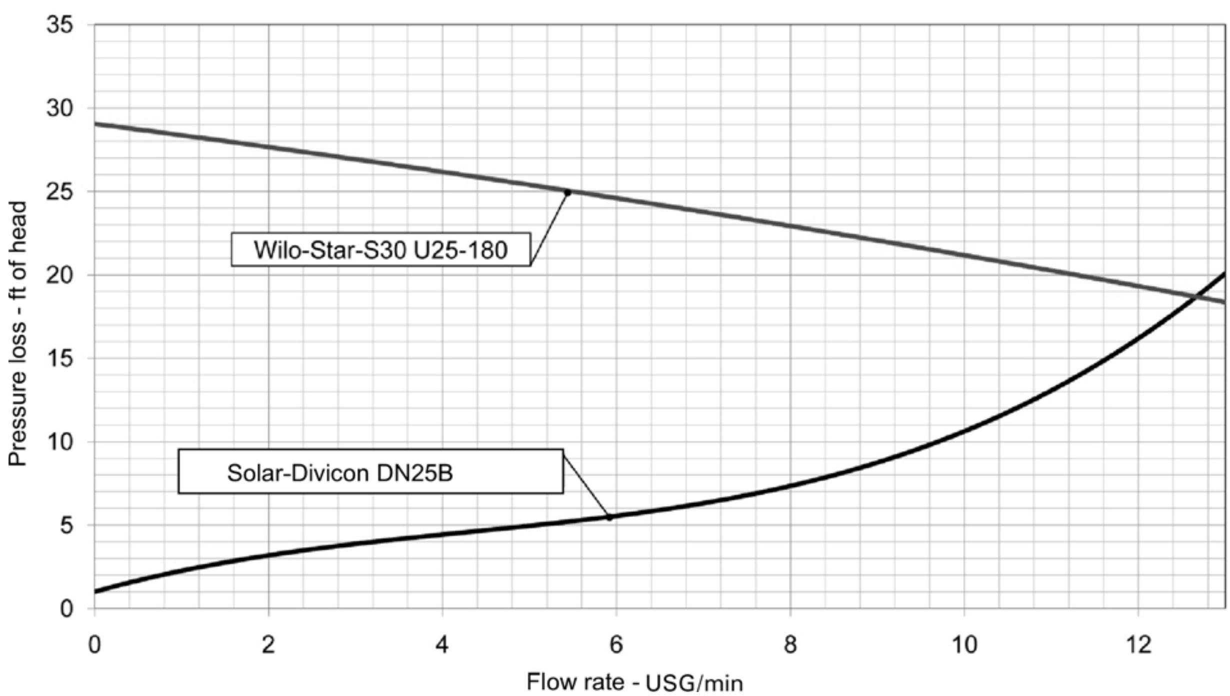
Refer to the Solar-Divicon Installation and Service Instructions Manual for detailed information on sizing, installation and performance parameters.

Solar-Divicon Pump Curves

Solar-Divicon DN20B



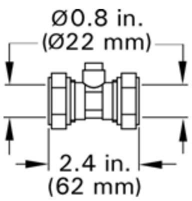
Solar-Divicon DN25B



Refer to the Solar-Divicon Installation and Service Instructions Manual for detailed information on sizing, installation and performance parameters.

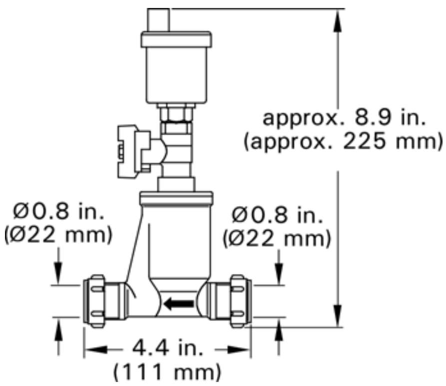
6020 457 - 01

Manual Air Vent Valve



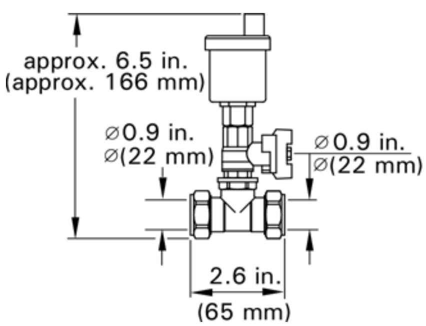
Locking ring fitting with manual air vent valve.
For installation at the highest point of the system.
Can be used as an alternative to a fast acting air vent.

Air Separator (with shut-off)



Installation in the supply pipe of the solar circuit, preferably upstream of the inlet into the DHW tank.

Fast-acting Air Vent Valve (with shut-off)

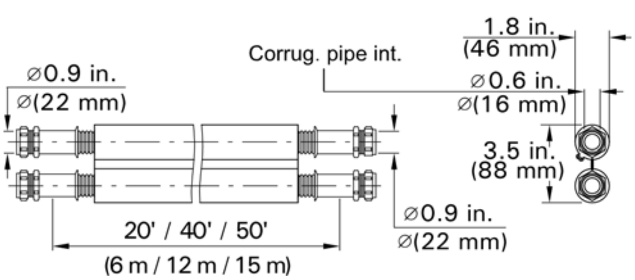


With shut-off valve and locking ring fitting. Install one fast acting air vent valve in each collector array, and at the highest point of the system.

IMPORTANT

Shut-off valve must be closed after initial system commissioning. Failure to close will result in glycol steaming off during stagnation.

Flexible Insulated Piping

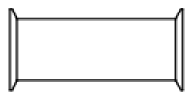


Stainless steel corrugated pipes with thermal insulation and protective foil, locking ring fittings and sensor wire.

Available in three coil sizes:
- 20 ft. (6 m) long
- 40 ft. (12 m) long
- 50 ft. (15 m) long

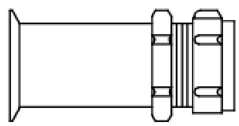
For use in smaller scale solar systems having up to four Vitosol 200-FM collectors. Refer to pressure drop chart on page 73.

Splice Kit for Insulated Piping



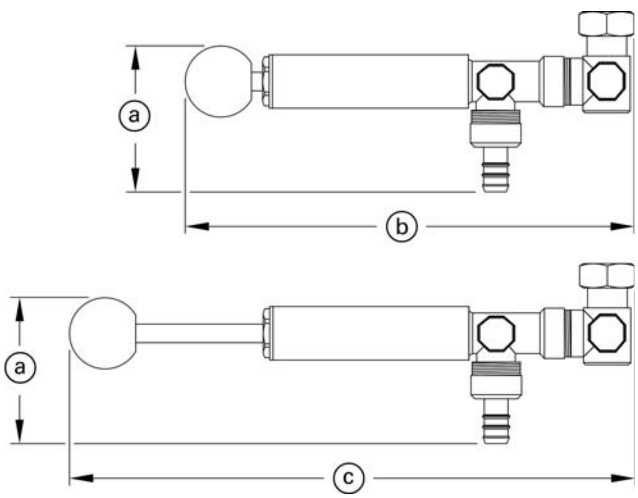
For splicing together flexible stainless steel piping:
- 2 pipe sleeves
- 8 O-rings
- 4 pipe support rings
- 4 profile clips

Connection Set with Locking Ring Fitting



For joining the flexible stainless steel piping to Copper type-L of the solar thermal system:
- 2 pipe sleeves with locking ring fitting
- 4 O-rings
- 2 pipe support rings
- 2 profile clips

Manual Solar Fill Pump



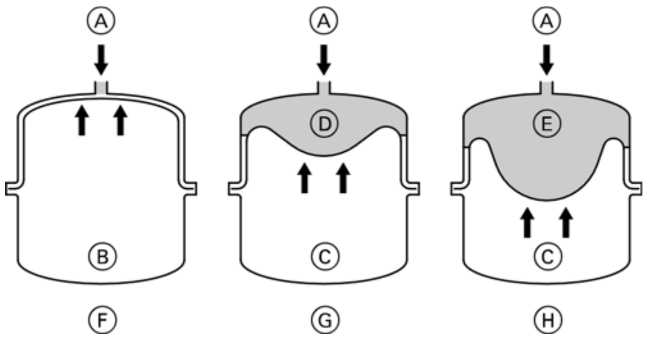
For topping-up and raising the pressure of the solar fluid. Solar fill pump connects to ¾ BSP fittings. Use the supplied adaptor to connect to the Solar-Divicon, sediment faucets or boiler drain valves having standard ¾ in. garden hose threads (GHT).

Legend
Ⓐ 3 in. (75mm)
Ⓑ 9⁷⁄₈ in. (250mm)
Ⓒ 11⁷⁄₈ in. (300mm) *Fully extended

Mobile Solar Charge Station

For flushing and filling of solar systems:
- telescopic handle
- 120VAC, 5 bar (75 psig), 8 USGPM (30 L/m)
- dirt and debris filter on suction side
- 1 charge hose, 1 suction hose
- 8 USG (30 L) storage tank for glycol

Solar Expansion Vessel



Legend

Ⓐ Heat transfer medium
Ⓑ Nitrogen pre-charge
Ⓒ Nitrogen buffer
Ⓓ Minimum safety seal 0.8 USG (3 L)
Ⓔ Safety water seal
Ⓕ Delivered condition [pre-charge pressure 3 bar (44 PSI)]
Ⓖ Solar thermal system filled without heat effecting the system
Ⓗ At maximum pressure and the highest heat transfer medium temperature

Layout and function

A solar expansion vessel is a sealed unvented vessel where the gas space (nitrogen charge) is separated from the space containing liquid (heat transfer medium) by a diaphragm; the pre-charge pressure is subject to the system height.

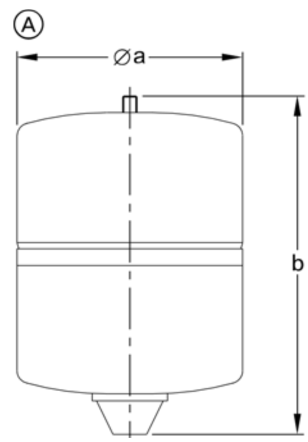
Notes on the expansion tank

- The solar heating system must be equipped with a high temperature or solar rated expansion tank.
- The membrane and gaskets of the expansion tank must be suitable for the heat transfer medium, and for the high temperature in a solar system.
- Should the expansion tank be installed at the same level or higher than the Solar-Divicon, a heat insulating loop (p-trap) is required to prevent steam from entering the expansion tank.
- Adjust air cushion pressure of the expansion tank to cold fill gas pressure calculated for the system; for information regarding the calculation of the cold fill fluid pressure value refer to the Installation, Operating and Service and Instructions for information on setting the system and expansion tank pressures.

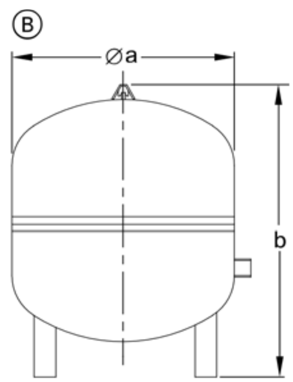
For expansion tank sizing refer to page 82.

Solar Expansion Vessel Specification

Wall hung models (18 L, 25 L & 40 L)



Floor standing models (50 L & 80 L)



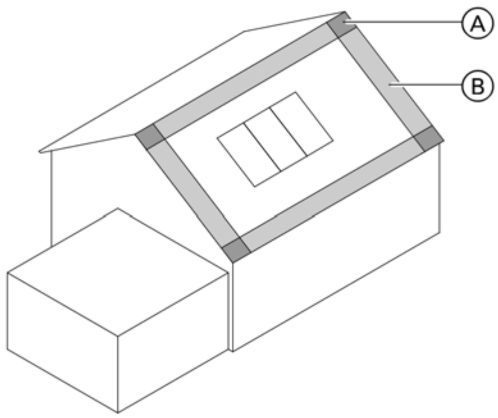
- Maximum temperature 248ºF (120ºC)
- Maximum pressure 150 psig (10 bar)
- Suitable for glycol concentrations up to 50%
- Expansion vessels are supplied with a service valve c/w check valve and drain valve. This allows vessel to be separated from the system such that the gas charge pressure to be checked as part of the system service.

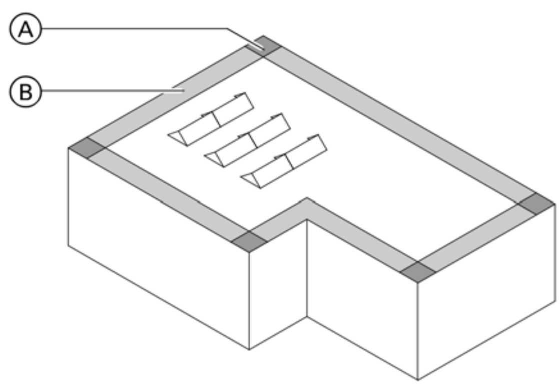
Expansion vessel	Nominal Capacity USG (L)	Dimension Øa in. (mm)	Dimension b in. (mm)	Connection	Weight lb. (kg)
Ⓐ	4¾ (18)	11 (280)	15 (380)	R¾	17 (7.5)
	6½ (25)	11 (280)	19⅝ (499)	R¾	20 (9.1)
	10½ (40)	14 (354)	20½ (520)	R¾	22 (9.9)
Ⓑ	13¼ (50)	16⅛ (409)	19⅞ (505)	R1	27 (12.3)
	21¼ (80)	18⅞ (480)	22¼ (566)	R1	41 (18.4)

Snow Load and Wind Load Zones

The collectors and the fixing system must be designed in such a way that they can withstand any snow and wind loads that may occur.

Distance from the Edge of the Roof





Observe the following for installation on pitched roofs:

- If the distance from the top edge of the collector array to the ridge of the roof is greater than 3.3 ft. (1 m), we recommend installing a snow guard.
- Never install collectors close to roof overhangs where snow is likely to slide off. If necessary, install a snow guard.

Note: The additional loads due to accumulated snow on collectors or snow guards must be taken into account in the structural calculations for the building.

Certain parts of the roof are subject to special requirements. Allow for increased wind turbulence in these areas:
- Corner area Ⓐ: limited on two sides by the end of the roof
- Edge area Ⓑ: limited on one side by the end of the roof

The width of Ⓐ and Ⓑ should never be less then 3.3 ft. (1 m) with 6.6 ft. (2 m) preferred. Check with local codes to verify distance required in your area.

Routing Pipe Work

During the design phase, ensure the copper, steel or stainless steel pipes are installed having a slight slope which descends from the collector. This ensures better steam expulsion characteristics in the solar thermal system as a whole in the event of stagnation. The thermal load exerted on all system components is reduced (see page 79 and 80).

Equipotential Bonding/Lightning Protection of the Solar Thermal System

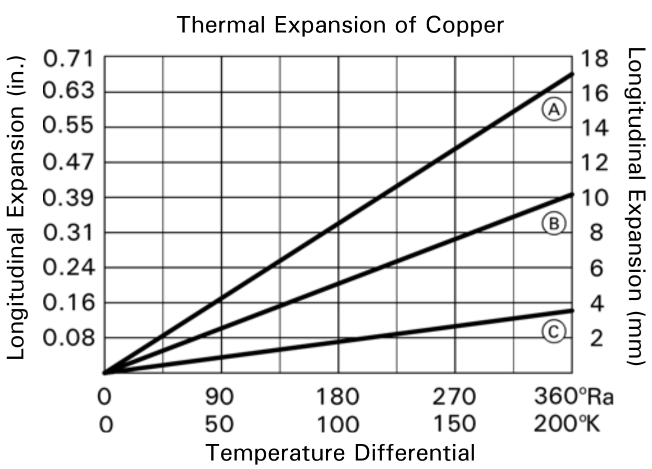
Connect the solar circuit pipework with an electrical conductor (grounding cable) in the lower part of the building in accordance with local regulations. The integration of the collector system into a new or existing lightning protection facility or the provision of local earthing must only be carried out by authorized personnel, who should take the site conditions into account.

6020 457 - 01

Thermal Insulation

- The thermal insulation of the solar lines routed outdoors must be protected against pecking damage from birds and gnawing by small animals, as well as protection against ultraviolet (UV) radiation. A cover protecting the insulation against damage by small animals (e.g. metal sheath) generally also provides adequate ultraviolet (UV) protection.
- The thermal insulation material provided must withstand the operating temperatures to be expected and must be permanently protected against the influence of moisture. Some open pore insulation material that can be subjected to high thermal loads cannot provide reliable protection against moisture produced by condensation. The high temperature versions of closed-cell pipe insulation, on the other hand, offer adequate protection against moisture, but cannot be subjected to temperatures higher than approximately 338°F (170°C). In the case of the Vitosol 200-FM switching absorber collectors (ThermProtect) the maximum temperature that can be reached in the collector area is approximately 295ºF (145ºC). When working temperatures exceed 338°F (170°C), the insulation material becomes brittle. However, the brittle zone is limited to a few millimeters directly contacting the pipe. This overload only occurs for a short period and does not pose any further risk to other components.

Solar Supply and Return Lines



Legend
Ⓐ 16.4 ft. (5 m) pipe length
Ⓑ 9.8 ft. (3 m) pipe length
Ⓒ 3.3 ft. (1 m) pipe length

- Use stainless steel pipe or commercially available hard or soft copper pipe and bronze fittings.
- Metal seals (conical or locking rings and compression fittings) are suitable for solar lines. If other seals such as flat gaskets are used, adequate glycol, pressure and temperature stability must be guaranteed by the manufacturer.
- Never use:
  – Teflon (inadequate glycol stability)
  – Hemp connections (not sufficiently gas-tight)
- Generally, copper lines in solar circuits are hard soldered or joined by press fittings. Soft solder or low temperature solder (e.g. 60/40) could be weakened, particularly near the collectors, due to the maximum temperatures that may occur there. The melting temperature of any solder used on solar systems must be above 450 °F (232 °C). If soft solder is to be used, Viessmann recommends using 95/5 Tin/Antimony. This soft solder becomes a liquid around 464 °F (240 °C) and will solidify around 452 °F (233°C). Metal sealing connections, locking ring fittings or Viessmann push-fit connections with double O-rings are the most suitable connection option.

Note: If using press fittings, ensure the O-rings are suitable (resistant to glycol and temperature). Only use O-rings that have been approved by the manufacturer.

- All components to be used must be resistant to the heat transfer medium.

Note: Fill solar thermal systems only with "Tyfocor HTL" or similar non-toxic heat transfer medium.

- Take high temperature differentials in the solar circuit into consideration when routing and securing pipes. At pipe sections that may be subject to steam loads, temperature differentials of up to 360°Ra (200°K) can be expected, otherwise 216°Ra (120°K) can be expected.
- Route the solar connection lines through a suitable roof flashing.

Collector Fixing

Due to the many varieties available, solar collectors can be installed in almost all types of building, both in new build and modernisation projects. As required, they can be installed on pitched roofs, flat roofs and on walls, as well as freestanding on the ground.

Viessmann offers universal fixing systems to simplify installation. These fixing systems are suitable for virtually any form of roof and roof cover as well as for installation on flat roofs and walls. For more detail, refer to the installation manual for the individual collector model.

Sloped Roof Installation

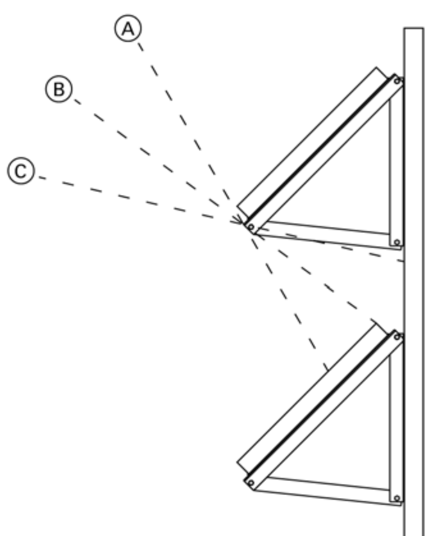
In sloped roof systems, the collectors and the roof frame are connected. At each fixing point, a roof bracket and rafter anchor penetrates the water-carrying level below the collector. This requires a completely rain-proof and secure anchorage. The fixing points and therefore also any possible defects will no longer be visible post installation. Maintain the minimum clearances from the roof edge in accordance with local codes.

Flat Roof Installation

During installation of the collectors (freestanding or lying flat), the minimum clearances from the edge of the roof in accordance with the standard must be observed (see page 42). If the roof size necessitates a split array, ensure that collector of the same size are created. The collectors can be secured on any solid substructure or on concrete slabs.

Note: When installing collectors on concrete slabs, secure them with additional ballast to prevent against slippage, tipping and lifting. Slippage is the movement of the collectors on the roof surface due to wind, because of insufficient friction between the roof surface and the collector fixing system. Collectors can be secured against tipping and lifting by using guy ropes or by being fixed to other roof structures.

Wall Installation



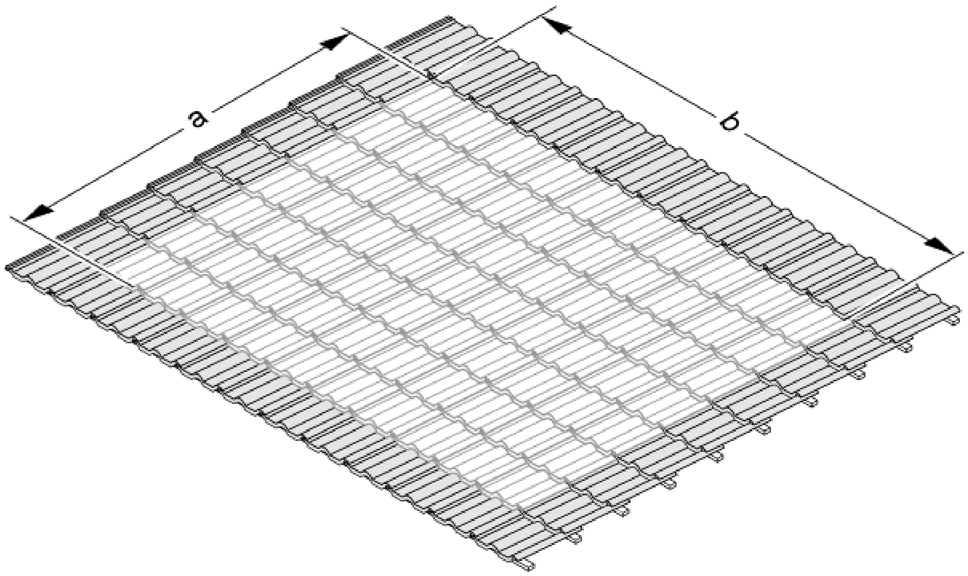
Legend
Ⓐ Summer Sun Angle
Ⓑ Spring/Fall Sun Angle
Ⓒ Winter Sun Angle

This is a unique option for installing solar collectors as it is possible to have the collectors mounted to the wall. This installation option can be used to create an awning system or to have the collector array become part of the building architecture.

