پیوست

شماره ۱۱

(ایزولاسیون حوضچه ها)

MANUAL FOR

PARABEAM® 3D GLASS FABRICS

IN DOUBLE WALL LININGS

Manual for Parabeam® 3D Glass Fabric in Double Wall Linings

INTRODUCTION

This manual explains how this system combines lining and leak detection technology in new and existing tanks and how this system can provide improved leak protection compared to either lined tanks or double-bottom storage with leak detection equipment. The manual illustrates how the system can be installed, and it gives applicators view on the systems strengths and limits.

WHY LININGS?

In many countries around the world in the last decade, governmental officials and legislators have had extensive discussions and agreed that linings with leak control monitoring systems are the only acceptable way to prevent tanks from leaking into the water table and open waters. In many countries, legislation already has set the standard for linings with leak monitoring systems for aboveground and underground storage tanks. It is only a matter of time before other countries will set this legislation as well. There is also a very strong push within the newly industrialised countries to adapt the latest environmental legislation standards from Europe and the USA. These countries understand very well the importance in keeping live environment safe and pleasant to life in.
Apart from straight legislation, many workgroups and regional authorities have set regulations for the industry in general to become more proactive with spill and leak concerns. Large fines and expensive insurance's are the results and finally offenders will be closed down.

WHAT TYPES OF LININGS ARE AVAILABLE?

SINGLE WALL COATING / LINING:

The first line of protection used for AST's and UST's is a single wall coating or lining system on the tank wall. This is very justifiable for AST's inside and outside walls, because they can easily be checked visually or ultrasonically. For UST's and AST floors however, this is no solution. The lifetime of a tank wall will be extended, however when it starts leaking, there will be no warning and environmental damage will still be the result.

DOUBLE STEEL FLOOR:

For AST's, a double steel floor can be installed. Herewith a leak warning system can be installed and a possible leak will be signalled. The new steel floors are separated from the old steel floors by concrete or sand and they themselves become a sacrificial anode. Ironically, once a double steel floor is installed, it still requires a liner to stop the galvanic action; otherwise the new double bottom will corrode approximately 4 times faster than the old bottom. Between the new and old bottom there is increased corrosion risk due to the humidity in direct contact to both steel substrates. The double steel floor is the most widely applied system since there used to be no good alternative. Big disadvantages such as short life time and cost efficiency where simply accepted.

OTHER MATERIALS:

For both AST's and UST's there are several double wall systems available where the new wall is build with glass fibre reinforced thermoset resin (GRP). The interstice is than realized by distance holders, which can be achieved in many ways. A netting grid, aluminium or steel bubble foil, stripes of material, open cell foams etc. have been used for this purpose. The new GRP tank wall is corrosion resistant on itself, so it doesn't need additional protection. At the edges the GRP tank wall needs to be adhered to the first tank wall. With the continuous deflection of the tank floors and the vibration of UST's this area is very susceptible for damage. The absence of full adhesion between old and new tank wall only allows vacuum monitoring and finding a leak by a low pressure in the interstice is out of the question, because of a high risk of delamination.

THE PARABEAM® LINING:

The Parabeam® lining is the answer to the leak monitoring demands, without the imperfections of the previous systems. It is fully bonded to the old substrate ensuring a very good delamination resistance due to an integral woven bonding between the vertical piles and both faces. It is a full glass fibre reinforced thermoset resin system, which means full corrosion resistance. The interstice enables an installation of any kind of monitoring devices, for leak detection and monitoring. The system can quickly and in one go be installed, which means a very cost-efficient solution.

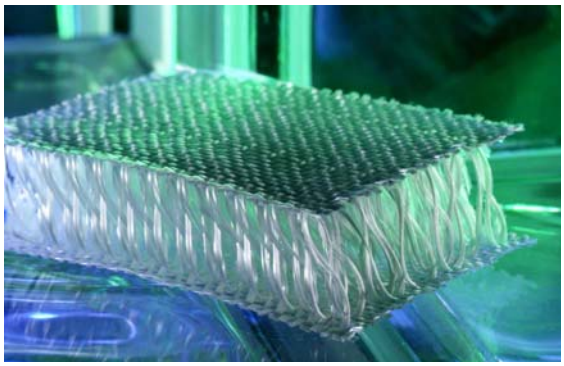
This Parabeam® lining system allows for:
- ✓ permanent leak detection
- ✓ full integration and bonding
- ✓ secondary containment inside the primary structure itself
- ✓ a chemical-resistant corrosion barrier.

