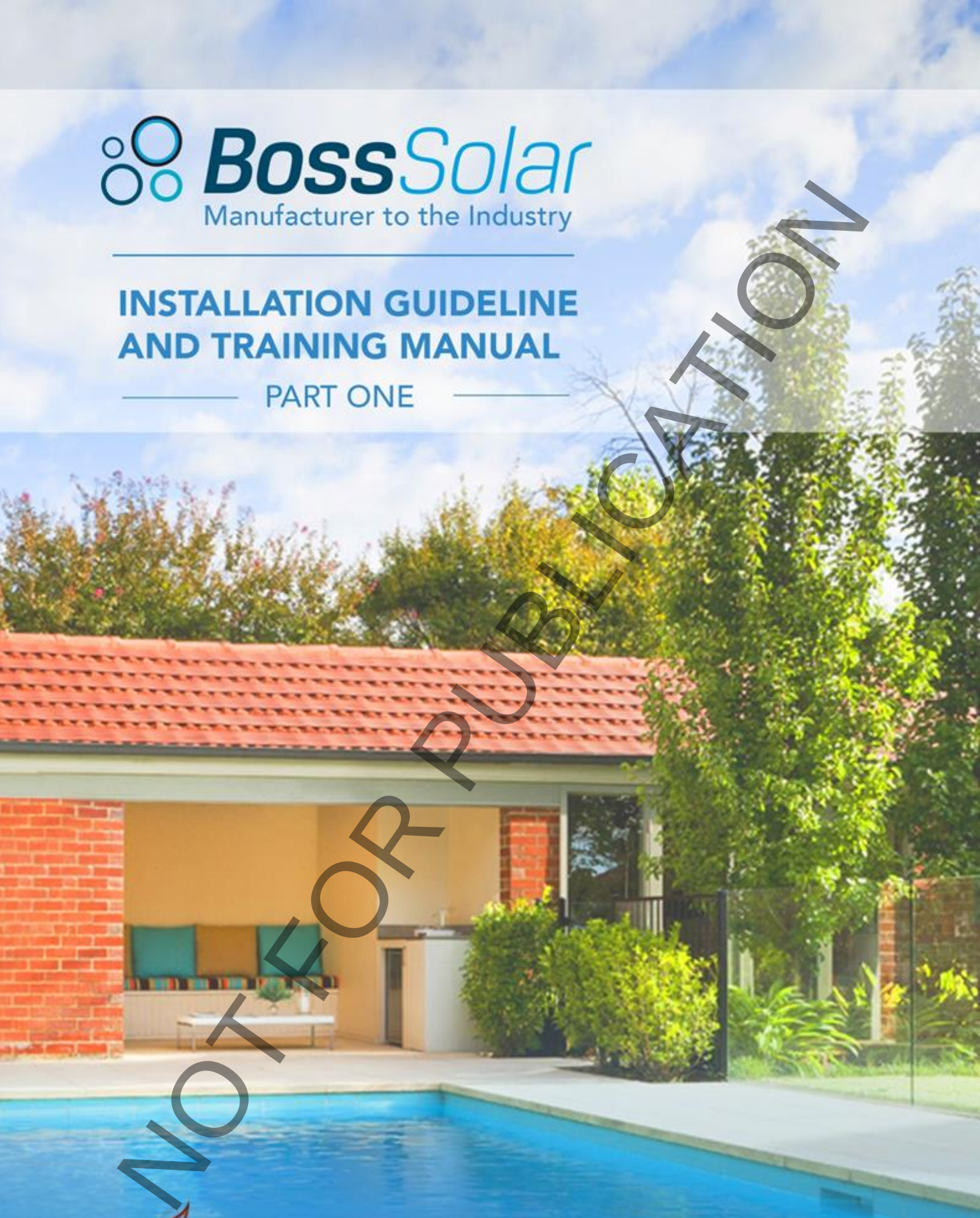
BossSolar
Manufacturer to the Industry

INSTALLATION GUIDELINE AND TRAINING MANUAL

PART ONE



MultiLayered
CUSTOM SOLAR POOL HEATING SYSTEM
FOR THE POOL PROFESSIONAL

Celebrating 20 Years 1991 2011

Document Reference: F650 01 1016

1. INTRODUCTION

1.1 About Boss Solar

Boss Solar (Boss) is a Melbourne based manufacturer of an extensive range of solar pool heating products, which it on-sells to Solar Pool Heating Companies (SPHC) / Installers across Australia. Boss supplies its solar products with the express expectation that the system will be installed by an experienced, competent installer and in accordance with all relevant BOSS Installation Manual and Australian Standards.

As a service to the industry, Boss offers technical support and advice regarding the proper installation of Boss products. This is available to professional installers via the Boss Solar Trade Portal, or upon request by contacting Boss on sales@bosspolymer.com.au. Alternatively you can request a copy over the phone during normal business Australian Eastern Standard Times (AEST) on +61 3 9561 2777.

1.2 Purpose and Scope

The intention of this guide is to equip the reader with the comprehensive knowledge and skills to design, install, operate and maintain a Boss Solar System. Guidelines and recommendations are derived from relevant Australian Standards and industry best practice and knowledge. They form the basis on which the Boss MultiLayered Customised Solar System and Ancillary Solar Components are designed and manufactured.

This manual cannot cover all possible installation configurations, and does not include advice on non-Boss components.

Boss also welcomes constructive feedback in order to ensure that this installation guide and training manual remains relevant to Boss clients and the Pool Industry in general. Any Pool Professional who wishes to offer technical details / images for consideration in future revisions of this manual please email sales@bosspolymer.com.au

1.3 Relationship to Boss Product Warranty

The SPHC must understand that proper installation is critical to the performance, efficiency and longevity of the system and Boss products. Incorrectly or poorly installed and maintained systems are not covered by the Boss warranty.

Note: *Boss acknowledges that there are a number of highly regarded SPHC / Installers, whose solar pool heating systems do not strictly adhere to the recommendations and guidelines set out in this manual (either by using non-Boss components and / or alternative installation methods)*

– whether as a result of historical geographical preference or their own "time-proven" methods. On the strict condition that Boss is satisfied that any system / component failure is not the direct result of any deviation from this manual, Boss will warrant all Boss manufactured components in accordance to our Standard Component Product Warranty (Standard Warranty).

To ensure that all Boss Solar Systems and Components function correctly and perform as intended, and the system is eligible for the Boss Extended System Warranty (Premium Warranty), all recommendations presented in this manual should be adopted by the SPHC / Installer. Failure to do so **may** affect the Boss Premium Solar Warranty.

As the manufacturer, Boss has little control over person/s responsible for the installation, how Boss products are installed, commissioned or maintained. Therefore it must be understood that the Boss product warranty is limited to manufacturing defects in workmanship or material of the Boss products only, and does not cover issues shown to be outside of Boss's Control. Failures or claims shown to be the result of poor or incorrect installation, commissioning or maintenance will not be covered. The table below displays warranty Icons to distinguish strict recommendation adherence and warranty levels.

STANDARD WARRANTY PRE-REQUISITE
Boss advises that this product and/or recommendation must be included or adhered to. This product and/or recommendation are a requirement of the relevant Australian Standard or minimum Industry Best Practice. Omission will automatically void all/any warranty.

STANDARD WARRANTY RECOMMENDATION
Boss strongly recommends that this product and/or recommendation is included or adhered to. Omission will not automatically void the standard component warranty, but it is incumbent on the SPHC to demonstrate that any component failure is not the result of the omission of this product or recommendation.

PREMIUM SYSTEM WARRANTY (EXTENDED WARRANTY) PRE-REQUISITE
Boss advises that this product and/or recommendation must be included or adhered to if the Premium System or Extended Warranty is required. Omission will automatically downgrade the warranty from the Premium System (Extended) to the Standard Component Warranty.

DESIGN RECOMMENDATION
Boss strongly recommends that this product and/or recommendation is included or adhered to. This design recommendation is based on the principles that Boss solar products have been designed and manufactured to. Omission will not necessarily affect any warranty, but will ensure that the Boss system will operate to its optimum potential.

1.4 The Solar Pool Heating System

The Boss MultiLayered Customised Solar System is designed to be installed either as a "U" Loop or a "S" Serpentine (Butterfly) pattern across the roofs surface. The system allows the installer to custom make a tailored system to suit the size, configuration and shape of virtually any roof or structure using bulk coils and components. A custom made tailored system, offers the unique advantage of maximising the solar collecting coverage on virtually any available surface, in order to maximise heat absorption for virtually any solar installation.

The MultiLayered System allows the SPHC to select the most suitable solar collector, from a variety of different Boss strip collector profiles, to suit the particular installation requirements and customer expectations.

The MultiLayered range of strip collector profiles include our "State of the Art" patented composite co-extruded collector range, NanoTek, Ultimate Blue, Venetian Blue and our highly acclaimed Triple Black. The Triple Black Collector has been industry proven and is the only Australian made Strip Collector with SRCC certification when used in conjunction with the TufMan manifold system, see Appendix 3.

All of the MultiLayered Systems range of profiles are produced in our Melbourne manufacturing plant, using compounds that meet Australian Standards AS 2369.2-1993. They are supplied in bulk coils, designed to suit the SPHC specific needs and requirements. Collectors range from pallet coils of 120 linear metres x 7 coils per pallet, through to easy to handle individual coils of 27 linear metres x 35 coils per pallet.

- Most of our Collector profiles are available in a range of options, 10, 12 and 14 tubes x 6mm or 8mm bore x 150mm to 160mm wide, black outer or coloured Venetian (designed to match most of the common Colorbond colours).
- Tube Connection - Collar and Barb.
- Collector Layout - Custom installed Loop or Serpentine with the optional TufReturn Flat Loop Manifold.
- Manifold System - Supply / Return - TufMan 10, 12 or 14 Tube, 6mm or 8mm barb, 400mm and 500mm long.
- Ancillary Components - All the components a Pool Professional requires to install a high quality, Australian made MultiLayered customised solar system.
- Supplied in bulk, coils, pallets and boxes.

1.5 Solar Basics

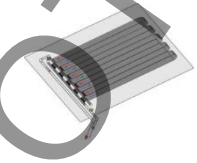
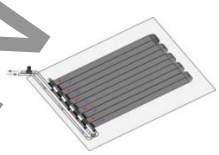
The purpose of a pool solar heating system is to capture and collect solar energy, convert it to heat and raise the temperature of the water in the swimming pool. Installing solar pool heating can increase the use of your pool by up to four months. By using the free energy from the Sun, heating a pool is very efficient and economical. The types of solar pool heating systems can vary, but the basic principles remain the same. The efficiency of the system depends on how well the basic solar fundamentals are applied in its design and installation.
Refer to Appendix 2 for further information

1.6 Safety Precautions

The Boss MultiLayered System should only be installed by industry trained and competent professionals. Always exercise extreme caution, care and good judgment when working on or around a roof or pool area. There is no substitute for safety, do not use short cuts. The installer of any Boss Solar Pool Heating System (or component) must accept full responsibility for assessing and implementing safety systems and procedures in accordance with all regulatory and moral requirements. The potential to fall from a roof is a major risk along with electric shock and exposure to harmful U.V. radiation and heat exhaustion. It is expected that the Installer(s) installing the system have been inducted, trained, and authorised by the SPHC regarding but not limited to; the competency of the installer/s, safety harnessing, scaffolding, safety railing, suitable footwear, roof access methods, electrical shock hazards, weather conditions, roof condition, pitch angle, and sun protection are all critical in determining suitability of allowing personal onto a roof as an installation working platform.

1.7 Quick Reference FAQ

The intent of this table is to equip the professional SPHC with a quick reference to Frequently Asked Questions FAQ and the corresponding chapter section (note: average sized, and correctly installed system).

	The Boss MultiLayered System should only be installed by industry trained and competent professionals. Please read this manual carefully, as failure to adhere to these guidelines may void your warranty. Should you require any clarification, please contact our head office within normal business hours, on (03) 9561-2777 and request to speak to one of our technical sales consultants, or alternatively email us at sales@bosssolar.com.au.	SWP
	100% or more of collector for Australian Southern States, 60%, 70% or more for Northern Australian States. ***Refer to www.bosssolar.com.au/solarcalculator/ and section 3.1***	DR
	6.67 linear meters of collector = 1 m2 27 linear metre coil = 4 m2 ***Refer to section 3.6.1***	DR
	Mounting location in order of preference: (1) North (2) flat (3) West (4) East Note: South facing roofs are not recommended. ***Refer to section 3.2***	DR
	**Bottom Feed** systems will automatically fully drain (recommended). ***Refer to section 3.8.1 and 3.11***	DR
	**Top Feed** systems will **not** automatically fully drain (not recommended) ***Refer to section 3.8.2 and 3.11***	DR

Install the **TufMan manifold system** nearest to the solar pump and filtration system, with the Loop Return or TufReturn™ installed further away.

Refer to section 3.8.3

DR

1.8 to 4.8 litres per minute per square metre of collector (reference AS3634 8.1a) and a system hydraulic pressure appropriate to the installation.

Refer to section 3.7 plus 6.5

DR

- **Bottom Feed** Systems: 100* kPa max (15 psi)
- **Top Feed** Systems: 50* kPa max (7 psi)
- **All** systems should have a small positive pressure.
- **Drill size 8.5 mm**

SWP

* Designed and installed to automatically fully drain with a TufFilta water strainer fitted as per this manual
Refer to sections 3.12 and 6.5

PSW

- No Primer or Solvent
- Apply Glue to **Male End ONLY**
- Max Five Divisions (50mm)
- Remove Excess Glue
- Securely Install TufMan™ to roof in a manner which allows for thermal movements of all components, without inducing linear or lateral stress to any section of the Manifold System.

Refer to Appendix 1

SWP

Every solar system should be installed with a **Drain Tube**.

- Drill size 8.5 mm

Refer to section 3.8.8

SWR

PSW

Ensure that the VacRel® is positioned at the **highest point** of the system with the centre line of the VRV as **vertical** as possible.

- Bottom Feed Systems - **Supply** line.
- Top Feed - **Return** line.

Refer to section 3.8.4

SWR PSW

All systems Top Feed and Bottom Feed should be installed with a flow **balance pipe** allowing the water to enter the bottom of the Supply Manifold, flooding the Collector tubes as well as the Return Manifold as it fills the System from below, in a direction moving up the roof.

Refer to section 3.8.7

SWR PSW

Ultimate Blue (10, 12 & 14 tube) ----- 9.25mm
Venetian Blue (all Colours) ---------- 9.25mm
NanoTek ---------- 10.0mm

PSW

All systems should have a TufFilta Installed.
Systems installed with poor or inadequate water straining, (refer AS 3634-1989 6.2) have the potential to cause blockages due to foreign matter.

Refer to section 3.10

SWR PSW

Refer to AS 3634-1989 Section 9 and ensure that all the relevant testing, procedures and documentation as detailed in AS 3634-1989 Section 9 and this installation manual are all followed and that your handover and warranty documentation is thorough and comprehensive.

SWR PSW

CONTENTS

2. THE MULTILAYERED SYSTEM GROUP OF COMPONENTS

The Boss MultiLayered System consists of various components listed below; when these are assembled together to form a solar pool heating system, they are referred to as 'The System' within this manual.

2.1 The Collector Range

The Boss MultiLayer Collector Range utilises the latest patented technology, available only from Boss Solar. With the ability to employ up to four different materials into a single profile the Boss MultiLayer Collector Range is the most technically advanced and best performing strip collector profile range on the market today.

PSW Nano***Tek Collector*** ™

NanoTek Graphitic Composite Collector combines BOSS patented technology with high-tech Nano Polymers, creating a World's first in solar collectors. NanoTek uses Nano Graphitic technology to allow pool owners to enjoy the same heating capacity with up to 40% less collector coverage, or greatly improved heating performance from the same collector coverage.

The high performance MaxBlack outer tube and web compound has been specifically formulated to provide:

- Improved Solar Thermal Absorption
- Premium UV and weathering resistance package
- Increased toughness, durability and resilience against mechanical damage and puncturing

The high tech Nano Graphitic inner tubes:

- Transfer the Sun's Energy t the water flow 30%* faster than standard solar collectors
- Have a larger 8 mm diameter, which equates to 18%* more water flow than standard 6mm tubes
- Results is a Solar Collector that is 40%* more efficient, meaning that you get more heating, with less roof coverage

Ultimate *Blue* ™

Ultimate Blue ™ forms the foundation of the Boss MultiLayer Collector Range. It is available in 10, 12 and 14 tube profiles, plus 10 tube punched. The distinctive inner blue tube utilises a Boss designed material that has been specifically formulated for:

- Maximum Chemical Resistance
- Improved Flex Fatigue Resistance
- Improved Shape Retention
- Increased Resistance to pressure
- Ease of installation and optimum sealing around manifolds and barbs

Ultimate Blue is manufactured using a High Performance UV Maax Black compound outer tube and web, which has been specifically formulated to provide;

- Improved Solar Absorption
- Premium UV and weathering resistance package
- Increased toughness, durability and resilience against mechanical damage and puncturing

Triple Black ™

Triple Black™ is a MultiLayered solar collector as the name suggests, tested and rated by SRCC, the Triple Black Collector has been industry proven in the harsh Australian Conditions over many years and is the only Australian Made Strip Collector with SRCC certification when used in conjunction with the TufMan manifold system, see Appendix 3: Boss Solar Solutions - SRCC

This highly acclaimed 10 tube x 6mm bore x 150mm wide collector is manufactured in our Melbourne Plant from multiple layers of heat conductive, UV resistant, lead free, flexible, black PVCn compound to Australian standards AS 2369.2-1993
(NoSH formula available upon request) *

PSW Venetian **Blue** ™

The Venetian Solar System allows you to gain many of the benefits of a traditional black solar system, without impacting upon the aesthetic appeal of your house. The secret behind the Venetian system lies with the patented co-extruded composite technology, utilizing multiple compounds in the same profile. The predominant back and top section of the collector that faces the sun is black to enable optimum heat absorption, while on the visual leading edge of each tube has a co-extruded coloured strip, your eye sees only colour as the panels blend into your roof, creating the ultimate illusion of full colour.

