

# Flexible Pillow Tanks for Liquid Storage

(Non-Flammable Liquids/Bund-less installation)



## *User Guide*

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## **CONTENTS**

Introduction.....	3
The Pillow Tank .....	4
Site Selection .....	5
Site Preparation .....	6
Tank Installation .....	7
Connection of Tanks into the System .....	9
Filling the Tank(S) .....	10
Operation.....	11
Emptying the Tank(S).....	12
Packing and Storage .....	13
Maintenance.....	14
Inspection of Flexible Pillow Tanks .....	15
Repair Instructions.....	16
Temporary Repairs.....	16
Adhesive or Cold Cure Repairs.....	17
Factory Repairs .....	17
Fittings.....	18
Post-Repair Checks.....	18



## **Introduction**

This manual is a general guide to the installation, use, care and maintenance of flexible pillow tanks for liquid storage.

It is intended to enable new users of the products to maximise effectiveness in their installation and use. The information provided in this manual is for use by trained and qualified personnel only.

Since the size and design of tanks can vary depending on the end user's requirements not all the information provided in this document may be relevant. It is intended specifically as a support publication for successful equipment management of pillow tanks.

The pillow tanks are manufactured from a durable material and, with care, a satisfactory operational life of at least 5 years should be expected. However, it must be noted that they cannot withstand the same type of rough handling that a metal container could.

It is important that the requirements and safety precautions are fully understood before attempting to use the tanks. Failure to install the tanks and any associated equipment in accordance with the advice given in this document, or any damage resulting from maintenance by untrained personnel may invalidate any warranty. Express permission must be obtained from Ridge product Services Limited for any alternative methods or procedures not detailed in this publication.

We wish you many years of successful operation of our product.

## The Pillow Tank

When full of liquid the tanks look like large pillows, hence the name, but when empty and laid out, the tanks are a flat rectangular shape which aids packing for storage and transportation. The tanks require minimal site preparation, and almost any flat surface can be converted into a storage installation in the space of a few hours. The tanks and their associated equipment may be used either as single units or in multiple units interconnected with pipes, valves, pumps and filters as required. There is no limit to the number of tanks that may be connected to form a storage installation. Particularly for large volumes, when use in groups, they can afford storage facilities that can be relocated and reused faster than any metal container of like size or capacity.

A Ridge Product Services Limited pillow tank consists of the tank carcass, fabricated from high tenacity coated fabric, complete with metal or plastic connection fittings and air vent or PRV arrangement according to the required specification. This is normally supplied with blanking caps/plugs for all connection fittings.

The following accessories may be supplied with the tanks (as required), or may be obtained separately:

- (i) Groundsheet.
- (ii) UV shade cover.
- (iii) Inlet or drain hose assemblies and/or valves.
- (iv) Repair kit consisting of a selection of repair materials, tools and spares.



***NOTE: We recommend that the ground should always be covered with a groundsheet (tarpaulin, polythene sheet or similar material) to give added protection to the tank.***

Each tank has a number of fittings to aid operation of the tank. The number, type and location of such fittings may vary dependent on the particular specification chosen by the customer. A typical arrangement is shown in the image on the front cover, and may include:

- Inlet/Outlet fitting(s) – typically BSP or Cam and groove type fittings for connection to flexible hoses.
- Vent pipe or PRV – for release of air or over-pressure, dependent on application.
- Drain fitting or drain line assembly – Positioned on the underside of the tank and to be positioned towards the lower end of any slope on which the tank is installed.
- Access hatch or manhole – for cleaning access.
- Handles – for use only for manual handling of the tank during installation or decommissioning and whilst the tank is empty.



## **Site Selection**

A detailed reconnaissance should always be carried out to determine the best available site for the tank(s), which may be erected in multiple units. Tanks should be sited in areas where the minimum ground bearing capacity has a California Bearing Ratio (CBR) of 7.5% or 100 kN/m<sup>2</sup>. This is not a direct comparison to the weight of the tank and contents but includes a Factor of Safety for construction traffic and site movement.

A flat well-drained location is the ideal choice of a site that should be free from rocks, stones, tree stumps or any other sharp objects that may chafe or puncture the tank. On rough or stony ground sharp objects should be removed and ideally a layer of sand laid to provide a base. Maximum care must be taken to avoid placing tanks on ground having a cross slope as the tank is liable to “roll away” when being filled (see site preparation below).

