

AS 3634:2022



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Solar heating systems for swimming pools



AS 3634:2022

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- Australian Bureau of Meteorology
- Australian Industry Group
- Australian Institute of Refrigeration Air Conditioning and Heating
- Consumer Electronics Suppliers Association
- CSIRO
- Gas Appliance Manufacturers Association of Australia
- James Cook University
- Smart Energy Council
- Swimming Pool and Spa Association of Australia
- University of New South Wales
- University of South Australia

Additional Interests

- Ascon Pool
- Boss Solar
- Daisy Pool Covers
- Optex Solar
- Sunbather Solar Pool Heating & Covers
- Supreme Heating
- Waterco

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Solar heating systems for swimming pools

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Preface

This Standard was prepared by the Australian members of Joint Standards Australia/Standards New Zealand Committee CS-028, Solar Heating and Cooling, to supersede AS 3634:1989.

The objective of this document is to specify the design, construction, and installation aspects of solar heating systems for swimming pools.

The major changes in this edition are as follows:

- (a) Additions to definitions.
- (b) Updated diagrams.
- (c) Addition of different types of solar collectors.
- (d) Introduction of method to mitigate hot water returning to pool upon start-up.
- (e) Suggested increase to minimum collector area for jurisdictions across Australia.
- (f) Calculation of pool heating load has been updated.
- (g) Pool cover appendix has been expanded.

The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

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Introduction

This document was reviewed by the CS-028 Committee in response to a request from the swimming pool and spa industry to address climatic, performance requirements and installation changes and advances since the document was first published in 1989.

Changes within this document support industry and consumer demand expectations that the performance requirements of solar heating systems are underpinned by data, provide environmental and social benefits to consumers and are of a high standard.

NOTES

Australian Standard®

Solar heating systems for swimming pools

1 Scope

This document sets out requirements for the design, installation and commissioning of solar heating systems for swimming pools and spas, using direct and indirect circulation of pool water to the solar collectors. This document excludes electrical safety requirements, water treatment requirements, and solar performance requirements. The appendices include system design, pool covers, calculation of heating load, and collector positioning.

This document is applicable to domestic and commercial or public pools heated by solar energy either alone or in conjunction with other auxiliary heating means and excludes water treatment requirements, and solar pump performance requirements.

NOTE High temperature collectors designed for household or commercial hot water generation, such as evacuated tubes are not recommended for swimming pool heating and would need additional safety control measures introduced into the design to ensure that there is no scalding risk.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1432, *Copper tubes for plumbing, gasfitting and drainage applications*

AS 1926.3, *Swimming pool safety, Part 3: Water recirculation systems*

AS 4130, *Polyethylene (PE) pipes for pressure applications*

AS/NZS 1477, *PVC pipes and fittings for pressure applications*

AS/NZS 2032, *Installation of PVC pipe systems*

AS/NZS 2712, *Solar and heat pump water heaters — Design and construction*

AS/NZS 3000, *Electrical installations* (known as the Australian/New Zealand Wiring Rules)

AS/NZS 60335.1, *Household and similar electrical appliances — Safety, Part 1: General requirements (IEC 60335-1 Ed 6, MOD)*

BS 5391-1, *Acrylonitrile-butadiene-styrene (ABS) pressure pipe — Specification*

BS 5392-1, *Acrylonitrile-butadiene-styrene (ABS) fittings for use with ABS pressure pipe — Specification*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

absorber

device within a collector for absorbing radiant energy and transferring the energy as heat into a fluid

3.2

collector

device containing an absorber with fluid passages

3.2.1

unglazed flat panel collector

non-concentrating collector in which the absorber (which is normally made of rigid plastic sheets) is essentially planar containing multiple internal fluid channels

3.2.2

glazed collector

collector in which a translucent or transparent glazing material covers the absorber

3.2.3

unglazed rigid tube panel collector

collector in which the absorber usually embodies numerous closely spaced tubes typically 6 mm to 10 mm in external diameter

3.2.4

unglazed piping collector

collector system in which piping (such as black polyethylene agricultural piping) is arranged to act as an absorber on a roof or other base

3.2.5

photovoltaic thermal solar collector

PVT collector

hybrid device used to convert solar radiation to thermal and electrical energy

3.2.6

unglazed strip collector

collector system in which extruded strips embodying multiple fluid passages are arranged to act as an absorber on a roof or other base

Note 1 to entry: The strip is typically around 50 mm to 150 mm in width and made of flexible elastomeric or plastic material.