AVAILABLE IN STANDARD COLOURS TO SUIT POPULAR ROOFING:

Surfmist	Shale Grey	Dune	Jasper	Woodland Grey
Wilderness	Cottage Green	Headland	Manor Red	Deep Ocean

- Buy only what you need.
- Boss stocks most popular colours so you don't have to.
- Combine colours or top the pallet up with black to suit your needs.

- Colour without compromise.
- Similar warranty and heating efficiency as a black system.

2.2 The Manifold System

	Definition
TufMan™ PSW	TufMan manifolds, High temperature black *BASF LURAN S™* ASA, supplied in either 400mm or 500mm long with the option of 10, 12 or 14 tube configurations by either 6mm or 8mm barb size to suit
TufTrak™ PSW	Manifold track, to fix the TufMan manifold Header system into position and allow for linear expansion and contraction without induced stress - High temperature black ASA
TufCover™ PSW	Clips into the TufTrak to protect and colour match the TufMan / TufPipe to the Venetian Coloured collector, UV resistant flexible PVCn (NoSH formula available).
TufClip™ PSW	Fastens the TufMan to the TufTrak, High temperature black ASA.
TufReturn™	Freeze crack resistant loop return manifold, Joins 10 tube Strip collector at the loop return end, High temperature black ASA body with 2 x internal Silicone Rubber Bladders, 305mm long (optional colour matched cover for Premium systems).
TufColar™ PSW	Rigid locking collars, slides over the outside the Collector tube to permanently lock and seal the collector tubes onto each individual barb, High temperature UV resistant black Nylon, available in 9.0, 9.25, 9.5 and 10mm to suit.
VacRel® PSW	High efficiency Vacuum Relief Valve (VRV) designed to allow filtered air to easily enter the system with only 10 mBAR resistance during drain down and 70mm² of non impeded air flow. High temperature black BASF LURAN S™ ASA body components with a Viton™ rubber Vernay USA Umbrella Check Valve™ and a 316 stainless steel mesh filter
TufPipe™	40mm pipe used for the balance, supply and return lines, High temperature black ASA

2.3 Specialist Components and Hardware

	Definition
Solar Pump	High quality Australian made pump
Digital Controller	Aquasun Digital Controller, Australian made, Controls the pools temperature by automatically switching the solar pump on and off based on the thermocouple temperature readings of the pool water and available solar energy
TufFilta 	Australian made In-line cartridge water filter/strainer, UPVC body and PMMA clear bowl with a disposable interchangeable filter element
PVC Fittings & Pipe	90 degree elbows, 45 degree elbows and end cap, black pressure pipe fittings, manufactured to Australian Standards from either black or white UV resistant UPVC
TREMsil® 870 Adhesive 	Collector to roof adhesive, high strength flexible, neutral cure, 100% Silicone RTV adhesive in 300g net gun-able tubes. Used to secure the collector to the roofs surface. TREMsil® is suitable for clean tile and metal roof surfaces; it creates an ultra-strong permanent bond with no acidic contamination to rainwater run-off in gutters and water tanks (available in neutral or black colour)
TufBarbs™ 	Joins and repairs collector tubing. Made from high temperature black ASA, it is designed to be used in conjunction with 2 x TufCollars.
TufValve ™	Two way rotary valve; used to control flow and pressure – UPVC.
TufGauge 	Pressure Gauge, used to measure and monitor the hydraulic pressure within the collector.
TufTape	Double sided PE reinforced black butyl rubber adhesive tape, 1mm thick x 24mm wide x 15 m log roll. Ideal use is on roofs with a steep incline, or on windy days, to assist with temporarily holding the collector in place during installation. When applied at regular intervals, the adhesive tape allows for immediate collector positioning and hold, permitting sufficient time for the primary adhesive (TREMsil® 870) to fully cure

	Definition
Tile Roof Strap	Rubber Hook Strap with corrosion resistant galvanized wire hooks at each end, designed to securely lock 2 strips of solar collector to a roof tile, suits a majority of tile sizes and shapes. Supplied as multiple individual tear out straps per mat with 50 mats per carton. Extruded from UV and weather resistant black EPDM tubing.
Tin Roof Strap	Designed to securely fix solar collector to tin roofing profiles. Extruded from premium UV and weather resistant EPDM, this component is available in 50 metres x 3 cavity coils (150 metres per coil).
Spray Lubricant	Pressure pack can of Silicone Lubricant. Aerosolve 302

3. DESIGNING THE SYSTEM

When designing the System, all factors within this chapter must be taken into account. In particular the considerations required to plan a correct system and layout for optimal efficiency, longevity and aesthetic appeal. This chapter is devoted to system design considerations before installation. It is expected that the Installer is fully aware and competent with all aspects discussed in this chapter, prior to beginning the installation process.

> ***Note:*** *At the time of the quotation the SPHC should determine the expectations of the customer, and as far as practical, design the System to meet those needs. The purpose of this manual is to assist the SPHC in designing and installing the MultiLayered group of components. It is based on the assumption that the System is intended to be used:*
>
> - *in Australia*
> - *for an average sized collector area (e.g. 20m2 to 60m2 with a maximum flow length of 30 linear metres)*
> - *for a domestic system mounted on a roof/s close to the pool*
> - *on an average one, or two story building,*
> - *on a common type and constructed tiled or metal roof above the pool level (i.e. the system is able to automatically drain down), and*
> - *directly exposed to the sun for the majority of the day*

Larger or unusual installations and / or commercial pools will most likely require additional considerations.
If in doubt the SPHC is strongly advised to contact BOSS prior to undertaking such an installation.

3.1 Determine How Much Collector is required

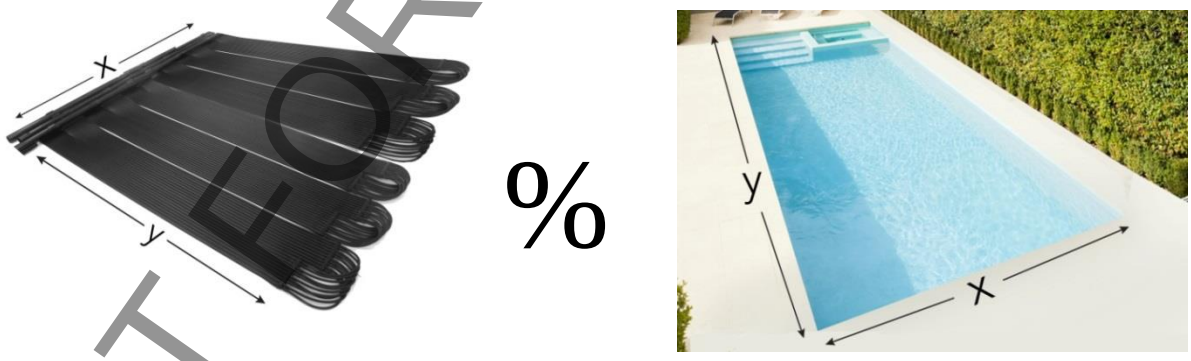


Figure 1: Collector Surface Area vs. Pool Surface Area

1. The first thing to do is calculate the surface area of the pool, to do this for a rectangular pool; multiply the width of the pool by its length: width x length = surface area.
   (e.g. if the pool is 9 metre x 5 metre the surface area of the pool is 45 square metres (m^2).

2. The next thing to do is to determine and calculate the required amount of collector to be installed.
   The total quantity of collector required must be large enough and correctly positioned on the roof to heat the pool efficiently.

The amount depends on many factors:

- **Customers Expectation:** the higher the expectation the greater percentage of Collector required
- **Pool Blanket:** the use of a pool blanket will greatly improve the efficiency of a solar system by reducing the heat loss only during the periods of time that the pool blanket is fitted. The less time the blanket is fitted, the greater percentage of Collector required
- **Climate:** colder climates will require a greater percentage of Collector compared to warmer climates
- **Pool:** surface area, depth, volume, shading and exposure to wind, colour of the interior surface of the pool
- **Roof:** available suitable roof surface area, pitch, orientation to the sun and shading
- **Proximity to Pool:** The system should be as close as possible to the pool in order to reduce heat loss and pump pressure loss

It is generally accepted that for the average customer and installation*, that a Collector area equal to the surface area of the pool, i.e. 100% of collector will suffice for Australian Southern States (see Figure 1), and 60% to 70%of the surface area will most likely be sufficient for systems installed for Northern Australian States. ***Refer to www.bosssolar.com.au/solarcalculator***

Calculation

To calculate the square metres of Collector required, simple multiply the pools surface area (m²) by the desired percentage (%) and divide by 100.

For example to provide:

- **60%** solar collector coverage for a 45 square metre pool = **27m²** of Collector is required.
- **80%** solar collector coverage for a 45 square metre pool = **36m²** of Collector is required.
- **100%** solar collector coverage for a 45 square metre pool = **45m²** of Collector is required.

3.2 Determining Where to Mount the Collector

The next thing to do is to determine the best location for the Solar Collector panel.
The following factors should be taken into account:

Orientation:

It is important that the System is installed in the optimum roof position in order to gain the maximum solar energy available. In Australia and other Southern Hemisphere countries, North facing pitched roofs (see Figure 2) provide an ideal mounting location, followed by flat roofs; as it has the potential to be exposed to the sun for the longest period of time in a given day.
If this is not possible, then a West facing installation is the next best option, followed by an East facing installation.

South facing roofs are not recommended.

Roof shading from trees, other buildings or other obstacles must be considered when selecting a suitable roof installation site. However, a degree of shading can be compensated by installing a greater percentage of Solar Collector.

> **Note:** *a major advantage of the flexible strip Collector system is that the strip Collector is able to be tailored / customised to suit the needs of the SPHC, thus they can be mounted on virtually any single or multiple roof surface/s.*
> *This allows the SPHC to take full advantage of the available suitable surface/s irrespective of shape/s, or the presence of valleys, ridges or obstructions.*

Figure 2: North Facing Roof and the Sun's Trajectory

3.3 The Roof Pitch and Safety

It is the SPHCs responsibility to adhere to all legal safety precautions. The SPHC is also recommended to follow the Safety Precautions specified in Section 1.4 of this manual. The roof pitch will also affect the retention of the collector to the roof, the Solar Collector may slide or sag between fixing points therefore special considerations are advised.

Roofs with a pitch of over 30 degrees must be approached with caution, and are not advised for the inexperienced SPHC / Installer.

3.4 Determine the Most Appropriate Location for the Manifold System

The 400mm and 500mm long TufMan™ Manifolds allow the SPHC to position the Manifold System virtually anywhere within the Solar System.
The 400mm long TufMan™ is used for the vast majority of U Loop and Serpentine installations where the Manifold System is installed at a right angle to the Collector run (refer to Figures 3 and 4).
For installs where the SPHC requires the Manifold System to match the angle of the roofs hip or valley, the longer 500mm TufMan™ should be used (refer to Figure 6).

When deciding the most appropriate Manifold Design, due attention should be paid to the most appropriate location and layout of the Loop Return, a number of factors should be considered:

- aesthetic appeal
- appropriate design to achieve the desired collector roof coverage
- automatic drain down
- roof obstacles and incursions, and
- locating the manifold system as close as possible to the solar pump

For atheistic appeal, the TufReturn™ Manifolds are a desirable option (refer to Figures 5 and 7).

Figure 3: Serpentine Manifold Design

Figure 4: End Manifold Design

Figure 5: TufReturn™ Loop Return Manifold

Figure 6: 500mm TufMan™

Figure 7: Colorbond ™ metal roof with Heritage green Venetian solar collector, Note the Multiple Roof Surfaces.

Figure 8: Tiled roof with Terracotta Venetian Solar™

Figure 7 depicts a Colorbond ™ metal roof with a Heritage Green Venetian Solar Collector; the design has taken full advantage of the non-rectangular multiple roof surfaces, by bridging a hip and valley, and employing a central Manifold System also known as a Serpentine Manifold Design (see Figure 3). This design requires the Collector to loop back to the Manifold System from either side; the multiple banks of TufReturn Manifolds provide a neat and professional appearance to the install
(see to Figure 5).

Figure 8 depicts a tiled roof with a ”U" Loop terracotta Venetian Solar system, the Manifold System has been installed at one end of the system (see Figure 4).

> ***Note:*** *the Serpentine Collector configuration requires additional design considerations in order to ensure each* ***flow length*** *of collector tubing (between the Supply Manifold and the Return Manifold) is similar in length (refer to Figure 38). This is important in order to achieve a balanced water flow in each length of Collector tubing run across the entire System. The SPHC must also consider flow rates and back pressure within the system, refer to Section 3.7 Design Considerations.*

3.5 Preparing a Schematic Design

At this stage, it is highly recommended that the SPHC prepare a Schematic Diagram with dimensions (see Figure 9). This design should include detailing on the:

- Roof surface
- Location of the Collector System
- Location of Manifold System
- Supply and Return pipe work from the solar pump back to the pool, and
- Relative position to the pool

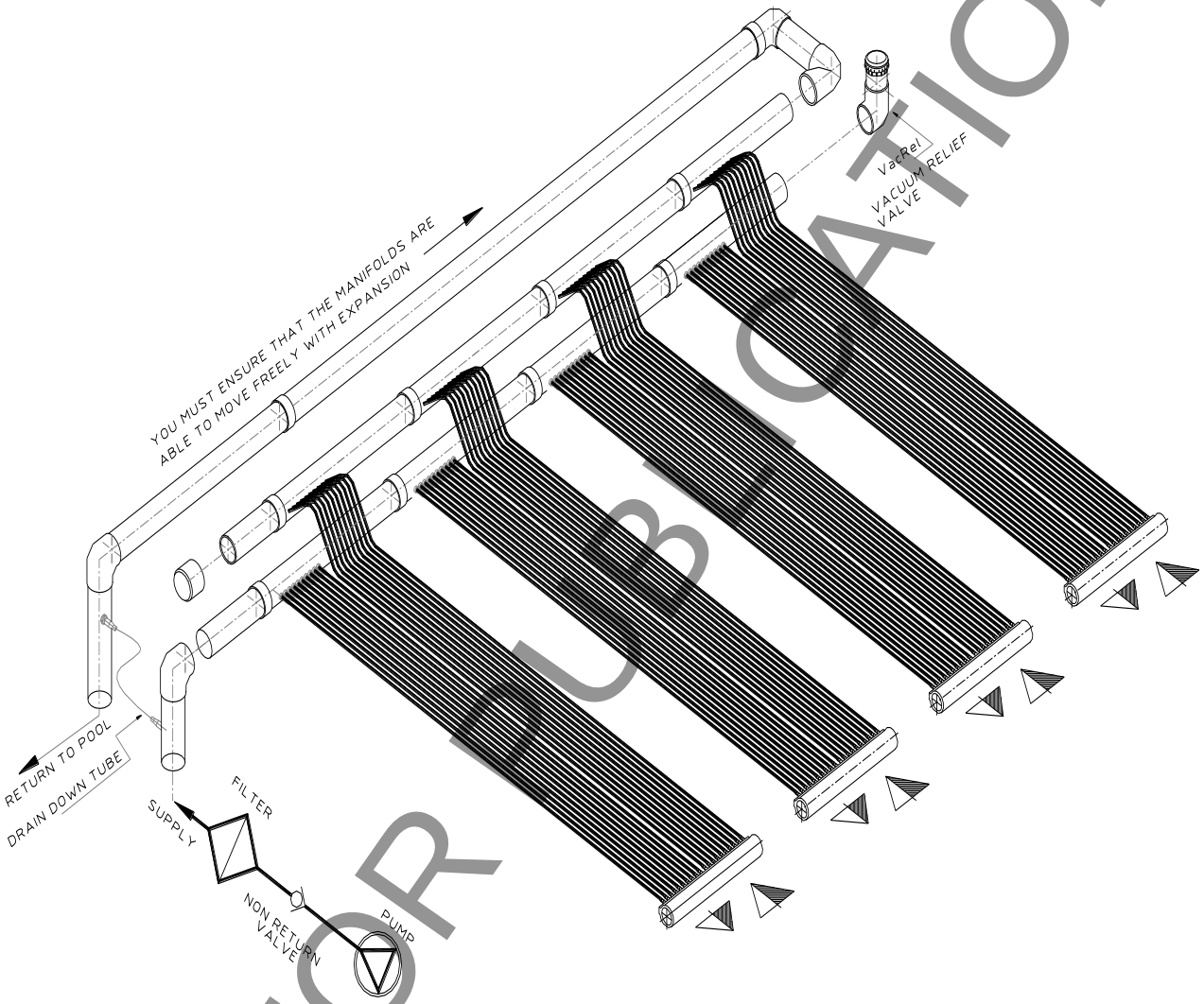


Figure 9: Sample of a Schematic diagram

3.6 Calculating the Required Components

Based on the design of the System, this chapter enables the SPHC to identify and calculate the required amount of MultiLayered Components
(Refer to Section 3.7 Design Considerations for further information).

> ***Note:*** *BOSS components are sold in standard minimum order quantities and lengths, variation from this must be agreed to by BOSS in writing.*
> *Requests that require items to be hand selected and/or box quantities to be broken may be declined or may incur an additional fee.*

3.6.1 - The Collector

Using the Schematic Diagram, calculate the amount of MultiLayered Solar Collector (refer to Figure 10) required for the installation, based on 6.67 linear metres of collector being equivalent to one square metre (m^2) of Collector coverage.

Figure 10: Solar Collector

> ***Note:*** *Collector is generally supplied in 27 linear metre coils, unless otherwise formally agreed in writing; therefore a standard 27 linear metre coil contains 4.0 square metres (m^2)*

3.6.2 - The TufMan™ Manifolds

Using the schematic diagram prepared earlier, work out how many times the collector is attached to the TufMan™ Manifolds (refer to Figure 6) for both the Supply and Return, each attachment equates to one TufMan Manifold.

This calculation is quite simple for "U" Loop designs; however care should be taken when calculating Serpentine flow design. This is due to the Collector periodically bridging the Manifold System as it weaves upward (equal flow lengths) (see Figure 3 & Figure 38).

