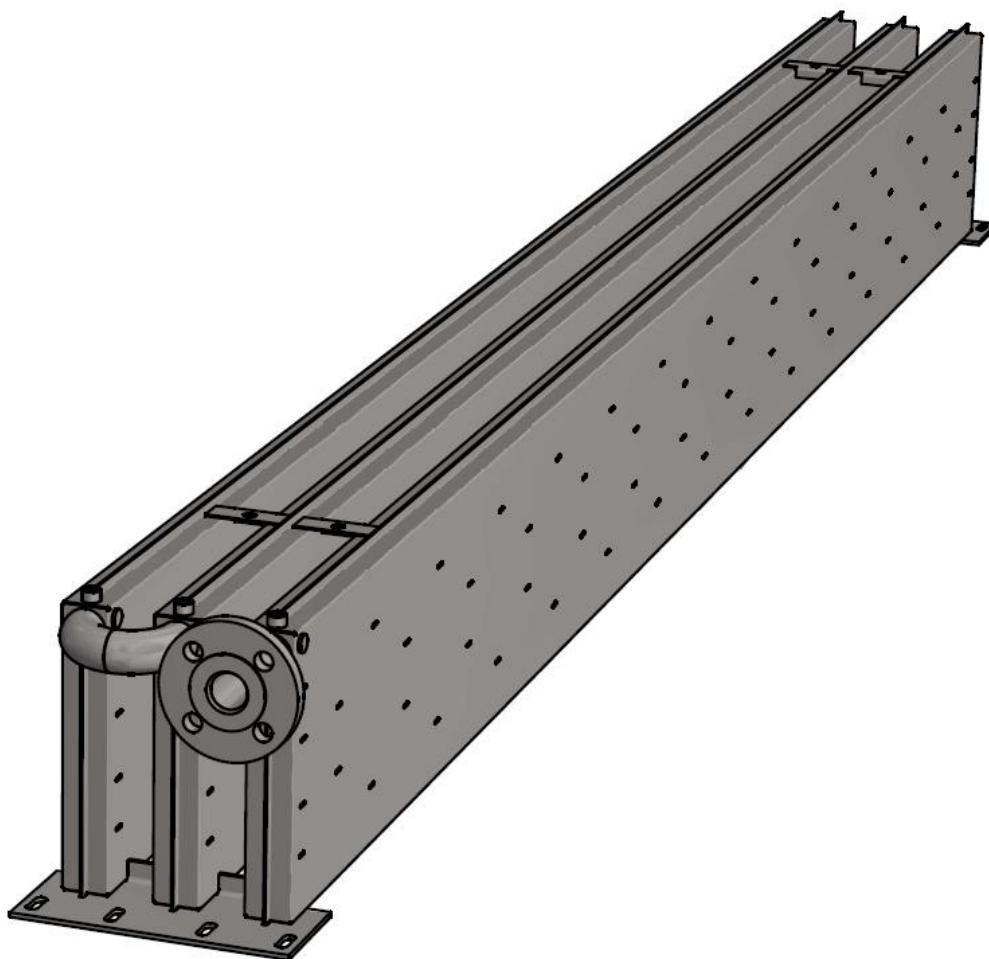




FIRE FLO

Installation and Maintenance Guide

Contents

1	General	3
1.1	Product description.....	3
1.2	Intended use	3
2	Transport and storage	3
2.1	Delivery	3
2.2	Transport.....	3
2.3	Storage	3
3	Installation.....	4
3.1	General installation guidance	4
3.2	Pipework assembly	4
3.3	Wall-mounted FireFlo installation	5
3.4	Bed mounted vertical FireFlo installation.....	7
3.5	Bed-mounted horizontal FireFlo installation	8
3.6	Bed-mounted embedded FireFlo installation	9
4	Commissioning	11
4.1	Fill/purge pump system	11
4.2	Filling and purging procedure	13
4.3	Pressure testing procedure.....	13
4.4	Adding antifreeze	14
4.5	Pressurising the system	15
5	Operation.....	16
6	Maintenance	16
6.1	Access.....	16
6.2	Cleaning.....	16
7	Warranty	16

1 General

1.1 Product description

The FireFlo heat collector system is a system of stainless-steel heat exchanger panels designed for collecting thermal energy from water courses in water source heat pump systems.

1.2 Intended use

The FireFlo system must only be used as specified in this installation and maintenance guide and in line with the FireFlo Design Guide. Incorrect use will invalidate the warranty.

The FireFlo panels are designed to be installed directly in flowing fresh water and fully immersed. Various standardised mounting systems are available to enable mounting to the wall of a channel or the bed of a channel.

Relevant conditions must be adhered to during the installation of the FireFlo system including:

- Regulatory consents.
- Planning consent.
- All regulatory standards, including building regulations.

2 Transport and storage

2.1 Delivery

Check the goods for damage and completeness on delivery. Any transport damages and/or missing parts must be notified immediately in writing and should be recorded on the delivery note.

2.2 Transport

The 3 panel FireFlo assemblies should be lifted using all four designated lifting points or underslung at both ends. Lifting from the centre may result in damage.

Single panel assemblies can also be underslung at both ends but can be manually manoeuvred by two people if safe to do so.

2.3 Storage

During storage, care should be taken to ensure that the pipe connections remain sealed to prevent ingress of debris.

It should also be ensured that the weight of the FireFlo assemblies is evenly distributed along the long edge when in storage.

Do not stack assemblies as this may result in damage to lower assemblies.

3 Installation

3.1 General installation guidance

The type and size of anchors and fixings for mounting the FireFlo assemblies to the wall or bed of a channel should be specified for each application.

All anchors and fixings should be stainless steel or a material with similar corrosion resistance in aqueous environments. Where dissimilar metals are in contact with each other, a method of electrically isolating the metals from each other should be implemented if there is the potential for electrolytic corrosion.

3.2 Pipework assembly

The flow and return pipework should be assembled to the FireFlo assemblies prior to submerging the assemblies in the watercourse to prevent the FireFlo assemblies filling with contaminated water from the watercourse. If the installation area is not to be drained during installation, this will involve assembling the pipework to the FireFlo assemblies above water level before filling them until they are neutrally buoyant and sinking them into their installation positions. The pipework will need to be assembled sufficiently so that when the FireFlo assembly is submerged, contaminated water cannot enter the system.