A clear working area is required sufficient to allow the tank(s) to be fully unrolled, allowing access for any Mechanical Handling Equipment (MHE) required, and with clear space between for personnel access as may be required.

The tank(s) should be arranged to impose the minimum suction and pumping heads on any associated activity. Allowances must be made for access to install and remove tanks as well as any associated hazard from fume dispersion either to personnel or as a fire hazard (if appropriate). Consideration must be given to other activities within the same area and a general safety distance must be considered between the outer edge of the tank(s) and any other site activity.



## Site Preparation

The chosen site should be cleared of any vegetation and then levelled. The subsoil should be disturbed as little as possible and any holes filled and high spots compacted. Ideally the slope should be <math>1:60</math> (<math><1^\circ</math>) both across the tank and along the length of the tank. The base area should slope down towards the outlet/drain end of the tank as this will greatly assist tank recovery and reduce suction head on any pumping system.

Any material removed should be placed so that it can be used for forming a bund wall around the tank(s) or for reinstating the site when no longer required. It is recommended that construction equipment operated by a competent person is used to initially develop the site, which is then finished off manually.

The base of the compound should be free from sharp objects. On rough or stony ground sharp objects should be removed and ideally a layer of sand laid to provide a base. If preferred the position for each tank can be marked out specifically using cord and pegs or other appropriate materials.

When applicable, the base of the compound or area on which a tank is situated should be recessed to accommodate drain lines and/or sumps.

In the case of recesses for drain lines these should be directly below the drain and of sufficient depth to house the elbow and pipe from the tank. This is to stop any damage to the fabric of the tank from the fittings and to facilitate the draining of any water or sludge from the lowest point in the tank.

In cases where tanks are positioned on hard standing such as concrete surfaces then sandbags can be used either side of the drain line elbow connection. This is to reduce excessive pressure on the fitting and stop the fabric being punctured. This method is not to be used in any other circumstances as full draining of the tank contents cannot be easily achieved.

## Tank Installation

The size and design of pillow tanks varies depending on the end users requirements and therefore every installation will vary slightly. Below are typical installation instructions and it is recommended that these instructions are followed as closely as possible.



***Tanks should be installed on level ground (see Site Preparation above). Ensure the site is free from debris and clear of sharp objects that might puncture the tank(s).***

- 1) Open the packing crate by removing the screws along the front of the lid, and remove any ancillary items included with the tank.
- 2) Using suitable MHE lift the tank from the crate using the slings in which they are packed and position the tank near one end of the working area.
- 3) Separate the UV cover (where supplied) and place to one side.
- 4) Take the ground-sheet and place at the centre of one end of the required position for the tank, such that it will unfold across the working area.
- 5) Unfold the full length of the groundsheet, and ensure this lies centred along the centreline of the required tank position.
- 6) Working to one side, unfold one half of the groundsheet.
- 7) Using appropriate MHE, position the tank onto the groundsheet close to the centre of the groundsheet, adjacent to the still folded half of the groundsheet.
- 8) If necessary re-level any tracks left when positioning the tank, and then unfold the other half of the groundsheet to cover the full tank area.  
*NOTE: If required, at this point remove any cord and pegs or other objects used to mark out the tank area.*
- 9) Unfold the tank along its length, then unfold the tank across its width.



***NOTE: Ensure that the soles of all footwear are free from stones or debris before walking on the tank or groundsheet.***

- 10) Check the position of the tank, that it is centred on the groundsheet and that the drain connection is correctly positioned to the downward end of the site. Also check for correct clearance to any adjacent tanks. Using the handles on the tank to facilitate, adjust the position of the tank as required, and then pull taut to remove any creases.



***NOTE: The handles are intended solely for manual handling and are not to be used for attachment to any mechanical handling equipment.***

*On large tanks, raising and flapping the edge of the tank rhythmically to drive air under the fabric can facilitate easier movement of the tank.*



- 11) Ensure the drain fitting lies over an appropriate recess in the ground surface (see Site Preparation above). If not, fold back the end of the tank and groundsheet and prepare a channel for the drain hose, as required.
- 12) Fold out the groundsheet and connect the drain hose to the fitting on the tank, and lay into position in the prepared channel.
- 13) Position the UV cover adjacent to one end of the tank.
- 14) Unfold along the length of the tank, then unfold the width of the UV cover and draw over the tank until the cut-outs in the cover align with the fittings on the tank.
- 15) Secure the UV cover using the ropes provided by either fastening to the handles on the tank, or by pegging to the ground.  
*NOTE: if pegging to the ground, the position of the pegs may need to be adjusted when the tank is filled, or as it is emptied, to maintain suitable tension on the ropes, without damage to the cover.*
- 16) Connect the vent and inlet/outlet connections to the tank, and cap off any unused fittings.  
*NOTE: To avoid excessive stress on the inlet/outlet fittings the connecting hose must be supported. A sandbag will suffice and this should be fitted close to the connection with the double elbows. The support should be removed when the tank is more than half full and when emptying/in use.*
- 17) Remove the packing crate to an appropriate dry storage location and retain for future use.