As a general guide only, the length of a right angled Manifold System using a 400mm TufMan Manifolds and "U" Loop design, can be calculated by multiplying the number of installed Collector runs by 175mm. The length of an angled Manifold System (Manifolds Parallel to Hip or Valley) using the 500mm Tufman manifolds will need to be determined on-site.

Note: *the TufMan Manifolds are offered at either 400mm or 500mm lengths.*

3.6.3 - Flow Balance Pipe (TufPipe)

The length of the TufPipe (see Figure 11) will be similar to the length of the Manifold System (refer to Figure 12), the SPHC should refer to their Schematic Diagram to calculate this. It is recommended that a greater length than required should be ordered, to allow fine tuning to occur on-site.

Note: *The final assembly will require cementing two 90 degree elbows and 1 end cap.*

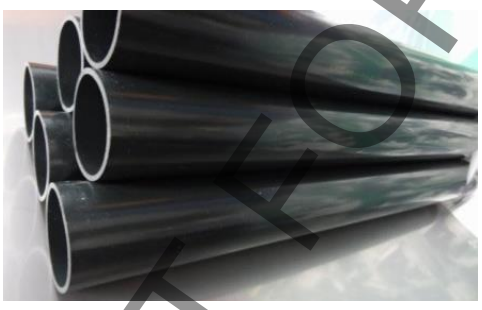


Figure 11: TufPipe

Figure 12: Manifold And Flow Balance Pipe Assembly. Note the VacRel VRV on top of the TufMan Supply Manifold.

As a general guide only, the length of the flow balance pipe (i.e. manifold system) will be based on multiplying the number of installed collector runs by 175mm

Example: refer to Figure 4 above, this photo depicts 12 collector runs, therefore the Manifold System and the Flow Balance Pipe are approximately 2100 mm long.
This factor will marginally depend on the roof type e.g. tiled roof vs. metal roof and possible other variables.

Note: *use this rule as a rough guide only.*

3.6.4 - Mounting the Manifold to the Roof

The length of the roof Mounting System will be similar to the length of the Manifold System and Flow Balance Pipe. Refer to the Schematic Diagram prepared earlier and deliver to the installation site a greater quantity of components and larger TufTrak™ length than required, to allow fine tuning to occur on-site.

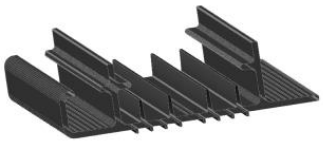


Figure 13: TufTrak™

Figure 14: Venetian TufCover™

Figure 15: TufClip™

The Roof Manifold System will require:

- **TufTrak™** (see Figure 13) 3 lengths that are a similar measurement to the Manifold System
- **TufCover™** (see Figure 14) 3 lengths are required that are similar in measurement to the Manifold System
- **TufClip™** (see Figure 15) allow one at each end, plus one every 700 mm apart for each TufTrak™ used. For example a 2100 mm long Manifold System with 3 tracks, will require approximately 12 Clips.

3.6.5 - Mounting the Collector to the Roof

The following items can be used to assist in mounting the Collectors to the roof surface:

Figure 16: TREMsil® 870 Adhesive

Figure 17: TufTape®

Figure 18: Tile Roof Strap

Figure 19: Tin Roof Strap

TREMsil® 870 Adhesive (see Figure 16) used on all roof types as the primary adhesive. The quantity required is approximately one tube per three square metres of required Collector, using the Schematic Diagram prepared earlier, the SPHC can easily estimate how many 300g tubes are required.

For example: a 45 square metre system would require approximately 15 tubes of TREMsil® 870 Adhesive

TufTape® (Figure 17) Optional – designed to be used in conjunction with TREMsil® Silicone adhesive, to fix the Solar Collector onto steep incline roofs, or during windy installation days. This Tape provides immediate short term Collector adhesion to most roofing materials, allowing time for the TREMsil® Silicone adhesive to fully cure. The quantity required is approximately 1 roll per 15 square metres of Collector, using the Schematic Diagram prepared earlier, the SPHC can easily estimate how many TufTape® rolls are required.

For example a 45 square metre system would require approximately 3 TufTape® rolls

Tile Roof Strap (Figure 18) Optional - securely fixes the Solar Collector to a variety of roof tiles and shapes (used for tiled roofs only). The quantity required is approximately three individual Tile Straps per one square metre of Collector.

For example a 45 square metre system would require approximately 135 individual Tile Roof Straps

Tin Roof Strap (Figure 19) Optional – Designed for metal and flat roofs to securely fix the Collector, the Tin Roof Straps are supplied as a coil, in linear metres. Using the Schematic Diagram work out how many linear metres are required based on using approximately 1 linear metre per 1 square metre of installed Collector.

For example a 45 square metre System would require approximately 45 linear metres of Tin Roof Strap.

3.6.6 - Loop Return Manifolds

Figure 20: TufReturn™ Loop Return Manifolds

Loop Return Manifolds, known as the TufReturn™ are an optional component.
Using the Schematic Diagram work out how many times the TufReturn™ Loop Return Manifolds (see Figure 20) are attached to the ends of the Collector as it loops back towards the Manifold System. This is usually easy to calculate for "U" Loop systems where generally half the amounts of TufReturn™ Manifolds are required compared to the total amount of TufMan™ Manifolds.

> ***Note:*** *care needs to be taken when calculating for a serpentine flow design as the TufReturn manifolds will be positioned on both sides of the TufMan manifold system.*

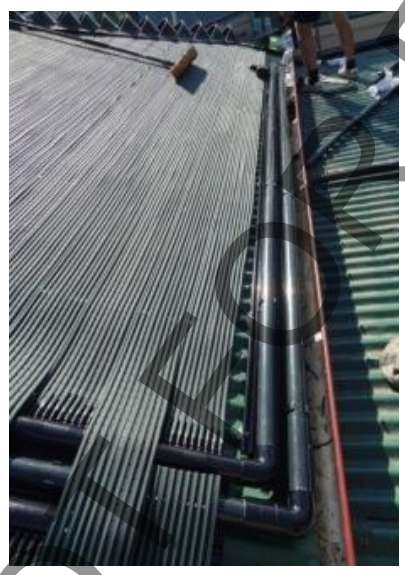


Figure 21: TufPipe™ connected to Collector and Manifold System

3.6.7 - Supply and Return Pipes

Using the schematic diagram work out how many linear metres of TufPipe™ are required to connect the Manifold System to the TufFilta™ and Pool Return (see Figure 21).

> **Note:** *On some installations it may be advantageous to utilise the TufTrak™, TufCilp™ and TufCover™. Additionally all pipe work should be designed and installed to allow for Thermal Expansion and Contraction, without applying stress on associated components such as the TufMan Manifolds*

3.6.8 - Pump Selection

Figure 22: Solar Pump

Different Solar Circuits typically have different Solar Pump requirements:

- Separate Circuit: Generally one dedicated Solar Pump is required for a Separate Solar Circuit System,
- Simultaneous Circuit / Connection: For a Simultaneous Circuit / Connection system one dedicated Solar Pump is usually sufficient, however extra care is required with designing and commissioning a simultaneous type of system.
- Manual Diverter Valve Connection: Typically there is no need for a dedicated Solar Pump for a Manual Diverter Valve Connection System, however extra care is required with designing and commissioning this type of system.

3.6.9 - Filter and Strainer – The Boss TufFilta™

Figure 23: TufFilta™ and Cartridge (Left), Debris collected in TufFilta™ Cartridge (Right)

As a general rule, use one TufFilta™ per average system

3.6.10 - Vacuum Relief Valve VRV – The Boss VacRel®

Figure 24: Deconstructed Boss VacRel®

As a general rule, use one VacRel® per average system

3.6.11 - Automatic Solar Controller

Figure 25: Dontek Automatic Digital Solar Controller

As a general rule, use one Solar Controller per average system. Refer below to decide on the most appropriate automatic controller to suit the system:

- Aquasun 2 is an entry level automatic solar controller with temperature adjustment, manual mode and winter mode features. Mode of operation and temperature limit settings are retained after a power outage
- Aquasun 3 is a premium automatic solar controller with temperature adjustment, manual, winter and tropical mode features. All configurable items are retained after a power outage for up to 14 days

3.6.12 - Collector Barb Locking Collars

Figure 26: Boss TufColar™ Rigid Collars

To calculate the required quantity of TufColar™ rigid collar components (see Figure 26) for the System, multiply the total quaintly of TufMan™ manifolds used by the number of barbs per TufMan manifold, additionally, if TufReturn™ Manifolds are to be used simply multiply the total number of TufReturn™ manifolds by twenty.

Available in a variety of different internal diameters to suit:
Ultimate Blue (10, 12 & 14 tube) ----- 9.25mm
Venetian Blue (all Colours) ---------- 9.25mm
NanoTek ---------- 10.0mm

Note: *the collars are easy to lose so ensure extra are on hand at time of installation.*

3.6.13 - Double Ended Barbs and Grommets

Figure 27: TufBarbs™

Figure 28: Grommets

2 x TufBarbs™ (Figure 27) and 2 x Grommets (Figure 28) are used for the Drain Tube (Figure 43) when combined with 2 x TufColars™ (Figure 26).

Note: *A minimum of two barbs, two grommets and two locking collars are required per system for the drain down tube (Figure 46). However it's always advisable to hold an extra quantity of each item at the time of the installation, for collector repairs or loss.*

3.6.14 - System Pressure Gauge

Figure 29: TufGauge™

Generally one TufGauge™ (Figure 29) is required per system.

3.6.15 - Flow Valve - The Boss TufValve™

Figure 30: The Boss TufValve™

As a general rule, use two TufValve (Figure 30) per average system, note however some systems may require more; please refer to figures 51, 53, 54 and page 48 to determine the appropriate quantity to suit the system:

3.6.16 - UPVC Pipe and Fittings

Figure 31: A range of UPVC Pipe and Fittings

White UPVC pipe and fittings (Figure 31) are generally available from most plumbing and hardware dealers, however black is generally more difficult to source; BOSS offers both colour options.
Using the Schematic Diagram, work out the length and quantity of each component required to plumb the entire system.

Note: *Pressure pipe and fittings shall comply with AS 1477 for Class 9 or higher.*

3.6.17 - Saddle Clamps

Figure 32: Saddle Clamps

Using the Schematic Diagram work out how many Saddle Clamps (Figure 32) are required to support the return and supply pipes for the entire system based on being:

- Spaced at a maximum of 1800mm apart on the vertical wall
- Spaced at a maximum of 900mm apart on horizontal surfaces
- Multiple tightly spaced Saddles under eaves.

3.6.18 - PVC Cleaner and Cement / Glue

Figure 33: Solvent Cement

For gluing PVC to PVC use a quality brand name *Type N* cement and primer (Figure 33), this is easily sourced from plumbing or hardware outlets. As a general rule, 250 ml of Type N cement and primer is sufficient per average system.

For gluing the ASA TufMan™ Manifolds, it is critical that the SPHC follows the Boss TufMan™ gluing instructions (Refer to Appendix 1).

3.6.19 - Silicone Lubricant

Figure 34: Silicone Lubricant

Aerosolve 302 Silicone lubricant (Figure 34) is the recommended form of silicone lubricant (refer to www.aerosolve.com.au). Generally one 300g silicone can will be sufficient for four average sized systems

3.6.20 - Tools and Equipment

The overall Boss MultiLayered system requires very few specialty tools and equipment to install.
The suggested list of required tools and equipment is displayed below:

Appropriate safety Equipment such as: Guard Rails, Harness Gear, stable roof access ladder etc.	Battery Drill (with Hammer Function)
	Soldering iron + solder
Chalk	Metal Drill Bits Metal and masonary drill bits
String Line	Appropriate Ladder
Hammer	Screws
Pliers	Green Screw Plugs
Pointy Nosed Pliers	Cable Ties
Tin Snips	Teflon Sealing Tape
Screwdrivers	Spanners 14 A/F and 16 A/F
Pipe Cutter or Hacksaw	Spirit Level
Caulking Gun	Tape Measure

SUGGESTED SPECIALTY TOOLS:

Figure 35: Uni Posca (or similar) Yellow Marking Pen

Figure 36: TufTool™ assists with easy TufCollar™ installation (available from BOSS)

3.7 Hydraulic Pressure Considerations

Refer AS 3634-1989 Section 6 and Appendix A3 and A4

Many factors can influence both positive and negative pressure within the system and must be taken into consideration during the design, installation and the final testing of the system prior to handover.

3.7.1 - Positive Pressure:

For a Solar Pool Heating System to operate correctly and efficiently, the system requires the pool water to be pumped evenly through each individual collector strip, at a combined flow rate between 1.8 to 4.8 litres per minute per square metre of collector (reference AS3634 8.1a) and a system hydraulic pressure appropriate to the installation (refer to 3.12 Hydraulic Pressure and System Design and 6.5 Pressure Testing/Setting).

In order to achieve this balanced flow rate and desirable system pressure across the entire collector system, the SPHC must consider and design for:

- The correct sized pump and plumbing system to adequately deliver the required amount of pool water up to the roof, through the solar system and back to the pool.
- The correct manifold and plumbing layout to allow the required volume of pool water to be evenly distributed to, and returned from the individual collector strips, at an appropriate pressure.
- An optimum and even flow length of collector strip, as the distance between the supply and return manifold will influence efficiency; back pressure and flow rate.

3.7.2 - Negative Pressure (vacuum) :

For a Solar Pool Heating System to operate correctly the system requires the pool water to return to the pool without creating a negative pressure (vacuum) within the collector tubes.

This requirement is for both:

1. **Pump on** with the system fully operational, and
2. **Pump off** with the system water draining back to the pool.

3.7.3 - Pressure Test

It is therefore critical that an internal positive and negative pressure test is conducted and appropriately documented prior to system handover. Failure to adhere to these guidelines may result in major non-repairable damage to the system such as but not limited to:

- barb blow off
- collector tube bulging or bursting, or
- vacuum crushing of the collector tubing that will ultimately result in the tube splitting along the internal flex / crush line

Note: *Installers must design and install their systems to accommodate for the hotter months of the year, where the Collector has been heat softened and is therefore more susceptible to the effects of internal positive pressure and vacuum* **Refer to 3.8.4 and 3.12**

3.8 Basic Collector and Plumbing Configurations

3.8.1 Bottom Feed Solar Systems:

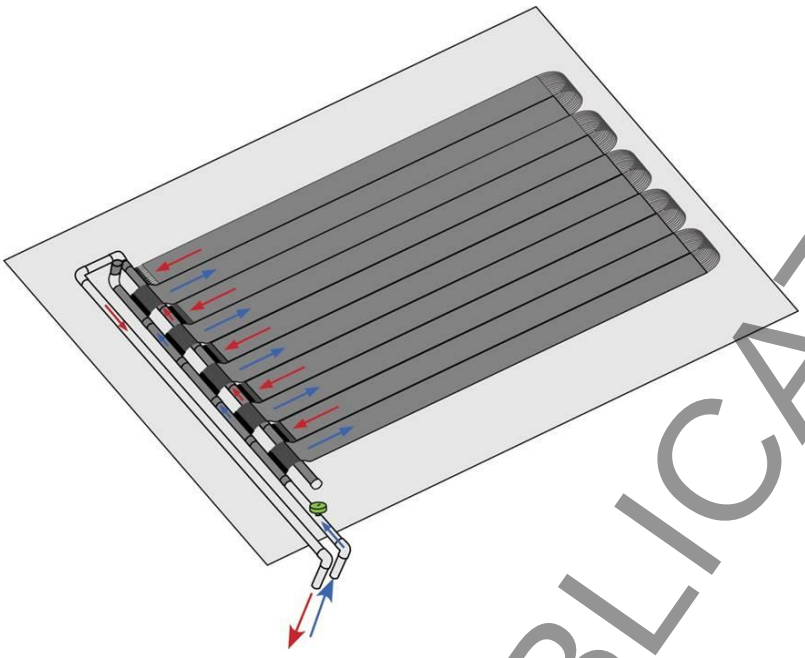


Figure 37: Bottom Feed System - "U" Loop Configuration

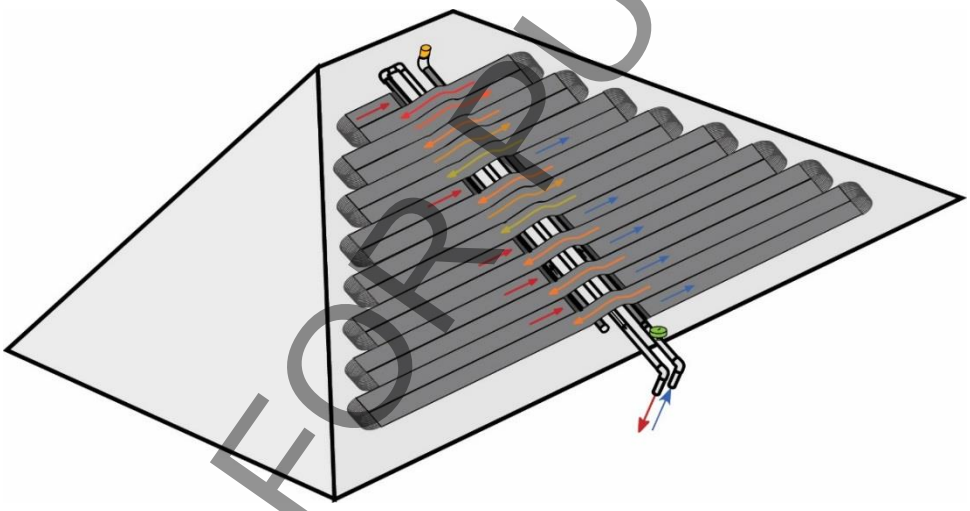
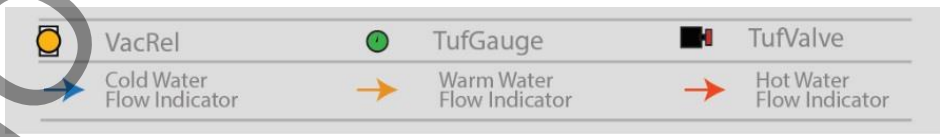


Figure 38: Bottom Feed System - Serpentine Configuration



Plumbing the supply and return pipes from below the Collector is generally referred to as a **Bottom Feed Solar System** (refer Figure 37 and 38). Bottom feed Solar systems using TufMan Manifolds and a Flow balance pipe with the VacRel® (VRV) at the highest point of the system on either the supply or return manifold, is the ideal plumbing configuration.

