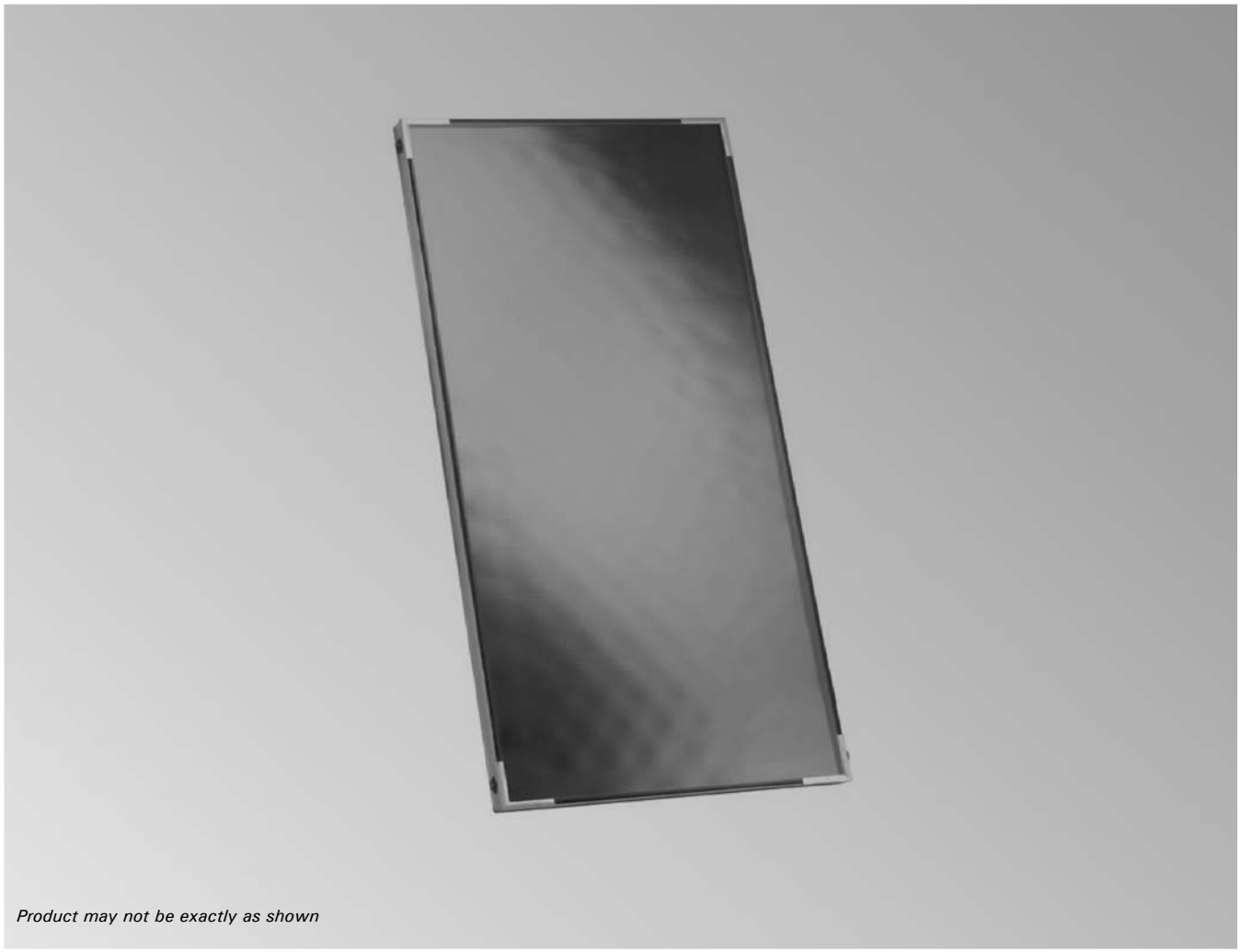
Technical Data Manual

Model Nos. and pricing: see Price List

Flat plate solar collectors for the harnessing of solar energy
Panels with 25 ft^2 (2.32 m^2) absorber surface

VITOSOL® 100-FM



Product may not be exactly as shown

VITOSOL 100-FM Model SV1F and SH1F

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.