The Parabeam® lining system is the perfect solution to prevent the accidental leakage of cargo from aboveground storage tanks (ASTs) and underground storage tanks (USTs). Legislators all over the world agree that linings with leak control monitoring systems are the only acceptable way to prevent tanks from leaking into the water table and open waters. The Parabeam® lining already has a proven record (see references) to fulfil this task by accomplishing a secondary containment inside the tank structure with leak monitoring capability.
The Parabeam® lining system has been approved and applied with great success in all countries with a proactive governmental or regional legislation. The system has been third party approved for its function as a leak monitoring system.

WHAT DOES IT LOOK LIKE?

The Parabeam® 3D Glass Fabric refers to a three dimensional E-glass fabric, manufactured on velvet weaving machines with E-glass yarns. This fabric has been developed in Europe in 1989 using the velvet weaving technique that dates back to 200 BC. The Parabeam® 3D Glass Fabric design consists of two identical plain fabric decks (upper and lower) woven integrally and mechanically together by means of vertical pile threads. Figure 1 shows a cross section of this design. The resulting fabric has a pre-set interstitial space between the two deck surfaces. Although the fabrics are available in various thickness' ranging from 3 to 25

Figure 1



millimetres, the 3-millimetre version is especially developed for the lining application and most commonly applied today. This 3-millimetre provides a very high laminate shear and compression strength and is also noted for its flexibility on critical deflection surfaces. In addition, the flexibility of the impregnated 3-millimetre fabric ensures a good contact and adhesion to itself and to the substrate, because it easily conforms to the contours of curved or irregular shapes.
The defined amount of resin and the fast impregnation caused by the capillary action between the filaments of the vertical fibres in the fabric help reduce material and labour costs.
All surfaces of the glass fabric have a silane sizing to provide compatibility and perfect wetting by the resin matrix system. The fabric has an inherent rebound, or spring resilience, which forces the upper deck to rise to a height dictated by the length of the vertical pile treads. This spring resilience of the Parabeam® 3D Glass Fabric is derived from:

- 500,000 vertical pile treads per square metre
- capillary forces during and after impregnation with a resin system
- the firmness with which the vertical piles are woven into the upper and lower deck
- the 100 % E-Glass composition

When the Parabeam® 3D Glass Fabric is impregnated with a resin matrix, and fully cured, a continuous interstitial space is formed between the upper and lower deck in the laminate. The lower deck of the Parabeam® 3D Glass Fabric is tightly bonded to the floor. Paratape is applied on top of the seams to cover it and to continue the interstitial space. Finally a chemical resistant corrosion barrier is applied. This process leaves an interstitial space to be continuously monitored by a leak detection system (Schematically shown in figure 2 and 3).