The flow and return pipework should connect to the FireFlo assemblies using DN32 PN16 flanges. Generally, this would be achieved using a PE stub flange with a PP coated or stainless-steel backing flange. The typical gasket to be used would be a 3mm thick EPDM gasket. For this size flange, 4 off M16 stainless-steel bolts should be used. The bolting torque should be 50 Nm.

The general assembly sequence for flanged joints is as follows:

1. Ensure that the faces of the flanges are flat, clean and free from dirt or foreign matter.
2. Use new undamaged bolts, nuts and washers. Lubricate the bolt threads and all mating surfaces of nuts, washers and flanges using a suitable lubricant.
3. Bolts to be inserted in the four bolt positions.
4. Position the gasket on the bolts.
5. Offer the adjoining flange to bolts.
6. Lightly tighten the four location bolts in the order as shown in Figure 1 to secure the adjoining flange.
7. Using a torque wrench, tighten in the correct sequence as shown as shown in Figure 1.
8. Tighten to 1/3 of specified torque initially, then 2/3, then full torque. Ensure that a sufficient number of circuits are undertaken to achieve the specified bolt torque.
9. Because of potential gasket creep, leave for one hour, check and, if necessary, retighten bolts. Repeat the checks until the bolts will not tighten any more.

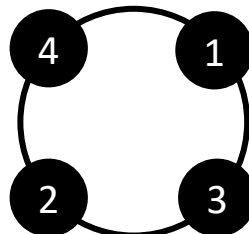


Figure 1: flange bolt tightening sequence.

The size of the flow and return pipework for each FireFlo loop is generally 40mm for PE pipe. However, this should be sized to suit the allowable pressure loss for the application.

The FireFlo connection flanges can be used as flow or return connections interchangeably.

3.3 Wall-mounted FireFlo installation

For FireFlo wall-mounted assemblies, the main support channels must first be fixed to the wall. The length of these support channels will vary depending on the number of vertically stacked FireFlo assemblies and the desired fixing positions.

If the wall is flat and vertical, the channels can be fixed directly to the wall. If the wall is uneven or sloping, the levelling brackets should first be fixed to the channel using M12 stainless steel bolts and nylon locking nuts. The levelling brackets will then be fixed to the wall.

The type and size of fixing used will depend on the construction of the wall and should be determined for the specific application. A typical fixing would be an M12 through bolt or an M10 chemical anchor. The filled mass of the FireFlo assemblies given in the FireFlo Design Guide can be used to inform the structural calculations.

The main support channels should be fixed vertically and at 2,919 mm centres. Lengths of timber can be bolted between the channels to assist with the correct spacing and alignment. The channels should also be fixed such that the cantilever supports on either channel are parallel. The levelling brackets can be shimmed using stainless steel shims to get the channel alignment correct.

The cantilever supports can be fixed to the main support channels prior to wall mounting if required. These should be fixed to the channels using 2 x M10 bolts and channel nuts per support. The required tightening torque for these bolts is 31.5 Nm to prevent vertical slippage.

The cantilever supports should be positioned to get the desired FireFlo positions. The minimum spacing between cantilever supports is approximately 420 mm to allow access to the bleed plugs.

The cantilever supports on the end where the bleed plug is located should be elevated approximately 10mm above the corresponding opposite support. This will ensure that the FireFlo assemblies can be fully bled.

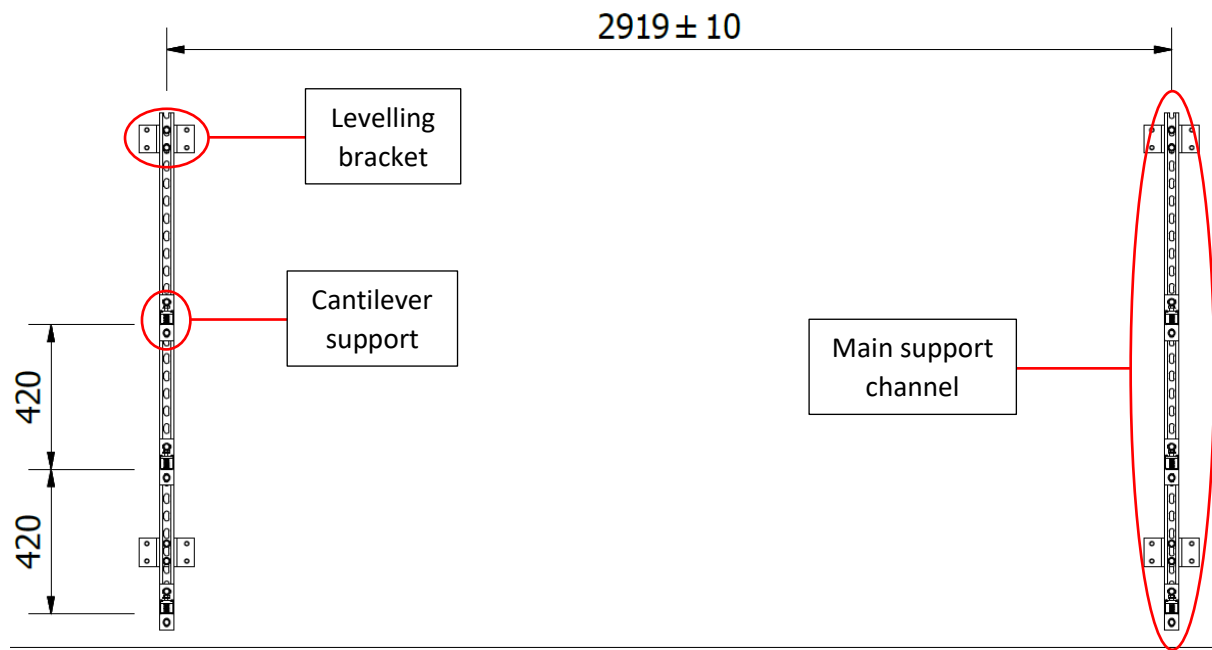


Figure 2: wall mounted bracket arrangement (front view)

Once the mounting brackets have been positioned, the FireFlo assemblies can then be mounted. The FireFlo assemblies are mounted to the cantilever supports using stainless-steel M10 bolts and channel nuts. A minimum of 2 fixings per end should be used.

If the cantilever brackets are submerged during installation, the FireFlo assemblies can be filled until neutrally buoyant, as described in section 3.2.