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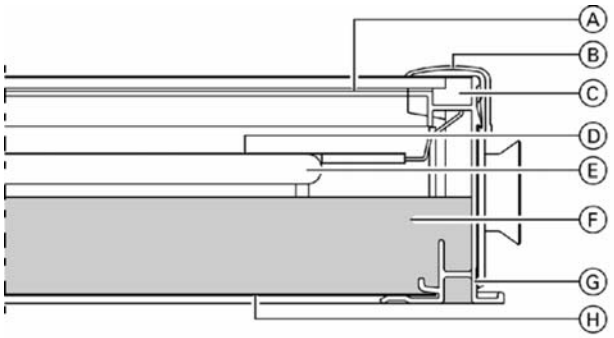
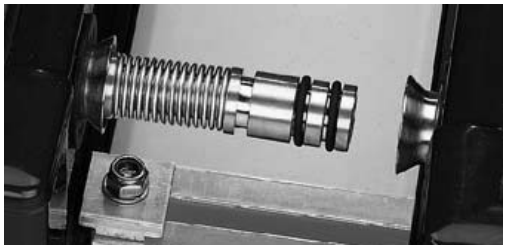
Product Description

Benefits

- **High performance** flat plate collector at an attractive price, thanks to a highly-efficient ThermProtect coated aluminum absorber.
- **Suitable for many residential or commercial applications** with vertical or horizontal versions available. Best suited for DHW or pool heating.
- **Rugged, high-quality construction** using impact-resistant low-iron solar glass, copper piping and absorber, aluminum frame and non-degrading thermal insulation. No screws or rivets are used in the frame for a clean finish.
- **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.



Legend
Ⓐ Solar glass cover, 0.13″ (3.2 mm) thick
Ⓑ Aluminum cover strip bracket at the collector corners
Ⓒ Continuous flexible seal for solar glass cover
Ⓓ Aluminum absorber sheet with ThermProtect coating
Ⓔ Meander-shaped copper pipe
Ⓕ Thermal insulation made from rockwool
Ⓖ Non-coated aluminum frame
Ⓗ Aluminum-zinc coated sheet steel back panel



Flexible interconnection pipes

Construction and function

The main component of the Vitosol 100-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 a solar glass panel with a very low iron content, thereby reducing reflection losses.
The tempered solar glass is 3.2 mm thick, making it very resistant to weather influences.

The glass is set into the collector 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.

The collector housing consists of a one-piece non-coated aluminum frame into which the solar glass is permanently sealed.

Up to twelve collectors can be joined quickly and easily to form a single collector array. For this, the standard equipment includes flexible connection pipes, sealed with O-rings (see flexible interconnection pipes picture).

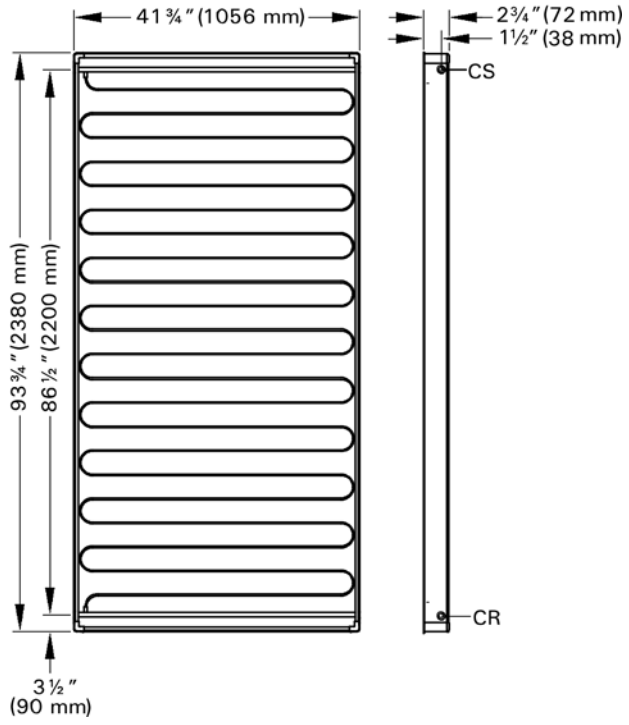
A connection kit with clamping ring fittings enables the collector array to be quickly connected to the pipes of the solar circuit. The collector temperature sensor is installed in the solar circuit flow using a sensor well set.