3.3

collector area

net area measured parallel to the plane of the collector available to admit solar radiation to the absorber

Note 1 to entry: [Figure 3.1](#) illustrates the width dimension used in calculating the collector area for different collector types.

3.4

collector array

group of solar collectors that are closely connected in series, in parallel, or a combination of both modes, with one hydraulic input and output

3.5

collector efficiency

ratio of the thermal power removed by the heat transfer fluid to the product of the defined collector area and the solar irradiance on the collector

3.6

differential temperature controller

device that detects a small difference between the pool water temperature and the roof temperature (or return line water temperature), and controls pumps and other electrical devices in accordance with this temperature difference

3.7

direct system

system in which pool water passes directly through the solar collectors

3.8 draindown

draining of the fluid from the collectors and associated pipework

Note 1 to entry: Draining prevents frost damage and/or heat distortion/damage to the fluid passages due to system stagnation.

Note 2 to entry: Draindown may be either automatic, occurring when the pump circulation ceases, or manual.

3.9 flat roof

roof where the pitch is less than 10°

3.10 indirect system

system in which the heat transfer fluid passing through the solar collectors is kept separate from the pool water, and where heat transfer takes place through a heat exchanger

3.11 may

indicates the existence of an option

3.12 outlets

openings in the pool wall or floor, other than a skimmer box, through which water is drawn from the pool by a pump

3.13 reverse return

arrangement of collector manifolds and inlet/outlet locations such that all fluid paths through the collector module offer approximately the same resistance to flow, and result in even flow through all collector elements as well as eliminating airlocks

3.14 shall

indicates that a statement is mandatory

3.15 should

indicates a recommendation

4 Collectors

4.1 Materials

Materials in contact with pool water shall be such that they will neither contaminate the water nor become corroded under normal service conditions. Guidance on the correct maintenance of water in private swimming pools and on desirable properties of pool water is given in AS 3633. Materials shall be resistant to degradation due to ultraviolet radiation. This is particularly important for organic materials.

Metals are normally unsuitable for the fluid passages because there can be rapid corrosion resulting in failure of collectors and rust staining of pool walls and fittings. Not all grades of stainless steel will resist corrosion in these applications; grade 316 type should be used.

NOTE Copper may be used as fluid passages for direct circulation solar collectors, but it is important to maintain the pH of the pool water within limits set out in AS 3633 to reduce corrosion. This, together with the correct total alkalinity and free residual chlorine level, will prevent undue corrosion/erosion of copper pipework at flow velocities up to 2.2 m/s.

4.2 Collector location

4.2.1 General

Collectors shall be located so that the pipe runs are as short as practicable in order to reduce heat losses and pumping energy requirements.

4.2.2 Orientation and inclination

For systems installed to heat domestic pools the actual inclination (and orientation) will often be dictated by the nature of the roof space available on buildings upon which the collectors are to be mounted. Where there is a choice, collectors should face a northerly or northwesterly direction. However, variations to the east and west are allowed with an appropriate sizing correction factor as indicated in [Figures D.1 to D.7](#).

Examples of the effect of non-ideal orientation and inclination are given in [Appendix D](#).

NOTE As a general principle for maximum season length extension, optimal collector inclinations are those closest to the noon sun inclinations presented during the heating season months.

4.2.3 Shading

Collectors should be located so as to be clear of shade from objects in front or to the north of the collector for at least 6 h each day during the pool heating season.