This plumbing configuration provides:

1. With the pump switched on - swift air expulsion and hydraulic equilibrium and water flow throughout the collector
2. With the pump switched off - swift and efficient drain down back to the pool

Depending on the roof shape and size, the SPHC has the choice to install the **Bottom Feed Solar System** in several different configurations:

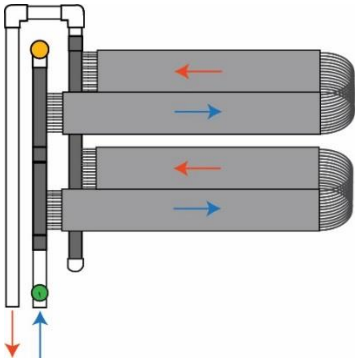


Figure 39: Single "U" Loop Configuration

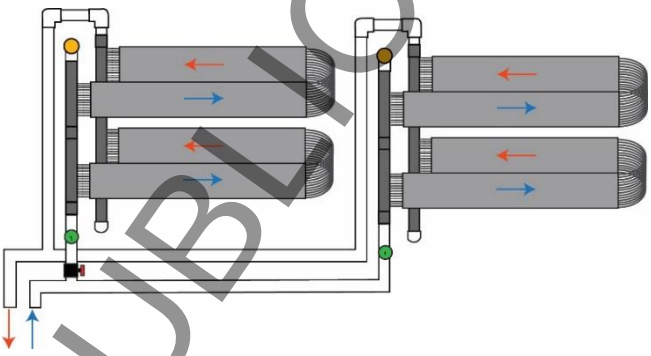


Figure 40: Multi "U" Loop Configuration

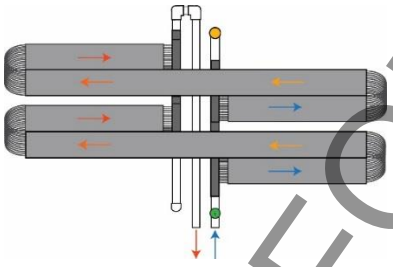


Figure 41: Single Serpentine Configuration

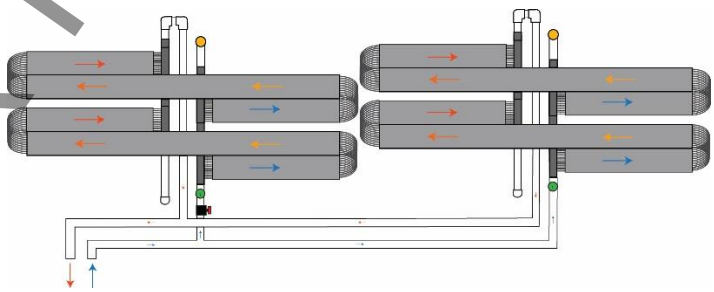
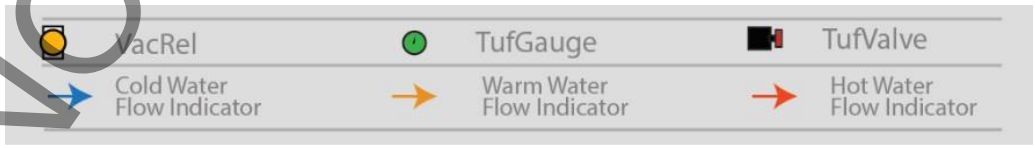


Figure 42: Multi Serpentine Configuration



- Single "U" Loop Configuration (Figure 39) – this configuration is the most common and easiest to install, the collector may bridge hips and valleys to utilize additional available roof surfaces
- Multi Loop Configuration (Figure 40) – this configuration is used when on the collector is unable to bridge to the additional required roof surface
- Single Serpentine Configuration (Figure 41 & 38) – used on triangular or complex shaped roofs the collector may bridge hips and valleys to utilize additional available roof surfaces
- Multi Serpentine Configuration (Figure 42 & 38) – used on triangular or complex shaped roofs, this configuration is used when on the collector is unable to bridge to the additional required roof surface

3.8.2 - Top Feed / Flooded Solar Systems:

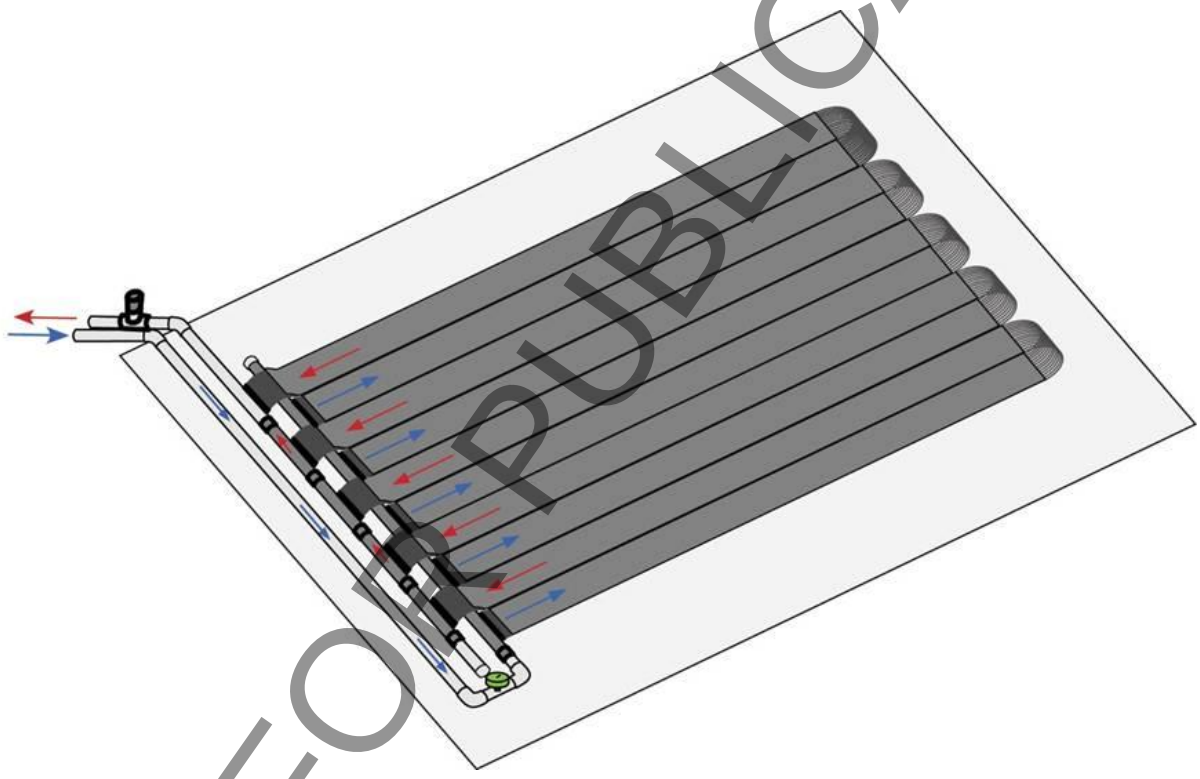
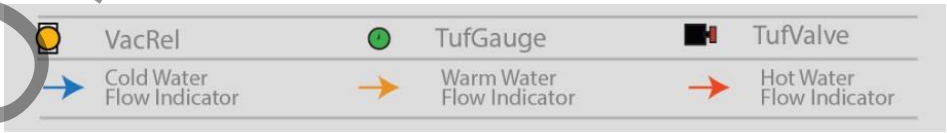


Figure 43: Top Feed System



For certain installations, some SPHCs consider it easier and quicker to plumb the system from above, such as over a ridge capping. Plumbing the supply and return pipes from above the Collector, is generally referred to as a **Top Feed** or **Top Flooded Solar System**. Top Feed systems have certain limitations that may cause long term operational issues in certain geographical locations and system designs if not correctly installed, therefore it is the responsibility of the SPHC to assess and decide on the most appropriate plumbing configuration.

All Top Feed solar system should be designed to operate at lower hydraulic pressures and to be installed with a Flow Balance Pipe and the VacRel® at the highest point of the system, ideally on the **return** line. This plumbing configuration provides:

- Swift air expulsion, hydraulic equilibrium and water flow throughout the collector when the pump is switched on
- Inefficient or poor drain down back to the pool, with possible water stagnation within the collector tubes with the pump switched off

Depending on the roof shape and size, the SPHC has the choice to install the Top Feed Solar System in several different configurations:
Refer to 3.11 Drain Down

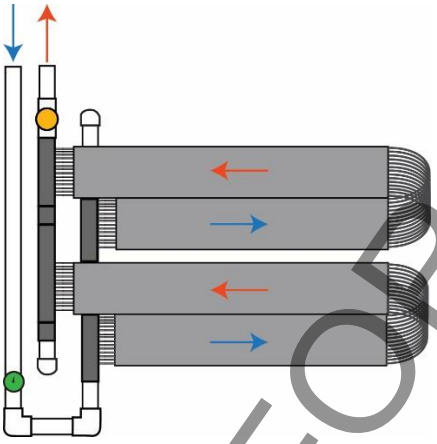


Figure 44: Top Feed Loop Configuration (Not recommended Refer 6f)

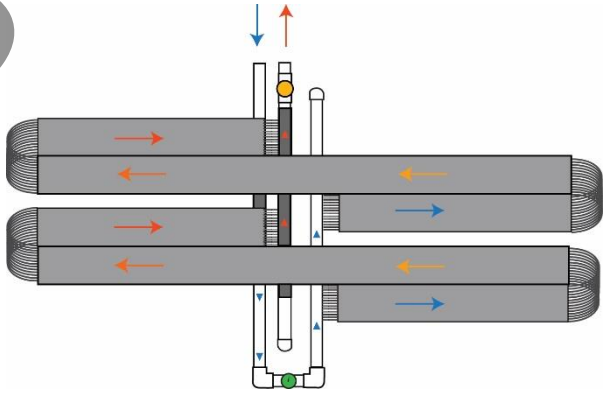
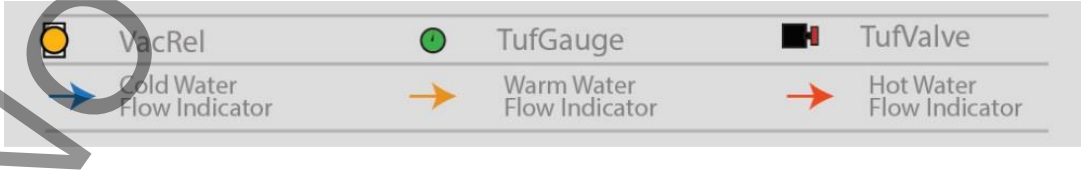


Figure 45: Top Feed Serpentine Configuration (Not recommended Refer 6f)



3.8.3 - Supply & Return Manifolds:

Refer to the preceding diagrams (Figure 32 to 45) for the correct TufMan supply and return plumbing configurations. It's generally best to install the TufMan manifold system nearest to the solar pump and filtration system, with the Loop Return or TufReturn™ installed further away.

Note: *How the supply manifold is always below the return manifold*

3.8.4 - Vacuum Relief Valve (VacRel VRV):

All thermoplastic Solar Systems must be designed and installed to ensure the Collector tubes will not distort from their original circular shape at any stage during the life of the system. ***Refer to 3.7.2 Negative Pressure.***

Distortion and crushing of the Collector tubes especially at time of elevated temperatures, is generally caused by internal vacuum and is referred to as Vacuum Crush. Vacuum crush generally occurs when the:

- solar pump is off; incoming air is restricted as water is draining back to the pool
- solar pump on; water is draining back to the pool faster than the incoming water

The Boss VacRel® is a high performance Vacuum Relief Valve (VRV) that provides minimal resistance to the air re-entering the collector tubes. The VacRel® is rated at a maximum of 10mbar (Air) 'Cracking' pressure, with a minimum of 70mm² of non-impeded air flow. The VacRel® has a multi-pass SS mesh filter, designed to protect the valve from airborne contaminants, such as spiders, wasps or ants from entering the valve.

Experience has proven that one Boss VacRel®, installed at the uppermost position of the system will guard against vacuum crush on an average sized, and correctly installed system. For average sized and installed systems, the installer has the option of positioning the VacRel® at the highest point of the system on either the top of the supply manifold, or on top of the return and balance pipe. Practice has shown that these two positions are optimal, however installing the VRV on the return side, will require the addition of a TufValve (flow control valve) on the return pipe. This valve is required to control the flow rate / system pressure of the returning water, and stop air being sucked through the VacRel®, which results in undesirable bubbles in the pools return water.

Ensure the VacRel® is installed as vertical as possible using either a 45 degree or 90 degree elbow dependant on the pitch of the roof on the end of the TufMan supply manifold or a "T" fitting on the top of the return line.

3.8.5 - Separate Suction and Return Plumbing:

For solar connections to a new pool, the SPHC should recommend that separate flow and return lines be provided by the pool builder. This plumbing configuration separates the solar system from the filtration system and thus allows the solar pump to operate independently to the filtration pump. This configuration minimizes power consumption and eliminates any issues that may arise due to the operation of the filtration system and any associated equipment such as pool cleaners, chlorinators and fossil fuelled heaters etc.

3.8.6 - Pipe Flow Rates:

It is important that the Solar System circulates the correct amount of pool water (flow rate) evenly throughout the system and back to the pool at a desirable pressure; therefore it is important that the correct pipe size is selected to suit the particular installation.

As a general rule, the vast majority of domestic solar pool installations will find a 40mm pipe size to be more than sufficient; in supplying and returning the required amount of pool water through the system and back to the pool. Large systems, systems with long pipe flow lengths or other flow restrictions (such as excessive number of 90 degree elbows) may require a larger pipe size to compensate.

For large systems with high flow rates, it may be necessary to employ an alternative plumbing design, such as the multi- "U" Loop or Serpentine Configuration (refer to 3.8 Basic Collector and Roof Plumbing Configurations). The multi - configuration allows the SPHC to design the supply and return piping to cope with the overall required flow rate, both to and from the multiple, separate collector flow circuits.
Table 1: Flow Rate - Recommended Pipe Diameters should be used as a guide only.

Table 1: Flow Rate - Recommended Pipe Diameter (AS 1477 Class 9)

Litres Per Minute	Gallons Per Minute	Pipe Diameter (mm)
Less than 170	44	40
170 to 300	44 – 80	50
300 to 600	80 - 160	65

Note: *All pipe work should be designed and installed to allow for Thermal Expansion and Contraction, without applying undue stress on associated components.*

3.8.7 - Balanced Flow:

The correct way to configure a System is discussed in Section 3.8 Basic Collector and Plumbing Configurations which details the various options.

The numerous designs detail how the pool water enters the bottom of the Supply Manifold, flooding the Collector tubes as well as the Return Manifold as it fills the System from below, in a direction moving up the roof.
Once the system is fully filled, the solar heated return water flows over the top of the Return Manifold and back to the pool. The design detailed above entails three items: a Supply Manifold, Return Manifold and a Flow Balance Pipe mounted on the roof together.

This design not only expels air out of the System but creates a hydraulic equilibrium and water flow throughout the Collector.

Some installers are of the incorrect belief that the above instructions are not necessary and that only the supply and return manifolds are sufficient when installing a solar system.

> ***Note:*** *Australian Standard clearly nominate the requirement for a Balance Pipe, therefore installing* ***any*** *type of system (bottom feed or top feed) without a Balance Pipe is an incorrect plumbing configuration and not recommended*

3.8.8 - Drain Tube:

It is recommended to install a drain tube between the supply and return pipes approximately one metre above pump level. The Drain Tube is comprised of two Grommets, two Header Barbs, two Rigid Collars and a length (approx. 150mm) of a single stripped out Collector tube (see Figure 46).

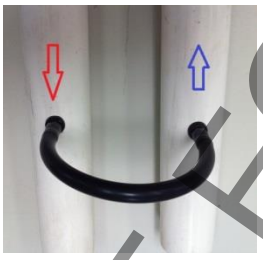


Figure 46: Drain Tube

The drain tube allows the supply pipe to slowly drain back via the return pipe, this, when combined with a correctly installed system, will allow the collector and supply pipes to automatically fully drain back to the pool, over time, when the pump is switched off.

3.8.9 - TufValve™ Flow Valve:

Figure 49: TufValve™ two way rotary valve

The use of a valve such as the TufValve™ (two way rotary valve: Figure 49) is sometimes required on the supply side of simultaneous systems. The TufValve™ allows the installer to set the optimum system hydraulic pressure.

The TufValve™ may also be used to control the return water for systems installed with the VacRel® on top of the return pipe, install a TufValve™ on the return line close to ground level, in order to control the flow rate and stop air from being sucked into the system via the VRV, and undesirable air bubbles appearing in the pool discharge. *Refer to Figure 83*

3.8.10 Natural Flow of Water - Roof Drainage

All care must be taken to ensure that the system is installed in a manner which will not affect the natural flow of rainwater off the roof.
For example: pipes that run horizontal along the roof with flat profile tiles - or similar - should be elevated above the tile to a sufficient height to allow water and debris to pass underneath.

Appropriate inspection, maintenance, procedures and documentation may also be required to ensure plant matter of foreign debris is cleared at regular intervals.

3.9 – Pump Considerations:

Figure 47: Solar Pump

3.9.1 – Separate Circuit:

In Australia, most reputable pool builders have adopted the modern approach of designing their pools with a dedicated solar suction and return porting at mid-depth, and opposing ends of the pool. During the pools installation phase the pool builder will generally lay and cap the underground separate suction and return plumbing close to the filtration system ready for the SPHC.