This mounting option has many benefits such as increased installation angles (e.g. 60° - 80°) which can reduce overheating during the summer. This mounting option is also referred to as passive solar shading. Passive solar shading is a good way of reducing solar exposure in the summer months while increasing the solar capturing potential during the winter heating season. When mounting the collectors for passive solar shaded installations, it is very important to accurately calculate the distance between the upper and lower course of collectors. If the vertical distance between the stacked arrays is either to small or to great to could affect the overall seasonal output of the solar system.

Required Installation Area (Sloped Roofs) - Vitosol 200-FM, Type SV

For vertical collectors installed between 10° - 80° degrees from the horizontal plane (ground)

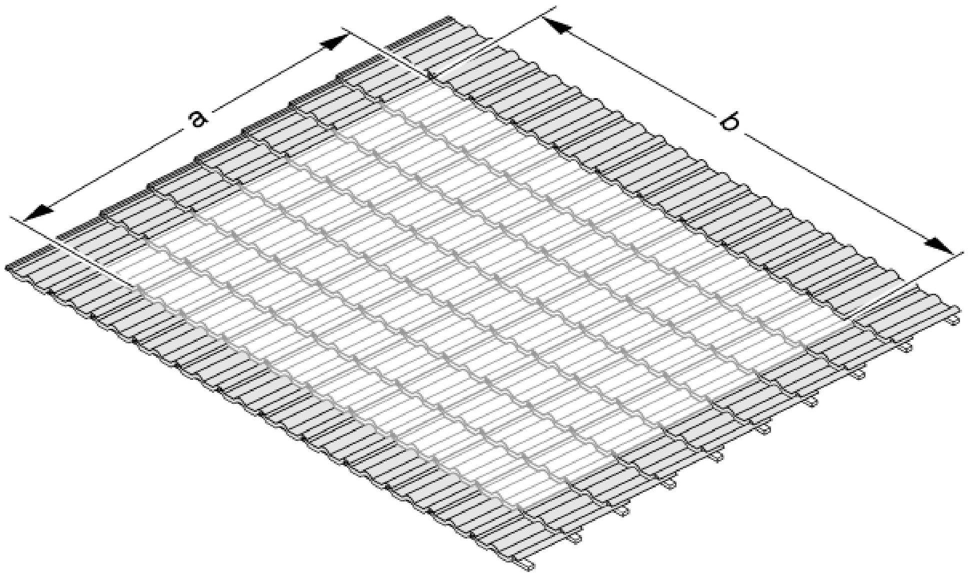


Number of Collectors	Vitosol 200-FM SV2F Array Dimensions				Slope Roof Installation Collector Array Weight (Collectors, racking, fittings & fluid)	
	Dimension "a"		Dimension "b"			
	in.	(mm)	in.	(mm)	lb.	(kg)
1 Collector	93¾	(2380)	43¼	(1098)	116	(53)
2 Collectors	93¾	(2380)	85¾	(2175)	222	(101)
3 Collectors	93¾	(2380)	128¾	(3273)	328	(149)
4 Collectors	93¾	(2380)	171¼	(4350)	434	(197)
5 Collectors	93¾	(2380)	214½	(5448)	542	(246)
6 Collectors	93¾	(2380)	257	(6525)	653	(296)
7 Collectors	93¾	(2380)	300	(7623)	757	(344)
8 Collectors	93¾	(2380)	342½	(8700)	869	(394)
9 Collectors	93¾	(2380)	385¾	(9798)	971	(440)
10 Collectors	93¾	(2380)	419½	(10654)	1083	(492)
11 Collectors	93¾	(2380)	471½	(11973)	1190	(540)
12 Collectors	93¾	(2380)	513¾	(13050)	1301	(590)

Note: It is recommended that a minimum service clearance of 12 in. (305 mm) should be added to each end of the collector array. This allows for ease of installation and servicing of the solar supply and return connections.

Required Installation Area (Sloped Roofs) - Vitosol 200-FM, Type SH

For horizontal collectors installed between 10° - 80° degrees from the horizontal plane (ground)

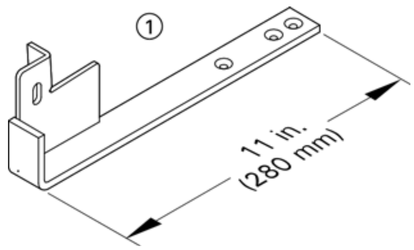


Number of Collectors	Vitosol 200-FM SH2F Array Dimensions				Slope Roof Installation Collector Array Weight (Collectors, racking, fittings & fluid)	
	Dimension "a"		Dimension "b"			
	in.	(mm)	in.	(mm)	lb.	(kg)
1 Collector	41¾	(1056)	95¼	(2422)	124	(56)
2 Collectors	41¾	(1056)	190¾	(4844)	240	(109)
3 Collectors	41¾	(1056)	286	(7266)	355	(161)
4 Collectors	41¾	(1056)	381½	(9688)	471	(214)
5 Collectors	41¾	(1056)	476¾	(12110)	587	(266)
6 Collectors	41¾	(1056)	572¼	(14532)	702	(319)
7 Collectors	41¾	(1056)	667½	(16954)	821	(373)
8 Collectors	41¾	(1056)	762¾	(19376)	935	(424)
9 Collectors	41¾	(1056)	858¼	(21798)	1054	(478)
10 Collectors	41¾	(1056)	953½	(24220)	1166	(529)
11 Collectors	41¾	(1056)	1049	(26642)	1285	(583)
12 Collectors	41¾	(1056)	1144¼	(29064)	1400	(635)

Note: It is recommended that a minimum service clearance of 12 in. (305 mm) should be added to each end of the collector array. This allows for ease of installation and servicing of the solar supply and return connections.

6020 457 - 01

Sloped Roof Installation with Roof Brackets General Information



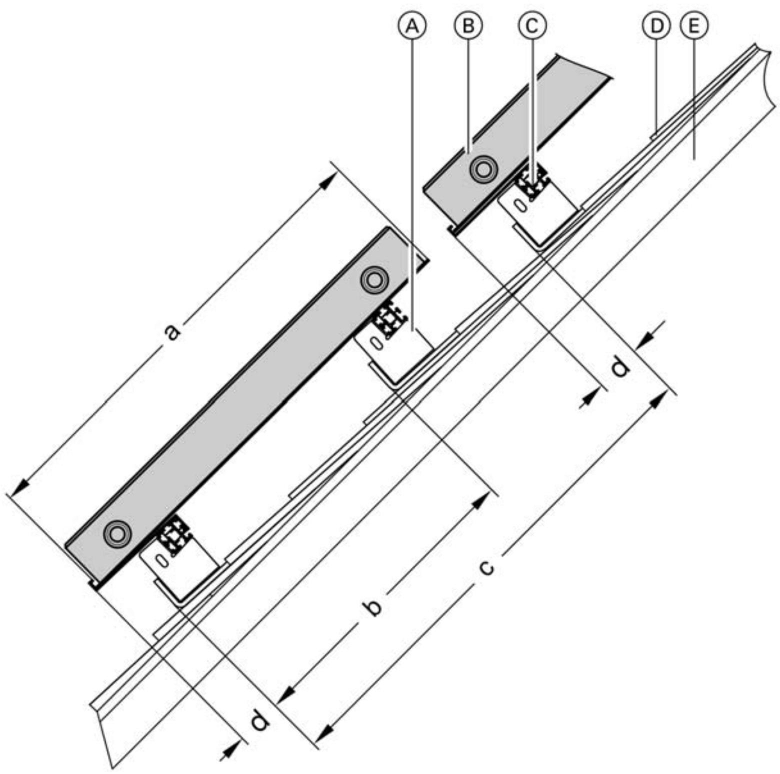
Roof hooks for shingled roofs

- This fixing system can be used for shingled or slate roofs.
- The fixing system comprises roof brackets, mounting rails, clamping brackets and screws.
- Forces are applied to the roof structure in various ways, including via the roof brackets and the slate cover.
  As these elements can vary greatly, damage may occur when loads are applied. We therefore recommend installing additional sheet lead or appropriate flashing between the roof brackets and the roof material.

Slope Roof Installations for Vitosol 200-FM Flat Plate Collectors

Overview - sloped shingled roof installation

Secure mounting brackets Ⓐ on site with factory supplied screws to the roof joist. For dimensions see 'Installing the mounting frames' from pages 49 and 50.



Legend
Ⓐ Mounting brackets
Ⓑ Collector
Ⓒ Mounting rail
Ⓓ Shingles
Ⓔ Roof joist

Type	a in. (mm)	b in. (mm)	c in. (mm)	d in. (mm)
SV	93¾ (2380)	74¾ - 82¾ (1900 - 2100)	≥ 94½ (≥ 2400)	2¾ (70)
SH	41¾ (1056)	17¾ - 33½ (450 - 850)	≥ 42½ (≥ 1077)	2¾ (70)

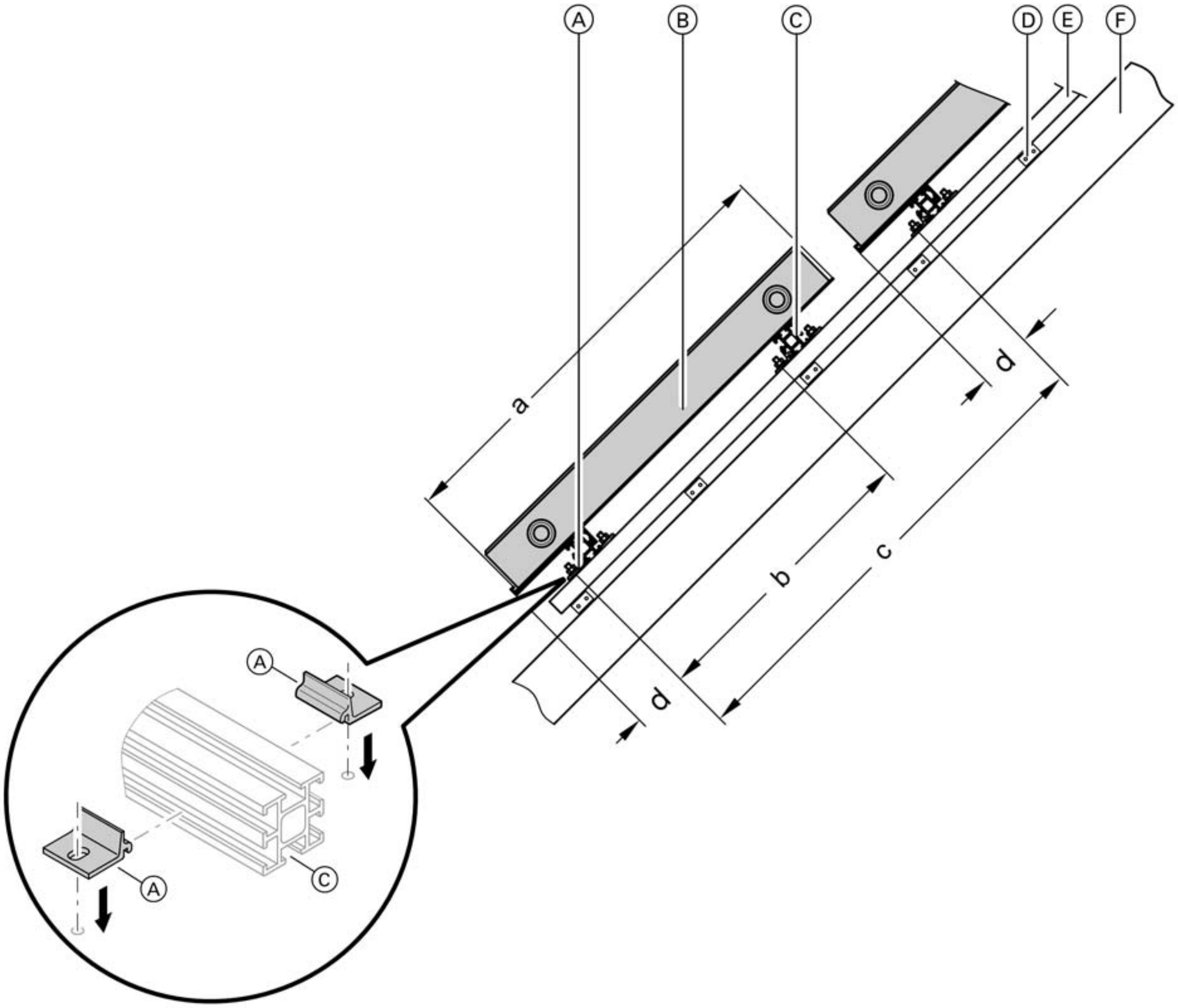
6020 457 - 01

Refer to the Vitosol-FM Installation Instructions for all mounting hardware dimensions and detailed installation instruction

Slope Roof Installations for Vitosol 200-FM Flat Plate Collectors

Overview - standing seam steel roof installation

Install clamping brackets Ⓐ to mounting rail Ⓒ and secure with field supplied fasteners to the field supplied support rail Ⓔ. For dimensions see 'Installing the mounting frames' on pages 49 and 50.



Legend

Ⓐ Clamping brackets with hole size Ø 5/16 in. (Ø 9 mm). It is recommended that a min. of 4 clamping brackets are required per support rail Ⓔ (clamping brackets are ordered separately from Viessmann)
Ⓑ Collector
Ⓒ Mounting rail
Ⓓ Standing seam profile clamps (field supplied)
Ⓔ Support rail (field supplied)
Ⓕ Standing seam steel roof

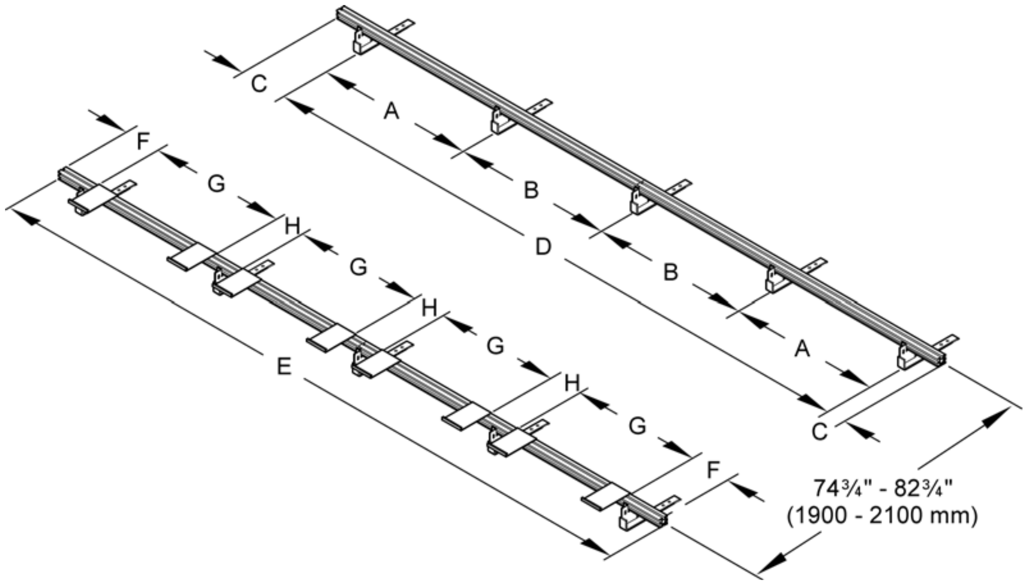
Type	a in. (mm)	b in. (mm)	c in. (mm)	d in. (mm)
SV	93¾ (2380)	74¾ - 82¾ (1900 - 2100)	≥ 94½ (≥ 2400)	4 (103)
SH	41¾ (1056)	17¾ - 33½ (450 - 850)	≥ 42½ (≥ 1077)	4 (103)

Refer to the Vitosol-FM Installation Instructions for all mounting hardware dimensions and detailed installation instruction

6020 457 - 01

Installing the Mounting Frames *(continued)*

Installation dimensions for Vitosol 200-FM, Type SV (vertical collectors)



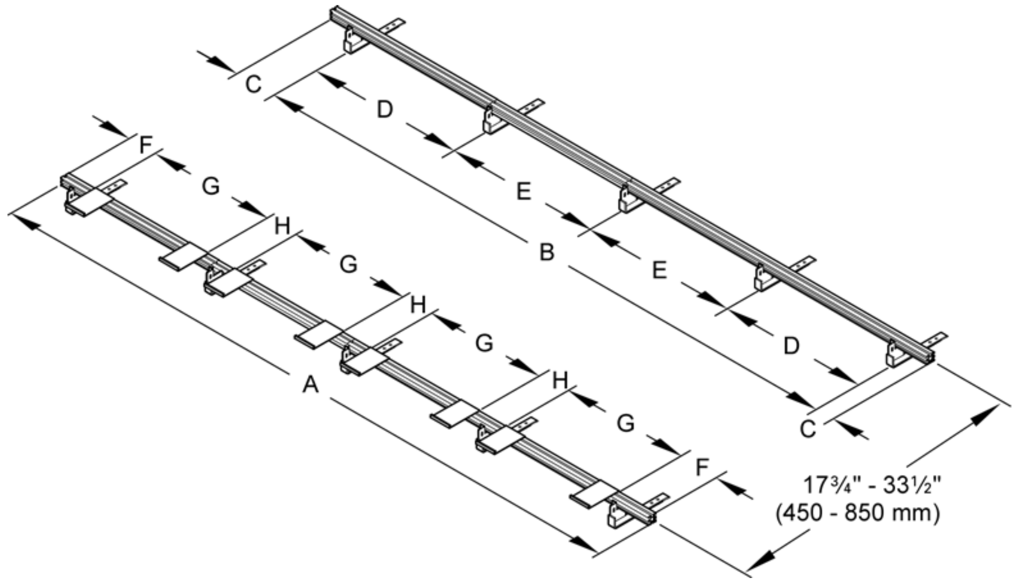
Dimensions for model SV collectors

Number of Collectors	Dimension A	Dimension B	Dimension C	Dimension D*1	Dimension E	Dimension F	Dimension G	Dimension H
	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)
1 Collector	40 (1019)	--	1½ (39.5)	40 (1019)	43¼ (1098)	3½ (87.5)	36¼ (923)	--
2 Collectors	40 (1019)	--	2¾ (68.5)	80¼ (2038)	85½ (2175)	3½ (87.5)	36¼ (923)	6 (154)
3 Collectors	40 (1019)	42½ (1077)	3 (79)	122½ (3115)	128¾ (3273)	4 (98)	36¼ (923)	6 (154)
4 Collectors	40 (1019)	42½ (1077)	3 (79)	165 (4192)	171¼ (4350)	4 (98)	36¼ (923)	6 (154)
5 Collectors	40 (1019)	42½ (1077)	3½ (89.5)	207½ (5269)	214½ (5448)	4¼ (108.5)	36¼ (923)	6 (154)
6 Collectors	40 (1019)	42½ (1077)	3½ (89.5)	249¾ (6346)	256¾ (6525)	4¼ (108.5)	36¼ (923)	6 (154)
7 Collectors	40 (1019)	42½ (1077)	4 (100)	292¼ (7423)	300¼ (7623)	4¾ (119)	36¼ (923)	6 (154)
8 Collectors	40 (1019)	42½ (1077)	4 (100)	334½ (8500)	342½ (8700)	4¾ (119)	36¼ (923)	6 (154)
9 Collectors	40 (1019)	42½ (1077)	4½ (110.5)	377 (9577)	385¾ (9798)	5 (129.5)	36¼ (923)	6 (154)
10 Collectors	40 (1019)	42½ (1077)	4½ (110.5)	419½ (10654)	428 (10875)	5 (129.5)	36¼ (923)	6 (154)
11 Collectors	40 (1019)	42½ (1077)	4¾ (121)	462 (11731)	471½ (11973)	5½ (140)	36¼ (923)	6 (154)
12 Collectors	40 (1019)	42½ (1077)	4¾ (121)	504¼ (12808)	513¾ (13050)	5½ (140)	36¼ (923)	6 (154)

*1 For static reasons, maintain the stated sequence. Maintain the dimensions A and B as far as possible. Roof brackets may also be offset if you need to locate roof joist. However, always maintain the overall dimension.

Installing the Mounting Frames *(continued)*

Installation dimensions for Vitosol 200-FM, Type SH (horizontal collectors)



Dimensions for model SH collectors

Number of Collectors	Dimension A	Dimension B	Dimension C*1	Dimension D	Dimension E	Dimension F	Dimension G	Dimension H
	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)
1 Collector	95¼ (2422)	88 (2250)	3½ (86)	88½ (2250)	--	4¼ (111)	86½ (2200)	--
2 Collectors	190¾ (4844)	177 (4500)	6¾ (172)	88½ (2250)	--	4¾ (121.5)	86½ (2200)	8 (201)
3 Collectors	286 (7266)	271¾ (6901)	7¼ (182.5)	88½ (2250)	94½ (2401)	5¼ (132)	86½ (2200)	8 (201)
4 Collectors	381½ (9688)	366¼ (9302)	7½ (193)	88½ (2250)	94½ (2401)	5½ (142.5)	86½ (2200)	8 (201)
5 Collectors	476¾ (12110)	460¾ (11703)	8 (203)	88½ (2250)	94½ (2401)	6 (153)	86½ (2200)	8 (201)
6 Collectors	572 (14532)	555¼ (14104)	8½ (214)	88½ (2250)	94½ (2401)	6½ (163.5)	86½ (2200)	8 (201)
7 Collectors	667½ (16954)	649¾ (16505)	8¾ (224.5)	88½ (2250)	94½ (2401)	6¾ (174)	86½ (2200)	8 (201)
8 Collectors	763 (19376)	744¼ (18906)	9¼ (235)	88½ (2250)	94½ (2401)	7¼ (184.5)	86½ (2200)	8 (201)
9 Collectors	858¼ (21798)	838¾ (21307)	9¾ (245.5)	88½ (2250)	94½ (2401)	7¾ (195)	86½ (2200)	8 (201)
10 Collectors	953½ (24220)	933½ (23708)	10 (256)	88½ (2250)	94½ (2401)	8 (205.5)	86½ (2200)	8 (201)
11 Collectors	1049 (26642)	1028 (26109)	10½ (266.5)	88½ (2250)	94½ (2401)	8½ (216)	86½ (2200)	8 (201)
12 Collectors	1144¼ (29064)	1122½ (28510)	11 (277)	88½ (2250)	94½ (2401)	9 (226.5)	86½ (2200)	8 (201)

*1 For static reasons, maintain the stated sequence. Maintain the dimensions D and E as far as possible.
Roof brackets may also be offset if you need to locate roof joist. However, always maintain the overall dimension.