Specification

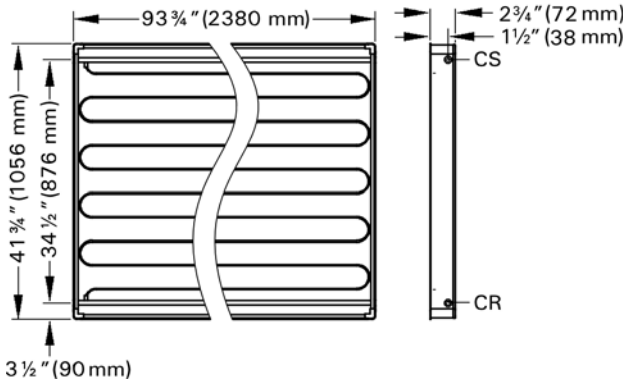
Vitosol 100-FM		SV1F	SH1F
Gross area	ft^2 (m^2)	27.0 (2.51)	27.0 (2.51)
Absorber area	ft^2 (m^2)	25.0 (2.32)	25.0 (2.32)
Aperture area *1	ft^2 (m^2)	25.1 (2.33)	25.1 (2.33)
Spacing between collectors	in. (mm)	¾ (21)	¾ (21)
Dimensions*2			
Width	in. (mm)	41¾ (1056)	93¾ (2380)
Height	in. (mm)	93¾ (2380)	41¾ (1056)
Depth	in. (mm)	2¾ (72)	2¾ (72)
Optical efficiency*3	%	81.3	81.3
Heat loss coefficient U1	W/(m^2·K)	4.460	4.311
Heat loss coefficient U2	W/(m^2·K^2)	0.0196	0.0217
Thermal capacity	kJ/(m^2·K)	5.33	6.4
Weight (dry)	lb. (kg)	91.3 (41.5)	91.3 (41.5)
Fluid capacity	USG	0.48	0.63
(heat transfer medium)	(L)	(1.83)	(2.4)
Maximum working pressure*4	psig (bar)	87 (6)	87 (6)
Maximum stagnation temperature*5	°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)	57.4 (2750)	57.4 (2750)
Max. tested negative load	lb/ft^2 (Pa)	50.1 (2400)	50.1 (2400)

*1 Important for system design considerations.
*2 Dimensions rounded to the nearest ¼ inch.
*3 Based on absorber area.
*4 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.
*5 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.

Model SV1F (Vertical mounting)



Model SH1F (Horizontal mounting)



Legend
CR Collector return (inlet)
CS Collector supply (outlet)

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Standard Equipment/Accessories

Standard equipment

Vitosol 100-FM, Models SH1F and SV1F come fully assembled in shrink-wrap packaging and ready to be connected.

Note: Viessmann offers complete solar heating system combi packages, as well as comprehensive design support in order to facilitate the component selection process.

Accessories

Accessories (individually packed, depending on order):
- Mounting hardware with technical literature
- Interconnection pipes with insulation
- General connection set
- Sensor well set
- Solar Divicon (pumping station for the collector circuit)
- Electronic differential temperature control
- Automatic air vent with air separator
- Fast air vent valve with tee and shutoff valve
- System filling manifold
- Solar hand pump
- Solar expansion tank
- Heat transfer medium

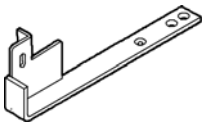
Mounting hardware

The mounting hardware consists of components required for the relevant method of installation, such as:

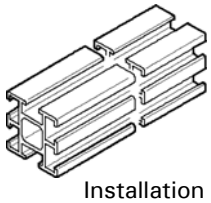
Roof brackets, mounting plates, mounting rails, connecting elements for mounting rails, clamping bolts, screws and nuts.

Sloped roof hardware

Required for mounting collector directly onto shingled roof. Raises collector 3½" (88.9 mm) above the roof.



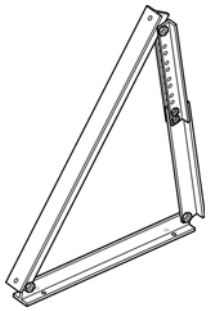
Roof bracket



Installation rail

Flat roof hardware

Required for freestanding, flat roof installations.

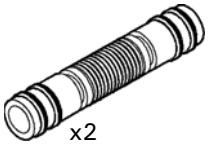


General connection set

Required to connect solar collector to system piping.
One set required per collector array - max. 269 ft^2 (25 m^2).

Pipe connection set

Required to connect multiple solar collectors.



x2

SCU 124/224/345

Electronic differential temperature control for solar heating.

Solar Divicon

Preassembled pumping station for solar collector circuit.
Includes: 3-speed pump (2 sizes), pressure gauge, 2 thermometers, 2 ball valves, pressure relief valve, flow meter, 2 flow check valves, air separator, system fill manifold, and foam insulation cover.

Heat transfer medium

Tyfocor non-toxic heating liquid for solar heating systems with active anti-corrosion and anti-ageing protection.