***Note**: The pipes should be installed close to the pools filtration system*

This updated approach, of designing and pre-installing new pools in order to enable easy retrofitting of Solar Heating, is now an accepted and expected practice within Australia. This practice has subsequently led to increased efficiencies and a reduction in costs; both for the pool owner and pool industry in general.

This dedicated solar circuit is referred to within this manual as a separate circuit.

The recommended separate circuit pump size guide (Table 2) should only be used as a general guide when selecting the appropriate separate circuit pump size. The guide is based on an average sized and installed system.

Non average sized and installed systems require the appropriate calculations to determine the correct size based on various factors; such as, but not limited to:

- pump head height
  (vertical distance from the pool to the top of the solar system),
- flow restrictions
  (distance from pool to collector or an excessive number of elbows etc)

Refer to suitable technical resources to assist with the selection of an appropriate pump, that will be capable of delivering a sufficient flow rate (1.8 to 4.8 litres per minute per square metre of Collector) through the System (refer to AS3634 8.1a).

Note:

- *all separate circuits should have a TufFilta inline filter / strainer installed after the pump (discharge) to prevent containments from entering the solar system*
- *all solar pumps must be fitted with a check valve on the discharge line and a Hair and Lint pot on the supply side*
- *any pump located below water level should be isolated from the pool with a shut off valve, so that pump maintenance and regular cleaning of the Hair and Lint pot is possible. (It is important to document and remind the customer that the valve should be closed prior to cleaning and re-opened after cleaning to avoid pump damage*
- *separate circuit solar pumps should never be installed more than one metre above water level as this will invariably lead to priming problems with the potential for pump damage. From time to time this does occur, the only possible cure is to install a check valve as close to the pool as possible to hold prime. However in most cases this is often not possible. Remember to never bury the valve underground for maintenance reasons.*

3.9.2 Simultaneous Circuit

Existing, (generally older) pools installed without a separate solar suction and return lines may be solar heated by tapping the solar heating circuit into the existing filtered return pipeline. This type of connection is generally referred to as a simultaneous connection.

Note:

- *the Solar pumps power supply must be connected to the appropriate outlet on the Digital Controller; ensuring that the solar pump will only operate when the filter pump is operating*
- *extra care is required with designing and commissioning a simultaneous type of system*
- *old gas heaters or Heat Pumps can sometimes impose significant hydraulic return line backpressure*
- *care should be taken when designing, installing and testing a system in these instances*

Table 2: Recommended Separate Circuit Pump Size and Supplier (based on average sized and installed systems)

	Separate Circuit	Simultaneous
Single Story	¾ hp with TufFilta	½ hp, TufFilta optional
Double Story	1 hp with TufFilta	½ or ¾ hp, TufFilta optional

3.10 - TufFilta™ - In-line Filter / Strainer

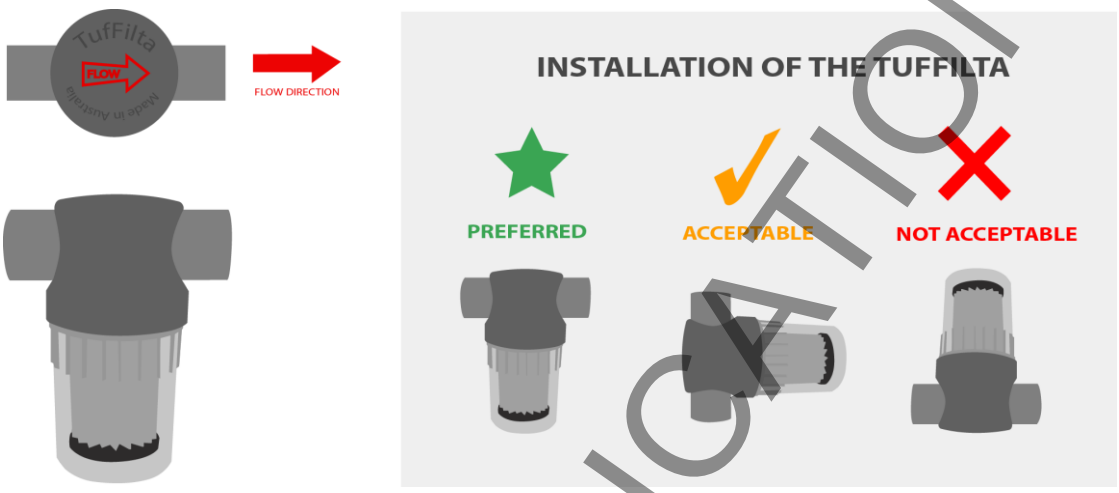


Figure 48: TufFilta™ installation Recommendations

For systems that employs a separate solar pump, independent of the pool filter circuit, the SPHC should install a TufFilta™ (in-line cartridge filter: Figure 48)) directly after the solar pump on the discharge side.

It is recommended that the TufFilta™ be positioned to allow for easy access during maintenance, and to be clear of other equipment below it that may be sensitive to pool water during replacement of cartridge element. If a TufFilta™ is installed, an isolating valve should be positioned on the discharge side, this enables the cartridge element to be removed and replaced without drenching equipment or the person performing the task.

Tip: Make sure you double check and install in accordance to the flow direction arrow icon on the top of the TufFilta™ (refer to Figure 48).

> ***Note:*** *most installers incorrectly assume that the solar pumps standard lint pot is sufficient to protect the solar system from blocking with foreign matter. However, experience in the field has extensively proven that this is not the case. It should be noted that Australian Standards AS 3634-1989 Section 6.2 clearly state that "A filter or strainer shall be provided to remove solids or debris from the water entering the solar circuit."*

3.11 Drain Down

3.11.1 Protection against freezing (winterising)

In geographical locations subject to freezing weather conditions, the SPHC should design the System to provide protection against freezing (winterising, refer to AS 3634-1989 Section 6.3).

Designed and installed correctly, a Boss MultiLayered bottom feed solar system, combined with the drain tube, TufFilta and TufMan Manifolds should fully drain down (automatically), once the pump is switched off. However, a top feed configuration will *not* automatically fully drain down, and may cause damage to components within the system, due to water freeze expansion.

If the geographical area is subject to freezing conditions, Boss recommends that the system be designed and installed to fully drain down automatically, *each and every time* the solar pump is switched off.

If automatic self-draining is not possible, then the SPHC should ensure that the system is designed to facilitate easy manual draining by the customer, with appropriate documentation and training (this should be in according to AS 3634-1989).

3.11.2 Protection against stagnant water

Designing a system for protection against freezing is a requirement for cold climates. However, for hot climates it is also ideal that the system drains down automatically, each and every time the system turns off.

Water stagnating within the collectors tubing, has been evidenced to rise to very high temperatures in particular geographical locations. Consequently heating and softening the thermoplastic collector tubing; affecting the collectors' resistance to excessive stress.

When the collector is subjected to this hot stagnant water, the waters weight has the potential (if incorrectly installed) to cause the collector to sag between adhesion lines on steep roofs. It may bulge or rupture the collector tubes due to excessive hydraulic back pressure when the hot stagnant water is being flushed from the collector tubes as the pump is first switched on.

Designed and installed correctly using TufMan manifolds, a bottom feed solar system combined with the drain tube and TufFilta should fully drain down automatically once the pump is switched off. Cold water flooding the fully drained system cools the hot collector prior to pressurisation, increasing the collectors' resistance to hydraulic pressure.

Top feed configuration systems, however, tend to not fully drain and are therefore not recommended for certain installations and geographical locations.
Unless the SPHC has ample experience and knowledge for their geographical location, Boss therefore recommends only installing bottom feed systems as per this manual.

Note: *Installing a Solar Collector System at or below the pool level is not recommended*

3.12 Hydraulic Pressure and System Design

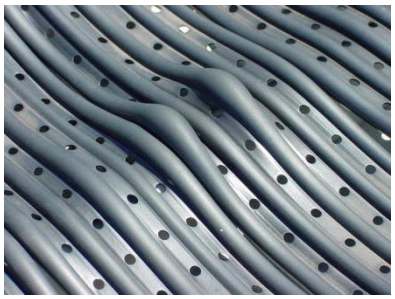


Figure 50: Enlarged Tubes Due to Poor Installation

Excessive hydraulic pressure within any section of the Collector has the potential to enlarge or rupture the walls of the collector tubes. It may also cause the collector tubes to leak or blow off from the TufMan manifolds barbs. Warranty issues resulting from excessive pressure are not covered by the Boss Polymer product warranty.

Systems installed with poor or inadequate water straining, (refer AS 3634-1989 6.2) have the potential to cause blockages due to foreign matter, which may result in stagnant water. Water stagnation may also be caused by flooded systems, plumbed from above, such as capping over a ridge or systems installed below the pool level also have the same potential.

Stagnant water within any solar system will then continue to absorb heat for prolonged periods, resulting in excessive temperatures, potentially softened the PVCn collector tubing. When the pump is eventually switched on, the hot stagnant water has the potential to resist being flushed away, subjecting the heat softened PVCn tubing to full or partial system pressure. In certain geographical locations, and poor system designs, relatively low operating system pressures have the potential to enlarge or rupture the collector tubes due to these conditions (refer to figure 50).

Systems that are designed to harbor stagnant water require appropriate water straining in order to ensure that no foreign matter enters the system, the system will also require a lower system pressure compared to a system that fully drains.

If a system is installed in such a way that water stagnation can occur, it is then the responsibility of the installer to determine the suitable system design based on their particular requirements, geographical location and experience (refer to section 6.5 Pressure Testing/Setting).

3.13 Paints and Solvents

Do not apply any form of solvent or primer (including solvent based paints) to any ASA component within the system; this includes the TufMan™, TufReturn™, VacRel®, TufTrak™, TufClip™, TufBarb™ etc. The use of water based paint on ASA components has been shown to be suitable, however care in the selection and application of an appropriate coating, is ultimately the responsibility of the installer.

3.14 Test

The SPHC should design and install the system to allow for easy and accurate testing/checking of all aspects of the system prior to handover (refer to AS 3634-1989 Section 9).

4. PLUMBING CONFIGURATIONS

This chapter deals with the various recommended plumbing designs.