Vitosol 200-FM Flat-Plate Collectors (on supports)

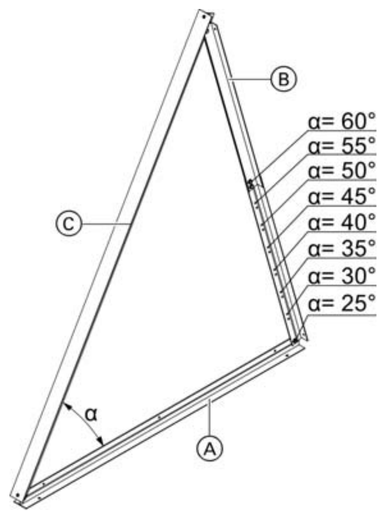
Viessmann offers adjustable collector supports for fixing the collectors:

— With a variable angle of inclination [snow loads up to 53.3 lb/ft^2 (2.55 kN/m^2), wind speeds up to 93.2 mph (150 km/h)]:

The collector supports are pre-assembled. They consist of the base rail, collector support and adjustable support with holes for adjusting the angle of inclination.

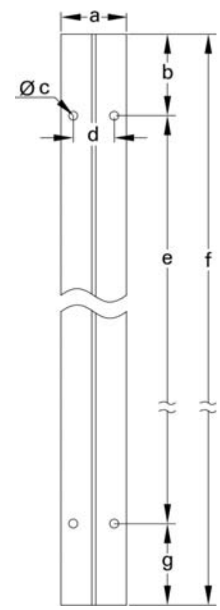
Refer to the Vitosol-FM Installation, Operating and Service Instructions for all mounting hardware dimensions and detailed installation instructions.

Collector supports with variable angle of inclination
Type SV — angle of inclination α 25 to 60°



Legend
Ⓐ Base rail
Ⓑ Adjustable support
Ⓒ Collector support

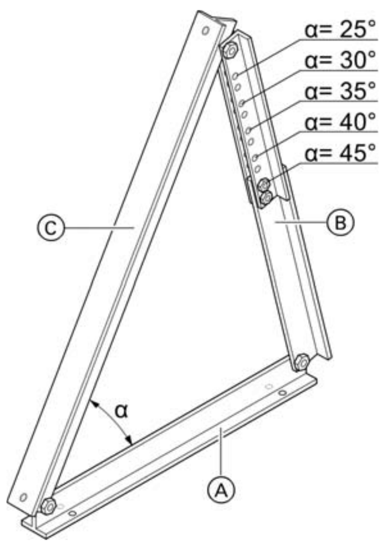
Collector support base rail (Type SV)



Dimensions:
a 3 in. (80 mm)
b 4 in. (100 mm)
c Ø 0.4 in. (11 mm)
d 2 in. (50 mm)
e 63 in. (1600 mm)
f 71 in. (1800 mm)
g 4 in. (100 mm)

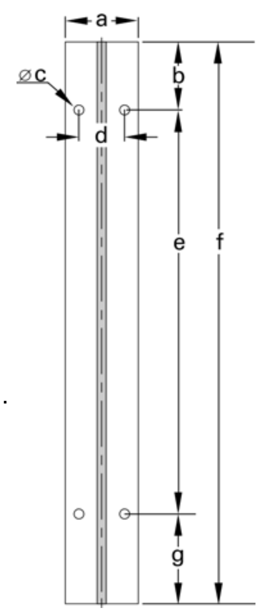
Note: Imperial dimensions are rounded to the nearest ¼ in.

Type SH — angle of inclination α 25 to 45°



Legend
Ⓐ Base rail
Ⓑ Adjustable support
Ⓒ Collector support

Collector support base rail (Type SH)



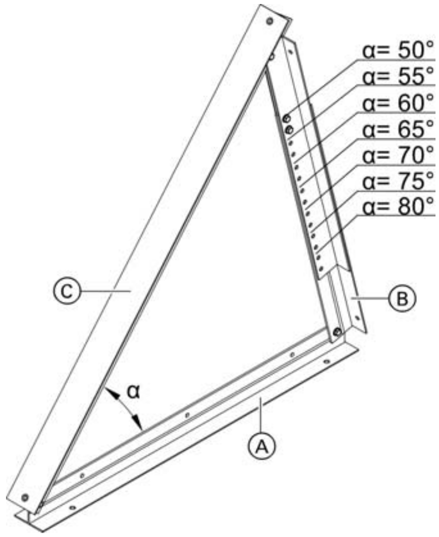
Dimensions:
a 3 in. (80 mm)
b 3 in. (75 mm)
c Ø 0.4 in. (11 mm)
d 2 in. (50 mm)
e 28½ in. (722 mm)
f 35¼ in. (897 mm)
g 4 in. (100 mm)

Note: Imperial dimensions are rounded to the nearest ¼ in.

6020 457 - 01

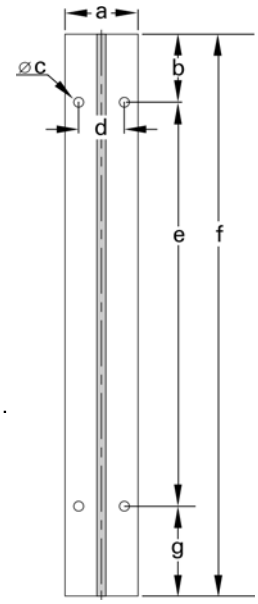
Vitosol 200-FM Flat-Plate Collectors (on supports) *(continued)*

Type SH — angle of inclination α 50 to 80°



Legend
Ⓐ Base rail
Ⓑ Adjustable support
Ⓒ Collector support

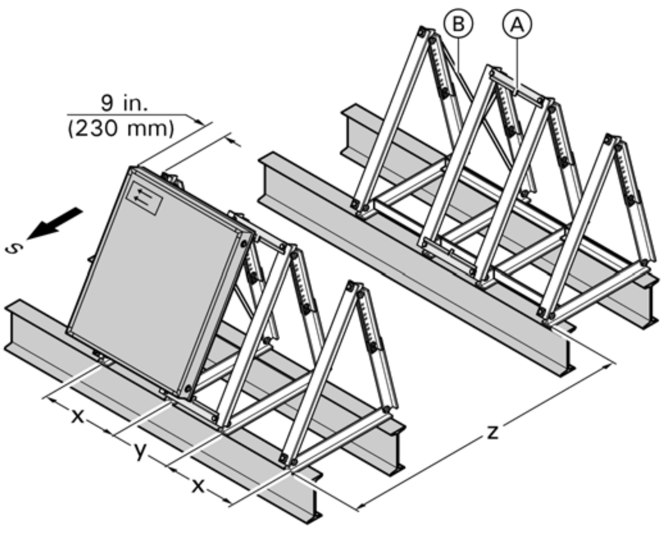
Collector support base rail (Type SH)



Dimensions:
a 3 in. (80 mm)
b 3 in. (75 mm)
c Ø 0.4 in. (11 mm)
d 2 in. (50 mm)
e 28½ in. (722 mm)
f 35¼ in. (897 mm)
g 4 in. (100 mm)

Note: Imperial dimensions are rounded to the nearest ¼ in.

Type SV and SH — installation on an on-site substructure, e.g. steel beams



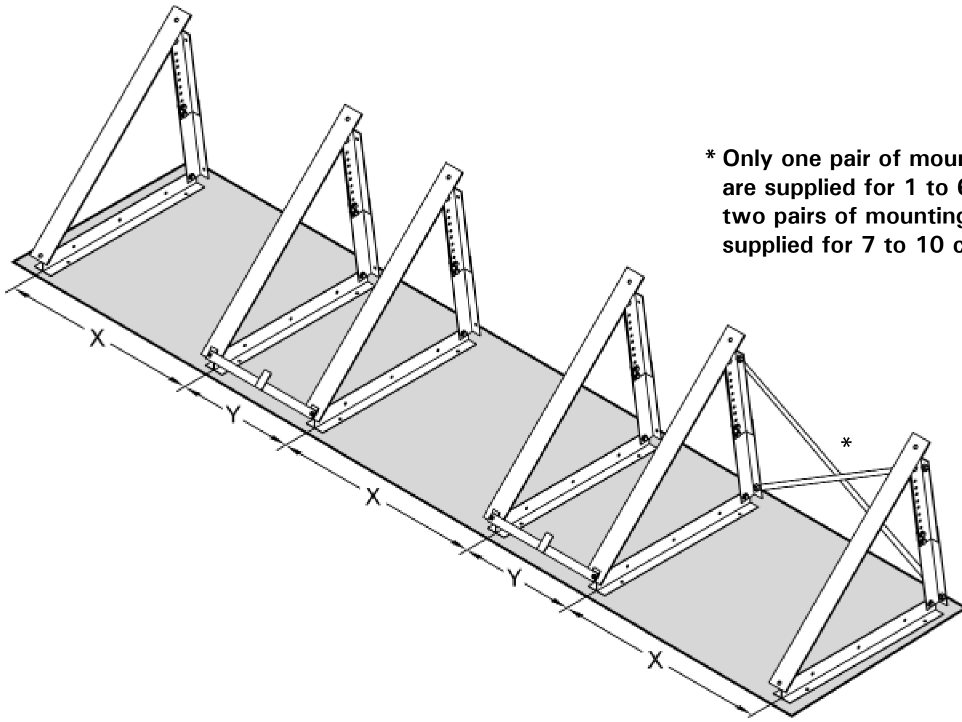
Legend
Ⓐ Connecting brace
Ⓑ Connecting ties

		Vitosol 200-FM, Type SV
x	in. (mm)	**23**½ (595)
y	in. (mm)	**18**7/8 (481)
z	in. (mm)	See page 56

		Vitosol 200-FM, Type SH
x	in. (mm)	**75**⅝ (1920)
y	in. (mm)	**18**7/8 (481)
z	in. (mm)	See page 56

Required Installation Area (Flat Roofs) - Vitosol 200-FM, Type SV

For vertical collectors installed between 25° - 60° degrees from the horizontal plane (ground)



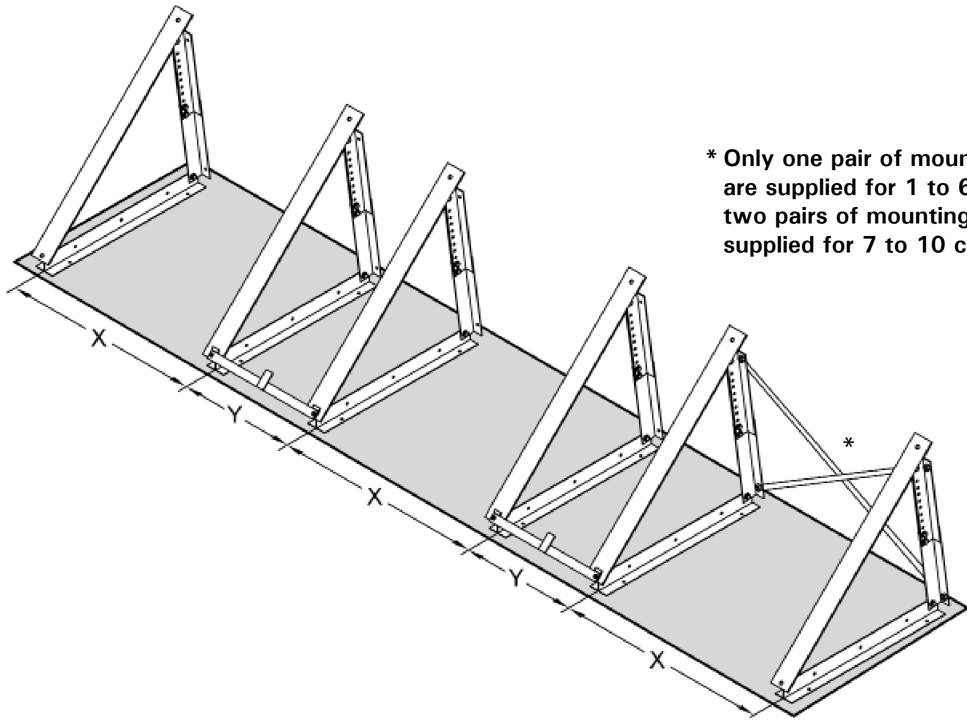
*** Only one pair of mounting crossbars are supplied for 1 to 6 collectors, two pairs of mounting crossbars are supplied for 7 to 10 collectors.**

Number of Collectors	Vitosol 200-FM SV2F Array Dimensions: Mounting Frame Spacing Dimensions	Overall Length of Array When Collectors Installed		Flat Roof Installation Collector Array Weight (Collectors, racking, fittings & fluid)	
	"X" = 23½ in (595 mm) "Y" = 18⅞ in (481 mm)	in.	(mm)	lb.	(kg)
1 Collector	1x "X"	42¼	(1071)	142	(65)
2 Collectors	2x "X" + 1x "Y"	84½	(2148)	278	(126)
3 Collectors	3x "X" + 2x "Y"	127	(3225)	414	(188)
4 Collectors	4x "X" + 3x "Y"	169¼	(4301)	549	(249)
5 Collectors	5x "X" + 4x "Y"	211¾	(5378)	685	(311)
6 Collectors	6x "X" + 5x "Y"	254¼	(6455)	820	(372)
7 Collectors	7x "X" + 6x "Y"	296½	(7532)	958	(435)
8 Collectors	8x "X" + 7x "Y"	339	(8609)	1094	(496)
9 Collectors	9x "X" + 8x "Y"	381¼	(9685)	1229	(558)
10 Collectors	10x "X" + 9x "Y"	423¾	(10762)	1365	(619)
11 Collectors	11x "X" + 10x "Y"	466	(11839)	1500	(681)
12 Collectors	12x "X" + 11x "Y"	508½	(12916)	1636	(742)

Note: It is recommended that a minimum service clearance of 12 in. (305 mm) should be added to each end of the collector array. This allows for ease of installation and servicing of the solar supply and return connections.

Required Installation Area (Flat Roofs) - Vitosol 200-FM, Type SH

For horizontal collectors installed between 25° - 80° degrees from the horizontal plane (ground)



*** Only one pair of mounting crossbars are supplied for 1 to 6 collectors, two pairs of mounting crossbars are supplied for 7 to 10 collectors.**

Number of Collectors	Vitosol 200-FM SH2F Array Dimensions			Flat Roof Installation Collector Array Weight (Collectors, racking, fittings & fluid)	
	Mounting Frame Spacing Dimensions	Overall Length of Array When Collectors Installed			
	"X" = 75⅝ in (1920 mm) "Y" = 18⅞ in (481 mm))	in.	(mm)	lb.	(kg)
1 Collector	1x "X"	94¼	(2395)	125	(57)
2 Collectors	2x "X" + 1x "Y"	188¾	(4796)	243	(110)
3 Collectors	3x "X" + 2x "Y"	283¼	(7197)	361	(164)
4 Collectors	4x "X" + 3x "Y"	377¾	(9597)	479	(218)
5 Collectors	5x "X" + 4x "Y"	472¼	(11998)	597	(271)
6 Collectors	6x "X" + 5x "Y"	567	(14399)	715	(325)
7 Collectors	7x "X" + 6x "Y"	661½	(16800)	836	(379)
8 Collectors	8x "X" + 7x "Y"	756	(19201)	954	(433)
9 Collectors	9x "X" + 8x "Y"	850½	(21601)	1072	(486)
10 Collectors	10x "X" + 9x "Y"	945	(24002)	1190	(540)
11 Collectors	11x "X" + 10x "Y"	1039½	(26403)	1308	(594)
12 Collectors	12x "X" + 11x "Y"	1134	(28804)	1426	(647)

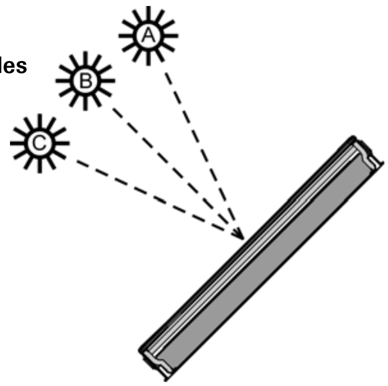
Note: It is recommended that a minimum service clearance of 12 in. (305 mm) should be added to each end of the collector array. This allows for ease of installation and servicing of the solar supply and return connections.

Calculating Solar Elevation Height

Solar elevation height can be easily calculated using the formulas below and the latitude for the location (see tables attached below):

Summer Solstice = 90° - Latitude + 23.45°
Spring Equinox = 90° - Latitude + 0°
Fall Equinox = 90° - Latitude + 0°
Winter Solstice = 90° - Latitude - 23.45°

Sun Angles



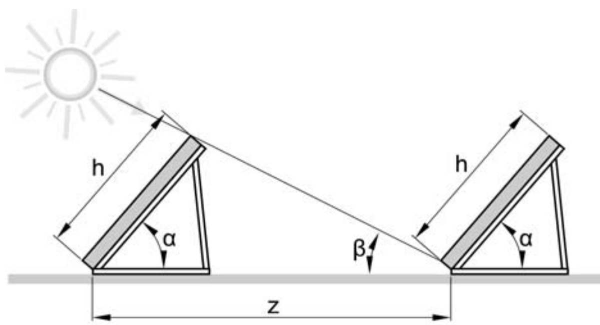
Legend
Ⓐ Summer Solstice (Jun 21)
Ⓑ Spring Equinox (Mar 20)
Ⓑ Fall Equinox (Sept 23)
Ⓒ Winter Solstice (Dec 21)

Canadian Provincial Capitals	Latitude (°N)	Longitude (°W)
Edmonton, AB	53.3	-113.6
Victoria, BC	48.7	-123.4
Charlottetown, PEI	46.3	-63.1
Winnipeg, MB	49.9	-97.2
Fredericton, NB	45.9	-66.5
Halifax, NS	44.9	-63.5
Toronto, ON	43.7	-79.6
Quebec City, QC	46.8	-71.4
Regina, SK	50.4	-104.7
St. Johns, NL	47.6	-52.7
Iqualuit, NU	63.8	-68.3
Whitehorse, YT	60.7	-135.1
Yellowknife, NT	62.5	-114.4

U.S.A State Capitals	Latitude (°N)	Longitude (°W)
Montgomery, AL	32.3	-86.4
Juneau, AK	58.4	-134.6
Phoenix, AZ	33.4	-112.0
Little Rock, AR	34.8	-92.2
Sacramento, CA	38.5	-121.5
Denver, CO	39.8	-104.7
Hartford, CT	41.9	-72.7
Dover, DE	39.1	-75.5
Tallahassee, FL	30.4	-84.4
Atlanta, GA	33.6	-84.4
Honolulu, HI	21.3	-157.9
Boise, ID	43.6	-116.2
Springfield, IL	39.9	-89.7
Indianapolis, IN	39.7	-86.3
Des Moines, IA	41.5	-93.7
Topeka, KS	39.1	-95.6
Frankfort, KY	38.2	-84.9
Baton Rouge, LA	30.5	-91.2
Augusta, ME	44.3	-69.8
Annapolis, MD	38.9	-76.4
Boston, MA	42.4	-71.0
Lansing, MI	42.8	-84.6
Saint Paul, MN	44.9	-93.1
Jackson, MS	32.3	-90.1
Jefferson City. MO	38.6	-92.2

U.S.A State Capitals	Latitude (°N)	Longitude (°W)
Helena, MT	46.6	-112.0
Lincoln, NE	40.8	-96.8
Carson City, NV	39.5	-119.8
Concord, NH	43.2	-71.5
Trenton, NJ	40.3	-74.8
Santa Fe, NM	35.7	-106.0
Albany, NY	42.8	-73.8
Raleigh, NC	35.9	-78.8
Bismarck, ND	46.8	-100.8
Columbus, OH	40.0	-82.9
Oklahoma City, OK	35.4	-97.6
Salem, OR	44.9	-123.0
Harrisburg, PA	40.2	-76.9
Providence, RI	41.7	-71.4
Columbia, SC	33.9	-81.1
Pierre, SD	44.4	-100.3
Nashville, TN	36.1	-86.7
Austin, TX	30.2	-97.7
Salt Lake City, UT	40.8	-112.0
Montpelier, VT	44.2	-72.6
Richmond, VA	37.5	-77.3
Olympia, WA	47.0	-122.9
Charleston, WV	38.4	-81.6
Madison, WI	43.1	-89.4
Cheyenne, WY	41.2	-104.8

Determining the Collector Row Clearance z



$$z = \frac{h \bullet \sin (180° - (\alpha + \beta))}{\sin \beta}$$

Legend:

z = Collector row distance

h = Collector height
200-FM model SV = 93¾ in. (2380 mm)
200-FM model SH = 41¾ in. (1056 mm)

α = Collector angle of inclination
200-FM model SV = 25° - 60°
200-FM model SH = 25° - 80°

β = Solar angle
$\beta = (90° - 23.5°)$ - Latitude

IMPORTANT

When installing several collectors in series, maintain a distance of “z”.

Example:

Vitosol 200-FM, Type SV (Vertical Collector)
Toronto is located at approximately 43° latitude.

1. Determine the angle of the sun β. This should be chosen so that the midday sun December 21 falls on the second row of collectors without being obstructed by shadows.