4.2.4 Site exposure

Unglazed collectors are particularly subject to losses due to wind. Accordingly, for windy sites, consideration should be given to the use of increased collector area, see [Clause 4.5](#) and [Figure 4.2](#).

NOTE Windbreaks around the pool will also assist in reducing heat losses from the pool surface.

4.3 Mountings

The forces due to collector deadload and any wind load shall be such that the resultant loading on any supporting building structure does not exceed the provisions of the applicable building regulations for the installation site. Manufacturer's recommendations regarding mounting systems and fastenings shall be followed, taking into account the forces caused by wind lift, to which the collectors may be subjected in some circumstances. Where collectors are to be mounted on conventional building structures, reference should be made to AS 1170.2 to obtain an estimate of the wind loads that may be encountered.

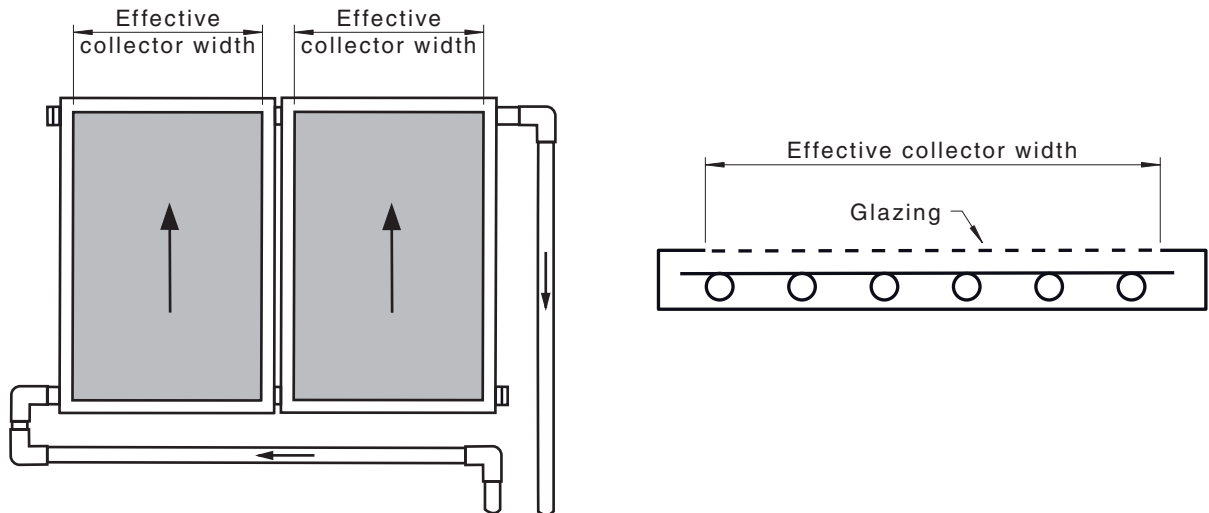


Figure 3.1(a) — Effective width for various collector types — Glazed flat plate collector