4.1 Separate Circuit Connection

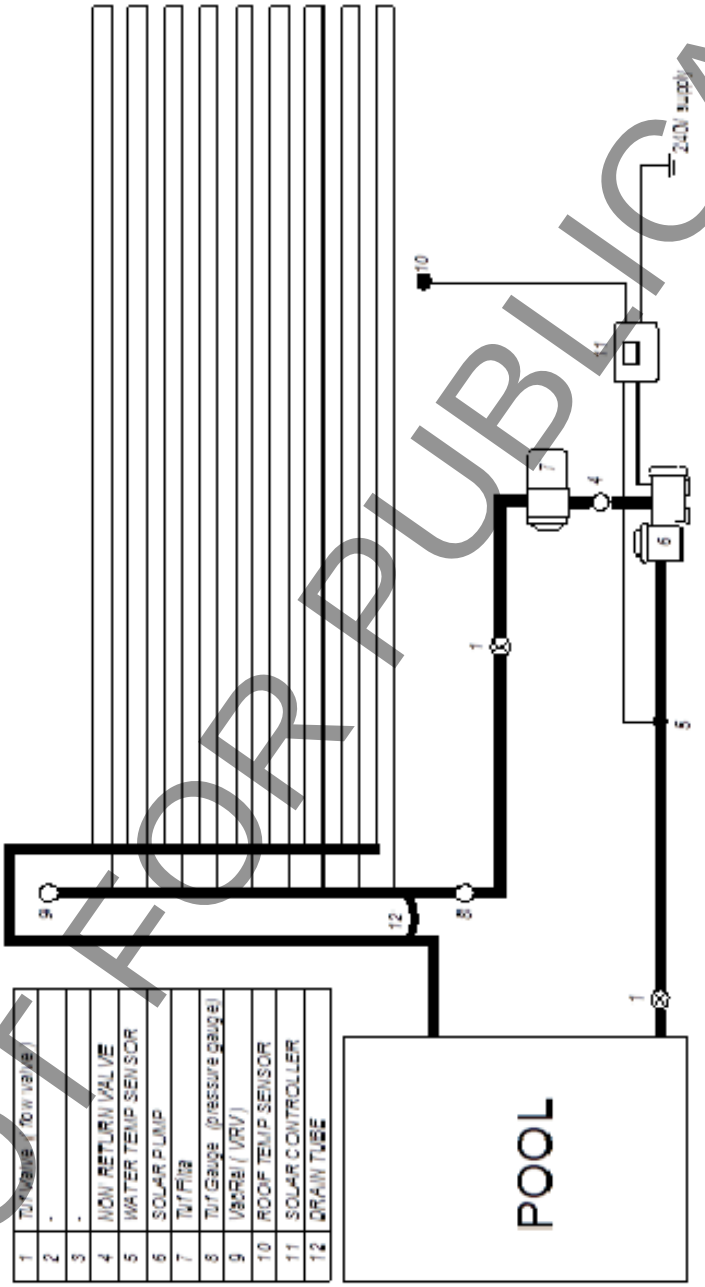


Figure 51: Separate Circuit Connection

4.2 Simultaneous Connection

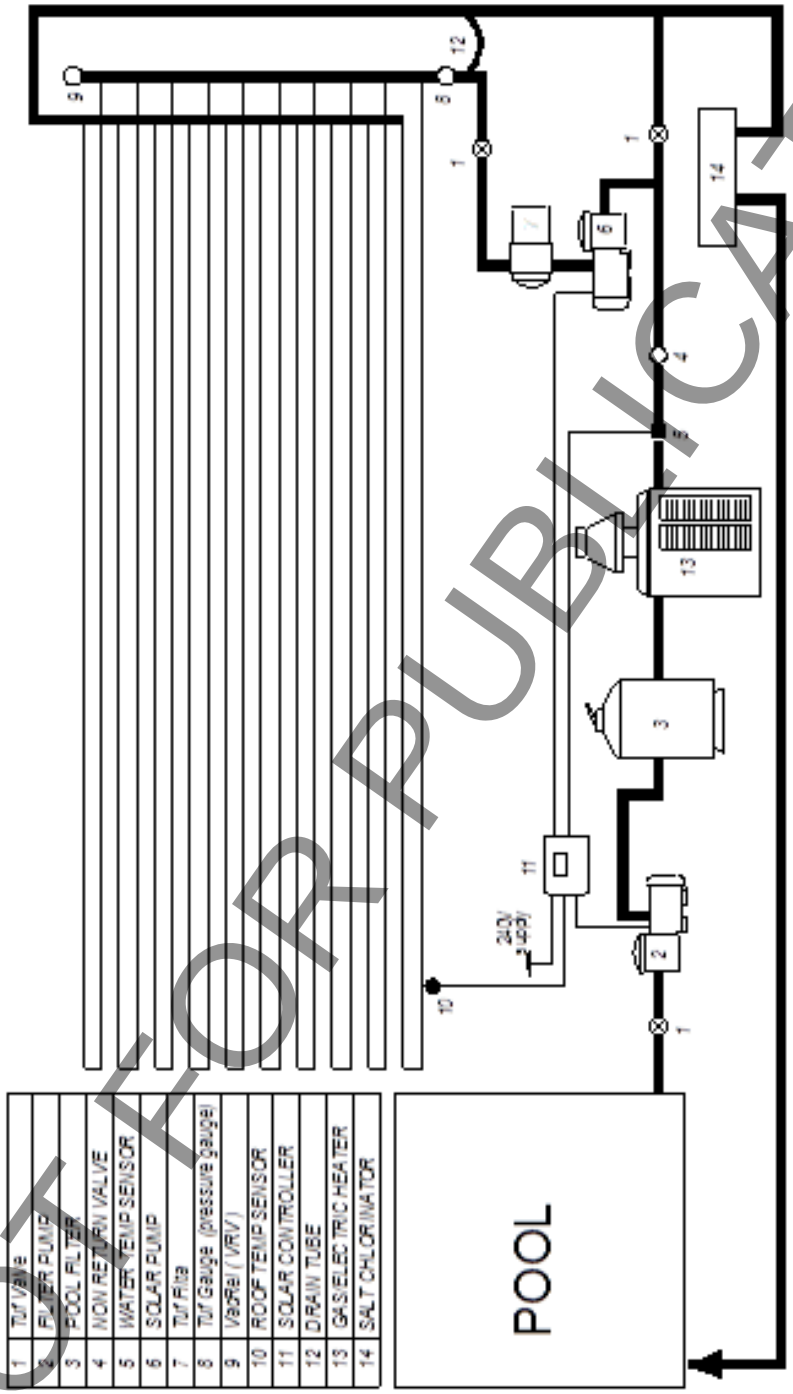


Figure 52: Simultaneous Connection

4.3 Manual Diverter Valve Connection

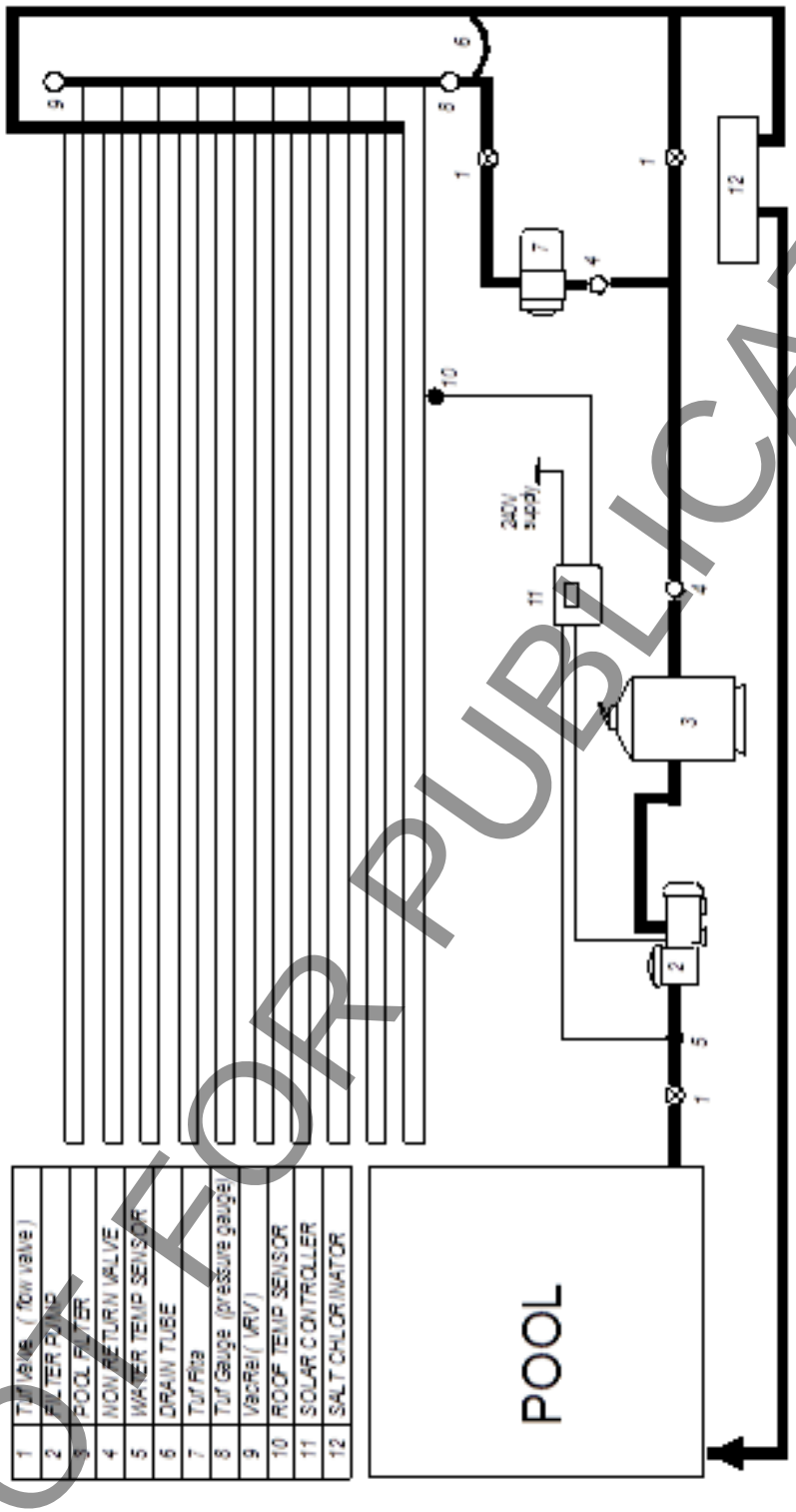


Figure 53: Manual Diverter Valve Connection

4.4 Multiple System Connection

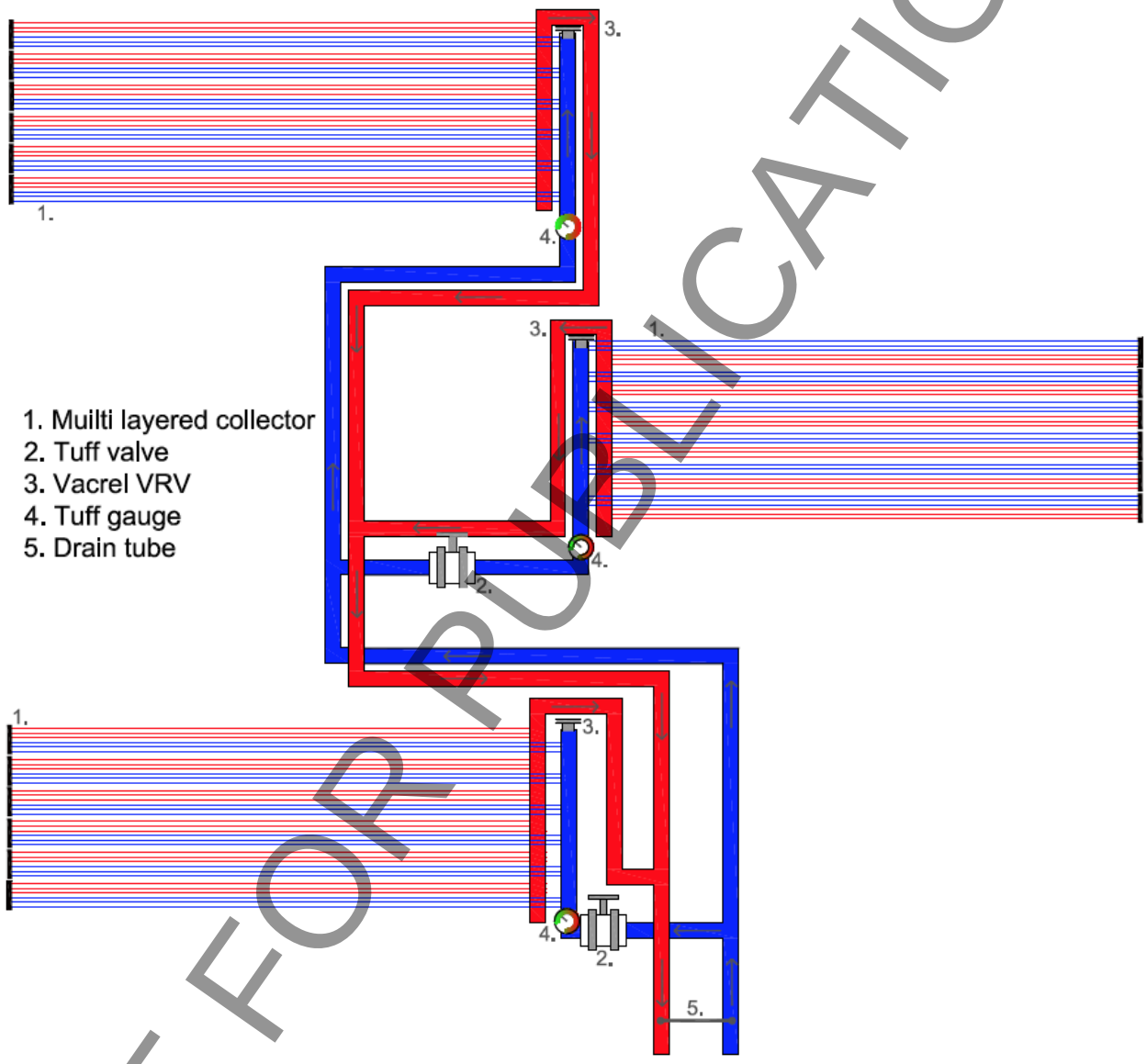


Figure 54: Multiple System Connection

5. INSTALLATION TECHNIQUES

Boss strongly recommends that prior to commencing this chapter; the SPHC should ensure that they are fully aware and competent with all the preceding chapters, principally all aspects detailed in Section 3 Designing the System and Section 4 Plumbing Configurations.

It is expected that by this stage the SPHC has designed and planned for the most appropriate system, and has all the components and tools required to perform the installation task correctly. It is also assumed that the SPHC has taken into account all the necessary precautions, advice and warnings outlined in preceding chapters.

> ***Note:*** *It must be remembered that roofs come in all different shapes and sizes, and most installations will be unique and different from one and other. Therefore, the installer will require some degree of skill and knowledge to custom make and tailor the installation to suit the particular installation site and customer.*

> ***Note:*** *Cutting and joining of the collector tubes or any other component within the system should be kept to the bare minimum. This reduces the chance of potential leaks and ensures a quality appearance.*

5.1 Installing the TufMan™ Manifold System - Supply, Return and Balance Pipe

Figure 55: Marking the TufTrak™ with a Uni Posca pen.

Figure 56: Placing the required number of pre-cut TufTrak™ lengths onto the roof

Figure 57: Securing the TufTrak™ into position using fixing screws at the top of the track only

Design Confirmation and Planning

Understanding the design and location of the manifold system, is critical during the early stage of the installation process. It is therefore highly recommended that ample time is allocated to planning prior to engaging in any cutting or bonding.

A good first step is to consult the schematic drawing prepared earlier and lay the lengths of TufTrak™ into their intended position, as well as a number of uncut and un-bonded TufMan™ manifolds for gauging length, position and orientation. Another tip is to take the balance pipe, VacRel® and a number of elbows and other fittings to confirm position and orientation of the connecting flow and return pipe-work.

Using a Uni Posca (or similar) yellow marker, mark the ideal position of the TufTrak™ on the roof and its intended cut length. For tiled roofs, it is a good idea to also mark the front leading edge position of each tile onto the TufTrak™, this marked position allows for easy and accurate TufMan™ cutting, bonding and pre-assembly on the ground (refer to Figure 55) to match each tile face and position .

Refer to Appendix A: *MAUFACTURER'S GUIDELINES FOR INSTALLATION OF THE TUFMAN™ MANIFOLD for detailed instructions.*

Tip: *Measure twice, cut once.*

Fixing the TufTrak™ into Position

Once the SPHC is fully satisfied with the design and orientation of all the components within the system, place the required number of pre-cut TufTrak™ lengths onto the roof (refer to Figure 56) and fix into position using the appropriate fixing screws on either side of the top of the TufTrak™ only (refer to Figure 57). Apply ample TREMsil® silicone under the fixing screws for sealing (refer to Figure 57). For the remainder of the TufTrak™ lengths, apply a generous quantity of TREMsil® silicone at regular intervals; to bond the TufTrak™ to the roof.

Tiled Roofs

Using a masonry drill, place holes in the tiles at the high points only, then install appropriate anchor plugs into each hole. Pre-drill through the TufTrak™ and fix it to the roof tile using self-tapping screws through the track and into the Green Anchor Plugs. Two screws on either side at the very top only of the TufTrak™ should be sufficient, these screws should be sealed using ample TREMsil® silicone. In order to bond the remainder of the TufTrak™ length, apply TREMsil® silicone liberally to the leading edge of each tile, where it makes contact with the TufTrak™.

Corrugated Iron Roofs

Pre-drill through the TufTrak™ and fix it to the corrugated iron roof using self-tapping screws. Two screws on either side at the very top only of the TufTrak™ are ample, these should be sealed using a sufficient amount of TREMsil® silicone. For the remainder of the TufTrak™ length, apply a sufficient amount of TREMsil® silicone at regular intervals to bond the track to the corrugated roof.

Flat Metal Roofs

On flat metal roofs it is important that the manifold system is NOT mounted in a valley, the manifold system should be mounted on bridging strips mounted on the roofs metal ridges; this ensures that water flow is not blocked. To achieve this, fix multiple bridging strips (PVC strip 50mm x 3mm) at a right angles to the TufTrak™ to bridge the required number of ridges, then fix the TufTrak™ to the top of the bridge strip and seal the screws using an ample amount of TREMsil® silicone.

Once the TufTrak™ is mounted, place the appropriate number of TufClip™ components into the TufTrak™ in their approximate final position. Ensure that the TufClips™ are in evenly staggered positions, with a clip situated at each extremity. Install the TufClip™ by inserting it into the TufTrak™ at a right angle and twisting the TufClip™ to lock it into its sliding position.

Refer to Appendix A: *MAUFACTURER'S GUIDELINES FOR INSTALLATION OF THE TUFMAN MANIFOLD for additional instructions*

Figure 58: Cutting the TufMan™ Manifold

Figure 59: Gluing the Male end of the Manifold

Figure 60: Clipping the TufMan™ Supply and Return Manifolds into the evenly spaced TufClips™

Figure 61: Plumbing at the top of the Manifold System

Figure 62: Plumbing at the Bottom of the Manifold System

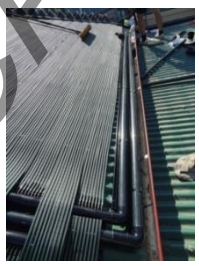


Figure 63: Supply and Return Plumbing

Cutting (if required) the TufMan™ Manifolds / Balance Pipe

Using the schematic drawing prepared earlier, calculate the required number of TufMan™ manifolds for both the supply and return manifolds. Once this number has been established and the length compared against the Uni Posca markings on the TufTrak™, decide if the TufMan™ manifolds and balance pipe require shortening and by how much.

Refer to Appendix A: *MAUFACTURER'S GUIDELINES FOR INSTALLATION OF THE TUFMAN MANIFOLD for additional instructions.*

Tiled Roofs

Generally, the moulded length of the TufMan™ (350 mm long) Manifold will suit most tiled roofs; therefore little or no cutting of the Manifold is required. The pre-marking on the front edge of each tile position relative to the TufTrak™ position will assist with this process.

Metal Roofs

As a general rule, the moulded length of the TufMan™ (350 mm long) Manifold will require cutting back by approximately 40mm or 4 divisions (refer to Figure 58).

Note: Non-standard 500mm long TufMan™ Manifolds, are generally required where the manifold system is at an angle to the lay of the collector, for example; installations where the manifold system is positioned parallel to the ridge or valley of the roof.

Tip: confirm length prior to any cutting

5.1.1 Recommended Bonding Procedure, TufMan™ to TufMan™, VacRel® to TufMan™, PVC fittings to TufMan™

Once the design of the Manifold System has been established and associated components prepared for assembly, the SPHC should ensure that the VacRel® is positioned at the highest point of the system with the centre line of the VRV as vertical as possible, refer to Figure 61.

Note: *Failure to provide adequate vacuum relief (i.e. unrestricted air flow back into the system) may cause collector tube vacuum crush and void warranty*

- remember that no primer, solvent, glue or cement is to be used in the **female** section of the TufMan™ Manifold
- Apply an appropriate amount of cement to the **male** end only; cover no more than five divisions (approximately 50mm) to ensure total 360 degree coverage (refer to Figure 59). The installer should be cautious to not over apply the glue. Any excess beads of glue or cement should be cleared from the joint.
- Insert the Male end of the Manifold into the Female Socket immediately after the cement is applied, align the longitudinal marks and ensure that the full five divisions are inserted into the female socket. The installer should hold the ends together long enough to ensure retention.
- After insertion a small bead of glue should be visible, this should be wiped clear

> ***Note:*** *Allow glue to set for at least 24 hours prior to the system being turned on and pressurised with water*

Refer to Appendix A: *MAUFACTURER'S GUIDELINES FOR INSTALLATION OF THE TUFMAN MANIFOLD for additional instructions*

5.1.2 Final Manifold Mounting and Pipe Connections

Clip the assembled length of TufMan™ Supply and Return Manifolds into the evenly spaced TufClips™. These Clips should have been pre-installed into the mounted TufTrak™ (refer to Figure 60).

Bond the Supply, Balance and Return pipes to the appropriate PVC fittings and VacRel® as per the schematic drawing, approved design and *Appendix A: MAUFACTURER'S GUIDELINES FOR INSTALLATION OF THE TUFMAN MANIFOLD.*

> ***Note:*** *It is important that the TufMan™ Manifold System and its Supply and Return connecting pipes, are securely installed onto the roofs surface; in order to resist external forces, such as wind. However, the entire system must also be installed to allow for all thermal movements; without inducing longitudinal or lateral stress on the TufMan™ Manifold System. Lateral stress for example may be induced from incorrectly installed collector or supply / return pipe work. Additionally all pipe work should be designed and installed to allow for Thermal Expansion and Contraction, without applying undue stress on associated components.*

5.2 Connecting the Collector to the TufMan™ Manifold

Figure 64: Venetian Collector Coils

Figure 65: Laying the Collector onto the roof

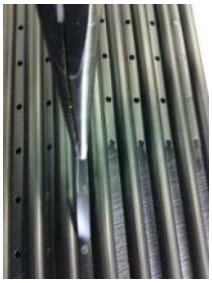


Figure 66: Using Pointy Nosed Pliers to peal the Collectors Webbing

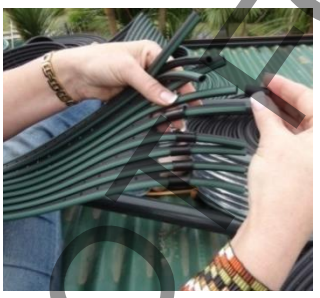


Figure 67: Sliding the required number of TufCollars™ onto the stripped Collector tubes

Figure 68: spraying lubricant onto corresponding TufMan™ barb connector

Figure 69: Using the TufTool™ to ensure full engagement of the TufCollar™

The following steps will assist the installer with connecting the Collector to the manifold system:

Step 1: Begin by placing the required quantity of collector rolls on the roof of the installation site (refer to Figure 64).

Step 2: Starting at the top of the Manifold System, un-coil the collector, (one at a time, maximum of 2 coils), away form the Manifold System (refer to Figure 65). The distance required should be specified in the schematic drawing prepared earlier.

> ***Note:*** *If the system is a Coloured Venetian System ensure that the collector strip is correctly orientated; with the coloured panel facing downwards for visual purposes*

Step 3: For the Return collector run Length, flip the MultiLayered Collector up-side down and continue to un-coil back towards the Manifold System, this Return End of the System is referred to as the Loop Return, (refer 5.3).
(i.e. work on only 2 collector runs at a time: refer Step 10)

Step 4: Starting at the uppermost end of Manifold System, one collector run at a time and on one end of the collector only, strip and remove the connecting webs between the collector tubes back by approximately 150mm. (i.e. work on only one end of the collector, refer Step 10)

> ***Note:*** *This task is made especially neat and easy with the use of Punched MultiLayered Collector rolls (collectors supplied with pre-punched holes through the webs) and pointy nosed pliers. By using a pair of pointy nosed pliers, the installer can insert the nose into the appropriate punched hole (the puncture closest to 150mm from the cut end), grip the web, and drag it back towards the cut end (refer to Figure 66).*

Step 5: Slide the required number of TufCollars™ over each individually stripped collector tube, ensuring that the larger shouldered end of the TufCollar™ is facing outward (Refer to Figure 67)

Bunch the individual collector tube together in one hand, and spray a minimal amount of Silicone Spray lubricant down into each individual tube

> ***Note:*** *Ensure that minimal overspray or cross contamination of the silicone spray is allowed onto other surfaces. As excessive overspray will contaminate the work site and may lead to poor TREMsil® silicone adhesion and a possible slippery / unsafe roof working surface for personal*

Tip: *the use of a cloth under or around the spray site is a good technique to control over-spray. The installer should also wipe their hands regularly with a clean cloth.*

Step 7: Spray or wipe a minimal amount of Silicone Spray Lubricant onto each individual corresponding TufMan™ barb connector (refer to Figure 68).