## Connection of Tanks into the System

Multiple tank units can be connected together to form larger installations and further detailed engineering design is required to develop such a system. This is outside the scope of this publication, but Figure 1 shows a typical schematic layout and the general rules for installation above can be applied and developed to match any scenario.

To avoid over-filling ensure there is some means of verifying the fill state of the tank. This can be done by various methods, for example:

- setting a lightweight pole across the tank at the required fill height as a visual indication,
- use of a calibrated flow meter to measure the volume of liquid delivered,
- where spillage is permissible, through use of an open ended stand pipe of the appropriate height connected to the drain connection, to act as an overflow relief (see Figure 2).

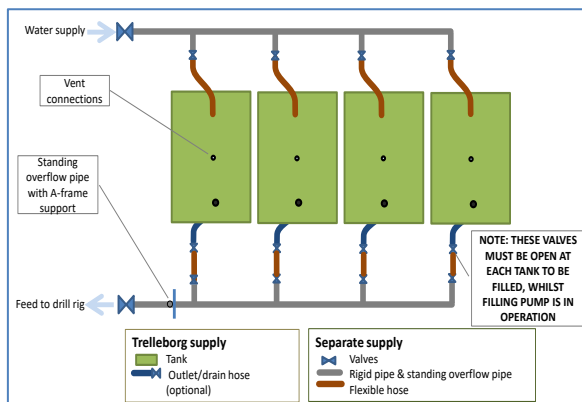


Figure 2 - Typical multi-tank schematic

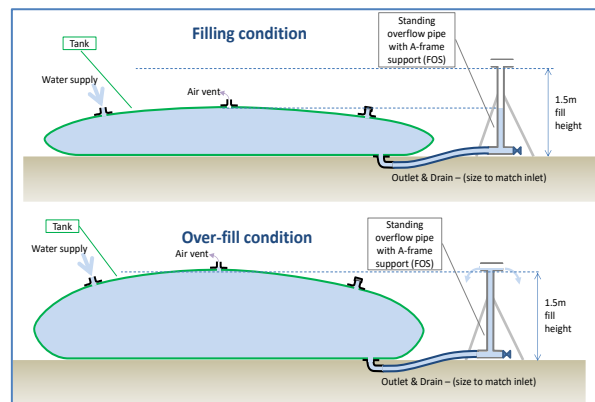


Figure 1 - Use of stand-pipe for over-fill prevention



## **Filling the Tank(S)**

Ensure that all required pipes, hoses, valves and supply pump (as required) are correctly connected and configured.

The tank(s) should initially be filled slowly (~490 litres/min, i.e. one metre per second through 100mm pipes) at first (10 minutes) so that any leaks in the system can be identified and suitable action taken in such an event.

*NOTE: The tank should rise evenly so that any creasing/bunching or rolling is avoided. If this occurs the tank should be emptied and any creases on the base of the tank pulled out. If creasing, bunching or rolling persists, consideration must be given to levelling the bund floor more accurately.*

Filling can proceed at a rate of between 1000 – 2000 litres/min depending on the size of the tank.

*NOTE: Small amounts of air contained in the tank will usually be expelled through the vent pipe as liquid is pumped in. The air may escape in short surges sometimes carrying over liquid droplets in this process.*

As the tank is filled a constant watch must be maintained on the volume of fluid entering the tank. Ideally the tank-filling rate should be reduced as the liquid level rises as the tank will rise more rapidly as full capacity is approached. A safety margin is recommended to allow for thermal expansion of the liquid in the tank and possibly elsewhere in the associated pipework system.

*NOTE: The tanks are tolerant to slight overflow condition but this should not be relied on in normal operation.*

## Operation

The normal operation of a tank is to receive, store and issue liquid. Once a tank has been initially filled the liquid contents can be transferred to suit the process involved. At low storage levels, air may be drawn into the tank or a vapour may exist. Re-filling the tank will alleviate this problem.