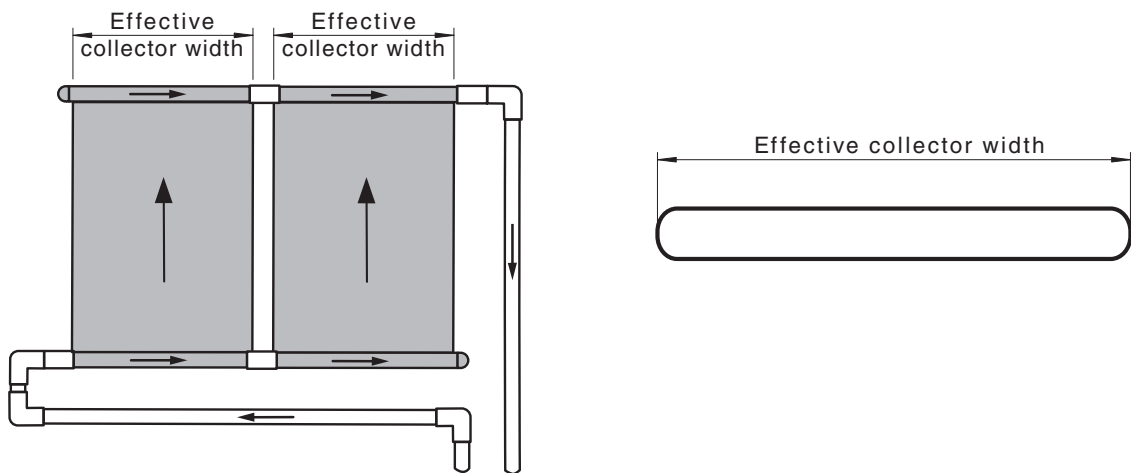


Figure 3.1(b) — Effective width for various collector types — Unglazed flat plate collector

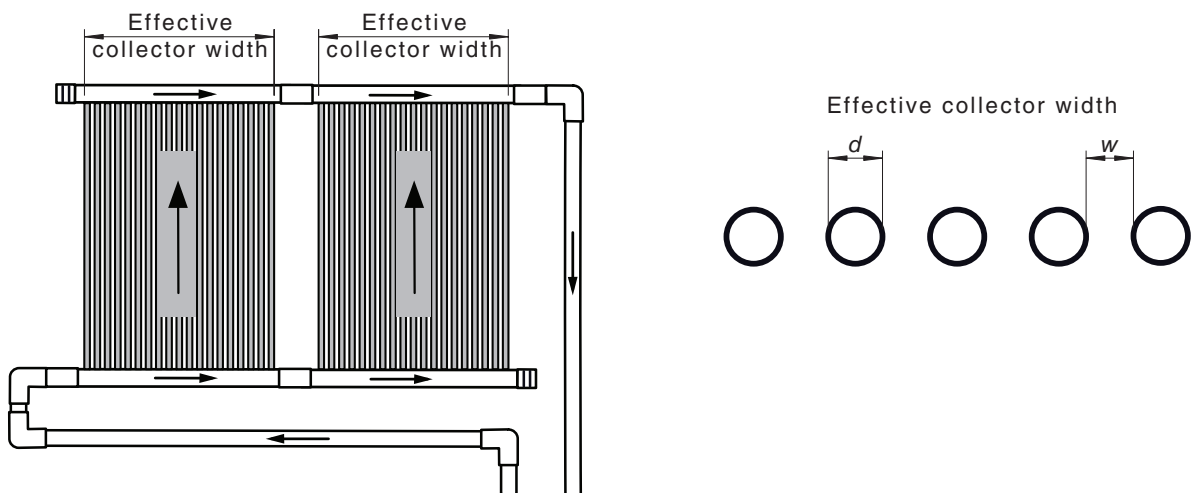
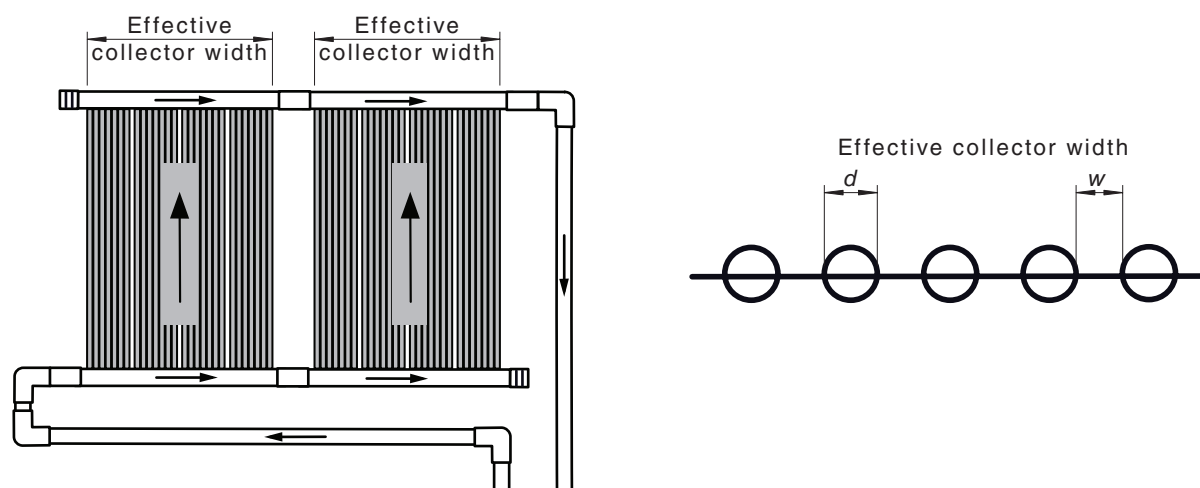
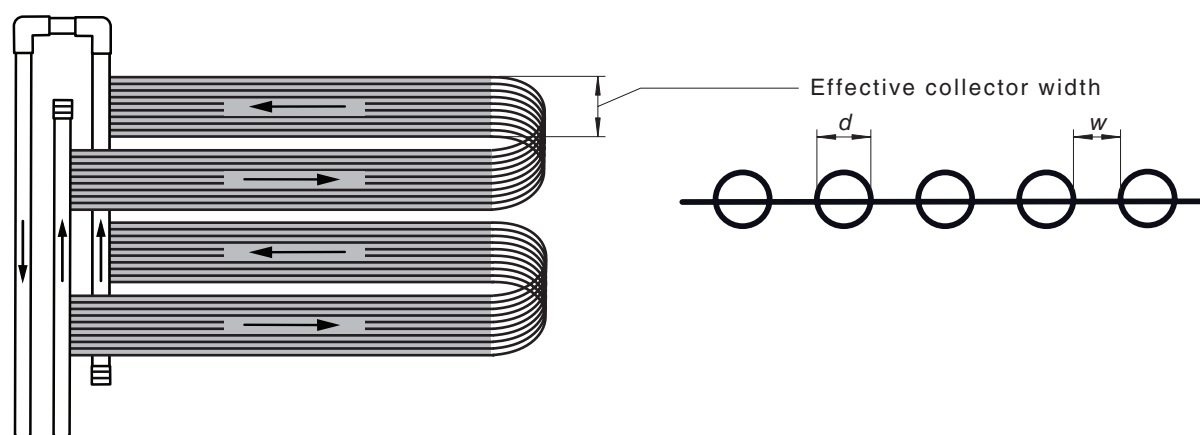