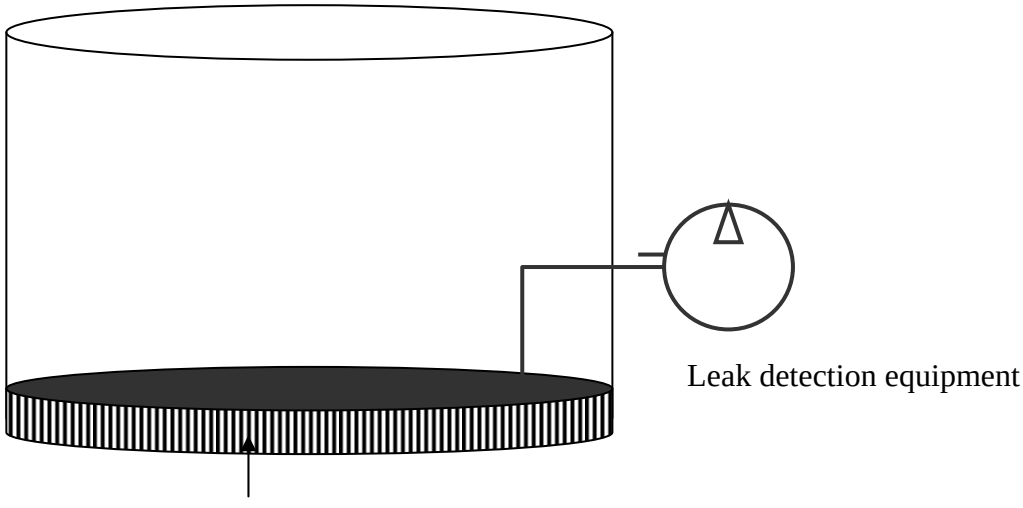


Figure 2

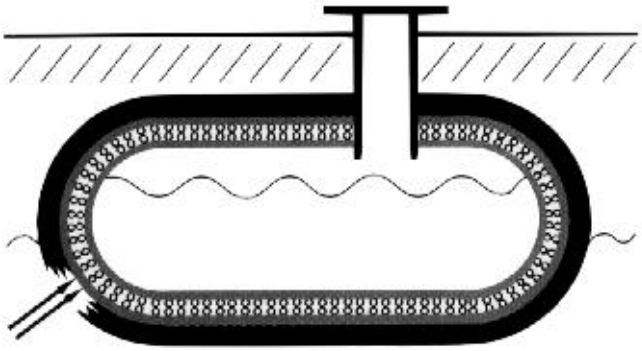


Figure 3

This system is permeable in all directions. In the event of a cargo side leak, the interstice contains leaking cargo and the specific alarm will detect a breach before the cargo reaches and contaminates the environment. The alarm will also sound if a groundside leak occurs. Appropriate repairs can than be carried out. Besides the leak warning feature, the system also provides corrosion protection for steel or concrete.

IN WHAT TANKS IS PARABEAM® APPLIED?

Parabeam® is applied in aboveground (AST) and underground (UST) storage tanks, in the chemical and petrochemical industry. Tank volumes range from 1 m^3 up to the largest petrochemical tanks of 100,000 m^3. Tanks can be made of steel, concrete, aluminium and glass fibre reinforced thermoset resin.
Tank shapes may vary from rectangular or cylindrical to spherical and the cargo's can be anything which can be kept in an absolute chemical resistant thermoset resin / coating system.
In aboveground tanks the Parabeam® is applied to the entire inside tank structure (floor, wall, ceiling) or to the tank floor only to achieve one leak warning system. For larger diameter petrochemical storage tanks Parabeam® is applied to the tank floor, as a warning system for a possible breach, where it wouldn't be possible to look underneath the huge tanks.
In underground storage tanks the Parabeam® lining technology is utilised to upgrade UST's. The system converts old and new single wall tanks into new double wall tanks.

MANUFACTURING GUIDELINES

WARNINGS

These manufacturing guidelines are available for general use by Parabeam, Parabeam® distributors and other interested parties. Parabeam shall not be responsible or liable in any way for loss or damage resulting from such use, or for the violation of any National, Federal, State or Municipal regulation with which it may conflict.
The process of lining underground and aboveground storage tanks is hazardous and requires adequate safeguards for personal and property in conducting the operation. This manual serves as a guideline for employers and employees to properly install the Parabeam® lining. Parabeam shall not be responsible to anyone for the use of, or reliance upon this specification. Parabeam shall not incur any obligation or liability for damages, including consequential damages arising out of or in connection with the use, interpretation of, or reliance upon this specification. Parabeam makes no representation, warranty or guarantee in connection with this specification and thereby disclaims any liability or responsibility for loss or damage from its use.

THE LAY-UP SCHEDULE

An overview of the Parabeam® lining is given in figure 4.