   Solar angle β:
   $\beta = (90° - 23.5°)$ - latitude
   (23.5° should be accepted as constant value for northern latitudes)

   $\beta = (90° - 23.5°) - 43° = 23.5°$

2. Calculating dimension “z”:
   h = 2380 mm
   $\alpha = 45°$
   $\beta = 23.5°$

   $$z = \frac{2380 \text{ mm} \bullet \sin (180° - (45° + 23.5°))}{\sin 23.5°}$$

   $$z = \frac{2380 \text{ mm} \bullet \sin 111.5°}{\sin 23.5°}$$

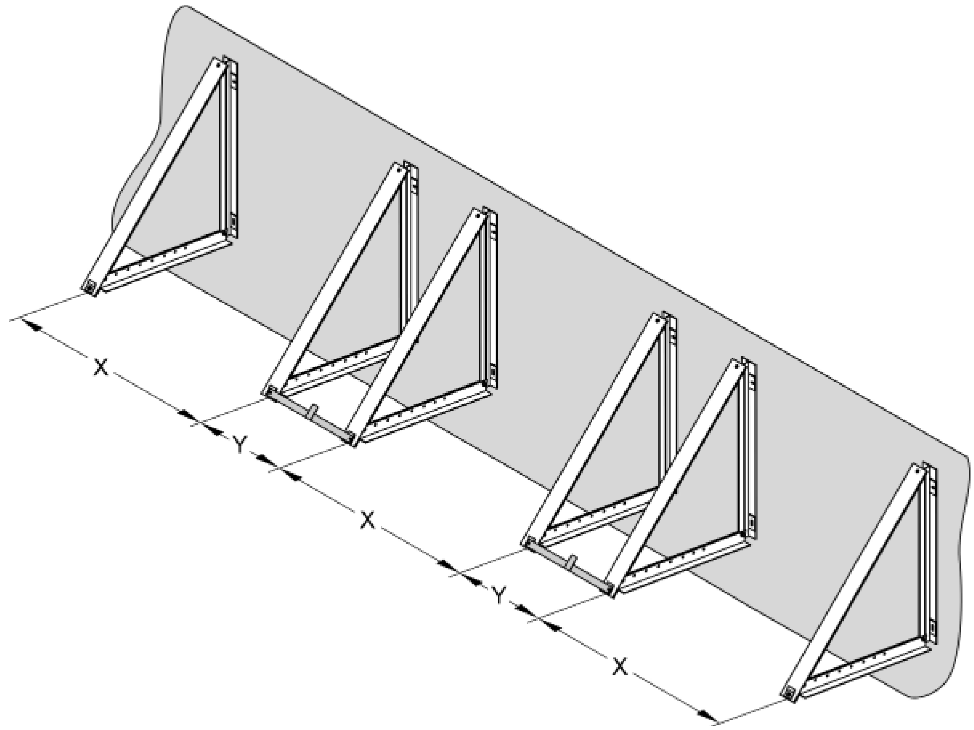
   z = 218.6 in. (5553 mm)

Note: Contact Viessmann Solar Tech Support for assistance with calculating distance “z”.

6020 457 - 01

Required Installation Area (Walls) - Vitosol 200-FM, Type SH

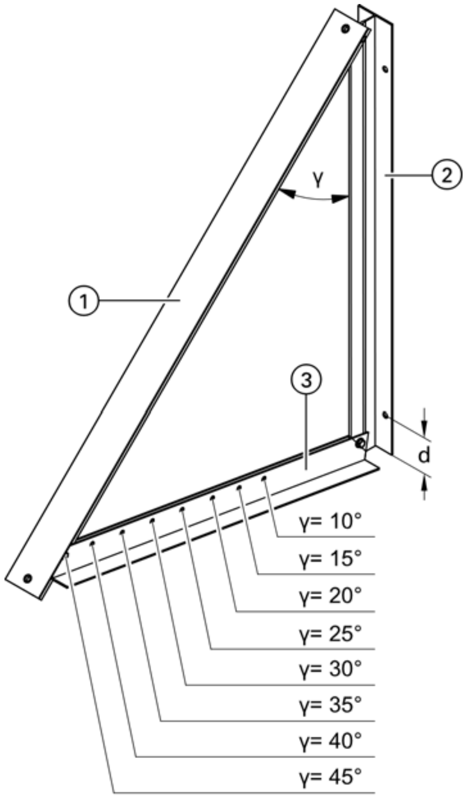
For horizontal collectors installed between 45° - 80° degrees from the horizontal plane (ground)



Number of Collectors	Vitosol 200-FM SH2F Array Dimensions			Collector Array Weight (Collectors, racking, fittings & fluid)	
	Mounting Frame Spacing Dimensions	Overall Length of Array When Collectors Installed			
	"X" = 75⅝ in (1920 mm) "Y" = 18⅞ in (481 mm)	in.	(mm)	lb.	(kg)
1 Collector	1x "X"	94 ¼	(2395)	120	(55)
2 Collectors	2x "X" + 1x "Y"	188 ¾	(4796)	236	(107)
3 Collectors	3x "X" + 2x "Y"	283 ¼	(7197)	352	(160)
4 Collectors	4x "X" + 3x "Y"	377 ¾	(9597)	467	(212)
5 Collectors	5x "X" + 4x "Y"	472 ¼	(11998)	583	(265)
6 Collectors	6x "X" + 5x "Y"	567	(14399)	699	(317)
7 Collectors	7x "X" + 6x "Y"	661 ½	(16800)	814	(370)
8 Collectors	8x "X" + 7x "Y"	756	(19201)	930	(422)
9 Collectors	9x "X" + 8x "Y"	850 ½	(21601)	1046	(475)
10 Collectors	10x "X" + 9x "Y"	945	(24002)	1161	(527)
11 Collectors	11x "X" + 10x "Y"	1039 ½	(26403)	1277	(579)
12 Collectors	12x "X" + 11x "Y"	1134	(28804)	1393	(632)

Note: It is recommended that a minimum service clearance of 12 in. (305 mm) should be added to each end of the collector array. This allows for ease of installation and servicing of the solar supply and return connections.

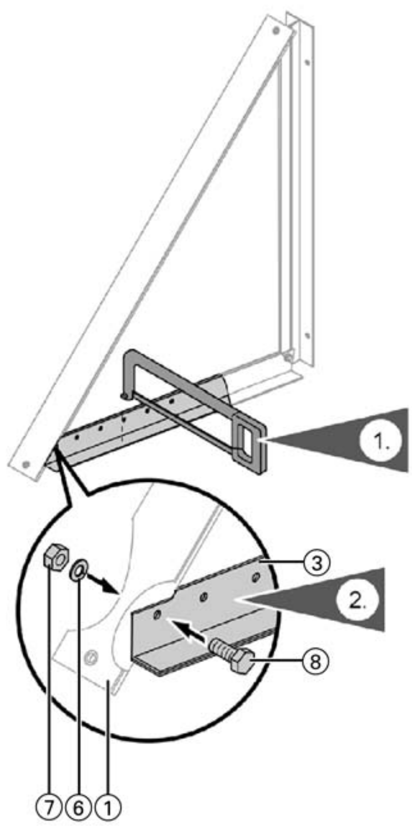
Vitosol 200-FM Flat Plate Collectors, Type SH (wall mounting using supports)



Collector supports – angle Y 10 to 45°

Legend

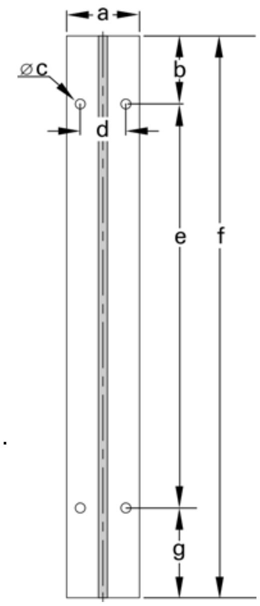
① Collector support
② Base rail
③ Adjustable support



The collector supports are pre-assembled. They consist of a base rail, a collector support and adjustable supports. The adjustable supports contain holes for adjusting the angle of inclination.

Refer to the Vitosol-FM Installation Instructions for all mounting hardware dimensions and detailed installation instructions.

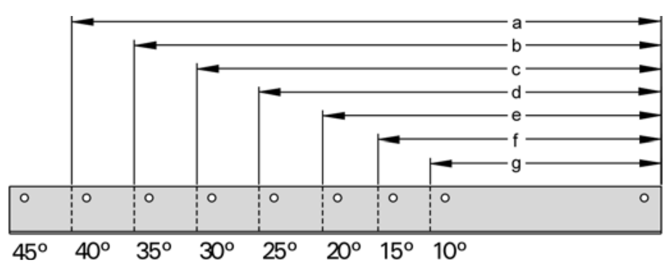
Collector support base rail (Type SH)



Dimensions:
a 3 in. (80 mm)
b 3 in. (75 mm)
c Ø 0.4 in. (11 mm)
d 2 in. (50 mm)
e 28½ in. (722 mm)
f 35⅜ in. (897 mm)
g 4 in. (100 mm)

Note: Imperial dimensions are rounded to the nearest ¼ in.

1. Trim adjustable supports ③ in accordance with the required angle of inclination.
2. Secure the adjustable support ③ to the collector support ① with bolts ⑧, nuts ⑦ and washers ⑥.



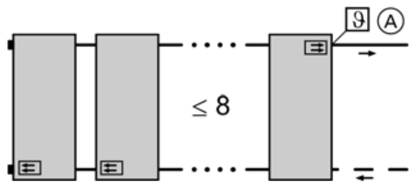
Cutting dimensions:
a 10¾ in. (272 mm) = 40°
b 13⅛ in. (334 mm) = 35°
c 15¾ in. (399 mm) = 30°
d 18⅝ in. (474 mm) = 25°
e 21½ in. (547 mm) = 20°
f 24½ in. (621 mm) = 15°
g 27⅜ in. (695 mm) = 10°

CAUTION

Be sure to cut the adjustable supports such that approximately 11/16" (17.5 mm) of material is left on the end.

6020 457 - 01

Vitosol 200-FM, Type SV and SH Low Flow Operation (single-sided connection)

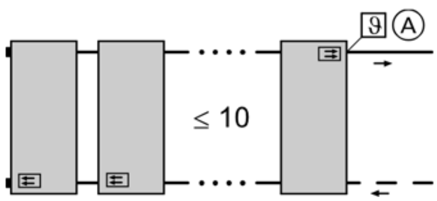


Single array less than or equal to (≤) 8x flat plate collectors

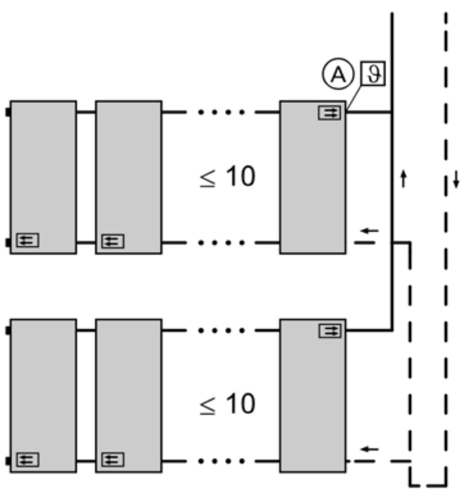
Legend

Ⓐ Collector temperature sensor (field installed)

Vitosol 200-FM, Type SV and SH High Flow Operation (single-sided connection)



Single array less than or equal to (≤) 10x flat plate collectors

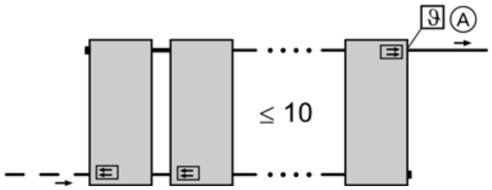


Multiple arrays less than or equal to (≤) 10x flat plate collectors per individual array

Legend

Ⓐ Collector temperature sensor (field installed)

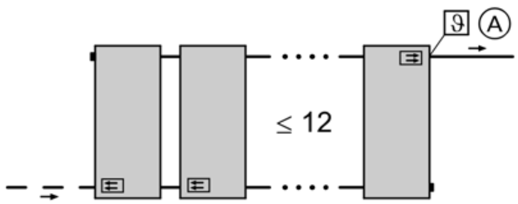
Vitosol 200-FM, Type SV and SH Low Flow Operation (connection on alternate sides)



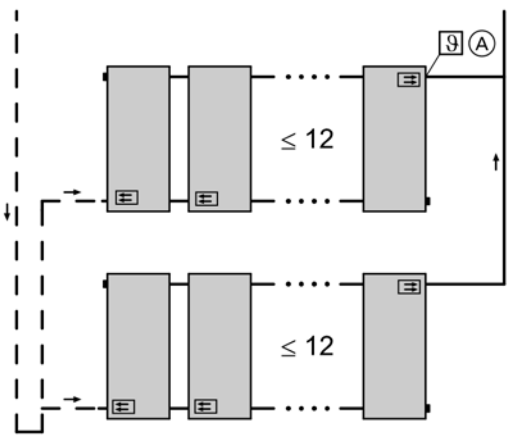
Single array less than or equal to (≤) 10x flat plate collectors

Legend
Ⓐ Collector temperature sensor (field installed)

Vitosol 200-FM, Type SV and SH High Flow Operation (connection on alternate sides)



Single array less than or equal to (≤) 12x flat plate collectors



Multiple arrays less than or equal to (≤) 12x flat plate collectors per individual array

Legend
Ⓐ Collector temperature sensor (field installed)

Sizing the Solar Thermal System

The sizing of a solar thermal system must take the size of the DHW load into careful consideration, to avoid system overheating due to excess solar energy. Ideally the solar system should be sized to capture and store the amount of energy required for the daily consumption of DHW. Over estimated DHW loads, oversized collector arrays and undersized solar storage tanks are common design errors that can result in problems with overheating in the collector loop. The resulting collector stagnation will cause glycol degradation, increased system maintenance, and possible system failure. The ThermProtect switching absorber limits the collector stagnation temperature to a level that will not cause the glycol to experience thermal degradation.

To avoid oversizing, it is important to try not to cover too much of the DHW load with solar energy. It is recommended that for small scale solar DHW systems a maximum solar coverage of 55-60% be targeted. For larger commercial scale systems a maximum solar cover rate of 40-45% is often advisable.

Commercially available solar simulation software programs such as T*Sol, RETScreen or Polysun should be used to evaluate any solar system design. These programs allow for the many system parameters to be manipulated and adjusted to come up with the optimal solar design. Viessmann provides solar design services and will be happy to provide solar simulations for your project.

Calculating the DHW consumption

The most important first step in system sizing is to establish the size of the average daily DHW load. This load information is not always readily available, but it can be either measured or estimated. For calculating the demand and consumption of DHW, we have to differentiate between the maximum demand of a point of use, and the design consumption.

- The maximum demand of a point of use is often based on the number of fixtures, and forms the calculation base to safeguard the supply of sufficient DHW at all times. It is the engineering variable for sizing the auxiliary DHW tank, and reheat output of the boiler. The maximum demand of the point of use **should not** be used for sizing the solar system.
- The design consumption forms the basis for the ideal utilisation of the solar thermal system. The design consumption describes the average expected daily consumption, and it is the engineering variable for sizing the solar thermal system. If the load is lower in the summer months then use this rate for solar system sizing.

The maximum demand at the point of use is often higher by a factor of two than the actual daily consumption. Where possible, the actual DHW consumption should be measured with a water meter in the cold water line to the DHW tanks over a longer period of time to aid the system engineering. However, for practical reasons this is not always possible. If no accurate details can be measured for the point of use, the consumption can be estimated based on industry recognized consumption data.

Typical examples of consumption rates are as follows:

- In a detached house the average consumption per head is higher than in apartment buildings. The consumption is assumed to be 8 to 12 USG (30 L to 45 L) per person at 140°F (60°C).
- For apartment buildings, the recommended value (according to VDI 6002 part 1) is 6 USG (22 L) per person at 140°F (60°C).

If unsure of the exact design consumption it is better to underestimate the consumption to avoid solar system oversizing.

Sizing the Solar Thermal System *(continued)*

Domestic hot water pre-heat systems
Solar thermal systems have the ability to considerably reduce the energy requirements of the backup heat generator, assuming that the building has a constant daily DHW load throughout the year. As a result solar thermal systems are well suited to almost all residential and high occupancy apartment buildings.

Using the formula below, it is possible to quickly identify the number of Vitosol 200-FM collectors which are required to provide 100% of the monthly domestic hot water load for a residential household.

For this sizing calculation, the user must select a location from the list (see pages 64 and 65). Since solar availability is greater during the summer months than it is during the winter, it is recommended that calculations be completed for each month to identify the appropriate number of collectors to meet the monthly DHW demand.

Note: To speed up the calculation process, calculate for the months of June & July. Since these months receive the greatest amount of solar radiation, as a result they will require the least number of solar collectors to satisfy the DHW load.

Nc = ((Ndays x Npersons x Vperson x p x Cp x ΔT) ÷ Se) ÷ (Gt x 1,000,000 x Ndays) ÷ (Ca)

Where:

Nc = Number of collectors required to meet 100% of the domestic hot water load

Ndays = Number of days per month (see table below)

Npersons = Number of people in the home or building

Vperson = Volume of hot water consumed per person each day (50-75 Liters per person per day)

p = Density of water (1 kg/L)

Cp = Specific heat of water (4190 J/kg°C)

ΔT = Temperature difference between hot water to be delivered from the storage tank and the cold water coming in from the well or city mains (50 °C rise)

Se = System efficiency in decimal format (assume 70% collector efficiency x 60% balance of system efficiency = 42% or 0.42)

Gt = Solar radiation (MJ/m²/day)
*Note: 1 kwh = 3.6 MJ or 3,600,000 Joules

Ca = Collector absorber area (Vitosol 200-FM = 2.32 m²)

Number of days in each month

January	= 31	July	= 31
February	= 28	August	= 31
March	= 31	September	= 30
April	= 30	October	= 31
May	= 31	November	= 30
June	= 30	December	= 31

Calculation example for Vitosol 200-FM

Number of days per month: ....30 days in June
Number of people in the home: 4
Volume of hot water consumed
per person per day: ....50 L/per/day
Density of water: ....1 kg/L
Specific heat of water:...............................4190 J/kg°C
Temperature difference between hot water tank
and cold water supply:...50°C
System efficiency:...0.42
Solar radiation (Boston):.........................22.1 MJ/m²/day
Collector absorber area (Vitosol 200-FM):............ 2.32 m²

Nc = ((30 days x 4 people x 50 L/per/day x 1 kg/L x 4190 J/kg°C x (50°C)) ÷ 0.42) ÷ (22.1 MJ/m²/day x 1,000,000 x 30 days) ÷ (2.32m²)
= 1.95 Vitosol 200-FM collectors

Note: To prevent overheating it is recommended to round the quantity of collectors down to the next whole number. For this example, 2x Vitosol 200-FM collectors would be the recommended number of collectors to satisfy the DHW load for the month of June.

Sizing the Solar Thermal System *(continued)*

Solar storage tank requirements

Fossil fuel fired DHW heaters can turn on and heat water when there is a demand, and off when there is not. Solar water heaters however must collect energy when the insolation is available, and store the energy for when there is a demand. The period of heat generation and the period of consumption are rarely the same, so having sufficient solar storage tank capacity is essential for the efficient operation of the solar system. Insufficient storage capacity will lead to higher temperatures in the collector loop, resulting in low collector efficiency, reduced system yields and collector stagnation. In almost all cases more storage volume equals better system efficiency. The amount of storage required is based on the type of solar application and the size of the collector array. The following can be used as a guideline for selecting the solar storage tank requirements:

Solar storage requirements based on collector aperture area	Type of solar application:		
	DHW heating with high usage rate and low Solar Fraction (commercial)	DHW heating with low usage rate and high Solar Fraction (residential)	Combi systems, DHW + space heating supplement (both)
USG / ft^2 (L/m^2)	0.85 - 1.23 (35 - 50)	1.23 - 1.60 (50 - 65)	1.72 - 2.45 (70 - 100)

Maximum Number of Solar Collectors per Vitocell Tank

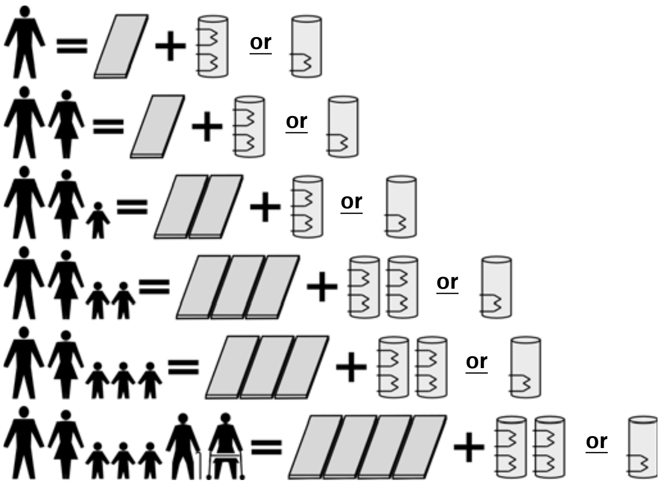
Tank Model	Maximum number of Vitosol 200-FM *Based on 50 L/m2 of tank volume
Single Coil Vitocell Tank Models	
1x Vitocell 300-W, EVIA 42 USG (160 L)	1
1x Vitocell 300-V, EVIA 53 USG (200 L)	1 to 2
1x Vitocell 300-V, EVIA 79 USG (300 L)	2 to 3
1x Vitocell 300-V, EVIB 119 USG (450 L)	4 to 5
Dual Coil Vitocell Tank Models (Top coil used for DHW backup via boiler)	
1x Vitocell 300-B, EVBA 79 USG (300 L)	1 to 2
1x Vitocell 300-B, EVBB 119 USG (450 L)	2 to 3

Note: When using Vitocell dual coil storage tanks where the top coil is not connected to a backup heat generator, the maximum number of collectors allowed can be increased to match that of single coil tanks.

Heat rejection units

In cases where the DHW load is very intermittent or much lower during the summer months, some type of mechanical heat rejection unit in the solar loop must be used to minimize collector stagnation and glycol degradation. The heat rejection unit can take the form of a hydronic fan coil unit, finned tube radiators, or a ground loop. The rejection unit should be sized based on the maximum possible output of the solar collector array and all parts of the rejection loop must be rated for temperatures of at least 200°F (95°C). For Vitosol collectors it is recommended to size the rejection unit at 225 Btu/h per ft^2 (700 W/m^2) of collector aperture area. The control of the heat rejection circuit should be based on the collector temperature sensor, and activated by the solar controller.

General Sizing Guidelines for Domestic Hot Water Preheat Systems



The details in the table below are only applicable under the following conditions:

- SW, S or SE collector array orientation
- Roof pitches from 25° to 55°
- Northern latitude of 45°
- Daily hot water consumption of 13 USG (50 L) per person per day.