All tanks differ in that they may look slightly longer/wider/higher or more rounded than others when full. It must be noted that if a tank looks abnormally different, for example showing an irregular shape or localised distortion, then it should be drained down, inspected and if necessary replaced.

It is possible to mount a tank to gain access to the vent, fittings or for any other required reason. To get up onto a full tank a number of steps can be formed out of sandbags or similar situated adjacent to but away from one corner or side of the tank.



***NOTE Use of any form of sharp object to form steps should be avoided. Also ensure that the soles of all footwear are free from stones or debris before walking on the tank or UV cover.***

A daily visual inspection of the tank should be carried out to ensure there are no leaks from the fabric or fittings, or any abnormal distortion.

When a tank that is in use has to be moved it is important that all liquid is removed. The following section describes the recommended method of decommissioning a tank.

### Emptying the Tank(S)

- 1) The tank contents should be pumped out as much as possible. If the tank is sited on a slight slope this will be an advantage.
- 2) When the pump begins to cavitate, remaining liquid trapped in low spots can be encouraged towards the tank outlet by manually lifting, and rolling or folding the tank fabric. Additionally, "rolling bars" or tubes may be placed under the end of the tank and drawn towards the outlet/drain end whilst holding the tank in position, to progressively lift the tank and move residual water towards the outlet/drain.



**NOTE: Ensure that the soles of all footwear are free from stones or debris before walking on the tank.**

*Note: rolling bars might be improvised by using lengths of 6" pipe or similar, joined together to provide an appropriate span. However, **all such materials must be free from burrs or sharp edges**, to avoid the potential of damage to the tank. With care it is possible to use mechanical handling equipment to assist with the movement of such bars/tubes under the tank.*

- 3) Once all liquid possible has been removed by the pump, the suction line is disconnected from the tank ensuring that no liquid is spilled, where such spillage is not permissible. Suitable containers may be required for the remaining liquid in the tank.
- 4) The tank can now be further drained as far as possible by using smaller manual or mechanical pumps, as appropriate, ensuring safe practices are used at all times.
- 5) Once all possible liquid has been drained from the tank it is to be laid flat and the vent tube and any remaining top fittings/caps removed. The tank is then folded back and the drain line removed.
- 6) Collect all the removed items together in a convenient location ready for packing with the tank.

## Packing and Storage

- 1) Position the transportation/storage crate for the tank etc. to a convenient position close to the tank.



**NOTE: Ensure that the soles of all footwear are free from stones or debris before walking on the tank.**

- 2) Remove the UV cover from the tank to a clear working area and pull out flat, ensuring there are no creases or folds in the fabric.

*Note: if there is insufficient clear space available away from the tank the UV cover can be folded in situ, but taking care to ensure the cover is lifted clear of the fittings during folding.*

- 3) Fold each side of the UV cover in to the centre, until the folded width achieved is just less than the width of the transportation/storage crate.
- 4) Fold one end of the UV cover over to the other, and then fold again until the folded length is just less than the length of the transportation/storage crate.
- 5) Move the UV cover to a convenient position close to the transportation/storage crate.
- 6) The tank is to be pulled out flat ensuring there are no folds or creases.
- 7) Both sides of the tank are carefully folded into the centre of the tank ensuring there are no creases in the fabric. Fold each side in again until the folded width achieved is just less than the width of the transportation/storage crate.



**NOTE: Ensure that the soles of all footwear are free from stones or debris before walking on the tank.**

- 8) Both ends of the tank are then carefully folded into the centre of the tank. Fold each end in again until the folded length achieved is less than the length of the transportation/storage crate.
- 9) Carefully lift/tip the tank to position the lifting slings provided with the tank under the tank.
- 10) Fold one side of the groundsheet in towards the folded tank to permit access by appropriate MHE and lift the tank and place safely away from the groundsheet and to a convenient position close to the transportation/storage crate.
- 11) Pull the groundsheet out flat, ensuring there are no creases or folds in the fabric.
- 12) Fold each side of the groundsheet in to the centre, until the folded width achieved is just less than the width of the transportation/storage crate.
- 13) Fold one end of the groundsheet over to the other, and then fold again until the folded length is just less than the length of the transportation/storage crate.

- 14) Stack the groundsheet on top of the folded tank.
- 15) Stack the UV-cover on top of the tank and groundsheet.
- 16) Using the slings provided with the tank place the tank in their original boxes, or other suitable storage container.