Figure 3.1(c) — Effective width for various collector types — Unglazed blow moulded collector

**Key**

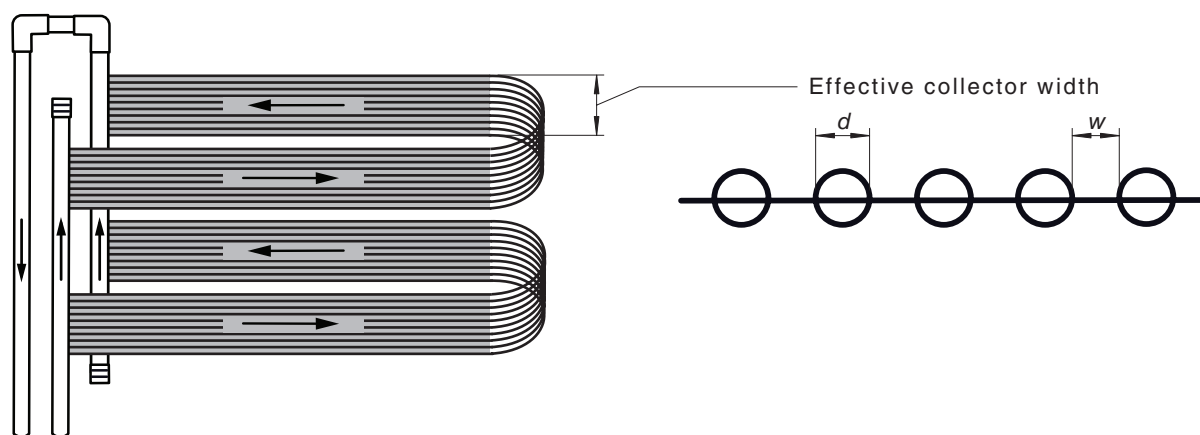
The effective collector width is $n \times (d + w)$, where n = number of tubes per collector, d = tube diameter and w = gap width between adjacent tubes. The maximum allowable gap widths w , that may be counted as part of the effective collector width is: $w \leq 0.25d$. This is not to be interpreted as a design criterion for unglazed rigid tube collectors