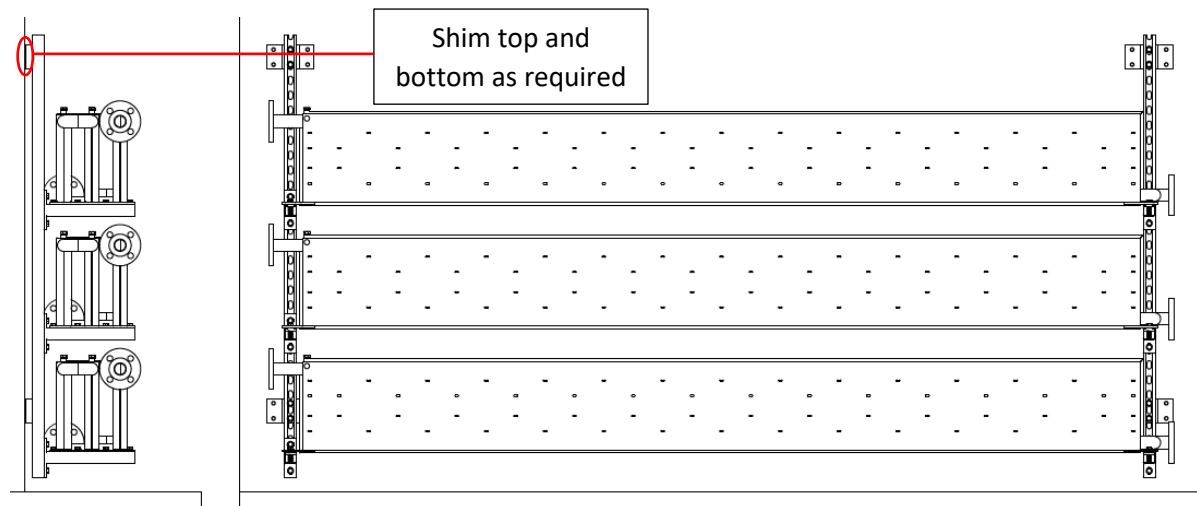


Figure 3: FireFlo assemblies mounted to wall mounting brackets (end and front views)

3.4 Bed mounted vertical FireFlo installation

For FireFlo bed-mounted vertical assemblies, the main support channels must first be fixed to the bed of the channel. The length of these support channels will vary depending on the number of adjacent FireFlo assemblies.

The levelling brackets should first be fixed to the main support channels using M12 stainless steel bolts and nylon locking nuts. The main support channels should be mounted level and parallel to each other. The support channel at the bleed port end of the assemblies should be elevated approximately 10 mm above the opposite support. If the bed of the channel is solid and relatively level, the main support channels can be mounted using the standard levelling brackets. If the bed is soft, bed mounting plates can be installed and the levelling brackets can be fixed to the mounting plates. Stainless-steel shims can be installed between the bed mounting plates and the levelling brackets to level the main support channels. The main support channels should be fixed at 2,919 mm centres. Lengths of timber can be bolted between the channels to assist with the correct spacing and alignment.

If fixing directly with the levelling brackets, the type and size of fixing used will depend on the construction of the bed and should be determined for the specific application. A typical fixing would be an M12 through bolt or an M10 chemical anchor.

If fixing using the bed mounting plates, these should either be anchored through to the bedrock or masonry below using chemical anchors or through bolts. Alternatively, earth anchors can be used if the material below is not suitable for chemical or mechanical anchors. A minimum of 2 anchors should be used per mounting plate. Again, the type and size of fixing used will depend on the construction of the bed and should be determined for the specific application.

When installing the mounting plate on a soft bed, the flanges should generally be installed vertically into the bed. This helps prevent lateral movement over time.

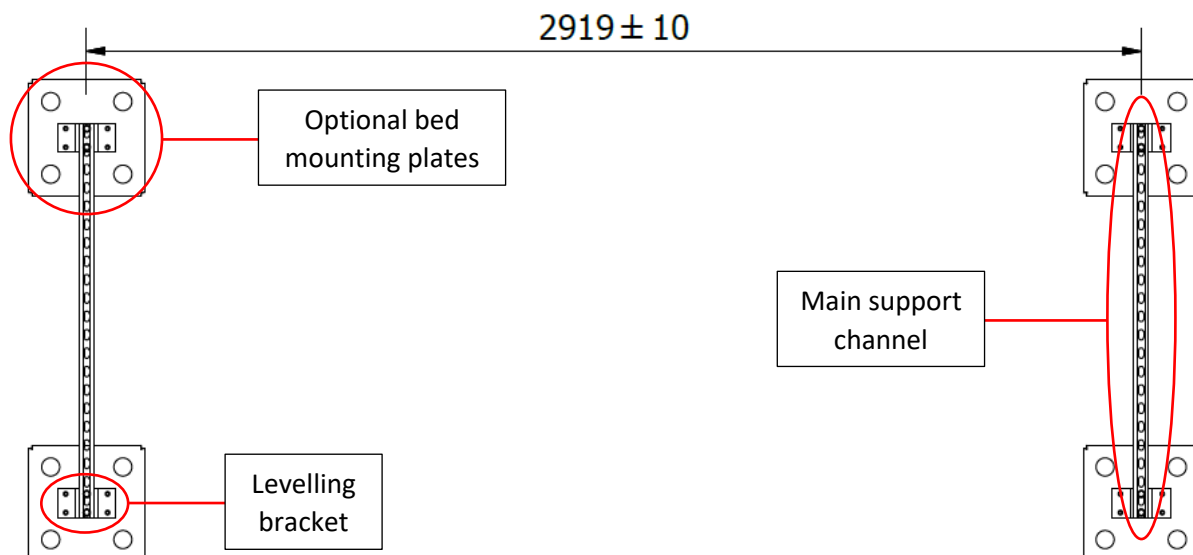


Figure 4: vertical bed mounted bracket arrangement (plan view)

Once the mounting brackets have been positioned, the FireFlo assemblies can then be mounted. The FireFlo assemblies are mounted to the mains support channels using stainless-steel M10 bolts and channel nuts. A minimum of 2 fixings per end should be used.

If the brackets are submerged during installation, the FireFlo assemblies can be filled until neutrally buoyant, as described in section 3.2.