Number of Occupants	Daily DHW demand in USG (L) [at 140°F (60° C)]	Solar Storage Tank capacity in USG (L)		Number of Vitosol 200-FM Collectors
		Dual coil	Single coil	
1	13 (50)	1x 79 (300)	1x 42 (160)	1
2	26 (100)	1x 79 (300)	1x 42 (160)	1
3	40(150)	1x 119 (450)	1x 79 (300)	2
4	53 (200)	2x 79 (300)	1x 79 (300)	3
5	66 (250)	2x 79 (300)	1x 79 (300)	3
7	92 (350)	2x 119 (450)	1x 119 (450)	4

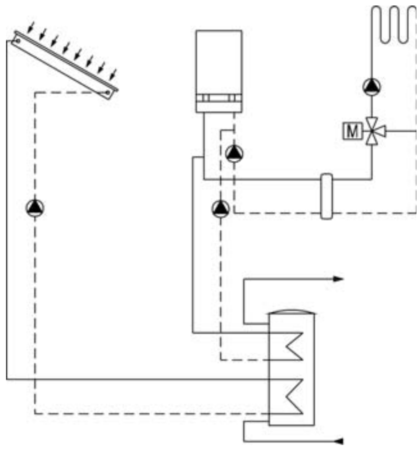
Solar Radiation Data For Canada

Canadian Provincial Capitals	Solar Radiation in MJ/m²/day (horizontal plane)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Edmonton, AB	4.1	8.0	13.0	17.9	20.4	22.0	21.7	18.0	12.8	8.6	4.5	3.0
Victoria, BC	3.2	5.8	10.4	15.8	19.3	21.6	22.7	19.9	14.8	8.2	4.0	2.6
Charlottetown, PEI	5.4	8.8	12.7	15.2	18.3	20.6	20.5	17.5	13.1	8.1	4.6	3.8
Winnipeg, MB	5.0	8.5	13.5	17.6	20.8	22.1	22.8	18.9	13.0	8.0	4.7	3.8
Fredericton, NB	5.5	8.6	12.3	15.3	18.0	19.9	20.0	17.5	13.0	8.6	5.1	4.2
Halifax, NS	5.6	8.9	12.7	14.4	17.7	19.6	19.3	16.9	13.4	8.8	5.3	4.3
Toronto, ON	6.1	8.2	13.0	17.6	19.3	21.0	22.3	19.0	14.0	9.0	4.6	4.3
Quebec City, QC	5.8	9.6	14.7	17.7	19.7	20.6	20.3	17.4	12.6	8.1	5.0	4.5
Regina, SK	5.4	9.4	13.7	19.0	21.9	23.9	24.2	20.1	14.5	9.8	5.5	4.2
St. Johns, NL	4.1	6.9	10.4	13.5	16.5	18.9	19.4	16.0	11.9	7.0	4.1	3.1
Iqualuit, NU	0.8	3.4	9.3	17.4	21.6	20.8	17.8	12.6	7.6	3.4	1.1	0.4
Whitehorse, YT	1.3	3.6	9.2	15.6	19.1	21.1	18.7	14.8	8.9	4.3	1.6	0.7
Yellowknife, NT	1.1	4.2	10.9	18.2	20.3	22.5	20.6	15.3	8.8	3.5	1.4	0.5

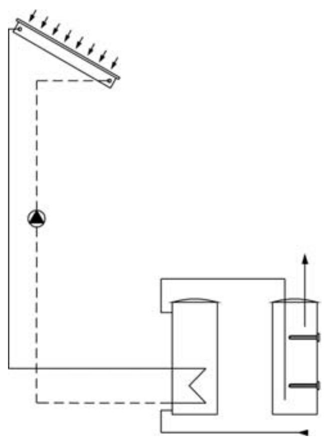
Solar Radiation Data for U.S.A.

U.S.A State Capitals	Solar Radiation in MJ/m²/day (horizontal plane)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Montgomery, AL	9.6	12.6	16.2	20.3	22.4	23.2	21.7	20.6	17.7	15.0	10.9	9.4
Juneau, AK	1.5	3.8	8.0	14.4	18.2	18.2	15.6	13.2	8.2	4.1	2.0	0.7
Phoenix, AZ	11.7	15.4	19.9	25.5	28.9	30.1	27.4	25.4	21.9	17.6	13.0	10.7
Little Rock, AR	8.0	10.8	14.4	18.6	20.5	22.1	22.7	21.0	17.4	13.0	8.8	7.2
Sacramento, CA	7.0	10.7	15.6	21.3	25.9	28.3	28.6	25.3	20.6	14.5	8.6	6.3
Denver, CO	8.4	12.1	16.4	19.7	22.8	25.1	24.4	21.3	18.1	13.4	8.9	7.7
Hartford, CT	6.7	9.7	13.1	16.7	19.6	21.3	21.1	18.5	14.8	10.7	6.7	5.5
Dover, DE	6.9	10.0	13.1	17.2	19.8	21.2	20.6	18.9	15.1	11.4	7.9	6.3
Tallahassee, FL	10.5	13.4	17.0	21.2	22.6	22.1	21.0	19.7	17.7	15.7	12.0	9.9
Atlanta, GA	8.8	11.4	15.2	19.3	21.6	21.1	21.6	19.3	16.4	13.2	9.6	8.0
Honolulu, HI	14.5	16.9	19.4	21.2	23.0	23.5	23.7	23.2	21.3	18.1	14.9	13.5
Boise, ID	5.9	9.0	13.6	19.1	23.5	26.1	27.4	23.6	18.5	12.3	6.7	5.2
Springfield, IL	7.5	10.4	13.5	17.9	21.5	23.5	23.1	20.5	16.6	12.3	7.8	6.3
Indianapolis, IN	7.1	10.0	13.2	17.5	21.2	23.3	22.6	20.3	16.4	11.9	7.5	5.9
Des Moines, IA	7.2	10.2	13.6	17.6	20.9	23.4	23.3	20.4	16.0	11.7	7.4	6.0
Topeka, KS	8.2	10.9	14.3	18.4	21.1	23.2	23.7	20.9	16.6	12.7	8.5	7.0
Frankfort, KY	6.7	9.3	13.0	17.0	18.4	21.0	20.6	18.7	16.6	12.3	7.9	5.9
Baton Rouge, LA	9.5	12.5	15.8	19.4	21.3	21.8	20.6	19.6	17.3	15.4	10.9	9.1
Augusta, ME	5.4	8.3	12.1	15.5	17.6	19.5	19.2	17.6	13.3	8.8	5.4	4.4
Annapolis, MD	7.6	10.4	14.0	17.4	19.7	20.9	20.3	18.1	15.8	12.6	8.6	6.9
Boston, MA	6.7	9.8	13.5	17.0	20.3	22.1	21.8	19.3	15.4	10.8	6.8	5.5
Lansing, MI	5.9	8.9	12.5	16.6	20.2	22.2	21.9	18.9	14.5	9.8	5.9	4.7
Saint Paul, MN	5.3	8.2	12.5	15.9	18.5	20.6	21.1	17.9	14.0	8.8	5.0	4.2
Jackson, MS	9.4	12.4	16.2	19.9	22.1	23.1	22.2	20.8	17.8	15.1	10.7	8.8
Jefferson City. MO	6.8	9.4	13.4	17.0	19.7	22.2	22.8	20.3	16.6	11.8	7.4	6.2
Helena, MT	5.3	8.4	12.7	17.2	20.7	23.3	25.2	21.3	15.8	10.4	6.1	4.5
Lincoln, NE	6.5	9.7	13.7	17.1	19.8	21.9	22.5	19.6	16.6	11.5	7.1	5.9
Carson City, NV	8.3	11.6	16.2	21.3	25.2	27.5	28.2	25.0	20.6	14.9	9.3	7.5
Concord, NH	6.9	10.2	13.9	17.0	20.2	21.9	21.8	19.1	15.1	10.5	6.5	5.5
Trenton, NJ	6.6	9.9	13.1	16.9	19.4	20.7	20.6	18.4	15.0	10.9	7.3	5.8
Santa Fe, NM	11.1	14.3	18.7	22.9	25.5	26.2	23.6	21.0	19.8	15.9	12.1	10.2
Albany, NY	6.4	9.5	13.0	16.8	19.7	21.6	21.8	18.7	14.8	10.1	6.2	5.1
Raleigh, NC	8.8	11.7	15.7	19.7	21.6	22.8	21.8	19.7	16.6	13.5	9.8	8.0
Bismarck, ND	6.1	9.3	13.7	17.7	21.4	23.8	24.4	20.8	15.2	10.2	6.2	4.9
Columbus, OH	6.4	9.1	12.5	16.6	19.8	21.6	21.2	19.0	15.4	11.3	6.9	5.3
Oklahoma City, OK	10.0	12.6	16.5	20.3	22.4	24.4	25.0	22.5	18.1	14.5	10.5	8.9
Salem, OR	4.6	7.1	11.3	15.8	19.8	22.0	23.7	20.7	15.7	9.7	5.2	3.8
Harrisburg, PA	7.1	9.9	13.5	17.3	19.9	21.9	21.4	18.9	15.3	11.4	7.3	5.9
Providence, RI	6.8	9.7	13.4	16.9	20.0	21.6	21.2	18.8	15.2	11.1	7.0	5.7
Columbia, SC	9.4	12.3	16.1	20.4	21.9	22.6	21.8	19.8	17.1	14.4	10.6	8.7
Pierre, SD	6.6	9.6	13.9	18.0	21.5	24.1	24.4	21.5	16.3	11.2	7.1	5.5
Nashville, TN	8.3	11.2	14.7	19.4	21.7	23.5	22.5	20.6	16.9	13.5	9.0	7.2
Austin, TX	10.7	13.6	17.0	19.5	21.2	23.8	24.4	22.8	18.9	15.7	11.9	10.1
Salt Lake City, UT	7.0	10.5	14.8	19.4	23.4	26.5	26.4	23.4	18.8	13.3	8.1	6.1
Montpelier, VT	5.5	8.4	11.8	15.7	18.0	20.5	19.8	17.7	13.3	8.4	5.0	4.1
Richmond, VA	8.1	10.9	14.8	18.6	20.9	22.5	21.5	19.6	16.3	12.7	9.0	7.2
Olympia, WA	3.7	6.1	10.0	14.3	18.0	20.1	21.2	18.2	13.6	8.0	4.3	3.2
Charleston, WV	7.1	9.7	13.4	17.2	20.2	21.7	20.8	19.0	15.6	11.9	7.7	6.1
Madison, WI	6.7	9.9	13.4	17.0	20.7	22.9	22.4	19.4	14.8	10.3	6.3	5.3
Cheyenne, WY	7.9	11.1	15.3	19.2	21.4	24.2	24.0	21.4	17.7	13.1	8.8	7.1

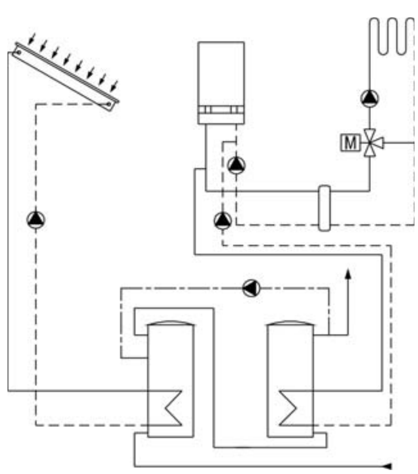
System for Heating DHW



System with a dual coil DHW tank



System with single coil and a direct fired DHW tank



System with two single coil DHW tanks

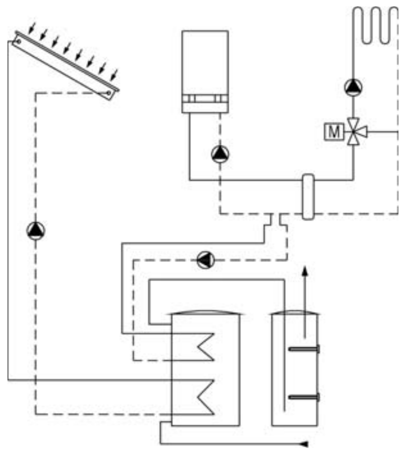
DHW heating in detached houses can be realized either with one dual coil solar DHW tank or with one single coil (for retrofitting an existing system) solar tank preheating the water prior to the auxiliary DHW tank.

Examples: For further detailed examples, see the "Sample Piping Layout Drawings" manual, available for download from the Viessmann website.

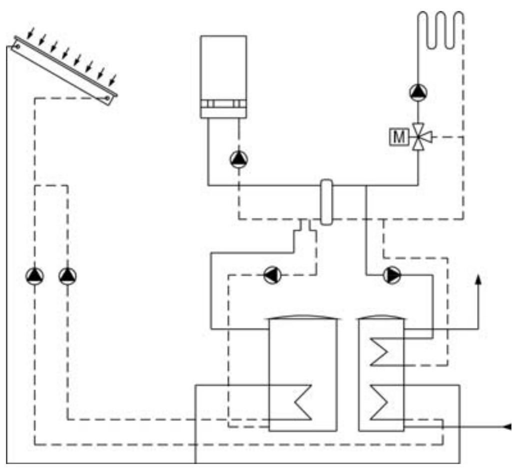
Single coil
The basis for sizing a solar thermal system for DHW heating is the DHW demand. Viessmann solar packages are sized for a solar coverage up to 60%. The tank capacity must be greater than the daily DHW demand, taking the required DHW temperature into account.
To achieve solar coverage of approximately 60%, the collector system must be sized so that the entire tank capacity can be heated on a single sunny day (5 hours of full sunshine) to at least 140°F (60°C) . This would enable poor insolation the following day to be bridged.

6020 457 - 01

System for DHW Heating and Central Heating Backup



System with dual coil heating buffer tank and a direct fire DHW tank



System with single coil heating buffer tank and a dual coil DHW tank

Systems for central heating backup can be configured several different ways. The simple method utilizes a dual coil as a DHW preheat tank prior to the auxiliary DHW tank, and uses the top coil to inject excess solar heat into the space heating circuit. A single dual coil tank is suitable for most small applications, but two tanks in parallel can be combined together for larger systems. Another common space heating supplement configuration is to use a dedicated space heating buffer tank in addition to a solar DHW tank. A solar control with two-tank logic is required.

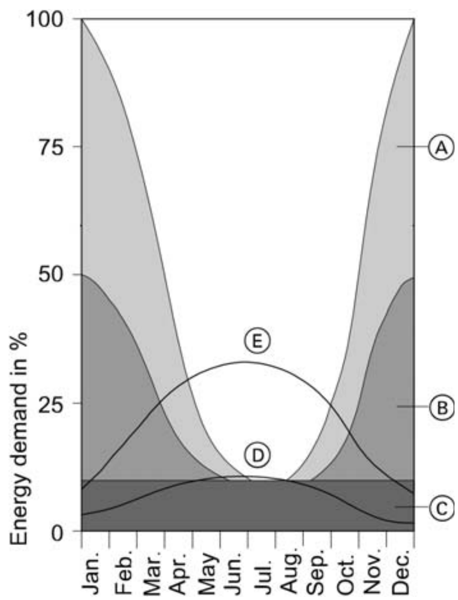
Examples: For further detailed piping layout examples, see the "Sample Piping Layout Drawings" manual, available for download from the from the Viessmann website.

For sizing a system for DHW heating and central heating backup, the seasonal efficiency of the entire heating system must be taken into consideration. The summer heat demand is always decisive. This is a combination of the heat demand for DHW heating and other project specific consumers. The collector area must be sized for this demand. The calculated collector area for DHW heating is multiplied by a factor of 2 to 2.5. The result is the range within which the collector area should be for solar central heating backup. The precise determination is then made taking into consideration the building conditions and the planning of an operationally reliable collector array. The storage tank capacity must be sufficiently sized to minimize overheating. At least 1.7 to 2.5 gallons of storage is required per ft^2 of collector aperture area (70 to 100 L/m^2). A heat rejection circuit is recommended for all DHW/space heating systems to dissipate excess solar energy during the summer months. If the ThermProtect switching absorber collectors are to be used, then the heat rejection circuit may be exempt or removed.

DHW + Central Heating Support Example:

- House occupants:..4
- Average daily DHW usage:..................60 USG (225 L)
- Aperture area:................................Vitosol-FM panels
  4 panels = 100 ft^2 (9.3 m^2)
  5 panels = 125 ft^2 (11.6 m^2)
- Storage volume required: Vitosol-FM panels
  4 panels = 170 - 250 USG (640 - 950 L)
  5 panels = 212 - 312 USG (800 - 1200 L)

System for DHW Heating and Central Heating Backup *(continued)*



Legend
Ⓐ Central heating demand for a house (conventional housing stock)
Ⓑ Central heating demand for a low energy house
Ⓒ DHW demand
Ⓓ Solar yield at 53.8 ft^2 (5 m^2) absorber area
Ⓔ Solar yield at 161.5 ft^2 (15 m^2) absorber area

For low energy houses [space and DHW heat demand less than 1,836 MBH/ft^2 (50 kWh/m^2) per annum], solar coverage of up to 35%, relative to the total energy demand, including DHW heating, can be achieved according to this sizing. For buildings with a higher heat demand, the coverage will be much lower.

Commercially available solar simulation software programs can be used for the exact calculation. Contact your Viessmann sales representative for a customized design and sizing analysis for your project.

General sizing guidelines for DHW heating and central heating systems

Number of Occupants	Daily DHW demand in USG (L) [at 120°F (50°C)]	Buffer tank capacity in USG (L)	Number of Vitosol 200-FM Collectors
2	30 (115)	200 (750)	4
3	45 (170)		
4	60 (230)	250 (950)	5
5	75 (280)		
6	90 (340)		
7	105 (400)	300 (1150)	6
8	120 (450)		

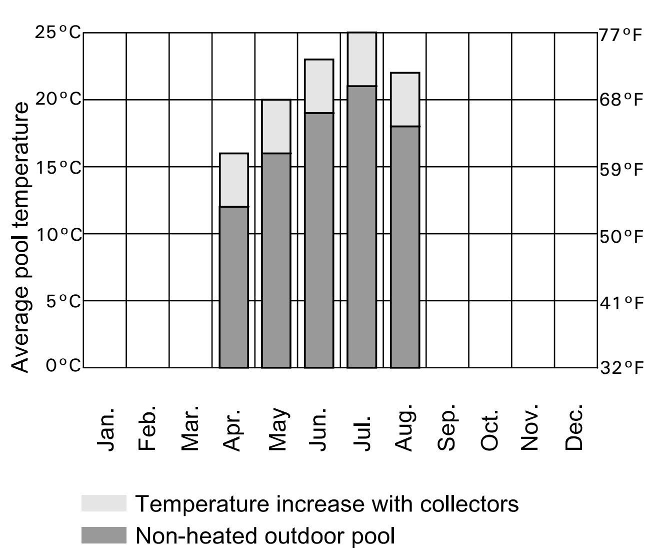
6020 457 - 01

Swimming Pool Heating System with Heat Exchanger and Collectors

Outdoor pools

In northern climates, outdoor pools are mainly used between May and September. Your energy consumption depends primarily on the leakage rate, evaporation, loss (water must be replenished cold) and transmission heat loss. By using a cover, the evaporation and consequently the energy demand of the pool can be reduced to a minimum.

The largest energy input comes directly from the sun, which shines onto the pool surface. Therefore the pool has a "natural" base temperature that can be shown in the following diagram as an average pool temperature over the operating time. A solar thermal system does not alter this typical temperature pattern. The solar application leads to a definite increase in the base temperature. Subject to the ratio between the pool surface and the absorber area, a different temperature increase can be reached.

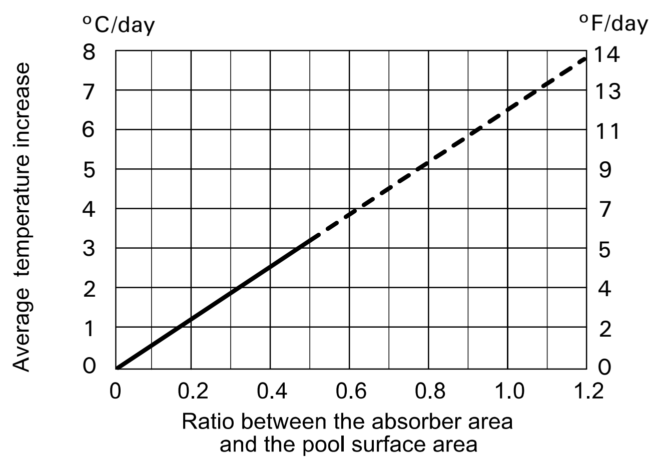


Typical temperature curve of an outdoor pool (average monthly values)

Project example:	
Location:	Boston
Pool surface area:	430 ft.^{2} (40 m^2)
Depth:	5 ft. (1.5 m)
Position:	sheltered and covered at night

The diagram shows what average temperature increase can be achieved with which ratio of absorber area to pool surface. This ratio is independent of the collector type used due to the comparably low collector temperatures and the operating period (summer).

Note: Heating and maintaining the pool temperature at a higher set temperature using a conventional heating system does not alter this ratio. However, the pool will be heated up much more quickly.



6020 457 - 01

Swimming Pool Heating System with Heat Exchanger and Collectors *(continued)*

Indoor pools
Indoor pools generally have a higher target temperature than outdoor pools and are used throughout the year. If, over the course of the year, a constant pool temperature is required, indoor pools must be heated in dual mode. To avoid sizing errors, the energy demand of the pool must be measured. For this, suspend reheating for 48 hours and determine the temperature at the beginning and end of the test period. The daily energy demand can therefore be calculated from the temperature differential and the capacity of the pool. For new projects, the heat demand of the swimming pool must be calculated. For this sizing calculation, the user must select a location from the list (see pages 64 and 65).