Figure 3.1(d) — Effective width for various collector types — Unglazed rigid tube collector

**Key**

The effective collector width is $n \times (d + w)$, where n = number of tubes per collector, d = tube diameter and w = web width between adjacent tubes. The maximum allowable web widths w , that may be counted as part of the effective collector width is: $w \leq d$. This is not to be interpreted as a design criterion for unglazed rigid webbed tube collectors

Figure 3.1(e) — Effective width for various collector types — Unglazed rigid webbed tube collector



Key

The effective strip width is $n \times (d + w)$, where n = number of tubes per strip, d = tube diameter and w = web width between adjacent tubes. The maximum allowable web widths w , that may be counted as part of the effective strip width is: $w \leq d$. This is not to be interpreted as a design criterion for flexible strip collectors

Figure 3.1(f) — Effective width for various collector types — Flexible strip collector

Mountings and fastenings should be resistant to corrosion and should not cause rainwater leaks or work loose because of wind vibration.

Collectors shall be mounted so as to avoid capillary or other retention of water, or the accumulation of debris between the collector and the roof. This is particularly important in the case of unpainted metal deck flat roofs at a low angle, where strip collectors should be run across the ribs rather than along the channels.

Where collectors are mounted directly on the ground, the foundation should provide sufficient support to prevent movement, which might damage pipework connections, and be capable of supporting the dead weight of the covering and any expected traffic load without damage.

4.4 Interconnection of panel collectors (unglazed or glazed)

4.4.1 Flow distribution

When using panel or strip collectors interconnected to form an array, the connections should primarily be made such that water is introduced in parallel to all collector array elements (see [Figures 4.1\(a\) and \(b\)](#)).

NOTE 1 The use of series connection (see [Figure 4.1\(c\)](#)) should not be used as this will increase the pumping power requirement for a given flowrate, or cause the downstream collectors to operate at higher, less efficient temperatures. Parallel connection, in which the water returns to the pool after passing through one collector, avoids these problems.

[Figures 4.1\(a\) and \(b\)](#) illustrate the recommended arrangements, with the line from the pool entering the parallel row at one end and the line to the pool being taken from the far end (reverse return), with the guiding principle being that all water paths should have an equal distance and hence resistance to flow.

NOTE 2 Connection of both lines to the same panel at one end of a parallel row (see [Figure 4.1\(c\)](#)) may mean that those panels at the near end short-circuit the flow, while those at the far end receive less flow and suffer a reduction in performance. Such an arrangement should only be used where the pressure drop in the headers is very much less than that in the fluid passages across the panels.

The flow paths to and from the pool shall be designed so that the flow through all passages is balanced and approximately uniform, such that no flow passage outlet of the system has a temperature higher

than 5° above the mean for all flow passage outlets, measured near solar noon on a clear day. This can be achieved by the layout of the plumbing (reverse return) or the use of balancing valves.