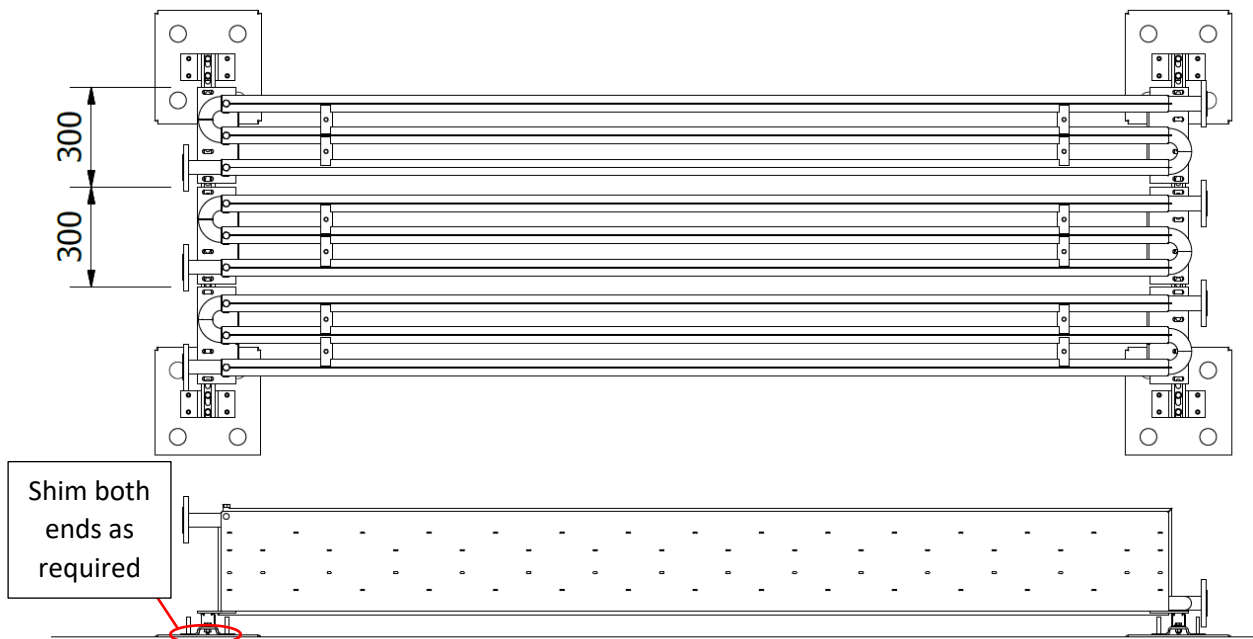


Figure 5: vertical FireFlo assemblies mounted to bed mounting brackets (plan and front views)

3.5 Bed-mounted horizontal FireFlo installation

For bed-mounting using horizontally orientated FireFlo assemblies, the main support channels should be installed at 2,700 mm centres, as per Figure 6. Besides this dimension, the bracket installation procedure detailed in section 3.4 should be followed.

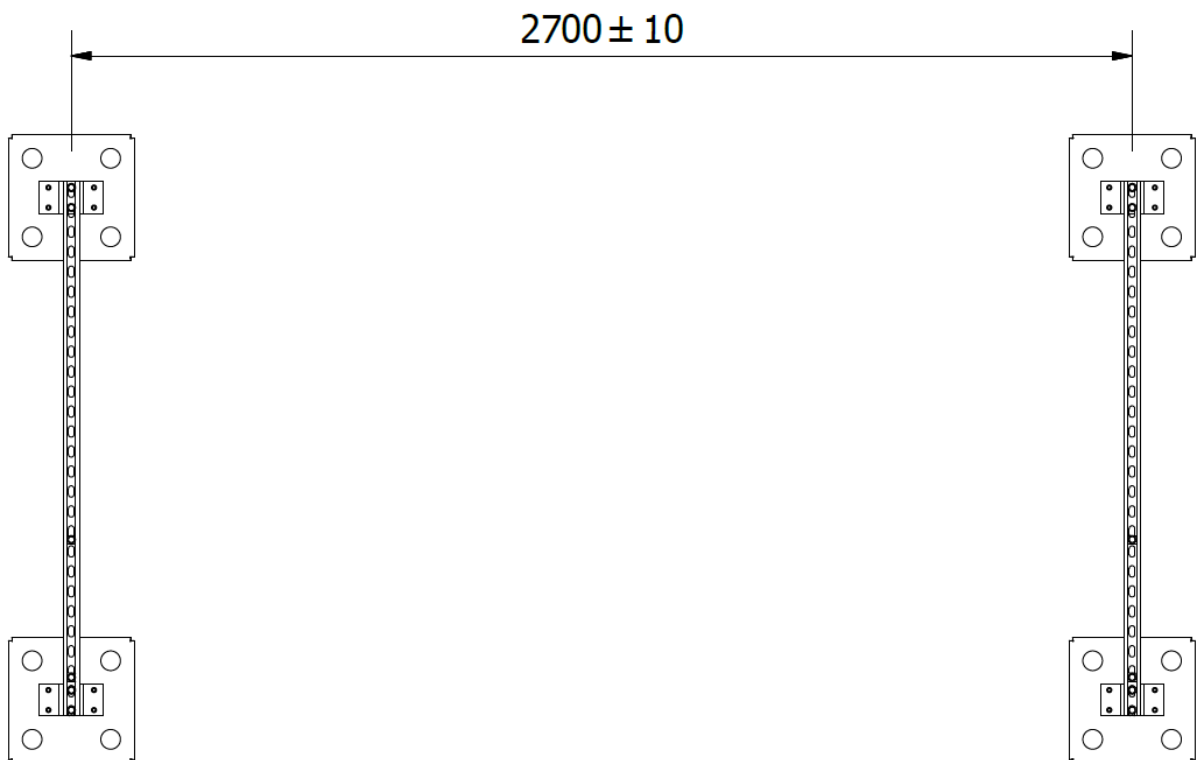


Figure 6: horizontal bed mounted bracket arrangement (plan view)

Once the brackets have been installed, the FireFlo assemblies can be bolted to the main support channels. If the FireFlo assemblies are to be submerged during installation, any interconnections between panels should be assembled above water level to prevent contamination from the watercourse (as per the guidance in section 3.2). The assembled panels can then be lowered onto the main support brackets and bolted down with stainless-steel M10 bolts and channel nuts. A minimum of 2 fixings per end should be used.