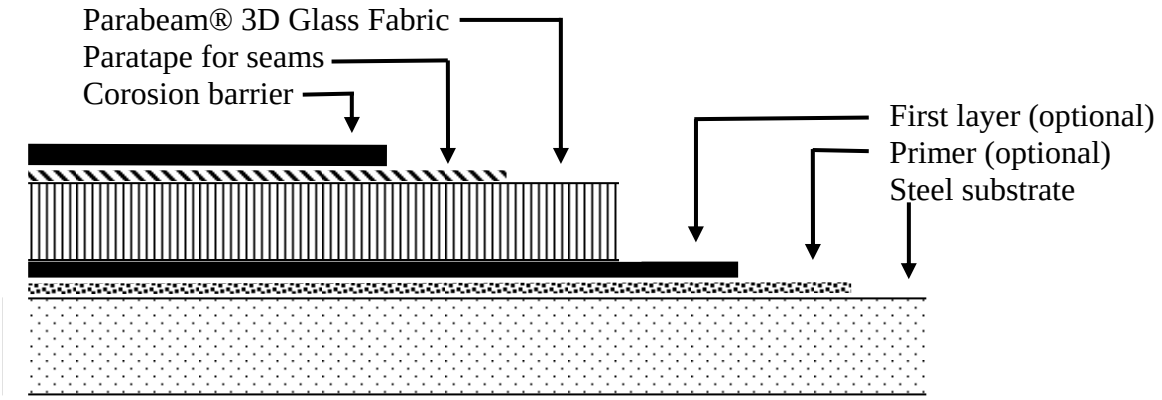


Figure 4

RESIN / COATING SYSTEMS

Commonly used resin / coating systems for interior linings of underground or aboveground tanks with Parabeam® may be epoxy-based, polyester-based, or vinylester-based. The choice is depending either on the compatibility with the given cargo, the application expertise of the applicator with the particular resin / coating system and warranties supplied by the resin / coating manufacturers.
Acceptable materials must be tested in accordance with standards developed by a nationally recognised associated or independent testing laboratory or must satisfy the requirements as cited by the resin / coating manufacturer.

TANK CLEANING

After initial entry into the tank, any liquid, sludge or residue must be removed from the tank. An absorbent material capable of absorbing residues shall be spread throughout the tank bottom to solidify any remaining liquids. Continue to monitor vapor readings throughout the entire cleaning process. If any lighting is required during the initial cleaning operation an explosion proof light shall be used. Use a non-ferrous or spark proof shovel to remove any solid sludge or saturated absorbent material from the tank and place in tightly sealed containers or drums. Disposal shall be in accordance to local or national regulations.

TANK INSPECTION

If groundwater is entering the tank through a perforation in the tank shell, then repairs will be performed prior to an inspection related abrasive blast operation. The entire interior surface of the tank shell or tank floor shall be abrasively blasted until free of scale, rust and other foreign materials.
The tank condition and the structural integrity must be carefully determined before accepting it as a candidate for a Parabeam® lining. During a visual inspection, the extent of any internal

and / or external corrosion should be determined. Suspected areas of severe corrosion and other randomly selected areas in the tank should be tested to determine the structural integrity of the steel shell. Uniform corrosion may be difficult to detect and may require the use of ultrasonic techniques to determine the metal thickness.

TANK PREPARATION

New or retrofitted tanks must be cleaned and blasted to a roughness, which will ensure a good bonding.
For heavily pitted and corroded areas, welded seams, radiuses and overlaps, a flexible grout (trowel applied) should be carefully worked into these areas. An optional adhesive primer should be applied before the grout to ensure a maximum bonding strength between the substrate and the grout.
This procedure is extremely important to produce a friendlier radius and a uniform substrate that assists in installing a void-free application of the laminate (figure 5).