Balancing valves may be used to obtain uniform flow distribution when site requirements make it impractical to balance the flow with simple plumbing arrangements. If required, balancing valves should be installed in the line returning water to each group of collectors. Upon commissioning (see [Clause 9.2\(e\)](#)) the balancing valves shall be adjusted to give uniform flow through the panels.

Groups of collectors at different heights should be connected in such a way that they all receive water from the lowest point in the system and return it from the highest point. If the lines to the collectors do not come from a common height, flow through the panels can be uneven, causing a reduction in performance. A balancing valve may, in any case, be required to reduce the flow rate in the lower collector(s).

4.4.2 Connections

Connections between modules and between panels, as well as main pipework, shall accommodate variations in alignment at installation and movement due to thermal expansion in service. The material of the connections shall be no less durable than that of the piping under the conditions of use. The arrangement of strip collectors will be largely governed by the nature of the roof or other structure upon which they are installed.

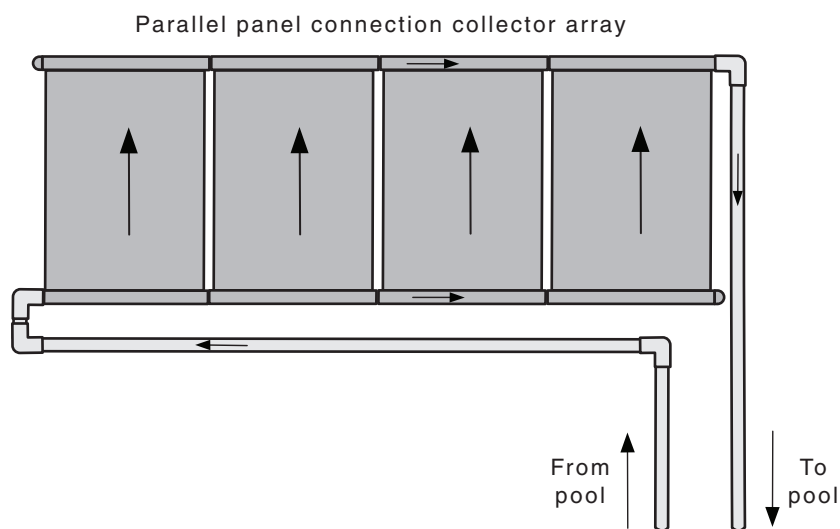


Figure 4.1(a) — Parallel connection of panel collectors (pipework arranged for reverse return)

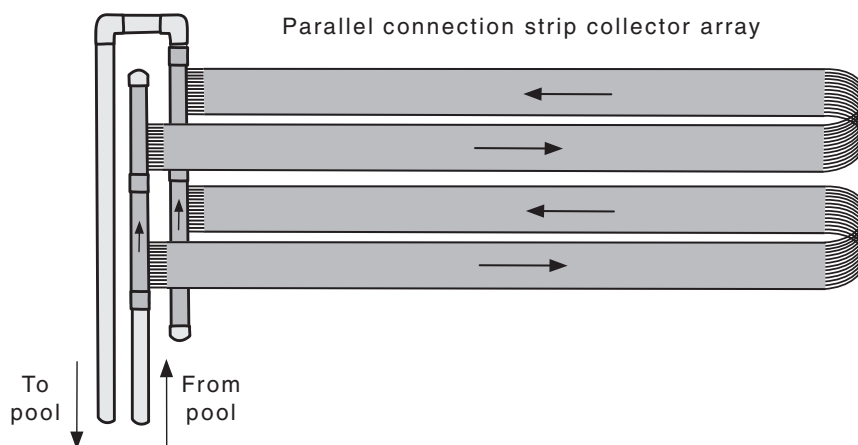


Figure 4.1(b) — Parallel connection of strip collectors (pipework arranged for reverse return)