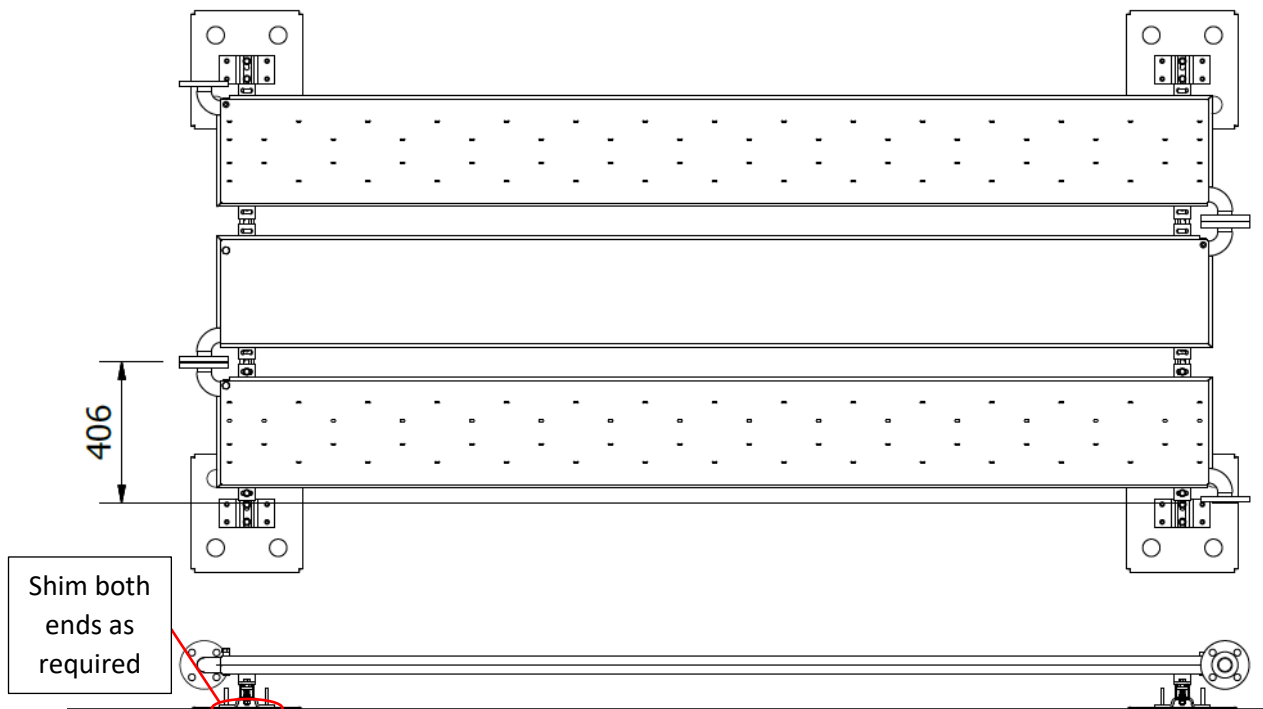


Figure 7: horizontal FireFlo assemblies connected in series mounted to bed mounting brackets (plan view)

3.6 Bed-mounted embedded FireFlo installation

When embedding FireFlo assemblies within the bed of a channel, the bed material must first be excavated to a depth of approximately 40 mm. This will ensure the top surface of the panels is exposed to flowing water during operation but that the panels do not significantly disrupt flow in the channel.

If the panels are being submerged during installation, the interconnections should be assembled above water level and the complete assemblies should then be lowered. However, for this mounting method, installation is likely to be difficult without creating a dry working area.

Once the panels are in position, they should be fixed down at each end using the integrated mounting brackets. Earth anchors can be used if the material below is not suitable for chemical or mechanical anchors. The type and size of fixing used will depend on the construction of the bed and should be determined for the specific application. If possible, each panel should be fixed at both ends. However, it may be possible to use fewer fixings if panels are interconnected and site conditions allow for it.

Following installation and connections, the panels should be backfilled with the excavated bed material such that the top surface is raised 10 mm above the normal bed level.