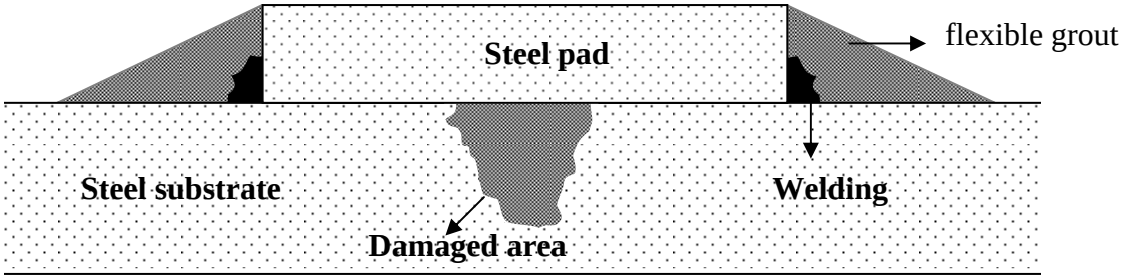


Figure 5

Since columns or supports in aboveground storage tanks (AST) are on corrosion allowance pads (re-pads), the Parabeam® 3D Glass Fabric is made to butt up to the re-pads. For a continuation of the interstitial space underneath the re-pads, these re-pads can be welded on a 2 – 3 mm distance holders and the Parabeam® 3D Glass Fabric can afterwards be connected with this space.

The same system can also be used for installation o a leak detection nozzle through a welded steel plate with on two sides several centimetres open edge for a connection with the Parabeam® interstitial layer (figure 6).

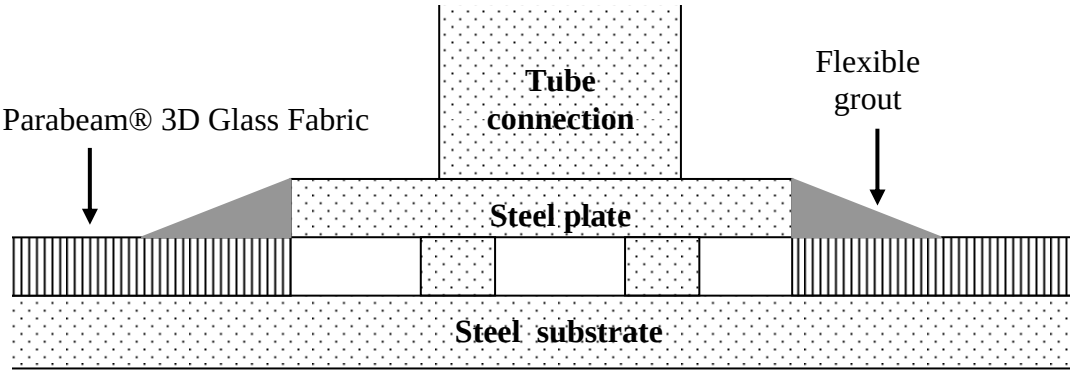


Figure 6

This type of connection has a very strong bonding to the tank floor structure and can be connected by a fixed or a flexible tube to the tank wall. In case of a fixed tube it should have a two-direction curvature to allow some flexibility between tank wall and floor (figure 7).

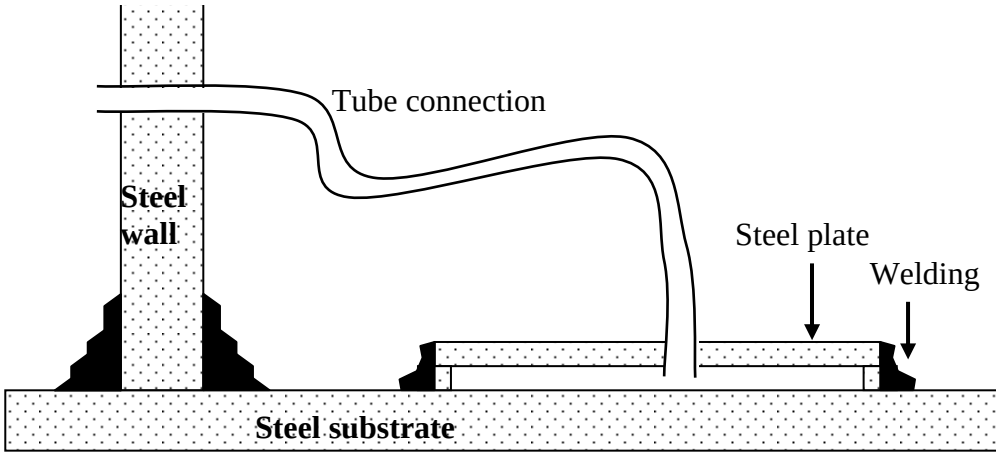


Figure 7

In figure 8 this fitting is shown from a top view. On both sides of the steel plate along several centimetres there is an opening which will be connected with the Parabeam® hollow interstice.