Calculation example for Vitosol 200-FM
Pool surface area:....................387 ft^2 (36 m^2)
Average pool depth:.................5 ft. (1.5 m)
Pool capacity:.........................14,300 USG (54,126 L)
Temperature loss per day:........1.8°F (1°C)

Nc = ((Ndays x Vpool x p x Cp x ΔT) ÷ Se) ÷ (Gt x 1,000,000 x Ndays) ÷ (Ca)

Where:
- Nc = Number of collectors required to meet 100% of the pool heating load
- Ndays = Number of days per month (see table below)
- Vpool = Volume of indoor pool (Liters)
- p = Density of water (1 kg/L)
- Cp = Specific heat of water (4190 J/kg°C)
- ΔT = Temperature loss of pool water per day (°C)
- Se = System efficiency in decimal format (assume 70% collector efficiency x 80% balance of system efficiency =56% or 0.56)
- Gt = Solar radiation (MJ/m²/day) *Note: 1 kwh = 3.6 MJ or 3,600,000 Joules
- Ca = Collector absorber area (Vitosol 200-FM = 2.32 m²)

Number of days in each month

January	=	31	July	=	31
February	=	28	August	=	31
March	=	31	September	=	30
April	=	30	October	=	31
May	=	31	November	=	30
June	=	30	December	=	31

Calculation example for Vitosol 200-FM
Number of days per month: ....30 days in June
Volume of indoor pool:................................... 54,126 L
Density of water: ....1 kg/L
Specific heat of water:...............................4190 J/kg°C
Temperature loss of pool water per day: ....1°C
System efficiency:..0.42
Solar radiation (Boston):.........................22.1 MJ/m²/day
Collector absorber area (Vitosol 200-FM):............ 2.32 m²

Nc = ((30 days x 54,126 L x 1 kg/L x 4190 J/kg°C x 1°C) ÷ 0.56) ÷ (22.1 MJ/m²/day x 1,000,000 x 30 days) ÷ (2.32m²) = 7.9x Vitosol 200-FM

Note: To prevent overheating it is recommended to round the quantity of collectors down to the next whole number. For this example, 8x Vitosol 200-FM collectors would be the recommended number of collectors to satisfy the DHW load for the month of June.

Flow Rate in the Collector Array

All Vitosol collectors have a minimum required flow rate (low flow) and maximum flow rate (high flow). The collectors must operate within this range and the system designer must choose a flow rate based on the specific parameters of the system. At the same collector output, a higher flow rate means a lower Δt or temperature spread across the collector array. Inversely a lower flow rate will have a higher Δt or temperature spread across the collector array. When the Δt or temperature spread across the collector array becomes too large, the efficiency of the collectors will also decrease.

For larger solar installations, high flow is usually not recommended as this results in bigger pumps and larger pipe sizes. Typically low flow would be used as the decreased flow requirements results in smaller pumps which would use less energy, and smaller pipe sizes, reducing the overall installation and operating cost for the system.

Operating modes:

Low flow operation

Operation with flow rates between:
0.010 - 0.012 USG/min/ft^2 (25 - 30 L/h/m^2)

High flow operation

Operation with flow rates between:
0.012 - 0.025 USG/min/ft^2 (30 - 60 L/h/m^2)

Matched flow operation

Operation with variable flow rates based on actual temperature spread across panels. This mode is possible with all SCU solar controls.

All operating modes are possible with Viessmann collectors.

Which operating mode is the right one?

Since every project has it’s own unique combination of collector array size and piping length, the system designer can choose the flow rate that best meets the requirements of the project. The specific flow rate must be high enough to ensure a reliable and even flow through the entire array. High flow mode is usually best for smaller collector arrays and low flow mode is often used for larger scale projects.

The optimum flow rate (relative to the current tank temperatures and the current solar insolation level) in systems with a Viessmann solar control unit will adjust itself automatically in matched flow operation. Single array systems with Vitosol 200-FM can be operated without problems down to approximately 50% of the specific flow rate.

Example:

2x Vitosol 200-FM collectors
(collector absorber area = 25 ft^2 (2.32 m^2)
Target flow rate: 0.018 USG/min/ft^2 (45 L/h/m^2)

2 x 25 ft^2 x 0.018 USG/min/ft^2 = 0.9 USG/min
(2 x 2.32 m^2 x 45 L/h/m^2 ÷ 60 min = 3.5 L/min)

This value should be reached at 100% pump rate. An adjustment can be made at the speed control switch of the pump. The positive primary energetic effect is lost if the required collector flow rate is achieved through a higher pressure drop (equals higher power consumption). Choose the pump speed that lies above the required value. The flow rate is automatically reduced via the solar control unit through a lower current supply to the solar circuit pump.

Flow Rate - Vitosol 200-FM

Specific Flow Rate

	Low Flow		**High Flow**					
USG/min/ft^2	0.0102	0.0123	0.0143	0.0164	0.0184	0.0205	0.0225	0.0245
(L/h/m^2)	(25)	(30)	(35)	(40)	(45)	(50)	(55)	(60)
USG/min	0.26	0.31	0.36	0.41	0.46	0.51	0.56	0.62
(L/min)	(1.0)	(1.2)	(1.4)	(1.6)	(1.7)	(1.9)	(2.1)	(2.3)

Recommended flow rate for the number of collectors per individual array

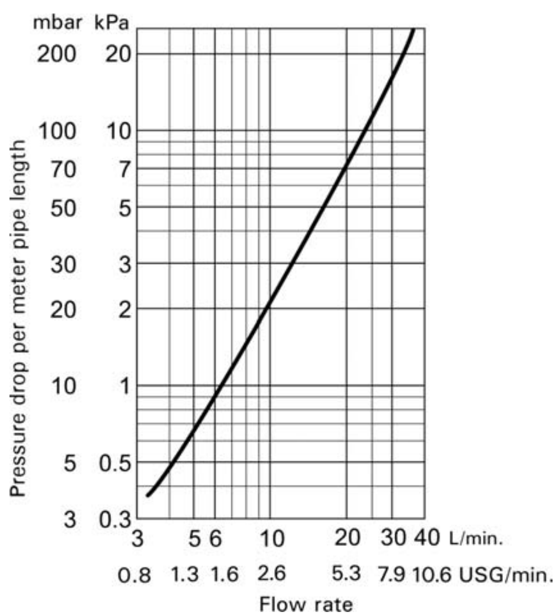
Number of Collectors	**USG/min (L/min)**							
1 Collector	0.26 (1.0)	0.31 (1.2)	0.36 (1.4)	0.41 (1.6)	0.46 (1.7)	0.51 (1.9)	0.56 (2.1)	0.62 (2.3)
2 Collectors	0.51 (1.9)	0.62 (2.3)	0.72 (2.7)	0.82 (3.1)	0.92 (3.5)	1.03 (3.9)	1.13 (4.3)	1.23 (4.7)
3 Collectors	0.77 (2.9)	0.92 (3.5)	1.08 (4.1)	1.23 (4.7)	1.39 (5.2)	1.54 (5.8)	1.69 (6.4)	1.85 (7.0)
4 Collectors	1.03 (3.9)	1.23 (4.7)	1.44 (5.4)	1.64 (6.2)	1.85 (7.0)	2.05 (7.8)	2.26 (8.5)	2.46 (9.3)
5 Collectors	1.28 (4.9)	1.54 (5.8)	1.80 (6.8)	2.05 (7.8)	2.31 (8.7)	2.56 (9.7)	2.82 (10.7)	3.08 (11.7)
6 Collectors	1.54 (5.8)	1.85 (7.0)	2.15 (8.2)	2.46 (9.3)	2.77 (10.5)	3.08 (11.7)	3.39 (12.8)	3.69 (14.0)
7 Collectors	1.80 (6.8)	2.15 (8.2)	2.51 (9.5)	2.87 (10.9)	3.23 (12.2)	3.59 (13.6)	3.95 (15.0)	4.31 (16.3)
8 Collectors	2.05 (7.8)	2.46 (9.3)	2.87 (10.9)	3.28 (12.4)	3.69 (14.0)	4.10 (15.5)	4.51 (17.1)	4.92 (18.6)
9 Collectors	2.31 (8.7)	2.77 (10.5)	3.23 (12.2)	3.69 (14.0)	4.16 (15.7)	4.62 (17.5)	5.08 (19.2)	5.54 (21.0)
10 Collectors	2.56 (9.7)	3.08 (11.7)	3.59 (13.6)	4.10 (15.5)	4.62 (17.5)	5.13 (19.4)	5.64 (21.4)	6.16 (23.3)
11 Collectors	2.82 (10.7)	3.39 (12.8)	3.95 (15.0)	4.51 (17.1)	5.08 (19.2)	5.64 (21.4)	6.21 (23.5)	6.77 (25.6)
12 Collectors	3.08 (11.7)	3.69 (14.0)	4.31 (16.3)	4.92 (18.6)	5.54 (21.0)	6.16 (23.3)	6.77 (25.6)	7.39 (28.0)

Note: Maximum of 10x Vitosol 200-FM can be connected in one array, having single-sided connections.
Maximum of 12x Vitosol 200-FM can be connected in one array, having alternate side connections (reverse return).

Pressure Drop of the Solar Thermal System

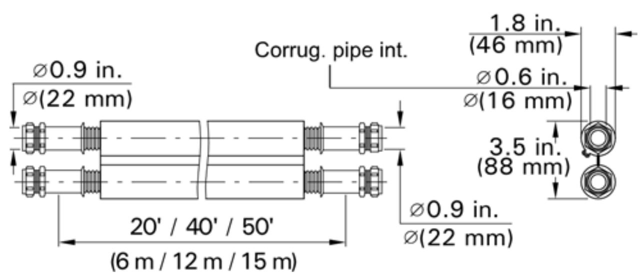
- The specific flow rate for the collectors is determined by the type of collector and the intended method of operation of the collector array. The way the collectors are connected or piped determines the pressure drop of the collector array.
- The overall flow rate for the solar thermal system results from multiplying the specific flow rate by the absorber area. Assuming a required flow velocity of between 1.3 and 2.3 ft/s (0.4 and 0.7 m/s), the pipework dimension is then determined.
- Once the pipework dimension has been determined, the pressure drop for the pipework is then calculated.
- External heat exchangers must be calculated as well and should not exceed a pressure drop of 40”w.c. (100 mbar). For smooth tube internal indirect coils, the pressure drop is much lower and can be ignored in solar thermal systems with a collector area of up to 215 ft^2 (20 m^2).
- The pressure drop of further solar circuit components can be seen from the technical documentation and is included in the overall calculation.
- When calculating the pressure drop, take into account the fact that the heat transfer medium has a different viscosity to pure water. The hydraulic characteristics become more similar to water as the temperature of the heat transfer medium increases. At low temperatures around freezing, the high viscosity of the heat transfer medium may result in a system flow rate some 50% lower than it is for pure water. With a medium temperature above approximately 122°F (50°C) (controlled operation of solar thermal systems), the difference in viscosity is only minor.

Pressure Drop of the Solar Supply and Return Lines

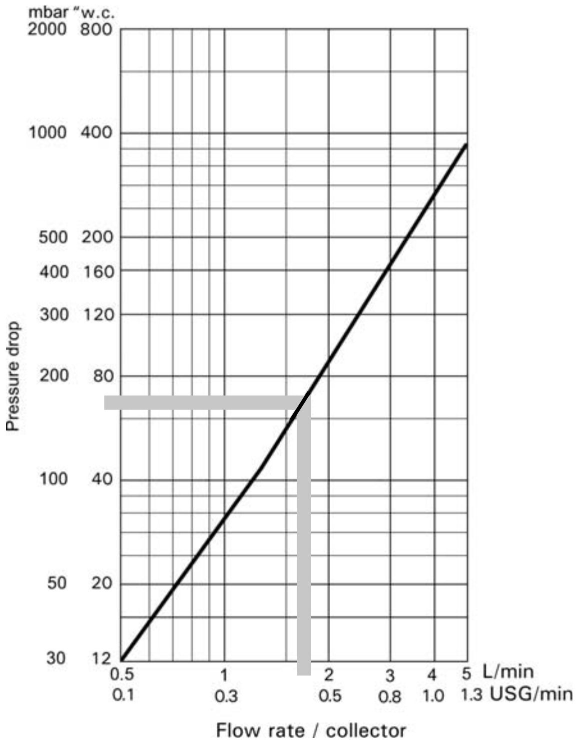


Per 3.28 ft (1m) pipe length, corrugated stainless steel pipe DN 16, relative to water, corresponds to Tyfocor HTL at approximately 140°F (60°C)

Note: Add together the individual lengths of the supply and return lines to calculate the pressure drop of the entire line set.



Pressure Drop of Vitosol 200-FM, Type SV and SH



Relative to water, corresponds to Tyfocor HTL at approximately 140°C (60°C).

Note: For multiple Vitosol 200-FM collectors installed in a single array, use the flow rate per individual collector to calculate the pressure drop.

Example:

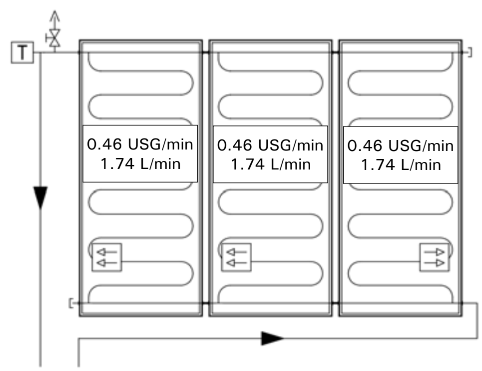
3x Vitosol 200-FM collectors having a target flow rate of 0.018 USG/min/ft^2 (45 L/h/m^2):

3 x 25 ft^2 x 0.0184 USG/min/ft^2 = 1.4 USG/min
(3 x 2.32 m^2 x 45 L/h/m^2 ÷ 60 min = 5.2 L/min)

Since the flow rate stated above is for the entire array, this value will need to be adjusted to account for the flow through each individual collector:

1.4 USG/min / 3 collectors = 0.46 USG/min/collector
(5.2 L/min / 3 collectors = 1.74 L/min/collector)

Using the pressure drop table on the left side of this page draw a vertical line at the required flow rate per collector. Draw a horizontal line at the point where the vertical line intersects the collector pressure drop curve. This will identify the collector pressure drop across the entire array (indicated by the grey lines on the pressure drop chart). For this example the resulting pressure drop will be approximately: 165 mbar (66 "w.c.).



Total Flow Rate
1.4 USG/min (5.2 L/min)

Collector Pressure Drops for Vitosol 200-FM SV2F & SH2F

Specific Flow Rate

	Low Flow		High Flow					
USG/min/ft^2	0.0102	0.0123	0.0143	0.0164	0.0184	0.0205	0.0225	0.0245
(L/h/m^2)	(25)	(30)	(35)	(40)	(45)	(50)	(55)	(60)
USG/min	0.26	0.31	0.36	0.41	0.46	0.51	0.56	0.62
(L/min)	(1.0)	(1.2)	(1.4)	(1.6)	(1.7)	(1.9)	(2.1)	(2.3)

Resulting Pressure Drop for Vitosol FM, Type SV and SH for collector arrays consisting of 1 to 12 collectors (connected in parallel)

"w.c.	29	39	49	60	72	86	100	116
ft/hd	2.4	3.2	4.1	5.0	6.0	7.1	8.3	9.6
(mbar)	(73)	(96)	(121)	(149)	(180)	(213)	(249)	(288)
(kPa)	(7)	(10)	(12)	(15)	(18)	(21)	(25)	(29)

Note: Maximum of 10x Vitosol 200-FM can be connected in one array, having single-sided connections.
Maximum of 12x Vitosol 200-FM can be connected in one array, having alternate side connections (reverse return).

Fluid Velocity

To minimize the pressure drop through the solar thermal system pipe work, the fluid velocity in the pipe should not exceed 3.3 ft/s (1 m/s). We recommend fluid velocities between 1.3 and 2.3 ft/s (0.4 and 0.7 m/s). At these fluid velocities, an approximate pressure drop as indicated below can result:

0.12 and 0.3 “w.c. per foot of pipe length
(1 and 2.5 mbar per meter of pipe length)

For the installation of collectors, we recommend sizing the solar supply and return pipes as for a normal heating system according to flow rate and velocity.

Note: Excessively high fluid velocity results in a higher pressure drop and potentially could erode the walls of the pipe work. If the fluid velocity is too low, the system will not capture or move the air trapped in the system.

Any residual air that has collected at the collector must be routed downwards through the solar return line to the air vent in the Solar-Divicon. This will have to be manually vented.

Fluid Velocity and Pressure Drop (Copper)

			Pressure Drop and Fluid Velocity for Copper Type-L											
			1/2” Copper (Type-L)				**3/4” Copper (Type-L)**				**1” Copper (Type-L)**			
Flow Rate			Pressure Drop		Fluid Velocity		Pressure Drop		Fluid Velocity		Pressure Drop		Fluid Velocity	
USG/min	(L/h)	(L/min)	ft/hd per 100 ft	mbar/m	ft/s	m/s	ft/hd per 100 ft	mbar/m	ft/s	m/s	ft/hd per 100 ft	mbar/m	ft/s	m/s
0.55	125	2.1	0.86	0.84	0.76	0.23								
0.66	150	2.5	1.18	1.16	0.91	0.28								
0.77	175	2.9	1.55	1.52	1.06	0.32								
0.88	200	3.3	1.95	1.92	1.21	0.37								
1.10	250	4.2	2.89	2.83	1.51	0.46								
1.32	300	5.0	3.97	3.89	1.82	0.55								
1.54	350	5.8	5.20	5.10	2.12	0.65	0.92	0.90	1.02	0.31				
1.76	400	6.7	6.57	6.44	2.42	0.74	1.16	1.14	1.17	0.36				
1.98	450	7.5	8.07	7.92	2.72	0.83	1.42	1.40	1.31	0.40				
2.20	500	8.3	9.70	9.52	3.03	0.92	1.71	1.68	1.46	0.45				
2.64	600	10.0	13.36	13.10	3.63	1.11	2.36	2.31	1.75	0.53	0.66	0.65	1.03	0.31
3.08	700	11.7	17.49	17.15	4.24	1.29	3.08	3.02	2.04	0.62	0.87	0.85	1.20	0.37
3.52	800	13.3	22.10	21.67	4.84	1.48	3.90	3.82	2.33	0.71	1.09	1.07	1.37	0.42
3.96	900	15.0					4.79	4.70	2.63	0.80	1.34	1.32	1.54	0.47
4.40	1000	16.7					5.76	5.65	2.92	0.89	1.62	1.59	1.71	0.52
6.61	1500	25.0					11.71	11.48	4.38	1.34	3.29	3.22	2.57	0.78
8.81	2000	33.3									5.44	5.33	3.42	1.04
11.01	2500	41.7									8.03	7.88	4.28	1.31
13.21	3000	50.0									11.05	10.84	5.14	1.57
15.41	3500	58.3									14.48	14.20	5.99	1.83

Recommended Operating Range

***It is recommended that you add a safety factor of 10% to 20 % to the values in the table**

Fluid Velocity and Pressure Drop (Steel)

Flow Rate			Pressure Drop and Fluid Velocity for Steel (Sch.40)											
			1/2" Steel (Sch.40)				**3/4" Steel (Sch.40)**				**1" Steel (Sch.40)**			
			Pressure Drop		Fluid Velocity		Pressure Drop		Fluid Velocity		Pressure Drop		Fluid Velocity	
USG/min	(L/h)	(L/min)	ft/hd per 100 ft	mbar/m	ft/s	m/s	ft/hd per 100 ft	mbar/m	ft/s	m/s	ft/hd per 100 ft	mbar/m	ft/s	m/s
0.55	125	2.1	0.54	0.53	0.58	0.18								
0.66	150	2.5	0.74	0.73	0.70	0.21								
0.77	175	2.9	0.97	0.95	0.81	0.25								
0.88	200	3.3	1.23	1.20	0.93	0.28								
1.10	250	4.2	1.81	1.78	1.16	0.35								
1.32	300	5.0	2.49	2.44	1.39	0.43	0.72	0.70	0.79	0.24				
1.54	350	5.8	3.26	3.20	1.63	0.50	0.94	0.92	0.93	0.28				
1.76	400	6.7	4.12	4.04	1.86	0.57	1.19	1.16	1.06	0.32				
1.98	450	7.5	5.07	4.97	2.09	0.64	1.46	1.43	1.19	0.36	0.47	0.47	0.74	0.22
2.20	500	8.3	6.09	5.97	2.32	0.71	1.75	1.72	1.32	0.40	0.57	0.56	0.82	0.25
2.64	600	10.0	8.38	8.22	2.79	0.85	2.41	2.36	1.59	0.48	0.79	0.77	0.98	0.30
3.08	700	11.7	10.97	10.76	3.25	0.99	3.16	3.09	1.85	0.57	1.03	1.01	1.14	0.35
3.52	800	13.3	13.86	13.60	3.72	1.13	3.99	3.91	2.12	0.65	1.30	1.27	1.31	0.40
3.96	900	15.0	17.04	16.71	4.18	1.28	4.90	4.80	2.38	0.73	1.60	1.57	1.47	0.45
4.40	1000	16.7	20.49	20.09	4.65	1.42	5.89	5.78	2.65	0.81	1.92	1.88	1.63	0.50
6.61	1500	25.0					11.98	11.74	3.97	1.21	3.90	3.83	2.45	0.75
8.81	2000	33.3					19.81	19.43	5.30	1.62	6.46	6.34	3.27	1.00
11.01	2500	41.7									9.55	9.36	4.09	1.25
13.21	3000	50.0									13.13	12.88	4.90	1.50

Recommended Operating Range

***It is recommended that you add a safety factor of 10% to 20 % to the values in the table**

Pressure Drop for Commonly Used Valves & Fittings

	Equivalent Length of Pipe for Valves & Fittings								
Nominal Pipe Size	90º Elbow Standard Radius	90º Elbow Long Radius	45º Elbow Standard Radius	Tee - Side Port Flow	Tee - Straight Through Flow	Gate Valve - Open	Globe Valve - Open	90º Angle Valve	Swing Check Valve
1/2"	1.6	1.0	0.8	3	1.6	0.7	17	7	6
3/4"	2.0	1.4	0.9	4	2.0	0.9	22	9	8
1"	2.6	1.7	1.3	5	2.6	1.0	27	12	10
1-1/4"	3.3	2.3	1.7	7	3.3	1.5	36	15	14
1-1/2"	4.3	2.7	2.2	9	4.3	1.8	43	18	16

Sizing the Circulation Pump

If the flow rate and pressure drop of the entire solar thermal system are known, the pump can be selected on the basis of the pump curve.

Viessmann supplies the Solar-Divicon to simplify the installation and the selection of pumps and safety equipment. For construction and specification (see pages 36 and 37).

Note: The Solar-Divicon and the solar pump assembly are not suitable for direct contact with swimming pool water.