Note: *ensure that minimal overspray or cross contamination of the silicone spray is allowed onto other surfaces. As excessive overspray or contamination will affect the effectiveness of the TREMsil® adhesion, and may cause a slippery / unsafe working surface for personal.*

Tip: *the use of a cloth under or around the spray site is a good technique to control over-spray. The installer should also wipe their hands regularly with a clean cloth.*

Step 8: Using thumb and forefinger slide each individual collector tube onto its corresponding TufMan™ barb connector ensuring full engagement.

Step 9: Using the TufTool™ (refer to Figure 69), slide each individual TufCollar™ towards the main body of the TufMan™ manifold ensuring full engagement of the TufCollar™ over the tube and barb assembly (refer to Figure 69).

Figure 69: Final assembly of TufCollar™

Step 10: Do not cut or assemble the remaining non connected collector end, until the final installed length of collector has been established and confirmed. Confirm the required length by ensuring that the loop return end of the collector is completed as per the approved design and schematic diagram. The installer should also ensure that each Loop Return end is in alignment with subsequent Loop Return ends (or roof hip/valley), and that the collector length is lying straight, flat and in a fully relaxed position, ready for final installation on the roof.

Step 11: Once fully satisfied with Step 10, cut the free, non-installed end of collector runs to the desired length (if required, Refer Step 10) and repeat Steps 4 to 9 for approximately 2 runs down the roof at a time only; this allows the installer to easily reach over the previously laid Collector and apply the Collector to Roof fixing systems (Tile Straps, TREMsil® Adhesive etc) from below, without the need to stand or kneel on the collector or excessively lean over the laid collector.

Note 1: *Ensure that the Collector is installed in a relaxed state, such that it is not applying lateral force against the Manifold System*

Note 2: *When installing the MultiLayered Collector onto any barb connection within the system (such as the connector barbs found on the TufMan™, TufReturn™ and TufBarb™), Boss highly recommends the use of Aerosolve 302 silicone spray lubricant, combined with the Boss TufColar ™ Rigid Locking Collar*

5.3 Loop Return Ends

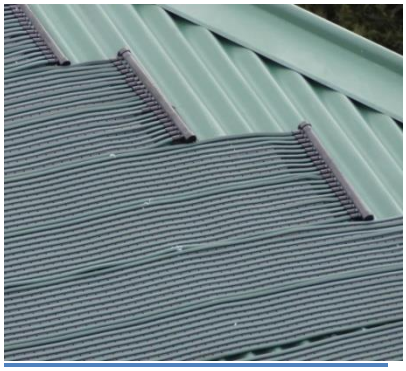


Figure 70: TufReturn™ Loop Return Manifolds

Figure 71: Standard method of flipping and looping the Collector

Figure 72: Installing the Collector tubes onto the TufReturn™ barbs

The SPHC has the option to install TufReturn™ Flat Loop Manifolds (Refer to Figure 70), or elect for the standard method of flipping and looping the collector (refer to Figure 71). This standard method (Figure 71) is more cost effective, but can look untidy and disorganised on the roof if installed incorrectly. The Boss TufReturn™ Manifolds are a relatively inexpensive option providing an easy to install, professional and aesthetically pleasing finish to the installation.

5.3.1 TufReturn™ Installation (Optional)

Starting from the top of the system, and working your way down the roof in batches of approximately 2 run lots (refer to steps 10 to 11 above), cut the collector to the desired length. Then strip and remove the connecting webs from both lengths (refer to Step 4 above) and install the Collector tubes onto the TufReturn barbs (see Figure 72)

5.3.2 Flipping, Stripping and Looping - Standard Method

Begin by placing the required quantity of collector rolls on the roof of the installation site, starting at the top of the Manifold System, un-coil the collector (one at a time) away for the Manifold System. The distance required should be specified in the Schematic Drawing prepared earlier. For the return length, flip the collector up-side down and continue to un-coil back towards the Manifold System.

Starting from the top of the system, and working your way down the roof in batches of approximately four run lots (refer to Steps 10 to 11 above), cut the Collector to the desired length, ensuring that all subsequent Loop Returns are aligned (refer to Step 10 above). Then, remove the connecting webs between the tubes for the distance of the Loop Length (approximately 400mm in total, see Figure 71). While not as neat as a TufReturn™, with the returning length flipped over the Loop Return will appear reasonably flat and neat.

Note: *This task is made especially neat and easy with the use of punched collector rolls and pointy nosed pliers. By using a pair of pointy nosed pliers, the installer can insert the nose into the appropriate punched hole, grip the web, and tear it out (refer to Figure 66)*

5.4 Fixing the Collector to the Roof

Figure 73: Applying a generous amount of TREMsil® silicone between the roofs surface and the underside of the Collector

Figure 74: Applying a generous amount of TREMsil® silicone between the roofs surface and the underside of the collector

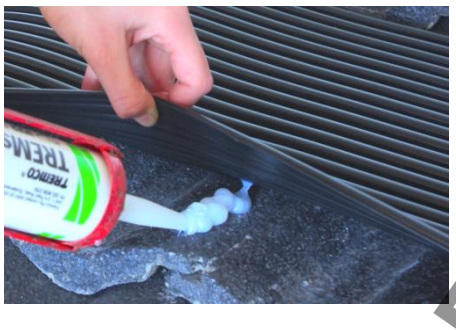


Figure 75: Close up - Applying a generous amount of TREMsil® silicone between the roofs surface and the underside of the collector

Figure 76: Silicone mushrooms created when the TREMsil® extrudes up through the punched collectors.

Starting from the top of the system and working down the roof in batches of approximately 2 runs (refer to Steps 10 to 11 in Section 5.2 above), apply a generous amount of TREMsil® silicone (translucent or black) between the roofs surface and the underside of the Collector (see Figures 73, 74 and 75).

Note: *the Installer should ensure that the roof surface and collector are clean and dry before applying the TREMsil® silicone, to ensure proper adhesion*

A generous bead of TREMsil® silicone will be sufficient for most average installations, to adhere the collector strips in their desired position for the life of the system (provided that the two surfaces are clean and dry). The beads of TREMsil® should be no more than 600mm apart for the majority of installations, in order to ensure a firm fix to the roof. By pushing the strips down firmly, the installer can ensure ample surface contact is achieved between the two surfaces.

Punched collectors allow the TREMsil® silicone to extrude up through its multiple holes, this creates mushroom shaped protrusions that enhance retention of the collector to the roof.

Working down the roof, repeat the process in batches of approximately 2 runs (refer to Steps 10 to 11 in Section 5.2 above).

For installations that are unusual, subject to strong prevailing weather conditions or a steep roof gradient, Boss recommends the installer employ multiple fixing methods at tightly spaced regular intervals across the entire installation. Such as, but not limited to:

- TREMsil® Silicone Adhesive (refer to Figure 16)
- TufTape™ a quick stick short term adhesive (refer to Figure 17)
- Tile and Tin Roof Straps (see Figure 18 and 19)

For metal roofs and other flat surfaces, use the Tin Roof Strap (refer to Figure 19) stretched over the top and at right angles to the Collector at regular intervals, starting at the top of the system.

Fix the Tin Roof Strap to the upper corrugated ridges only, use self-tapping screws and ample TREMsil® to seal the screw and attach the straps to the roofs surface.

For Tile Roofs, use the Tile Roof Strap (refer to Figure 18), simply hook the strap to the top and front leading edge of the tile at regular intervals, starting at the top of the system.

Note: It is ultimately the responsibility of the SPHC to develop a suitable roof fixing method(s) to suit each particular installation site

5.5 Fitting the Optional TufCover™

Cut and trim the TufCover™ (Figure 77) to the desired length and shape, then apply a generous amount of TREMsil® silicone to the top and bottom of the TufTrak™ retaining groove. Clip the pre-cut TufCover™ into the retaining groove, and ensure full engagement of the TREMsil® Silicone has been achieved between the two surfaces. Figure 77 & 78 displays a set of fully installed TufCovers™.

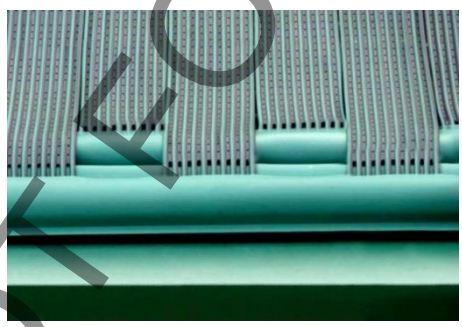


Figure 77: Boss TufCover™

Figure 78: Fully installed TufCovers™

5.6 Plumbing the System

Ensure the Manifold and Collector System is securely fastened to the roof according to all preceding chapters in this manual (refer to Section 4 Plumbing Configurations).

Once satisfied, the installer should refer to preceding chapter, the approved Schematic Drawing and AS3634-1989 to determine the appropriate:

- pipe configuration and layout
- pipe size
- fittings
- pipe fixing methods and spacing
- allowance for thermal expansion and contraction

Once satisfied attach the Supply and Return pipes to the Supply TufMan™ Manifold, Return Balance Pipe, TufFilta™, Solar Pump and Pool Return outlet according to preceding chapters of this manual, the approved Schematic Drawing, AS 3634-1989 and the instructions below:

5.7 Simultaneous Connected Systems

5.7.1 Power Connections

Refer to the detailed Aquasun Digital Controllers installation and programming instructions attached with the Digital Controller upon delivery.

5.7.2 Plumbing Connections

The existing filter pump will generally be a higher powered pump compared to a dedicated separate solar pump. As a result, always connect the solar system downstream after the Main Pool Filter and gas heater/heat pump.
Ensure that a one way check valve is included in the upstream line of the solar connections, as this prevents debris back flushing out of the main pool filter when the solar pump stops and water rushes down the return line.

Always connect the Solar System before a salt chlorinator to prevent high chlorine concentrates from entering the Solar Collector.

Note: *Never plumb across a salt chlorinator, that is, Solar suction on one side and Solar Return on the other side of the chlorinator. This will reduce water flow through the chlorinator and may affect its operation.*

5.8 Controller Installation

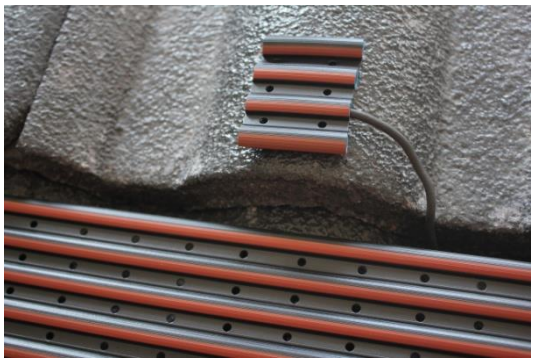


Figure 79: Roof Sensor

Figure 80: Pool Water Sensor

5.8.1 Aquasun Digital Control Box

Find a suitable location to mount the control box. The controller should be installed out of direct weather and no closer than 3 meters from the Pools edge.
Lift up the two mounting tabs at the back of the control box and use two appropriate screws to mount the control box to the wall, keeping in mind that the power cable is 1.8m long and should be plugged directly into a 240 Volt GPO power supply outlet (not into an extension lead).
The solar pump plugs into the 240 V AC socket marked as PUMP.

5.8.2 The Roof Sensor

The Roof Sensor (see Figure 79) should be installed at the same time as the Manifold Pipes. Install the roof sensor and then run the cable back along the supply and return pipe work to the Aquasun digital controller.

Roof sensors must be fitted into a small piece of solar collector or equivalent and attached to the roof (refer Fig 79). The best location is within an arm's length of the gutters edge of the house or shed; as long as the sensor end is not shaded and is on a roof of similar aspect of the main collector. It must not be fitted on the top of the actual solar collector itself or fitted to high points on the roof e.g. ridge capping, as false readings will be detected.

Keep in mind that it is of the utmost importance to keep the roof sensor as short as possible, as this will assist in the longevity of the sensor and controller in the event of electrical storm activity and power surges. Sensor cables must not be run parallel to power cables. Run lengths should be less than 50 meters if possible. Cable ties should be used to fasten the sensor cable to the cold water inlet pipe, making sure that the ties are approximately 10mm from PVC fittings. Cable ties should be tightened only firm, over tightening can cause breaks in the outer PVC cable sheath if not careful. If the cable is to be run under ground, a conduit must be used to protect the

wire. Additionally there is to be no cable joins within and conduit ends must be sealed to prevent water ingress. Any excess cable should be removed and re-fitted, ensuring that the wire ends are tinned with solder. The sensor plug is to be fitted to the right hand socket marked ROOF.

Note: *The Roof Sensor (Figure 79) needs to be in a position where it receives the same amount of sun as the collector itself. Do not adhere the Roof Sensor to the collector itself as this will provide a false reading. Refer to the detailed Aquasun Digital Controllers installation and programming instructions attached with the Digital Controller upon delivery.*

5.8.2 The Pool Water Sensor

The Pool Water Sensor (see Figure 80) is best positioned out of direct sunlight and as close to the Solar Pump's supply or discharge side, so that in the event of loss of prime, it will shut the pump down on the Solar Controllers over-temperature cut-out facility.

It is recommended that a 14.5mm hole be drilled in the PVC pipe. This can be carried out using a Dontek PD01 grinding drill, or a small pilot hole can be drilled and a 14.0mm drill-bit used spinning in a counter clockwise direction to minimise the chance of shattering pipe. Insert the grommet into the pipe and gently push in the black sensor barb.

The green sensor plug is to be fitted to the plug socket marked POOL. ***DO NOT*** cable-tie or tape sensor wires to mains power, in some cases there is some benefit to cable tie 300 mm of wire from the sensor to the pipe and insulate this section (some ambient differences can travel up the tinned copper wire and affect the sensor reading).

When installing a Pool Water Sensor:

- Do not join sensor cables underground
- Always ensure that the sensor cable used is long enough
- When running pipes underground, the trench should be a minimum of 300mm deep.
- The sensor cable should be in conduit cable tied underneath one of the pipes to protect it from any future damage that may be caused by shovels etc.

Refer to the detailed Aquasun Digital Controllers installation and programming instructions attached with the Digital Controller upon delivery.

5.9 Installing the Pressure Gauge TufGuage

Figure 81: Boss TufGauge™

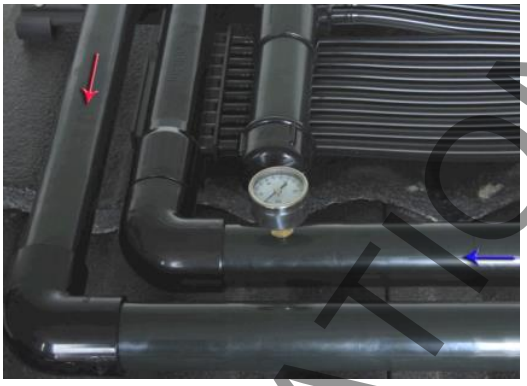


Figure 82: TufGauge™ installed in the Supply Pipe

The TufGauge™ (refer to Figure 81) should be installed in the Supply / pressure Pipe Only (see Figure 82) just below or close to the first Collector Strip, as this is the point in the Solar System where the pressure on the Collector tubing is at its highest.

To install the TufGauge:

Step 1: Assemble the enclosed brass barb onto the TufGauge using Teflon sealing tape and two open end spanners (14 A/F & 16 A/F). This ensures a permanent pressure tight assembly, without applying any stress to the stainless steel casing of the gauge.

Step 2: Drill a 8.5 mm hole in the PVC supply pipe in the appropriate position and orientation. Ensure the drilled wad, swarf and burrs are removed to prevent them from entering the system.

Step 3: Insert the tapered end of the enclosed rubber grommet into the hole, ensuring full engagement without using any form of lubricant.

Step 4: Lubricate the brass barb only with silicone lubricant, and insert it into the rubber grommet; ensuring full engagement.

6. COMMISSIONING THE SYSTEM

Commissioning the system is one of the most important steps for any solar installation. Performed correctly, commissioning should highlight any faults within the system prior to hand over.

Refer to AS 3634-1989 Section 9 and ensure that all the relevant testing, procedures and documentation as detailed in AS 3634-1989 Section 9 and this installation manual all are followed and that your handover and warranty documentation is thorough and comprehensive.

We recommend the SPHC ensures that the householder understands the importance of proper pool chemical maintenance Refer to AS 3633-1989, both for the negative affect it can have on their system and more importantly on their health.

6.1 Separate Suction and Return

- Allow 24 hours for all adhesives to set prior to commissioning the system
- Prime the pump by filling the lint pot with water, once filled start the pump via the manual mode on the Digital controller
- Once primed, air should purge from the system and back to the pool via the pool return outlet for only a short period of time, refer Figure 83
- After a minute or two inspect the pool's return outlet, if endless bubbles (Figure 83) continue this may be due to air entering the system via the VacRel VRV valve, refer to section 3.8 Basic Collector and Roof Plumbing Configurations – Vacuum Relief Valve (VacRel VRV) for an explanation and remedy

Figure 83: Air Bubbles

6.2 Simultaneous Connection

- Allow 24 hours for all adhesives to set prior to commissioning the system
- Turn on the pools main filtration pump and allow it to continue pumping until it operates at a steady pressure

- Turn on the solar pump via the Aquasun digital controller's manual mode switch. Air should purge from the system and back to the pool - via the pool return outlet - for short period of time (Figure 83)
- After a minute or two inspect the pool's return outlet, if endless bubbles continue this may be due to air entering the system via the VacRel VRV valve, refer to section 3.8 Basic Collector and Roof Plumbing Configurations – Vacuum Relief Valve (VacRel VRV) for an explanation and remedy

6.3 Check For Leaks

- With the solar system operating and stabilised for a few minutes, survey the entire system for leaks. The suggested method is to inspect the roofs surface for water dribbling towards the gutters. By following the dribbles up the roof you will generally find the source of the leak
- Repair and re-test as necessary. *Refer to Figure 6.6*

6.4 Drain Down, Vacuum Crush

- With the solar system operating and stabilised for a few minutes, turn the solar pump off, immediately inspect the VacRel (VRV) by listening for the sound of air being suck back into the system, air should easily re-enter the solar system as the pool water fully drains back to the pool without creating a vacuum within the system, refer to section 3.8 Basic Collector and Roof Plumbing Configurations – Vacuum Relief Valve (VacRel VRV) for an explanation and remedy
- At the same time inspect multiple sections of the MultiLayerd collector to ensure that the systems circular tubes remain un-distorted. Distorted tubes may be an indication of internal vacuum and must be remedied immediately

> ***Note:*** *Failure to adhere to these guidelines may result in major damage to the system.*

6.5 Pressure Testing/Setting

With the solar system operating and stabilised for a few minutes, refer to the mounted TufGauge pressure gauge to determine the systems pressure. The Gauge should operate within the recommended pressure range provided that the system has been installed according to this manual

- **Bottom Feed Systems:** Designed and installed to automatically fully drain with a TufFilta water strainer fitted - 100 kPa max (15 psi)

- **Top Feed Systems:** Installed with a TufFilta water strainer fitted - 50 kPa max (7 psi)

If the gauge is reading zero, adjust the TufValve on the return line to obtain a small positive pressure reading.