Frost protection:	to -31°F (-35°C)
Specific gravity at 68°F (20°C):	1.032 to 1.035 g/cm^3 to ASTM D 1122
Viscosity at 68°F (20°C):	6.5 to 8.0 mm^2/s to DIN 51562
pH value:	7.5 to 8.5 to ASTM D 1287
Color:	transparent, blue-green
Container:	5.3 USG (20 L) in a disposable container

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 result in smaller pumps which would use less energy, and small pipe sizes, reducing the overall installation and operating cost for the system.

Operating modes:
Low flow operation
Operation with flow rates up to approx. 0.014 USG/min/ft^2 0.010 - 0.0143 USG/min/ft^2 (25 - 35 L/h/m^2)

High flow operation
Operation with flow rates greater than 0.014 USG/min/ft^2 0.0143 - 0.0245 USG/min/ft^2 (35 - 60 L/h/m^2)

Flow Velocity

To minimize the pressure drop through the solar thermal system pipework, the flow velocity in the pipe should not exceed 3.3 ft/s (1 m/s). We recommend flow velocities of between 1.3 and 2.3 ft/s (0.4 and 0.7 m/s). At these flow velocities, a pressure drop of between 0.12 and 0.3 "w.c. (1 and 2.5 mbar) /m pipe length will result. For the installation of collectors, we recommend sizing the pipes as for a normal heating system according to flow rate and velocity.

Note: A higher flow velocity results in a higher pressure drop and potentially could erode the walls of the pipework. If the flow 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.

Flow Rate - Vitosol 100-FM

High-flow mode

High-flow mode is best suited for small scale systems consisting of less than 8 collectors.

Medium and low-flow modes

Medium and low-flow modes are best suited for larger scale collector arrays consisting of greater than 8 collectors.

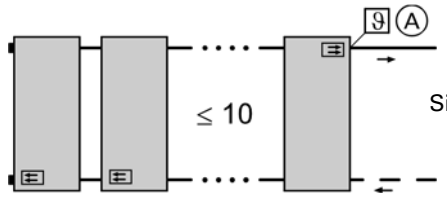
Vitosol 100-FM recommended flow rates per individual collector

Flow	**High flow mode** USG/min (L/min)	**Medium flow mode** USG/min (L/min)	**Low flow mode** USG/min (L/min)
SV and SH models	0.61 (2.32)	0.45 (1.74)	0.31 (1.16)

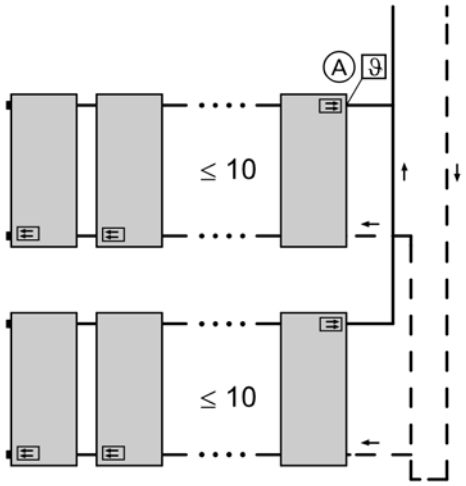
Collector array flow rates

Flow	**High flow mode** USG/min (L/min)	**Medium flow mode** USG/min (L/min)	**Low flow mode** USG/min (L/min)
2 collectors	1.22 (4.6)	--	--
3 collectors	1.83 (6.9)	--	--
4 collectors	2.44 (9.2)	--	--
5 collectors	3.05 (11.5)	--	--
6 collectors	3.66 (13.8)	--	--
8 collectors	--	3.6 (13.6)	2.48 (9.4)
10 collectors	--	4.5 (17.0)	3.1 (11.7)
12 collectors	--	5.4 (20.4)	3.72 (14.1)

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



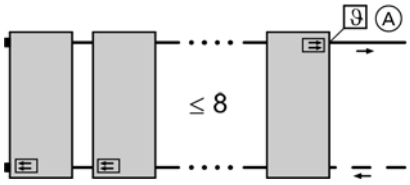
Single array less than or equal to (≤) 10x flat plate collectors



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

Legend
Ⓐ Collector temperature sensor (field installed)