Specific Flow Rate

	Low Flow		High Flow					
USG/min/ft^2	0.0102	0.0123	0.0143	0.0164	0.0184	0.0205	0.0225	0.0245
(L/h/m^2)	(25)	(30)	(35)	(40)	(45)	(50)	(55)	(60)
USG/min	0.26	0.31	0.36	0.41	0.46	0.51	0.56	0.62
(L/min)	(1.0)	(1.2)	(1.4)	(1.6)	(1.7)	(1.9)	(2.1)	(2.3)

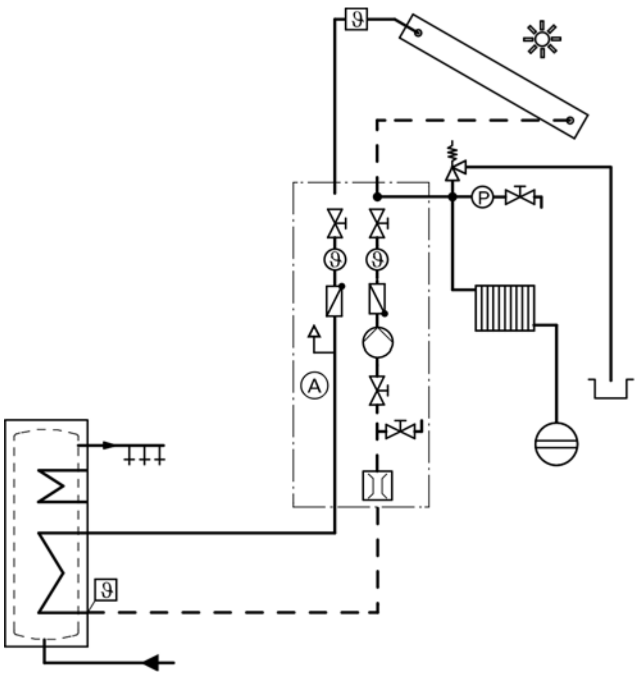
Recommended flow rate for the number of collectors per individual array

Number of Collectors	USG/min (L/min)							
1 Collector	0.26 (1.0)	0.31 (1.2)	0.36 (1.4)	0.41 (1.6)	0.46 (1.7)	0.51 (1.9)	0.56 (2.1)	0.62 (2.3)
2 Collectors	0.51 (1.9)	0.62 (2.3)	0.72 (2.7)	0.82 (3.1)	0.92 (3.5)	1.03 (3.9)	1.13 (4.3)	1.23 (4.7)
3 Collectors	0.77 (2.9)	0.92 (3.5)	1.08 (4.1)	1.23 (4.7)	1.39 (5.2)	1.54 (5.8)	1.69 (6.4)	1.85 (7.0)
4 Collectors	1.03 (3.9)	1.23 (4.7)	1.44 (5.4)	1.64 (6.2)	1.85 (7.0)	2.05 (7.8)	2.26 (8.5)	2.46 (9.3)
5 Collectors	1.28 (4.9)	1.54 (5.8)	1.80 (6.8)	2.05 (7.8)	2.31 (8.7)	2.56 (9.7)	2.82 (10.7)	3.08 (11.7)
6 Collectors	1.54 (5.8)	1.85 (7.0)	2.15 (8.2)	2.46 (9.3)	2.77 (10.5)	3.08 (11.7)	3.39 (12.8)	3.69 (14.0)
7 Collectors	1.80 (6.8)	2.15 (8.2)	2.51 (9.5)	2.87 (10.9)	3.23 (12.2)	3.59 (13.6)	3.95 (15.0)	4.31 (16.3)
8 Collectors	2.05 (7.8)	2.46 (9.3)	2.87 (10.9)	3.28 (12.4)	3.69 (14.0)	4.10 (15.5)	4.51 (17.1)	4.92 (18.6)
9 Collectors	2.31 (8.7)	2.77 (10.5)	3.23 (12.2)	3.69 (14.0)	4.16 (15.7)	4.62 (17.5)	5.08 (19.2)	5.54 (21.0)
10 Collectors	2.56 (9.7)	3.08 (11.7)	3.59 (13.6)	4.10 (15.5)	4.62 (17.5)	5.13 (19.4)	5.64 (21.4)	6.16 (23.3)
11 Collectors	2.82 (10.7)	3.39 (12.8)	3.95 (15.0)	4.51 (17.1)	5.08 (19.2)	5.64 (21.4)	6.21 (23.5)	6.77 (25.6)
12 Collectors	3.08 (11.7)	3.69 (14.0)	4.31 (16.3)	4.92 (18.6)	5.54 (21.0)	6.16 (23.3)	6.77 (25.6)	7.39 (28.0)

Use Solar-Divicon DN20B (unshaded)
Use Solar-Divicon DN25B (shaded)

Note: The table above is only to be used as a reference. It is important to consider the pressure drop and flow requirements of all components installed on the system when sizing or selecting the circulation pump.

Ventilation



Legend
Ⓐ Air vent valve, built into Solar-Divicon

At points in the system that are at high risk from steam or in roof installations, only use air separators with manual air vent valves, which require regular manual venting. This is particularly necessary after filling.

Correct ventilation of the solar circuit is a prerequisite for trouble-free and efficient operation of the solar thermal system. Air in the solar circuit generates noise and increases the potential for poor flow characteristics through individual collector arrays. In addition it can lead to accelerated oxidation of organic heat transfer media (e.g. commercially available mixtures of water and glycol).

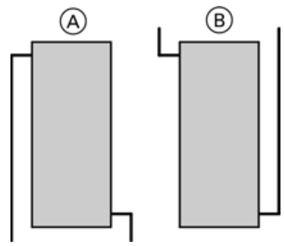
Air vent valves that can be used to vent air from the solar circuit:
- Manual air vent valve
- Automatic air vent valve
- Quick-action air vent valve
- Air separator

Solar thermal systems using a glycol based heat transfer medium must be vented for a longer period than systems that are filled with water. We therefore recommend automatic ventilation in such systems. For the construction and specification of air vent valves, see page 39. The air vent valves are installed in the solar supply line at an accessible point in the installation room upstream of the heat exchanger inlet.

When setting up and connecting larger collector arrays, the ventilation characteristics of the system can be optimized by supply lines joined above the collectors. This prevents air bubbles from causing flow problems in individual collectors in partial arrays linked in parallel. In systems higher than 82 ft (25 m) above the solar circulating pump air vent valve, air bubbles that form in the collectors are dispersed again as a result of the high pressure increase. In such cases, we recommend using vacuum deaerator systems.

Stagnation in Solar Thermal Systems

Steam Producing Power



Legend

Ⓐ Standard flat-plate collector without liquid "bag"
Steam production capacity = 19 Btuh/ft^2 (60 W/m^2)
Ⓑ Standard flat-plate collector with liquid "bag"
Steam production capacity = 31.7 Btuh/ft^2 (100 W/m^2)

Note: Vitosol-FM switching collectors do not produce steam if they are setup as per the recommended pressures indicated on page 83. Therefore the steam production capacity = 0 Btuh/ft^2 (0 W/m^2)

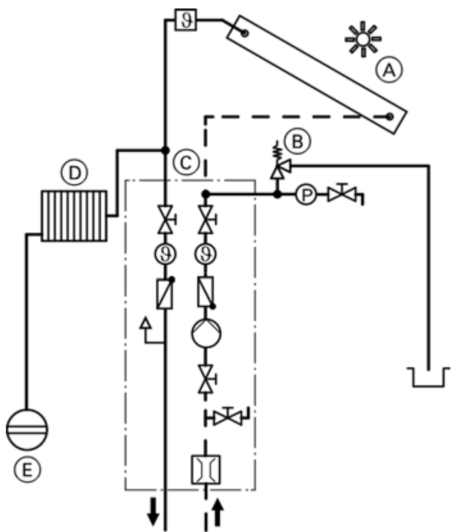
All safety equipment in a solar thermal system must be designed for stagnation. If solar generated heat can no longer be transferred inside the system, the solar circuit pump stops and the solar thermal system goes into stagnation. Longer system idle times, e.g. through faults or incorrect operation, can never be completely ruled out. This results in a rise in temperature up to the maximum collector temperature (energy in = energy out).

Solar thermal collectors can easily generate temperatures that exceed the boiling point of the heat transfer medium. Solar thermal systems must therefore be fail-safe in design in accordance with the relevant regulations.

Being fail-safe means the following:
- The solar thermal system must not be damaged by stagnation.
- The solar thermal system must not pose any risk during stagnation.
- Following stagnation, the solar thermal system must return to operation automatically.
- Collectors and pipework must be designed for the temperatures expected during stagnation.

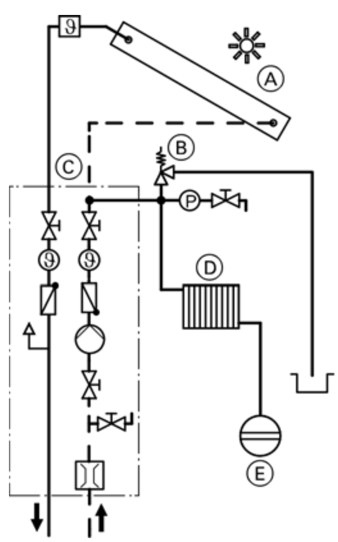
Stagnation in Solar Thermal Systems *(continued)*

Expansion vessel and heat sink in the supply
The steam can propagate only in the supply.



Legend
Ⓐ Collector
Ⓑ Safety valve
Ⓒ Solar-Divicon
Ⓓ Heat sink
Ⓔ Expansion vessel

Expansion vessel and heat sink in the return
The steam can propagate in the supply and return.



Legend
Ⓐ Collector
Ⓑ Safety valve
Ⓒ Solar-Divicon
Ⓓ Heat sink
Ⓔ Expansion vessel

Pressure in solar thermal systems with Vitosol 200-FM
The pressure set for Vitosol 200-FM switching collectors prevents the formation of steam. Safety cooling devices for the expansion vessels (stagnation cooler or pre-cooling vessel) are not required. For calculating the required pressure, see page 83. If the fluid pressure is set too low, a small amount of steam can form which will normally remain in the collectors and not be pushed into the system. Vitosol 200-FM switching collectors can therefore be used in systems where the collector array is below the DHW tank.

Steam-producing power, pressure maintenance and safety equipment. In the collectors, temperatures are reached that exceed the boiling point of the heat transfer medium. For this reason, solar thermal systems must be designed to be fail-safe in accordance with the relevant regulations.

The pipe run that holds steam during stagnation (steam spread) is calculated from the balance between the steam production capacity of the collector array and the heat losses of the pipe work. For the losses from a solar circuit pipe made from copper 100% insulated with commercially available material, the following practical values are assumed:

Dimensions	Heat loss in Btuh/ft (W/m)
⅜ to ½ in. (9.5 to 12.7 mm)	26.0 (25)
¾ to 1 in. (19.1/25.4 mm)	31.2 (30)

- Steam spread less than the pipe run in the solar circuit (supply and return) between the collector and the expansion vessel:
  The steam **cannot** reach the expansion vessel in the event of stagnation. The displaced volume (collector array and pipe work filled with steam) must be taken into account when sizing the expansion vessel.
- Steam spread greater than the pipe run in the solar circuit (supply and return) between the collector and the expansion vessel:
  Planning a cooling line (heat sink) to protect the expansion vessel diaphragm against thermal overload (see following diagrams). Steam condenses again in this cooling line and reduces the liquefied heat transfer medium to a temperature below 158°F (70°C).

The necessary residual cooling capacity is determined from the differential between the steam production capacity of the collector array and the heat dissipation of the pipework up to the connection point for the expansion vessel and the heat sink.

For the heat sink, standard radiators with an output calculated at 207°Ra (115 K) are assumed. To make things clearer, the heating output is given as 167/149°F (75/65°C).

Note: Viessmann recommends that stagnation coolers be equipped with a heat shield to provide contact protection. When using commercially available radiators, contact protection must be provided. All system components must be able to withstand temperatures of up to 356°F (180°C).

System Fluid Calculator

Solar Components	Quantity			Liquid Content USG	(L)		Total Liquid Content USG	(L)
Miscellaneous fluid content	1		x	0.80	(3.00)	=	0.80	(3.00)
Vitosol 200-FM, SV2F			x	0.48	(1.83)	=		
Vitosol 200-FM, SH2F			x	0.66	(2.48)	=		
Solar-Divicon, DN20B			x	0.11	(0.40)	=		
Solar-Divicon, DN25B			x	0.20	(0.75)	=		
Solar-Divicon-HX, DN20			x	0.26	(0.98)	=		
Vitocell 300-W, EVIA - 42 USG (160 L)			x	1.96	(7.40)	=		
Vitocell 300-V, EVIA - 53 USG (200 L)			x	1.96	(7.40)	=		
Vitocell 300-V, EVIA - 79 USG (300 L)			x	2.91	(11.00)	=		
Vitocell 300-V, EVIB - 119 USG (450 L)			x	3.43	(13.00)	=		
Vitocell 300-B, EVBA - 79 USG (300 L)			x	2.91	(11.00)	=		
Vitocell 300-B, EVBB - 119 USG (450 L)			x	3.43	(13.00)	=		
Vitocell 300-H, EHA - 92 USG (350 L)			x	3.43	(13.00)	=		
Vitocell 300-H, EHA - 119 USG (450 L)			x	4.23	(16.00)	=		
Other:			x			=		
Other:			x			=		
Other:			x			=		
Other:			x			=		
Solar Piping (select the following pipe size or combination of sizes)	**Total Length ft**	**(m)**		**Liquid Content USG/ft**	**(L/m)**		**Total Liquid Content USG**	**(L)**
½″ Copper, Type-L (5/8″ O.D.)			x	0.012	(0.15)	=		
¾″ Copper, Type-L (7/8″ O.D.)			x	0.025	(0.31)	=		
1″ Copper, Type-L (1-1/8″ O.D.)			x	0.044	(0.55)	=		
1¼″ Copper, Type-L (1-3/8″ O.D.)			x	0.066	(0.81)	=		
1½″ Copper, Type-L (1-5/8″ O.D.)			x	0.093	(1.15)	=		
½″ Stainless Steel Insulated Lineset *			x	0.020	(0.25)	=		
1/2″ Sch-40 Steel Pipe			x	0.016	(0.20)	=		
3/4″ Sch-40 Steel Pipe			x	0.028	(0.34)	=		
1″ Sch-40 Steel Pipe			x	0.045	(0.56)	=		
1-1/4″ Sch-40 Steel Pipe			x	0.077	(0.96)	=		
1-1/2″ Sch-40 Steel Pipe			x	0.106	(1.32)	=		
Total Liquid Content of System (Solar Components + Solar Piping)								

Note: Use this table to calculate the required amount of liquid content required for the solar thermal system.

1) Input the quantities for each listed item and the length of piping (in feet or meters) used in the system. Then multiply each item by the liquid content listed for each item and input each item total in the Total Liquid Content column.
2) Add all of the individual liquid content totals to determine the total liquid content of the system.

* This lineset comes in 20 ft., 40 ft. and 50 ft. lengths (it combines two pipes for supply and return wrapped in foam insulation). Example: A 20 ft. piping kit contains 20 ft. of supply and 20 ft. of return having a total length of 40 ft.

Expansion Vessel

For layout, function and specification of the expansion vessel, see chapter "Installation accessories".

The expansion vessel can be calculated once the steam spread has been determined and any heat sinks that may be used have been taken into consideration.

The required volume is determined by the following factors:
– Expansion of the heat transfer medium in its liquid state
– Liquid seal
– Expected steam volume, taking account of the static head of the system
– Pre-charge pressure

V_{dev} = (Vcol + Vdpipe + Ve + Vfv)·Df

V_{dev} Nominal volume of the expansion vessel in USG (L)
V_{col} Liquid content of the collectors in USG (L)
V_{dpipe} Content of the pipework subject to steam loads in USG (L) (calculated from the steam spread and the pipework content per ft (m) pipe length)

Note: V_{dpipe} is zero for Vitosol 200-FM collectors as there is no steam generation.

V_e Increase in the volume of the heat transfer medium in its liquid state in USG (L)

$V_e = V_a \cdot \beta$

V_a System volume (content of the collectors, the heat exchanger and the pipework (see page 81).

β Expansion factor
β = 0.13 for “Tyfocor-HTL” heat transfer medium from -4 to 248°F (-20 to 120°C)

V_{fv} Liquid seal in the expansion tank [4% of the system volume, min. 0.8 USG (3 L)]

D_f Pressure factor (p_e + 1): (p_e − p_o)

p_e Max. system pressure at the safety valve in bar (90% of the safety valve response pressure)
p_e = 87 psi · 0.90 = 78 psig
(6 bar · 0.90 = 5.4 bar)

p_o System pre-charge pressure
p_o = 44 psi + 0.45 psi/ft static head
(3 bar + 0.1 bar/m static head)

To determine the system and steam volume in the pipework, the content per foot (meter) of pipe must be taken into consideration.

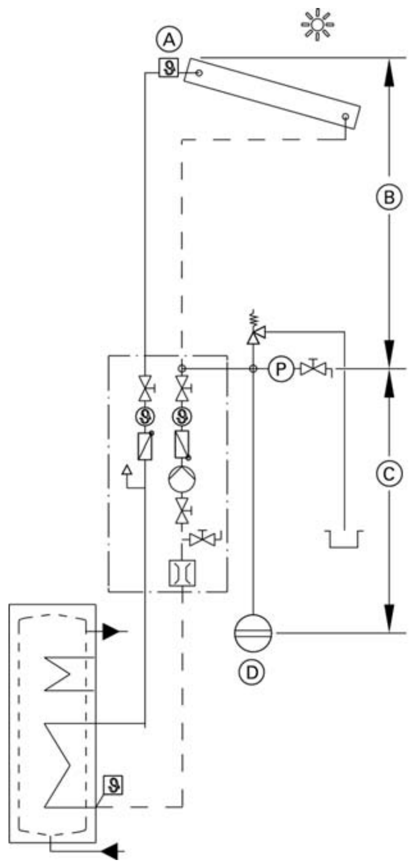
For the liquid content of the following components see “System fluid calculator” (see page 81).
– Solar piping
– Collectors
– Solar-Divicon and solar pump assembly
– DHW tank and heating water buffer tank

Selection of the expansion tank
The details in the table on page 86 are standard values. They allow quick estimates at the design and calculation stage. These values must be verified by appropriate calculations.

Note: Check the size of the expansion tank on site.

Note: Contact your local Viessmann sales representative for expansion tank sizing assistance.

System Fluid Expansion Tank Pre-charge Pressure Calculator



System Cold Fill Fluid Pressure Calculator

① Required system pressure at highest point Ⓐ	44 psig 3 bar						
② Supplement for static head Ⓑ	+ 0.45 psig/ft x		ft =		psig		
	+ 0.1 bar/m x		m =		bar		
③ Required system fluid pressure at pressure gauge Ⓟ Steps: ① + ② = ③	44	+		=		psig	
	3	+		=		bar	

Expansion Tank Cold Fill Gas Pressure Calculator

④ System cold fill fluid pressure at pressure gauge Ⓟ *from Step: ③		psig					
		bar					
⑤ Pressure deduction for hydraulic seal in expansion tank Ⓓ	–4.4 psig –0.3 bar						
⑥ Supplement for height difference Ⓒ between pressure gauge Ⓟ and expansion tank Ⓓ	+0.45 psig/ft x		ft =		psig		
	+0.1 bar/m x		m =		bar		
⑦ Required pre-charge gas pressure in expansion tank Ⓓ Steps: ④ + ⑤ + ⑥ = ⑦		+ –4.4	+		=		psig
		+ –0.3	+		=		bar

CAUTION

After de-aeration, the air vent c/w shut-off at top of system must be closed. To protect the solar system from overheating in the summer, e.g. during the holidays, do not shut off the power to the solar system.

System Fluid Expansion Tank Pre-charge Pressure Calculator

The collector circuit must be protected during system stagnation (emergency shutdown) such that no heat transfer fluid can escape from the pressure relief valve or the air vent located at the collector.

This is achieved by the appropriate sizing of the expansion tank and matching of the system pressure.

IMPORTANT

Under cold fill conditions, a minimum static fluid pressure must be maintained.

Recommended System Fluid and Expansion Tank Pressures

Static Head (vertical height)		Cold Fill Fluid Pressure		Cold Fill Gas Pressure	
ft	(m)	psig	(bar)	psig	(bar)
3	(1)	45.5	(3.1)	41.1	(2.8)
7	(2)	47.0	(3.2)	42.6	(2.9)
10	(3)	48.4	(3.3)	44.0	(3.0)
13	(4)	49.9	(3.4)	45.5	(3.1)
16	(5)	51.4	(3.5)	47.0	(3.2)
20	(6)	52.9	(3.6)	48.5	(3.3)
23	(7)	54.3	(3.7)	49.9	(3.4)
26	(8)	55.8	(3.8)	51.4	(3.5)
30	(9)	57.3	(3.9)	52.9	(3.6)
33	(10)	58.8	(4.0)	54.4	(3.7)
36	(11)	60.2	(4.1)	55.8	(3.8)
39	(12)	61.7	(4.2)	57.3	(3.9)
43	(13)	63.2	(4.3)	58.8	(4.0)
46	(14)	64.7	(4.4)	60.3	(4.1)
49	(15)	66.1	(4.5)	61.7	(4.2)

IMPORTANT

The solar expansion tank is factory pre-charged with Nitrogen to 44 psig (3 bar). The pre-charged gas pressure must be field adjusted prior to filling of the system with heat transfer fluid.