Installing systems to operate at greater pressures should only be attempted by highly experienced installers, who fully understand pressure limitations for their particular installation method and geographical location (Refer to AS 3634-1989 Sections 9.1 & 9.2(g) and 8.3(b)).

Note: *Failure to adhere to these guidelines may result in major damage to the system.*

6.6 Repairing a Damaged Collector Tube

- Locate and mark the position of the leak with chalk
- Shut down the pump
- Use a sharp blade to carefully cut the leaking tube at the site of the leak, being extremely cautious not to nick the other tubes. Cut a 3mm section out of the tube and strip out the connecting webs on either side of the leak by approximately 100mm
- Use a TufBarb joiner barb and two TufColar collars to repair the section.

Note: *Boss recommends that the SPHC provide the pool owner with a simple repair kit containing barbs, collars and fitment instructions.*

6.7 Set the Aquasun Digital Controller.

Refer to: The Aquasun Digital Controllers installation and programming instructions attached with the Digital Controller upon delivery.

6.8 Maintenance

It is expected that the SPHC will provide adequate and appropriate documentation, training and guidelines to the customer at handover (refer AS 3634-1989)

6.9 Warranty

For full details in relation to this warranty please refer to your Trade Portal www.BossSolar.com.au

7. TERMS AND CONDITIONS

This Solar Heating Installation Manual must be read in conjunction with Boss standard Terms and Conditions and the Boss Solar Pool Heating warranty (refer Trade Portal www.BossSolar.com.au).

Please read this manual carefully, as failure to adhere to these guidelines may void your warranty. Should you require any clarification, please contact our head office within normal AES business hours, on (03) 9561-2777 and request to speak to one of our technical sales consultants, or alternatively email us at sales@bosssolar.com.au.

8. GLOSSARY

	Definition
BOSS	Boss Polymer Technologies trading as Boss Solar.
Purchaser	The original company / person(s), acquiring the BOSS product directly from BOSS.
SPHC	Solar **P**ool **H**eating **C**ompany: Is the primary entity responsible for the solar installation,
Installer	The person/s physically installing the system with some commercial or other relationship with the SPHC
Customer	The original pool owner.
System	The installed solar pool heating system comprising of BOSS components listed in Section 3 of this manual and possibly other non Boss components.
Product	The components manufactured and supplied by BOSS.
Collector	The Boss MultiLayered Black or Coloured Solar Thermal Absorber / Collector Strip listed in Section 3 of this manual.
Cementing	Solvent bonding/cementing transition joints using a solvent cement such as type N PVC glue, Refer to Appendix 1: Recommended Cementing Procedure for suggested process.
AS	Australian Standards
Serpentine	The collector installation method where the collector is installed looping up the roof on either side of the roughly central manifold system. (see Figure 3).

U Loop	The collector installation method where the collector is installed looping up the roof on only one side of the manifold system only.
SRCC	SRCC ™ is a non-profit organization, based in Florida USA whose primary purpose is to provide authoritative performance ratings, certifications and standards for solar thermal products, with the intention of providing guidance to customers, incentive providers, governments, and the industry," refer http://www.solar-rating.org/ and *Appendix 3:*
VRV	Vacuum Relief Valve also referred to as the VacRel® Valve
Loop Return	Refers to the TufReturn manifold or the Return Loop of the collector furthers away from the TufMan manifold system.
Run Length	Refers to each individual collector strip length (metres) from the TufMan supply to the TufMan return manifold. Refer Flow Length.
Flow Length	Water flow distance from supply TufMan to return TufMan manifold (note: same as run length)
Simultaneous System	Existing (generally older) pools installed without a separate solar suction and return lines may be Solar Heated by tapping the solar heating circuit into the existing filtered return pipeline.
Separate Circuit System	Generally newer pools installed with a separate and dedicated Solar suction and return lines.
Drain Back	When the Solar Pump switches off, the pool water automatically drains from the System back to the pool.
Drain Tube	A small tube linking the Supply Pipe to the Return pipe in order to assist with maximizing drain back
Winterizing	A manual process of preparing the System for freezing conditions, e.g. manually draining the system of all water if the system is unable to automatically fully drain.
Multilayered Solar System	A customized Solar System designed to be installed either as a "U" Loop or a "S" Serpentine pattern across the roofs surface.
MultiLayered Solar Collector	Solar collectors co-extruded using multiple unique compounds into a single Collector profile.
Mono Solar Collector	Older technology where the Solar collector is extruded using a single compound only.

APPENDICIES

Appendix 1: Manufacturers Guidelines for Installation of the TufMan™ Manifold

TufMan™ Manifolds are manufactured from Luran® S, which is the brand name for BASF's unique styrene acrylonitrile co-polymer (ASA) that has been impact-modified with acrylic ester rubber. Luran® S is the stand-out material for this type of application because of its high thermal stability, excellent resistance to UV and the effects of weather on ageing and long term retention of properties, and good resistance to chemicals.
TufMan™ Manifolds have been designed to be used as part of the Unglazed Strip-Collector Solar Pool Heating Systems for domestic, commercial or public swimming pools. All systems using TufMan™ Manifolds must comply with AS 3634-1989: Solar Heating Systems for Swimming Pools, and BOSS F605 011016 Installation Guideling and Training Manual. The use of TufMan™ Manifolds for applications other than Solar Swimming Pool Heating Systems is not recommended by the manufacturer.
Recent amendments to the National Plumbing and Drainage Standard (AS/NZS 3500.2/Amdt 4/2011-12-23), and advisory announcements from National Plumbing Regulators, now accept the long-standing industry practice of solvent cement jointing PVC-U to ABS/ASA pipes and fittings. The TufMan™ Manifolds have been manufactured under strict process conditions, and designed to minimise the potential of solvent-induced stress cracking. Whilst some of the aggressive solvents used in commercial PVC-U solvent cements have been shown to adversely affect the joint strength of ABS/ASA to PVC-U or ABS/ASA to ABS/ASA pipes and fittings, the manufacturer of TufMan™ Manifolds recognises this practice as acceptable as long as the following precautions are strictly adhered to.
Note: Failure to adopt these recommendations may result in the product warranty being void.

Recommended Cementing Procedure

To make consistently good solvent cementing transition joints, the following points should be clearly understood:

- If required, cut the TufMan™ Manifold to the required length using the moulded ribs as a guide. Thoroughly de-burr edges and remove any loose material.

- Do not use a solvent primer on the TufMan™ Manifold or any other ASA component. Wipe down joint areas with only a clean cloth to remove dust or other contaminants. Apply primer to the PVC-U components only.

- Do not apply solvent cement into the FEMALE socket end of the TufMan™ Manifold. Apply adequate solvent cement to the MALE component/s only for the full 50mm length or five divisions on the TufMan™. This procedure is to ensure adequate bond surface area, while eliminating the possibility of excess solvent cement beading on the internal transition joint.

- On the Male end only, ensure total coverage and sufficient cement to fill the gap between the Male fitting and the Female fitting.

- Insert the Male end into the Female socket immediately after the solvent cement is applied. Assembly of Male and Female must be made while the male surface is still wet and solvent cement is still fluid. Align the longitudinal marks and ensure that the full five divisions (approx 50mm) are inserted into the female socket; hold components together long enough to ensure retention.

- After insertion, ensure that the external excess beads of solvent cement are wiped away with a clean cloth.

- We recommend that the solvent cement be allowed to dry for at least 24 hours before the system is turned on and pressurized with water.

> ***Note:*** *Ensure you follow the solvent cement manufacturer's directions for safe and proper use.*

Mounting and Connecting

It is important that the TufMan™ Manifold System and its Supply and Return connecting pipes are securely installed onto the roofs surface, in order to resist induced external forces (such as wind). However, the entire system must also be installed to allow for all thermal movements (TufMan™ and connecting pipes) without inducing longitudinal or lateral stress on TufMan™ Manifold System. An easy and effective method of pipe and Manifold mounting, is the TufMan™ Roof Mounting System; TufTrak™, TufClip™, TufCover™ (see figures 84 to 87), contact your authorised dealer for further details.

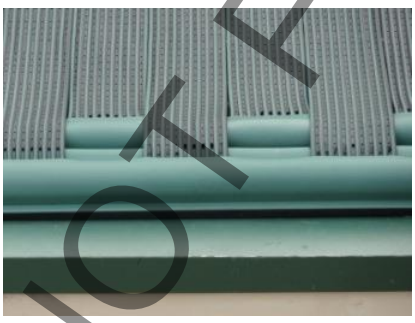


Figure 84: As Assembled

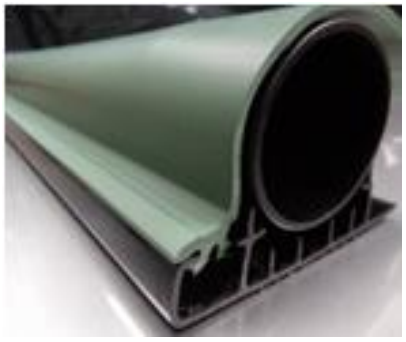


Figure 85: End View

Figure 86: TufClip (ASA resin)

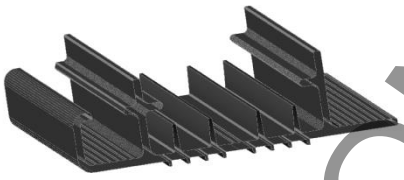


Figure 87: TufTrak (ASA resin)

Summary

Remember:

- No Primer or Solvent on the Female End, Male End ONLY
- Max Five Divisions
- Remove Excess Glue
- Securely Install TufMan™ to roof in a manner which allows for thermal movements of all components, without inducing linear or lateral stress to any section of the Manifold System

STRICTLY NO GLUE IN FEMALE SOCKET

Recommended Bonding Cements

Where maximum joint strength is required, BOSS recommends the use of commercial solvent cements specifically formulated to bond ABS/ASA to ABS/ASA or ABS/ASA to PVC-U.
Two such cements are:

- IPS Weld-On 771 for bonding ABS/ASA to ABS/ASA pipes or fittings.
- IPS Weld-On 794 for bonding ABS/ASA to PVC-U pipes or fittings.

Refer to: *The solvent cements manufacturer's instructions and recommendations in conjunction with the above TufMan™ procedures.*

Appendix 2: Solar Pool Heating Fundamentals

The performance of the solar pool heating system is determined by how efficiently the Sun's energy is transferred into the pool water. The total amount of energy delivered to the pool is the product of the amount of water flowing through the system's collector, multiplied by the water's temperature rise as it travels through the system and returns to the pool.

The fundamentals by which the Sun's energy is transferred to the pool water are:

- All natural systems seek to achieve a balance, heat always moves from hot (more energy) to cool (less energy).
- The greater the difference in temperature between two points of an object or between two objects (Temperature Differential), the quicker the heat is transferred from the hotter to the cooler point. This applies whether the heat transfer method is radiation, conduction or convection.
- The Sun's energy heats the incident surface of the collector via radiation. The energy of the Sun's electromagnetic waves, primarily in the invisible infrared spectrum, is converted to heat energy at the exposed surface of the collector.
- Heat is transferred through the wall of the collector via conduction, transferring heat energy from the outer surface of the collector to the inner surface in contact with the water flowing through it. The water draws heat away from the wall of the collector, maintaining a temperature differential across the collector wall – from the outer surface to the inner surface.
- The difference between the outer surface temperature of the collector and the water flowing through it, the thickness of the collector wall, and the material that the collector is made from all determine how quickly the water "absorbs" the Sun's heat through the collector wall.
- As the water flows through the solar heated collector it absorbs energy and heats up. As the water heats up the Temperature Differential between the outside of the collector and the water flowing through it gets smaller, and therefore the rate at which the water continues to heat up becomes slower. This is the reason why if the water path from the inlet to the outlet points of the solar collector is too long, the system loses efficiency.
- Water flowing through a pipe tends to flow in annular rings – like the rings in an onion that has been cut in half. At low flow rates, this flow pattern is very dominant, with the outer most "ring" in contact with the pipe wall being stationary due to friction between the pipe wall and the water. The water flows fastest at the centre of the pipe through the inner most "ring". At low water flow rates, there is very little mixing of the water between each "ring", resulting in very poor transfer of heat between the collector tube wall and the bulk of the water flowing through it. At higher flow rates there is good transfer of heat throughout the water as the result of turbulence (Convective Heat Transfer).

- Low flow rates tend to result in low system efficiencies, while high flow rates tend to result in higher system efficiencies. However, above a certain flow rate there is little improvement in convective heat transfer, but the pressure drop over the system continues to rise. This requires an increase in the horsepower of the circulating pump, and therefore the cost to run the system.

- For a solar pool heating system to operate correctly and efficiently, the system requires the pool water to be pumped evenly throughout the entire system at flow rates between 1.8 to 4.8 litres per minute per square metre of collector at an appropriate system pressure.

Appendix 3: Boss Solar Solutions – SRCC

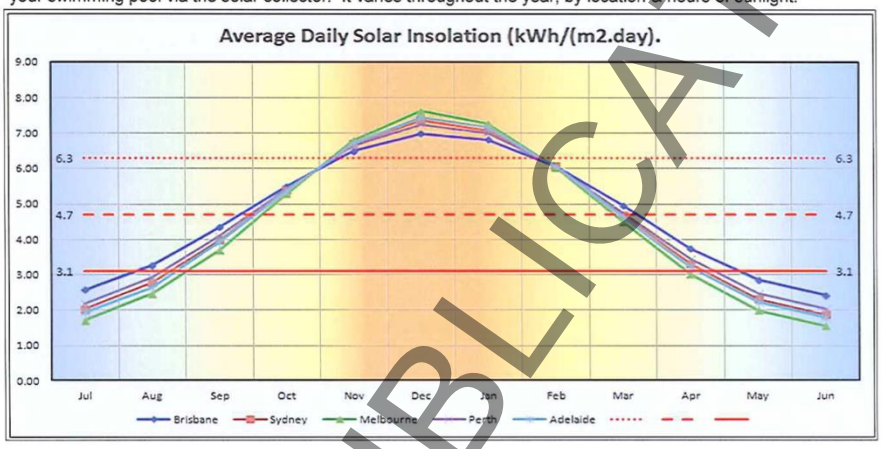
Boss Solar Solutions Pricelist - Season 2012_2013 **SRCC Certification**

SRCC - Solar Rating & Certification Corporation

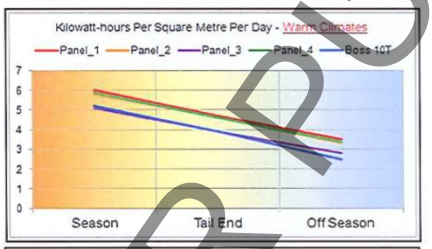
- An independant 3rd-party organisation that certifies and rates solar water heating collectors and systems. The rating includes a number of durability related tests as well as a test of the collector's heat output and efficiency. Tests are carried out against a recognised standard, providing a means to compare similar and different types of collectors under the same conditions. (*Note* - these ratings do not take into accout the relative costs of the different collectors tested)

Boss 10 Tube PVC The only Ausatralian-made flexible absorber to be tested and certified by the SRCC

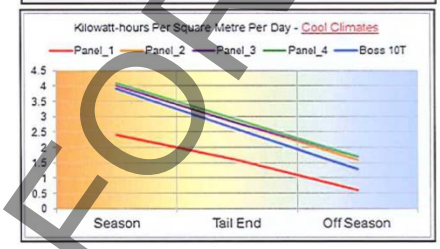
Solar Insolation is the measure of solar radiation energy (per square meter over a give time) available to heat your swimming pool via the solar collector. It varies throughout the year, by location & hours of sunlight.



Collectors perform differently under varying sun and wind conditions, exposure orrientation, shading, roof angle and the difference between the collector temperature, the water temperature & the ambiant air temperature.



SRCC Category A - Pool heating in Warm Climates where typically ambient temperatures are 5 °C higher than the temperature of the pool water going through the collector. Representing the peak swimming season throughout Australia, and the "tail-end" of the season for northern parts of Australia. Under these conditions, the 4 most popular solar panels have similar performance ratings. The Boss 10 Tube flexible performs favorably at a much lower investment cost than the panel systems.



SRCC Category B - Pool heating in Cool Climates where typically ambient temperatures are 5 °C lower than the temperature of the pool water going through the collector. Representing southern parts of Australia at both the start and end of the typical swimming season. Under these conditions, some of the most popular solar panels drop off in performance ratings. The Boss 10 Tube flexible system performs equal to the best panels - representing one of the best "Value-For-Money" options available.

Panels used in comparison - Heliocol HC-40, Techno-Solis Swimmaster, Aquatherm Ultraswim & Fafco Sunsaver. Boss 10 Tube TufMan or Venetian Triple Black flexible PVC absorber.

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