Tanks should be stored in a rodent free area, out of direct sunlight and, as far as is practicable, in accordance with ISO 2230.



***NOTE: A tank stored in a container is subject to continuous stress where the fabric is folded and rolled. To relieve these conditions it is recommended that tanks in long-term storage are removed from their containers at 12 month intervals, unrolled and air inflated. They should then be inspected before being refolded and rolled avoiding where possible the original fold lines and returned to their containers.***

## **Maintenance**

The tanks are designed to give long service without attention. The following procedures and inspection schedules are provided as a guide only. Inspection intervals and subsequent repair procedures vary greatly dependent on:

- Local climate
- System usage
- Local resources and equipment
- Owner philosophy to acceptable system life cycle

Regular visual observations should indicate if any tanks require closer inspection, together with any further need for remedial action.

The following recommendations are focused on providing the maximum life cycle for the system installed. Inspection intervals should be adjusted to suit local conditions and feedback from maintenance personnel.



## Inspection of Flexible Pillow Tanks

Item	Inspection	Frequency	Procedure	Note
1	Visual Inspection	Daily	Observe general tank form and for any evidence of leaks or anomalies.	The tank shape will vary with fill level.
2	Inspect for foreign matter on the top of the tanks and clean	As need arises	Remove foreign matter with a bristle or nylon brush, water and a biodegradable organic based cleaner. <b>DO NOT USE SOLVENT/PETROLEUM BASED PRODUCTS OR ABRASIVE MEDIA.</b>	Slight build-up of dirt/debris on the surface of the tank will not normally have any detrimental effect on the durability or performance of the tank.
3	Inspect the body of the tank for physical damage, tears or cracks	Annually, before each use, or as need arises	Note inspection results and schedule repair of any areas of exposed fabric.	It is recommended that whenever a tank is emptied the surface is visually inspected for cuts and abrasions.
4	Inspect the fittings	Annually, before each use, or as need arises	Check the fittings for any evidence of physical damage, or leaks. Ensure any fasteners securing the fittings are correctly tightened.	
5	Leak checking	Only when required (see item 1)	If a leak is suspected the tank should ideally be taken out of service and fully emptied, so that the whole surface can be closely inspected. Where leaks are not due to obvious physical damage, air inflate the tank to approximately 35mBar (0.5 psi) and apply a soapy water solution to the surface using a garden spray or similar. The formation of streams of bubbles in the soapy solution will reveal the location of any air leakage. Mark the locations of any leaks and repair as necessary	Repair procedures are described in a separate publication covering the following four categories of repair: (i) Emergency repairs, using rubber or clamp type leakstoppers. (ii) Permanent repairs where abrasion/cracks have exposed but not damaged the nylon fabric or cords in an area less than 75mm. (iii) Permanent repairs where cuts/tears have damaged the nylon fabric or cords in an area less than 75mm. (iv) Fabric damage in excess of 75 mm where the advice of Ridge Product Service Limited should be sought.



## Repair Instructions

By using the following prescribed methods a tank can be successfully repaired, maintaining its serviceability and fitness for role. While temporary plugs effectively stop leaks for long periods they cannot compensate for the loss of fabric strength occasioned by damage. It is therefore recommended that a permanent repair is carried out as soon as possible after damage has occurred.

Tanks may contain, or have contained, substances hazardous to health. Every effort should be made to identify the last contents stored and the appropriate safety measures taken in preparation for any repairs. Any components or tools inadvertently dropped into the tank during a repair process are to be recovered immediately.

**Patch Repairs.** Patches are to be selected as follows:

- Patches are to be 75 mm larger in all directions than the damage.
  - A large patch may be used to cover a number of small areas of damage that are close together.
  - Irregular shaped patches are to be avoided. Round or rectangular shapes are preferred and any corners are to be rounded.
1. Ensure the working environment is as clean and dry as practicable and as sheltered as possible from extremes of weather.
  2. Raise the damaged area by placing a flat surface beneath the tank.
  3. Select a suitable size of patch allowing 75 mm overlap around the damaged area.
  4. Fold the patch in half and place the fold along the tear or centre of the damaged area.
  5. Lay the patch flat on the tank and mark its outline.
  6. Draw a central line across the patch and onto the tank body for alignment purposes.
  7. Remove the patch to a clean area.
  8. Cut off any loose threads from the damaged area.
  9. Lightly abrade the surface of the tank in the area to be bonded using emery paper.
  10. Lightly abrade one face of the repair patch.
  11. Remove any surface dust and ensure the areas to be bonded are clean. Clean with solvent if necessary.
  12. Mix the adhesive and accelerator (if appropriate) in accordance with the manufacturer's instructions and stir well.  
*Note: Follow the manufacturer's instructions for the particular adhesive type should they differ from those given in points 13 & 14 below.*
  13. Apply one coat of adhesive to the prepared area of the tank and patch, using the brush and allow to dry until just tacky (approximately 10 minutes).
  14. Apply a second coat of adhesive and allow to dry until just tacky.