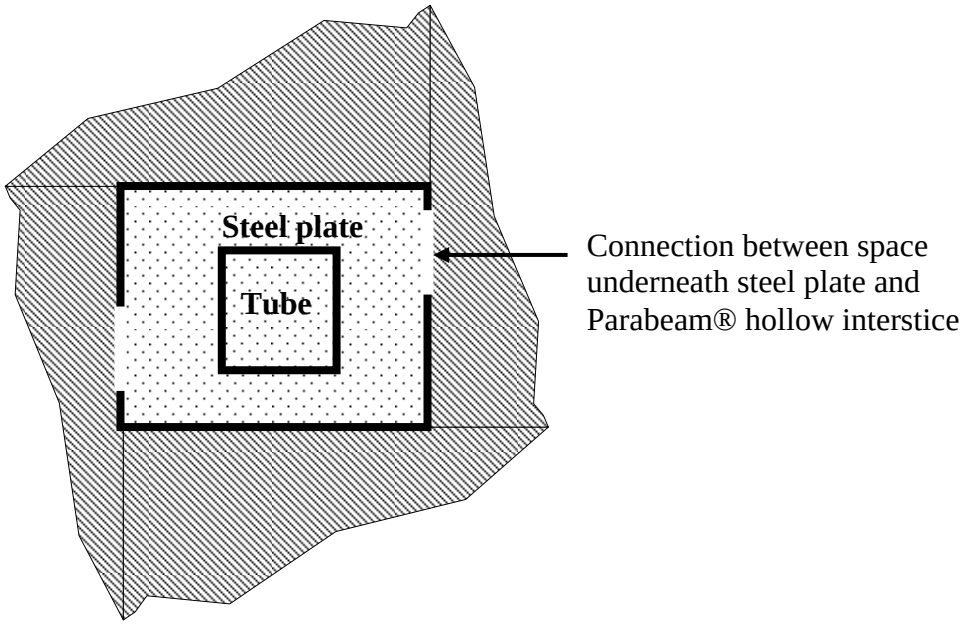


Figure 8

PRIMER APPLICATION (OPTIONAL)

After cleaning and blasting the substrate a (resin / coating) primer can be applied for a strong and flexible bonding between the first layer and the substrate. Apply a flexible thermosetting

resin / coating to substantially suppress stresses arising due to thermal expansion and flexure. Some epoxy resin systems allow an application both as a primer and as the laminating resin, which reduces the process with one application step. The primer has to be applied at the appropriate time interval, ensuring a proper bonding with the flexible grout.

FIRST LAYER (OPTIONAL)

In case polyester or vinylester resin systems are used, a chopped strand (mat) layer is recommended for an appropriate adhesion between the Parabeam® 3D Glass Fabric and the substrate. This layer must be cured before the Parabeam® 3D Glass Fabric is applied to ensure a proper laminating process.

THE PARABEAM® 3D GLASS FABRIC

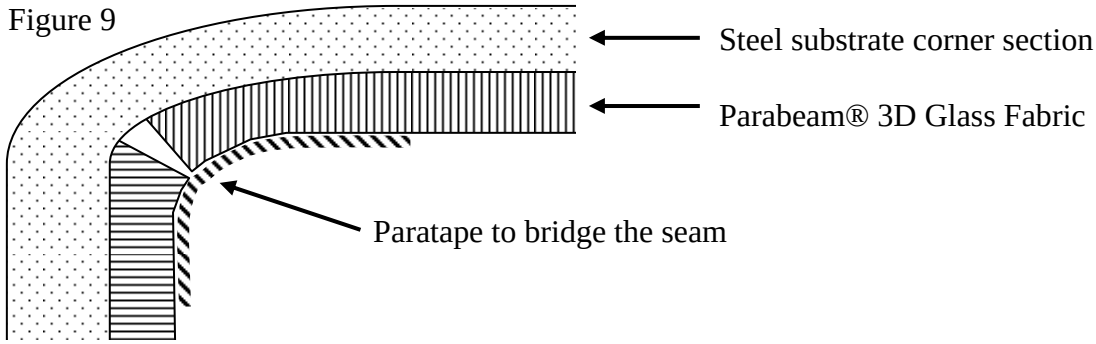
The Parabeam® 3D Glass Fabric is available on a 750 and 1500 mm width, both on 40 linear meter roll length. In general the 750 mm width is recommended, because it is more practical. Only for large AST's applicators prefer the 1500 mm width, since you can apply more surface area at a time and less seams have to be covered. The procedure for seams and edges is described in the following paragraph.