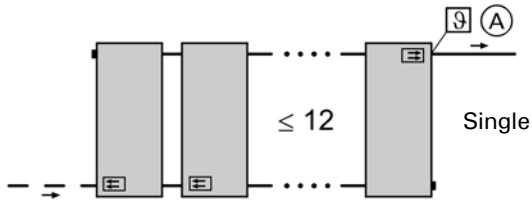
Vitosol-FM, Type SV and SH Low Flow Operation (single-sided connection)



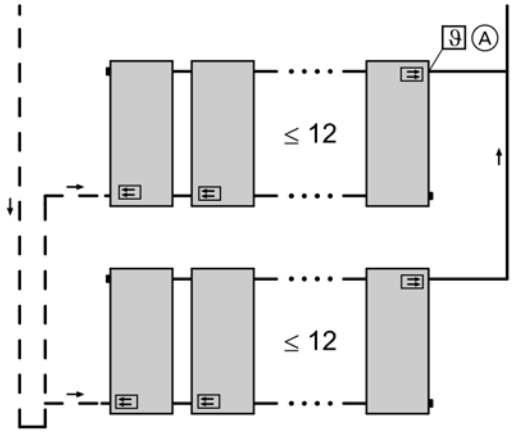
Single array less than or equal to (≤) 8x flat plate collectors

Legend
Ⓐ Collector temperature sensor (field installed)

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



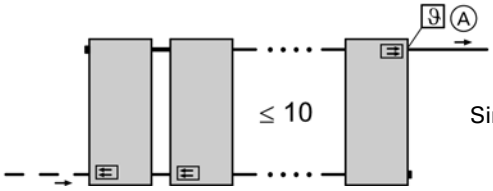
Single array less than or equal to (≤) 12x flat plate collectors



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

Legend
Ⓐ Collector temperature sensor (field installed)

Vitosol-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)

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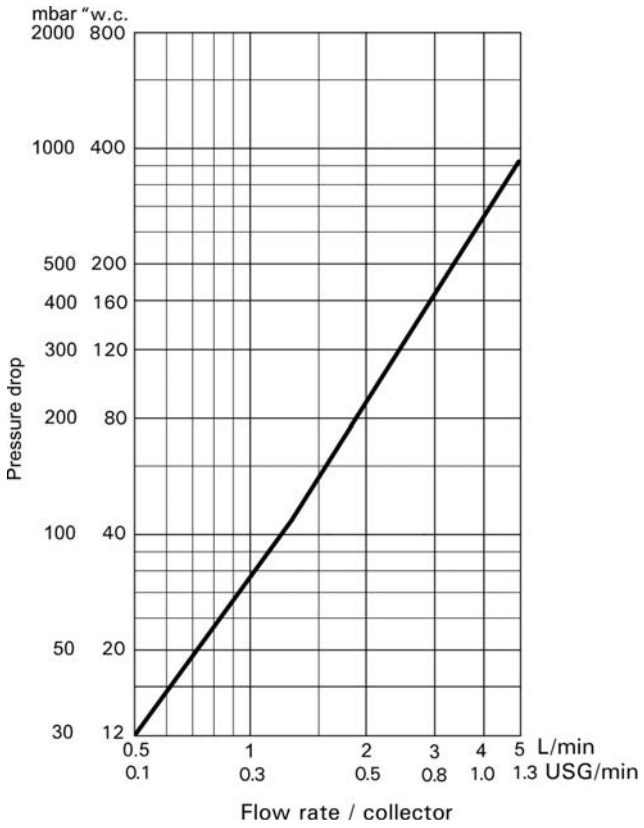
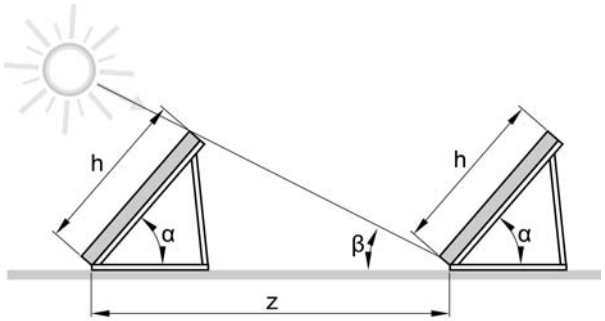
Pressure Drop of Vitosol-FM, Type SV and SH



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

Note: For multiple Vitosol-F collector arrays, use the flow rate per individual collector to calculate the pressure drop.

Determining the Collector Row Distance "z"



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

Legend:
z = Collector row distance
h = Collector height
100-FM model SV = 93¾ in. (2380 mm)
100-FM model SH = 41¾ in. (1056 mm)
α = Collector angle of inclination
100-FM model SV = 25° - 60°
100-FM model SH = 25° - 80°
β = Solar angle
β = (90° - 23.5°) - Latitude

IMPORTANT

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

Example:

Model SV
Toronto is located at approx. 43° latitude.