15. Line the patch up with the positioning marks on the tank and apply, ensuring that there is no air trapped between the patch and the tank.
16. When the patch has been positioned roll well using the hand roller, starting from the centre and working outwards. Continue rolling until all the air bubbles are removed.  
*Note: If any problem occurs before the adhesive has dried properly, correct immediately. Lift the patch, softening the adhesive with solvent if necessary to assist removal and repeat the above process.*
17. Allow the repair to stand for 24 hours. An evenly distributed weight can be placed over the patch during this period.

Minor edge lifts may be stuck down with adhesive using a similar procedure to that described above.



***NOTE: Repairs to handles are not permitted as these may cause damage to the tank body or may prove to be unsafe. Handles can only be repaired or replaced in the factory environment.***

### Factory Repairs

Major repairs often require patching on the inner as well as the outer face of the tank, and for rubber tanks these would then require vulcanization. This is best performed by returning the tank to the Ridge Product Services Limited factory or an appointed agent.

The repair follows the tank being thoroughly cleaned and can require the end seam being opened so that the tank can be entered. The tank and inner and outer patches are prepared and bonded/welded together. The end seam can then be re-made, which may require a slight reduction in the finished size of the tank.

Whole panels can be replaced should this be deemed necessary.

A decision on this type of repair is normally based on the condition of the tank, its age and comparative cost of replacement.

## Fittings

Tank fittings comprise the combined inlet/outlet connections, vent connection or PRV and drain connections. Dismantling and assembly are simple procedures and may be carried out for rectifying leaks or renewal of components.

Dismantle as follows:

1. Before removing components, mark each for ease of reassembly.
2. Loosen and remove all fasteners using appropriate tools.
3. Separate the components taking care to note the correct how they are correctly assembled.  
*Note: Sharp metal tools are not to be used to separate components, use wooden or nylon levers or rounded surfaces.*
4. Inspect components for serviceability and renew where necessary. Particular attention should be made to threaded fasteners, seals, gaskets and 'O' ring seats.  
*Note: Where applicable, seals, gaskets, 'O' rings and spring washers should be replaced whenever a fitting is dismantled.*
5. Remove burrs or sharp edges as required.
6. Replace any damaged nuts, bolts and screws as required with like for like components.
7. Any detached retaining cords for dust caps are to be re-attached.
8. Re-assemble in the reverse order to dismantling using new fittings as required.
9. Tighten any fasteners to a torque appropriate for their size/material.

## Post-Repair Checks

After a repair has been completed, check should be made to verify the integrity of the work. Where practicable, these checks are to be carried out by separate experienced Inspector.  
*Note: Thorough leak checks are conducted as part of the quality control process for tanks that are factory repaired.*

A visual inspection may be sufficient for patches applied over abrasions, minor cracks and in some instances for the replacement of tank fittings.

For all other repairs, the tank is to be inflated and the repair tested for leaks.



**NOTE:** This will require a sheltered location and additional equipment including a digital pressure gauge, a blower or other source of compressed air and appropriate fittings for connection to the tank, and a portable garden spray or similar for application of soap solution. **It must be taken into consideration that, when air inflated, the tank will assume a shape with significantly greater height than the normal liquid filled height.**



The test should be conducted according to the following process:

1. Arrange the tank so that it is sheltered from the wind and direct sunlight. Prepare suitable fittings so that it can be connected to the blower or air supply and the digital pressure gauge, and sealed in an inflated condition, using appropriate fittings and blanking caps on all unused connection fittings.
2. Inflate the tank with air to a pressure of 28-35 mBar (0.4-0.5 psi).
3. Spray the area of the repair with soap solution and check for bubbles forming around the edges of the repair. Formation of a continuous stream of bubbles constitutes a failure of the test.



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