The cold fill fluid and gas pressures are to be verified when the collectors are not exposed to solar energy. Failure to do so will result in system pressures which are too low. It is recommended that this step be completed:

- **First thing in the morning**
- **Late in the evening**
- **When collectors are covered**

Solar Pressure Relief Valve

CAUTION

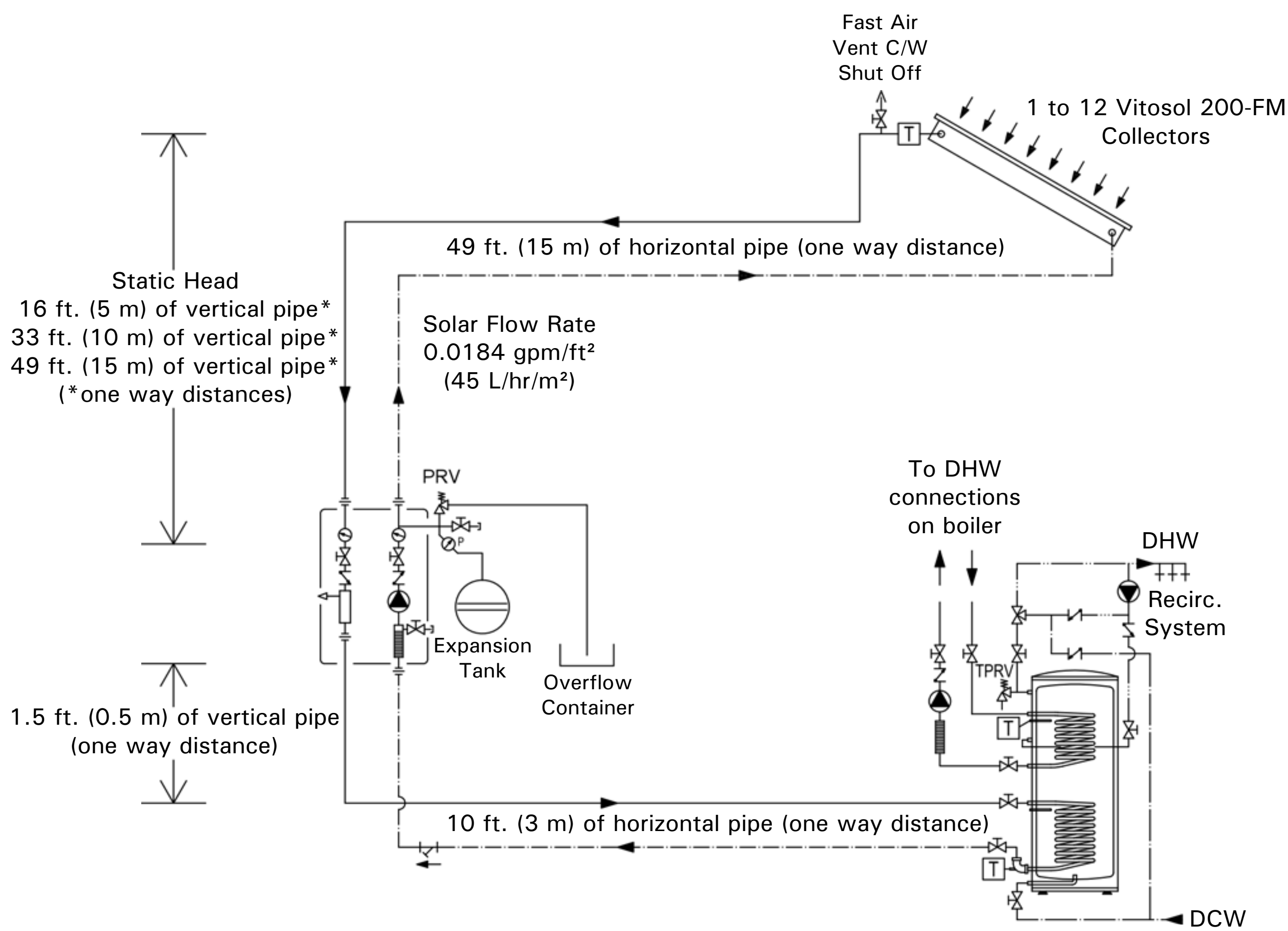
The pressure relief valve must be piped to the overflow container or drain at all times, since excessively hot fluid can discharge from the system.

Safety valve (PRV)
The heat transfer medium will be discharged from the solar thermal system via the safety valve if the maximum permissible system pressure 87 psig (6 bar) is exceeded. According to DIN 3320, the response pressure of the safety valve is the maximum system pressure +10%. The safety valve must comply with EN 12975 and 12977, be matched to the heating output of the collectors and be able to handle their maximum output of 222 Btuh/ft^2 (900 W/m^2).

Discharge and drain lines must terminate into an open high temperature rated container, capable of collecting 1.3 times the total collector fluid capacity. Use only safety valves sized for maximum 87 psig (6 bar) and 285°F (120°C), which bear the marking "S" (solar) as part of the product identification.

Note: The Solar-Divicon is equipped with a safety valve for up to 87 psig (6 bar) and 248°F (120°C). Check local codes to determine suitability.

Expansion Tank Quick Sizing Table for Vitosol 200-FM, Type SV & SH



Note: As a quick sizing example, use the image above and reference the information from the table on page 86, to select an applicable expansion tank. The values listed in the table are applicable for a single collector array consisting of 1 to 12 collectors.

Expansion Tank Quick Sizing Table for Vitosol 200-FM, Type SV & SH *(continued)*

Number of Collectors and Total Absorber Area	Static Head (vertical height)		Total Solar System Fluid Capacity		Recommended Capacity of the Expansion Tank	
	ft²	(m²)	USG	(L)	USG	(L)
1 Collector	16	(5)	7.2	(27)	4.8	(18)
	33	(10)	7.6	(29)	6.6	(25)
	49	(15)	8.0	(30)	10.6	(40)
2 Collectors	16	(5)	7.9	(30)	4.8	(18)
	33	(10)	8.3	(31)	6.6	(25)
	49	(15)	8.7	(33)	13.2	(50)
3 Collectors	16	(5)	8.5	(32)	6.6	(25)
	33	(10)	8.9	(34)	10.6	(40)
	49	(15)	9.3	(35)	13.2	(50)
4 Collectors	16	(5)	11.2	(42)	6.6	(25)
	33	(10)	12.0	(45)	10.6	(40)
	49	(15)	12.8	(49)	21.1	(80)
5 Collectors	16	(5)	11.8	(45)	6.6	(25)
	33	(10)	12.7	(48)	10.6	(40)
	49	(15)	13.5	(51)	21.1	(80)
6 Collectors	16	(5)	12.5	(47)	6.6	(25)
	33	(10)	13.3	(50)	10.6	(40)
	49	(15)	14.1	(54)	21.1	(80)
7 Collectors	16	(5)	15.8	(60)	10.6	(40)
	33	(10)	17.2	(65)	13.2	(50)
	49	(15)	18.6	(71)	21.1	(80)
8 Collectors	16	(5)	16.5	(62)	10.6	(40)
	33	(10)	17.9	(68)	13.2	(50)
	49	(15)	19.3	(73)	21.1	(80)
9 Collectors	16	(5)	17.1	(65)	10.6	(40)
	33	(10)	18.5	(70)	13.2	(50)
	49	(15)	19.9	(76)	21.1	(80)
10 Collectors	16	(5)	21.2	(80)	10.6	(40)
	33	(10)	23.4	(89)	21.1	(80)
	49	(15)	25.7	(97)	2x 13.2	(2x 50)
11 Collectors	16	(5)	21.9	(83)	10.6	(40)
	33	(10)	24.1	(91)	21.1	(80)
	49	(15)	26.3	(100)	2x 13.2	(2x 50)
12 Collectors	16	(5)	22.5	(85)	10.6	(40)
	33	(10)	24.8	(94)	21.1	(80)
	49	(15)	27.0	(102)	2x 13.2	(2x 50)

Note: The values listed in the table above are to be used for reference purposes only!

Viessmann does not assume any liability for systems that do not work as expected if an expansion tank is selecting from the table above.

The system designer or engineer, must manually calculate the required expansion tank capacity, based on all the solar thermal system components which are to be installed.

High Limit Safety Cut-out

The solar control units SCU124/224/345 and SM1 are equipped with an electronic temperature limiter. A mechanical high limit safety cut-out in the tank is recommended when the ratio of tank capacity to collector absorber area is less than 1 USG/ft^2 (40 L/m^2). This reliably prevents temperatures above 200°F (95°C) in the tank.

Example: 3x Vitosol 200-FM flat-plate collectors, 75 ft^2 (7 m^2) absorber area DHW tank with 79 USG (300 L) tank capacity.

79 USG / 75.3 ft^2 = 1.05 USG/ft^2
(300 L / 7 m^2) = (42.8 L/ m^2)

e.g. a high limit safety cut-out is not required.

Additional Function for DHW Heating

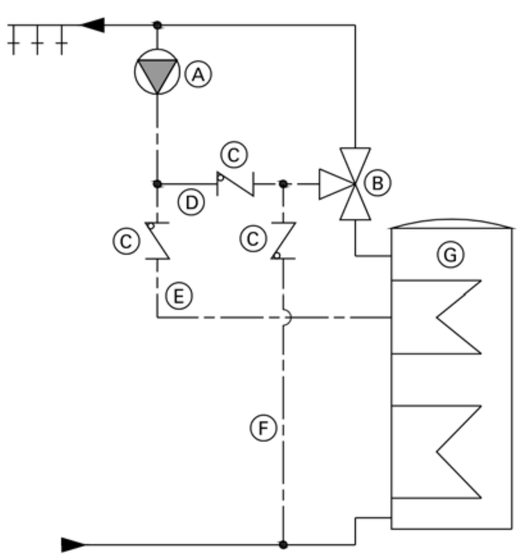
In solar thermal systems with DHW storage, we recommend heating the Solar preheat section of the tank to ≥ 140°F (≥ 60°C) once a day (regardless of the cylinder volume).

We recommend that the heating operation take place in the late afternoon. This will help ensure that the lower tank area or the preheating stage is cold again following the expected draw-offs (evenings and the following morning) and can subsequently be heated up again by solar energy.

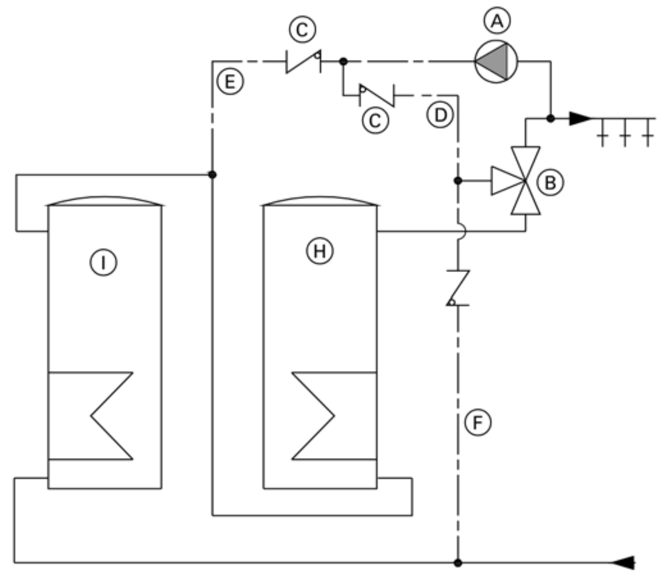
Note: For detached and multi-family houses, this heat-up is recommended, but not compulsory.
Check local codes to determine requirements for this function.

Connecting the DHW Circulation and Thermostatic Mixing Valve

Single tank - solar preheat with DHW backup



Multiple tank - solar preheat in line with DHW tank



Legend
- Ⓐ DHW circulation pump
- Ⓑ Automatic thermostatic mixing valve
- Ⓒ Check valve
- Ⓓ DHW circulation bypass line (required to prevent heating of entire solar tank).
- Ⓔ DHW circulation line. Flow temperature maximum 140°F (60°C).
- Ⓕ Cold water line to thermostatic mixing valve. Pipe runs as short as possible, as these receive no flow in winter.
- Ⓖ Dual coil tank heated by solar and boiler
- Ⓗ Single coil tank heated by boiler
- Ⓘ Single coil solar pre-heat tank

6020 457 - 01

Connecting the DHW Circulation and Thermostatic Mixing Valve *(continued)*

Mixing Valve

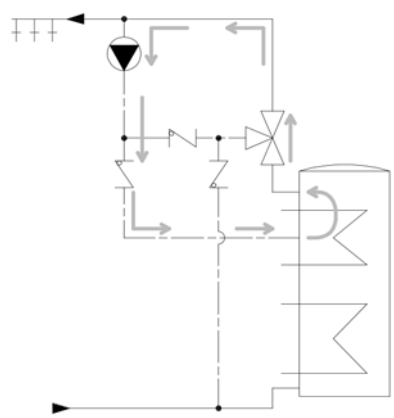
To ensure trouble-free functioning of the solar thermal system, it is important that the lower portion of the solar DHW tank remain cool so that it can receive the solar energy. The lower portion of the dual coil DHW tank or the solar pre-heat tank must not under any circumstances be heated by the DHW circulation pump. It is highly recommended that the DHW circulation connection be used when installing Vitocell DHW tanks (see diagram).

To limit the temperature to 140°F (60°C), install a mixing device, e.g. a thermostatic mixing valve. If the mixing valves maximum set temperature is exceeded [e.g. 140°F (60°C)], the valve will mix cold water with hot water, as it is drawn from the tank. This is very important as DHW temperatures in excess of 140°F (60°C) can cause scalding.

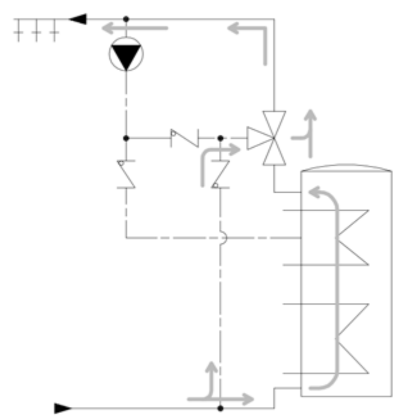
DHW Circulation Bypass Line

When a thermostatic mixing valve is used in conjunction with a DHW circulation pump, a bypass line is required between the DHW circulation inlet on the Vitocell tank and the cold water inlet on the mixing valve. To avoid incorrect circulation, a check valve must be installed (see page 87).

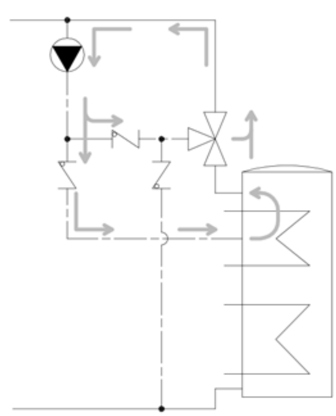
The bypass line will be used when the storage tank temperature is at a higher temperature than the DHW service temperature and there is no DHW being consumed in the building and the DHW circulation pump is operating. The bypass line ensures that the DHW supply temperature is maintained, while not forcing the entire dual coil tank or the pre-heat tank to be heated by the backup heat source. This is very important as this reverse circulation will reduce or eliminate the ability to store solar energy in the lower portion of the storage tank, or the solar pre-heat tank. (See diagrams below)



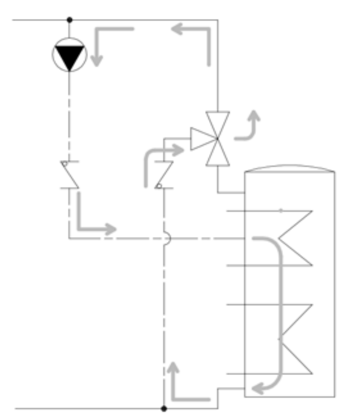
- Mixing valve set to 120°F (49°C)
- Tank Temperature < 120°F (49°C)
- No DHW being used and the recirculation pump is operating



- Mixing valve set to 120°F (49°C)
- Tank Temperature > 120°F (49°C)
- DHW is being used and the recirculation pump is operating



- Mixing valve set to 120°F (49°C)
- Tank Temperature > 120°F (49°C)
- No DHW being used and the recirculation pump is operating



NO BYPASS LINE
- Mixing valve set to 120°F (49°C)
- Tank Temperature > 120°F (49°C)
- No DHW is being used and the recirculation pump is operating

6020 457 - 01

Intended Use

The appliance is only intended to be installed and operated in sealed pressurized systems with due attention paid to these instructions.

DHW tanks are only designed to store and heat water of potable water quality. Heating water buffer tanks are only designed to hold fill water of potable water quality. Only operate solar collectors with the heat transfer medium approved by the manufacturer. Intended use assumes that a fixed installation in conjunction with permissible, system-specific components has been carried out.

Commercial or industrial usage for a purpose other than heating the building or DHW shall be deemed inappropriate. Any usage beyond this must be approved by the manufacturer for the individual case.

Incorrect usage or operation of the appliance (e.g. the appliance being opened by the system user) is prohibited and results in an exclusion of liability.

Incorrect usage also occurs if the components in the system are modified from their intended use (e.g. through direct DHW heating in the collector).

Adhere to statutory regulations, especially concerning the hygiene of potable water.

Recommended Maintenance and Inspection Periods

Maintenance and Inspection Items:	Recommended Inspection Interval:
The glazing (glass) of the collectors is clean	1 year
The valve on the automatic air vent at the collectors is closed	1 year
There are no fluid leaks from solar collector, system piping, tanks, pumps, etc	1 year
Circulating pumps are operational without excess noise	1 year
Flow meter is functioning and moving freely	1 year
System flow rate meets requirements for the installed collector type	1 year
External heat exchangers are not leaking or showing signs of damage	1 year
Solar tank connections are not leaking or showing signs of damage	1 year
Solar controller is functional without any alarms or faults indicated	1 year
Solar control accessories and monitoring equipment is functioning correctly	1 year
Solar heat transfer fluid pH tested with test strips (normal 7.5-8.5	1 year
Solar heat transfer fluid freeze point checked with refractometer	1 year
Solar heat transfer fluid is not thermally stressed or degraded (black or foul smelling)	1 year
Bleed air from the internal air separator on the Solar-Divicon	1 year
Solar fluid pressure has not dropped or changed since commissioning	1 year
Pressure Relief Valve (PRV) has not released or does not indicate signs of leakage	1 year
Overflow container does not contain glycol as a result of a discharge from the PRV	1 year
Interconnection pipes between collectors are centered and not damaged	2 years
System pipe insulation and protective jacketing is not damaged or missing	2 years
Roof or wall penetrations not leaking or showing signs damage	2 years
Solar control wires are secure without any visible damage	2 years
Thermostat gauges are operational and not showing signs of damage	2 years
Pressure gauges are operational and not showing signs of damage	2 years
Enamel steel tank sacrificial anode removed and inspected (replace if required)	2-5 years
Collector glass (glazing) seals are not cracked or broken	3-5 years
Collector absorber sheet not showing signs of degradation or flaking	3-5 years
Collector mounting hardware, racking or substructure components are secure	3-5 years
System pipe is supported properly with pipe hangers (not sagging)	3-5 years
System pipe markings or labels are present and legible	3-5 years
Solar tank internal heat exchanger inspected for leaks or signs of corrosion	3-5 years
External heat exchanger (brazed plate/shell & tube) inspected for leaks or signs of corrosion	3-5 years
Expansion tank gas pressure has not changed since commissioning	3-5 years
Solar heat transfer fluid replacement (complete flush and fill)	5-10 years

Subsidy Programs, Permits and Insurance

Solar thermal systems play an important role in protecting natural resources and the environment. Together with advanced Viessmann heating systems, they create an optimum system solution that is fit for the future for DHW and swimming pool heating, central heating backup and other low temperature applications. This is why solar thermal systems may receive government subsidies or grants.

Solar thermal systems are subsidized by some national, regional and local authorities. Further information is available from our sales offices. All Vitosol collectors are certified to Solar Keymark and SRCC OG-100 standards.

The approval of solar thermal systems is not universally regulated. Your local planning office will be able to advise you on whether solar thermal systems need planning permission.

Viessmann solar collectors are tested for impact resistance, for example against hailstones, to EN 12975-2 or ISO 9806. Nevertheless we recommend that the user insures against extreme weather conditions and includes the collectors on their buildings insurance. Damage due to these conditions is excluded from our warranty.

Glossary

Absorber
Device contained inside a solar collector designed to absorb radiation energy and transfer this as heat to a liquid.

Absorption
Radiation absorption

Condenser
Device where steam is precipitated as a liquid.

Convection
Transfer of heat by the flow of a medium. Convection creates energy losses caused by a temperature differential, e.g. between the glass pane of the collector and the hot absorber.

Dispersion
Interaction of radiation with matter by which the direction of the radiation is altered; total energy and wavelength remain unchanged.

Efficiency
The operating efficiency of a solar collector is the ratio of the collector output to the power input. Relevant variables are, for example, the ambient and absorber temperatures.

Emission
Transmission (radiation) of beams, e.g. light or particles.

Evacuating
Extraction of the air from a container. This reduces the air pressure, thereby creating a vacuum.

Heat pipe
Sealed capillary container that contains a small volume of highly volatile liquid.

Heat transfer medium
Liquid that absorbs the available heat in the absorber of the collector and delivers it to a consumer (heat exchanger).

Irradiance (insolation)
Radiation level impacting on a unit of surface area, expressed in Btuh/ft^2 (W/m^2).

Radiation energy
Volume of energy transmitted by radiation.

Selectively coated surface
The absorber in the solar collector is highly selective coated to improve its efficiency. This specially applied coating enables the absorption to be maintained at a very high level for the sunlight spectrum that hits the absorber (approximately 94%). The emission of long-wave heat radiation is largely prevented. The highly selective black chromium coating is very durable.

Standard roof pitch
The roof pitch limit, at which the roof cover is considered to be adequately protected against the ingress of rain, is described as standard roof pitch. Refer to the roof manufacture’s Installation details regarding roof pitch to ensure adequate weather protection.

Steam production capacity
The output of the collector array in Btuh/ft^2 (W/m^2) that, during stagnation, is transferred into the pipe work in the form of steam. The maximum steam production capacity is influenced by the draining characteristics of the collectors and the collector array (see page 79).

Steam spread
Length of the pipe work that is subjected to steam loads during stagnation. The max. steam spread is dependent on the heat loss characteristics of the pipe work (thermal insulation). Conventional details refer to 100% insulation strength.

Vacuum
A space devoid of air.

Printed on environmentally friendly (recycled and recyclable) paper.

Technical information subject to change without notice.

Scan for digital copy of this document

Viessmann Manufacturing Company Inc.
750 McMurray Road
Waterloo, Ontario • N2V 2G5 • Canada
TechInfo Line 1-888-484-8643
1-800-387-7373 • Fax (519) 885-0887
www.viessmann.ca • info@viessmann.ca

Viessmann Manufacturing Company (U.S.) Inc.
45 Access Road
Warwick, Rhode Island • 02886 • USA
TechInfo Line 1-888-484-8643
1-800-288-0667 • Fax (401) 732-0590
www.viessmann-us.com • info@viessmann-us.com

6020 457 - 01