1. Determine the angle of the sun b. 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:
   β = (90° - 23.5°) - latitude
   (23.5° should be accepted as constant value for northern latitudes)

   β = (90° - 23.5°) - 43° = 23.5°

2. Calculating dimension "z":
   h = 2380 mm
   α = 45°
   β = 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)

Refer to Vitosol System Design Guide for more information on calculating "z".

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

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Solar System Design

When designing a solar thermal system, the engineer or installing contractor must carefully select system components to ensure efficient, trouble free operation. During the design phase it is recommended that the following details be addressed:

- Type of collector to be used and how it will be installed
- The recommended flow rate for each collector or collector array
- The supply/return pipe size, material and total length of run
- Recommended size of the solar storage/buffer tank
- The pressure drop of the solar collectors, piping, solar pumps, tanks, heat exchangers and other hydronic devices added to the system
- The size of the solar pump required based on flow and pressure drop of the system
- The size of the expansion tank required based on the height of the installation and the thermal expansion of the solar fluid. Since there is a potential for steam to be created, this will also need to be considered when sizing the expansion tank

Refer to Vitosol System Design Guide System sizing information which is available online.

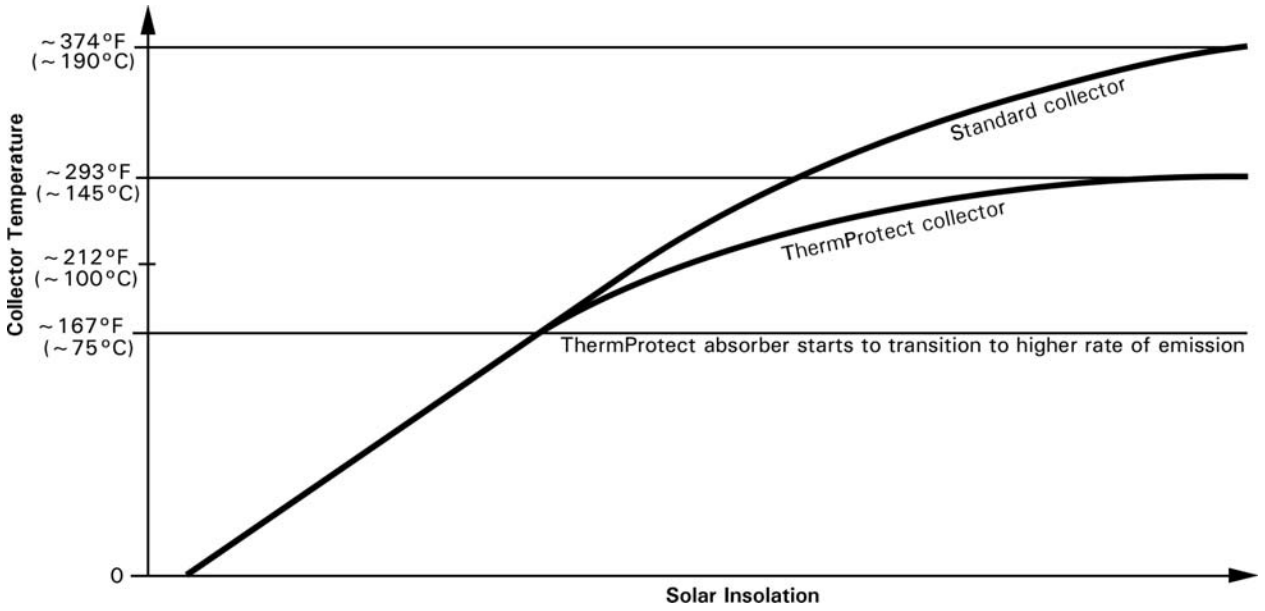
Note: Contact Viessmann Solar Tech Support for assistance with solar sizing.

ThermProtect Absorber Coating

ThermProtect temperature characteristics

Solar collector temperature	Solar tank operation	Emission ε
up to 167°F (75°C)	Solar storage tank being heated	~ 5%
from 167°F to 293°F (75°C to 145°C)	Solar storage tank at max. temperature	~ 5% increases to ~ 40%

- The absorber selective coating (ThermProtect), optical characteristics changes depending on operating temperature
- The rate of absorption α does not change
- The rate of emission ε automatically adapts to the system



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