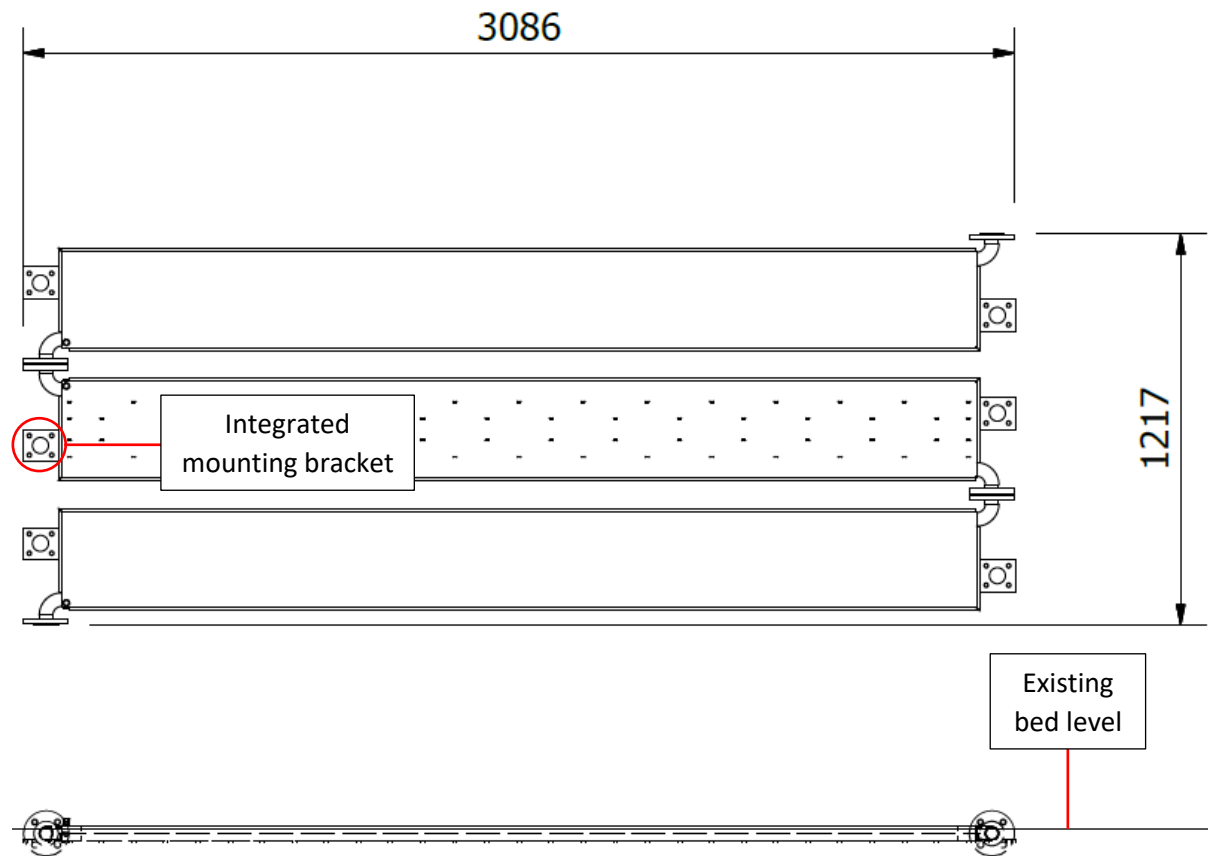


Figure 8: embedded FireFlo assemblies connected in series (plan and front views)

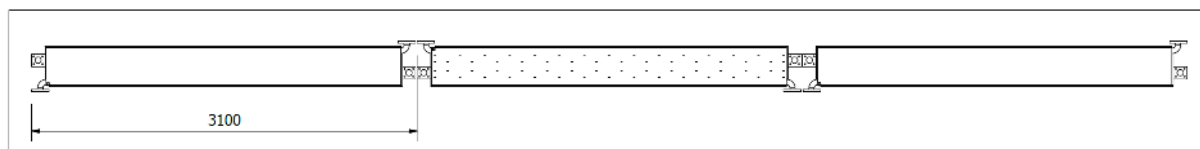


Figure 9: embedded FireFlo assemblies connected in series, interconnections not shown (plan view)

4 Commissioning

After all installation work has been completed, the following commissioning procedures should be followed.

4.1 Fill/purge pump system

In order for the FireFlo collector system to function correctly, all air should be purged from the system.

The pressure when filling and purging the FireFlo assemblies should not exceed the maximum operating pressure specified in the FireFlo Design Guide.

To remove air from the collector system, a suitable fill/purge pump system should be used. The fill/purge pump system should have the following features:

- Centrifugal water pump with a maximum head greater than the desired system pressure. A pump flow of at least 30 l/min at 1 bar should be sufficient for most systems. A Clarke SPE800 self-priming pump is a suitable option.
- Liquid container with a capacity of at least 80 litres. This could be a wheelie bin for example.
- Pressure relief valve with a pressure setpoint equal to the desired system pressure. This should be less than the collector system safety relief valve setpoint. The pressure relief valve discharge flow should be greater than the fill/purge pump flow at the pressure relief valve setpoint. For example, if the pressure relief valve setpoint is 1 bar, for an SPE800 pump, the flow is 2800 l/h at this pressure (see Figure 10). The relief valve should therefore discharge at least 2800 l/h at 10% overpressure. The recommended relief valve is a NABIC 500L or 542L.
- Pressure gauge for checking pump outlet pressure.
- Return flow filter for collecting debris (could be a fine kitchen pond filter bag).

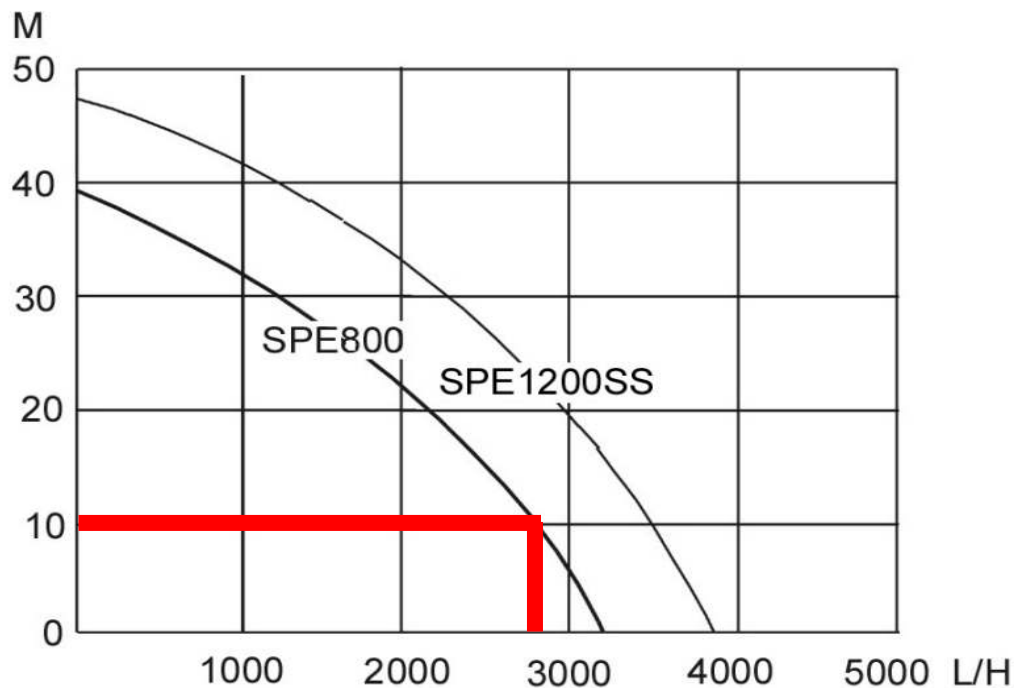


Figure 10: SPE800 pump curve with lines drawn at 10m head (approximately 1.0 bar)

The collector system should first be filled with clean water. The fill/purge system should be connected to the fill and purge connections on the collector system. These connections would typically be incorporated into the flow and return manifolds. However, if there are no manifolds, the connections can be built into the flow and return pipes. Figure 11 shows a typical collector system configuration with the fill/purge system connected to the fill and purge valves.