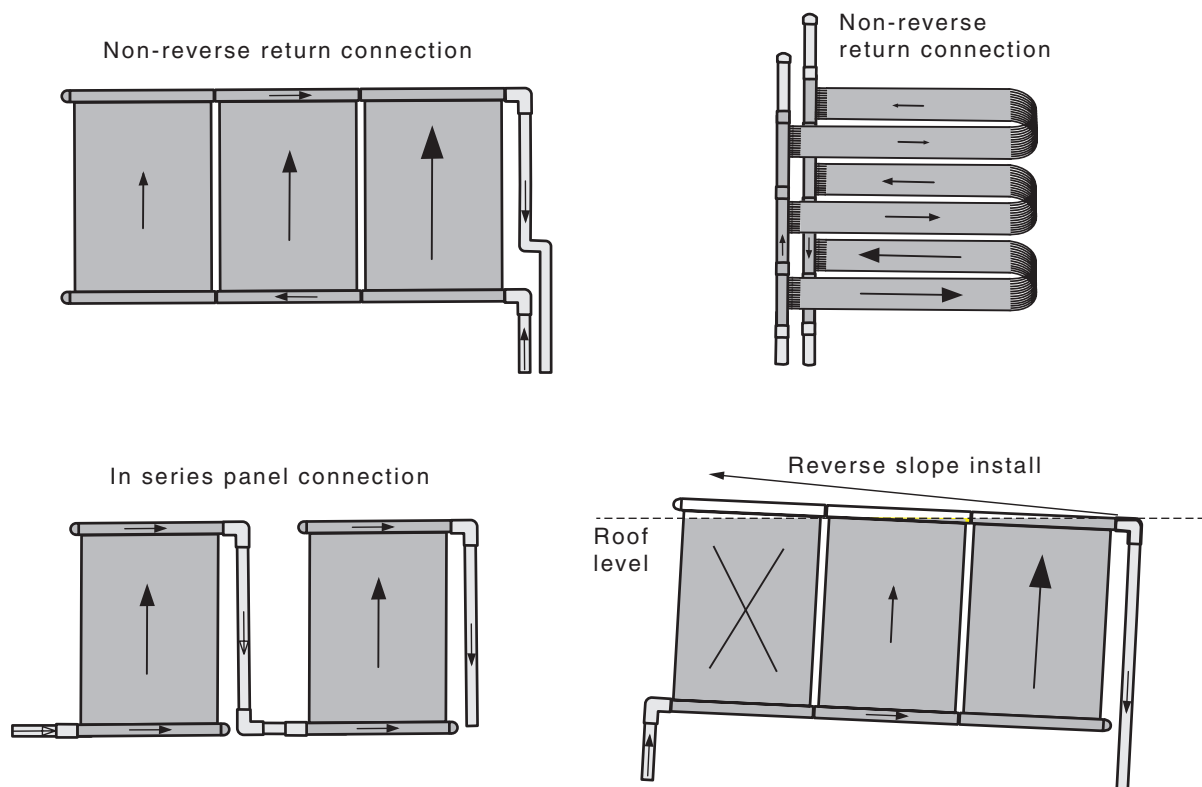


Figure 4.1(c) — Water flow configuration not recommended

4.5 Collector sizing

4.5.1 General

The collector area installed is one of the most fundamental aspects of solar pool heating system design. The extent to which the collector area is needed will depend on the operational requirements of the pool, including the following:

- (a) Whether a requirement exists for a specified temperature to be maintained, as may be the case in pools used for sporting or therapeutic purposes, or whether a varying temperature rise is acceptable, such as in a private pool.
- (b) Whether the swimming season will be all or part of the year.
- (c) Whether or not the solar heating system is to be used to reduce the fuel costs of an existing fossil fuel heater.
- (d) Whether the purchaser wishes to have an indication of the likely performance of the system in regard to temperature and extension of the swimming season.

Different design philosophies exist and are described briefly in [Appendix A](#). Factors that should be considered include —

- (i) Location factors including local climate.
- (ii) Site specific factors —
 - (A) shading of roof or pool;
 - (B) roof slope and orientation;