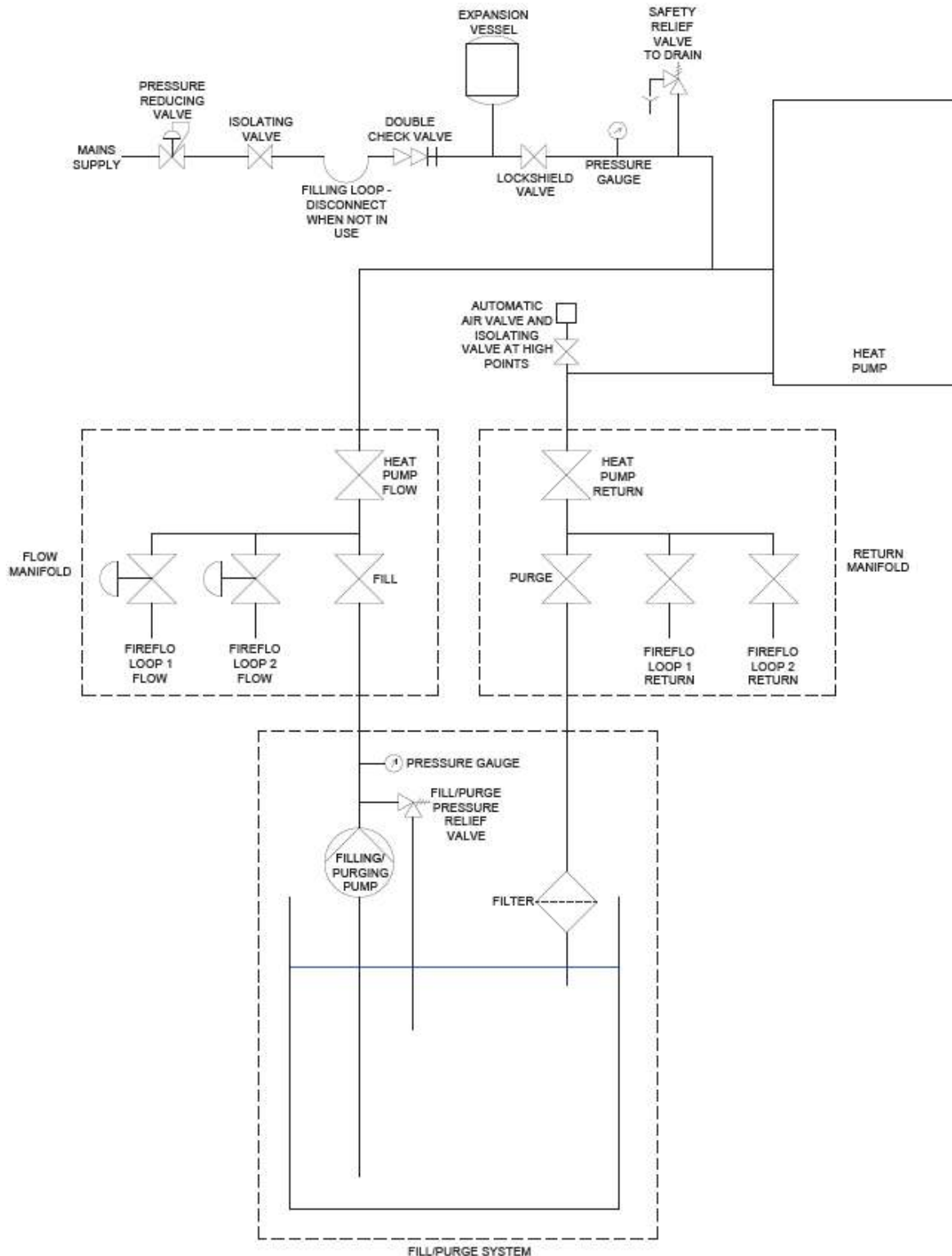


Figure 11: typical collector system configuration incorporating FireFlo collectors

4.2 Filling and purging procedure

The procedure for filling and purging with clean water is as follows:

1. Connect the fill/purge system to the fill and purge ports on the flow and return manifolds as per Figure 11. The ports can be connected either way round.
2. Fill the fill/purge system container with clean water. The water level in the container will need to be topped up throughout the filling and purging process.
3. Ensure all manifold valves are closed initially, including those to the heat pump. Then open the following valves:
 - FireFlo loop 1 flow and return
 - Fill and purge
4. Start the fill/purge system pump, being careful that the pipe returning water to the container is secure. After a short time, flow should return via this pipe.
5. Whilst flow is circulating, open all the bleed valves on the first FireFlo loop plates and pipework one at a time until all the air has been purged. Start with the bleed valve closest to the flow side of the pump. After water has circulated for at least ten minutes, and no more debris has collected in the filter, stop the pump. Ensure all bleed valves are fully closed before stopping the pump.
6. If 2 or more FireFlo loops are connected in parallel, at this stage close the valves to the first FireFlo loop and open the valves to the second FireFlo loop. Repeat the purging procedure (steps 4 and 5) until all FireFlo loops are purged.
7. Once all FireFlo loops are purged and all the valves to the loops are closed, the valves to the heat pump can be opened.
8. Again, start the pump and open any manual bleed valves whilst the pump is circulating.
9. Continue purging the heat pump until all air has been expelled and the filter is no longer collecting any debris.
10. Close any bleed valves fully before stopping the pump.

4.3 Pressure testing procedure

Following filling and purging with clean water, it is advisable that the system is leak tested before the antifreeze is added. This test is carried out in line with the instructions below which are based on BS EN 805 Section 11.3.3.4. **For a FireFlo collector system, the operating pressure should be used as the system test pressure.**

1. Close the fill and purge valves and open all the flow and return valves to the FireFlo loops and the heat pump.
2. Pressurise the system. The system can be pressurised using one of two methods:
 - a. Using the fill/purge pump system. Refer to section 4.5 below. Hold the system at the desired pressure for 10 minutes, repressurising if necessary.
 - b. Using the mains filling loop. Ensure the lockshield valve is fully closed (refer to Figure 11) and the setpoint on the pressure reducing valve is set to the desired operating pressure. Open the filling loop isolating valve. Slowly open the lockshield valve until a gradual increase in system pressure is observed. Leave the filling loop isolating valve open until the system pressure gauge shows the desired pressure. Close the isolating valve. Hold the system at the desired pressure for 10 minutes, reopening the filling loop if necessary.
3. Leave the system for 1 hour.
4. Visually check for leaks and address any that are found.

5. After 1 hour, if the pressure has dropped below 90% of the initial test pressure, repressurise the system and begin the test again. The pressure may drop due to expansion of the system components or the use of automatic air valves and may also be contributed to by fluctuations in the ambient temperature. If after the system is repressurised the pressure is still dropping, there is likely to be a significant leak that needs detecting.
6. If after 1 hour the pressure has not dropped below 90% of the initial test pressure, leave the system for 24 hours.
7. After 24 hours, if the pressure has dropped below 90% of the initial test pressure, repressurise the system and begin the test again. If after the test is repeated the pressure is still dropping, there is likely to be a leak that needs detecting.
8. If after 24 hours the pressure has not dropped below 90% of the initial test pressure, the system can be considered to be holding pressure.

Note: the pressure testing should not be conducted in cold weather where there is a risk of the water in the system freezing.

4.4 Adding antifreeze

The antifreeze provides protection to the heat pump by preventing the brine fluid from freezing in the heat exchanger. If not added in sufficient quantities the heat pump can freeze and cease working. It is recommended that the antifreeze is roughly divided between each of the FireFlo loops and the heat pump based upon their relative volume. The quantity of antifreeze added should be sufficient such that the brine solution has a minimum operating temperature of -10°C or lower.

A coloured antifreeze should be used, this will ease the filling process as well as aiding leak detection.

It is important to purge all the air from the system before adding the antifreeze.

The antifreeze should be added using the following procedure:

1. Open the flow and return valves to one of the FireFlo loops and the fill and purge isolation valves. Close the flow and return pipes to the heat pump.
2. Run the fill/purge system pump and reduce the level in the liquid container by directing the return pipe to the drain. This is fresh water and hence can be discharged to drain. The level should be reduced to just above the bottom of the container, such that the suction pipe remains covered with at least 100mm of liquid. Ensure that the suction pipe remains covered with sufficient liquid throughout to stop any air being admitted into the system.
3. Turn the purge pump off and close both the flow and return valves to the FireFlo loop.
4. Pour the volume of antifreeze required for the heat pump and flow and return pipes into the liquid container using appropriate handling protection as outlined in the COSHH sheet. Pour the antifreeze down the edge of the container to minimise the number of bubbles that form. Allow the solution to settle for a few moments to allow any trapped air to escape.
5. Open the flow and return valves to the heat pump and start the fill/purge pump to circulate the antifreeze around the system. Leave the pump running until antifreeze is seen returning to the liquid container.
6. Close the valves to the heat pump and turn the pump off.

7. Open the first FireFlo loop flow and return valves and with the return pipe inside of the liquid container, start the pump. Once the return discharge runs clear (i.e. discharging fresh water), move the return pipe out of the liquid container and discharge this fresh water to the drain until the antifreeze level within the liquid container drops to just above the bottom of the container, such that the suction pipe remains covered with at least 100mm of liquid.
8. Add the antifreeze required for the first FireFlo loop to the liquid container. The discharge pipe can then be placed back into the container and the fill/purge system pump should be run for about 5-10mins and then turned off.
9. Close the first FireFlo loop valves.
10. Repeat steps 7 to 9 for any subsequent FireFlo loops.
11. The system can then be pressurised using the process described in section 4.5.
12. To mix the antifreeze around the system thoroughly, the heat pump brine circulation pump should be turned on and left to circulate the brine for 2-3 hours.
13. Following pressurisation, there should be a small amount of brine mix within the container which can be poured back into an empty drum and retained for topping up the system or disposed of according to the instructions on the manufacturer's COSHH safety datasheet.
14. The concentration of antifreeze in the brine solution should be sufficient for a minimum operating temperature of -10°C or lower. The antifreeze concentration should be tested with a refractometer prior to running the system for the first time.

NOTE: The brine solution used within the FireFlo system must satisfy any environmental consents and regulatory standards.

NOTE: The FireFlo system has been designed for use with aqueous ethylene glycol or propylene glycol brine solutions. Use of other brine solutions or solutions with a freezing point above the minimum operating temperature may result in damage to components and will invalidate the warranty. Other brine solutions may be used if approved by the FireFlo team.

4.5 Pressurising the system

The collector system can be pressurised using the following procedure:

1. Open all FireFlo loop valves, the heat pump flow and return valves and the fill valve, but leave the purge valve closed.
2. Start the fill/purge system pump to pressurise the whole system. If the level in the liquid container drops significantly, this could indicate the system hasn't been correctly purged of air or that there is a leak in the system.
3. Once the system has reached the desired pressure, close the fill valve on the manifold with the pump running, so that the system is left under pressure.
4. The pump can then be stopped and the fill/purge system can be disconnected.

5 Operation

Following the first run of the system, each panel and any other high points should again be bled until all the air in the system has been purged. This should be repeated again after 1 month of operation. Subsequent bleeding of the panels may be necessary if air in the system is suspected or if a reduction in performance is observed. After bleeding, the system should be repressurised.

The maximum operating pressure specified in the FireFlo Design Guide should not be exceeded during operation. A safety relief valve or rupture disc should be used to ensure that this pressure cannot be exceeded.

6 Maintenance

6.1 Access

Access to the Fireflo panels should be sufficient to enable regular cleaning of the large faces of each plate. Access for bleeding of air is also required, although this is likely to be less frequent.

6.2 Cleaning

Cleaning requirements will depend on the site. However, initially it is recommended to clean the large surfaces of the panels and remove any debris monthly. More or less frequent cleaning may be required subsequently.

Failure to regularly clean the panels may result in a reduction in the heat pump system efficiency.

A 50 mm diameter polyester bristled brush is recommended for cleaning between panels.

7 Warranty

All FireFlo panels are thoroughly inspected and pressure tested on completion of manufacture. If you discover a manufacturing defect following delivery, this must be reported immediately to the FireFlo team who will repair or replace the product.

FireFlo products are warranted against manufacturing defects for 1 year from the date of dispatch. This warranty does not cover the following:

- Fair wear and tear.
- Products that have not been installed and operated in line with the FireFlo Installation and Maintenance Guide and the FireFlo Design Guide.
- Damage during transport, storage or installation.
- Damage during use resulting from external impacts from objects in the water.
- Alterations or repairs carried out without the manufacturer's written permission.
- Damage caused by exceeding the maximum working pressure.

The warranty only covers repair or replacement of the products. It does not cover the cost of dismantling, shipping or reinstallation.