The application of the Parabeam® 3D Glass Fabric is a 4 step process:

1. Evenly apply 450 g/m² resin / coating on the prepared substrate or on the optional first layer.
2. Apply the Parabeam® 3D Glass Fabric into the resin / coating layer and roll the fabric firmly with a mohair roller or a longitudinally grooved aluminium roller to achieve a good contact with the substrate or optional first layer underneath. The resin / coating will impregnate the Parabeam® 3D Glass Fabric bottom-up. This procedure should remove any entrapped air, eliminate wrinkles and uniformly impregnate and wet out the fibres on the bottom of the Parabeam® 3D Glass Fabric. Rolling is preferably done once or twice in the roll length direction (warp) or in the roll width direction (weft).
3. Evenly apply 450 g/m² resin / coating on top of the Parabeam® 3D Glass Fabric together with back rolling, using a mohair roller to ensure a full surface wet out, to prevent pinholing and air entrapment. The capillary forces in the Parabeam® 3D Glass Fabric will automatically impregnate the fabric. De-airing is not necessary, since the layers are thin and air will escape on all sides.
4. Gently roll the top face of the Parabeam® 3D Glass Fabric to ensure a plain surface.

Lay-down pattern of the Parabeam® 3D Glass Fabric in the tank?
Underground storage tanks:
Start at the domed end on the opposite end of the manhole. Than the cylinder is applied with 1.5 - 2.0 m lengths at 0.75 m width starting at that domed end in hoop direction. Both ends of a Parabeam piece are cut under a 30° angle to prevent fraying. Pieces are butted up and the cylinder is fully covered up to the manhole. Arriving at the manhole the other domed end is applied and the cylinder part towards the manhole. Finally the area underneath the manhole is applied and the lining is left to cure. The resin supplier specifies the time interval. The corner sections are applied from the domed end side half way into the radius and from the cylinder side also half way into the radius as shown in figure 9.

Figure 9



Aboveground storage tanks:
The Parabeam® 3D Glass Fabric application has to start right opposite the manway entrance and the fabric stripes have to be applied perpendicular to it. In this way the Parabeam® 3D Glass Fabric is applied towards of the manway. After the last strip, the lining is left to cure according to the resin suppliers specification.

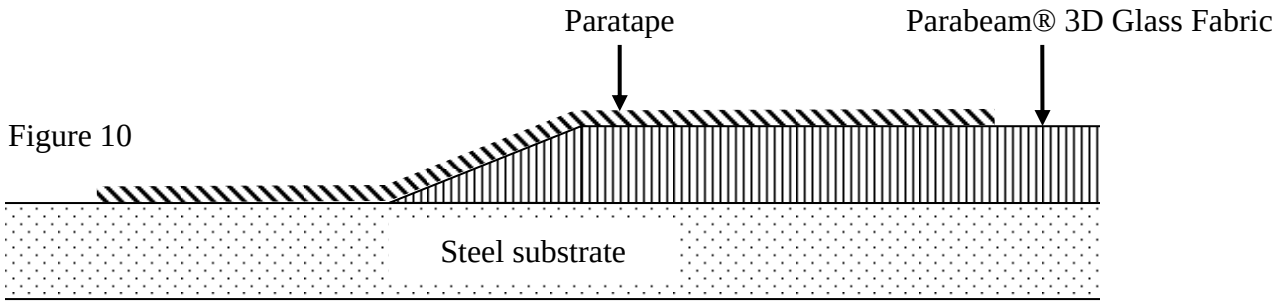
EDGES

Make sure that the edges of the Parabeam® 3D Glass Laminate are sealed during the wet stage with the Paratape to ensure a strong and tight edge finish. Apply the 100 mm wide Paratape according to the following procedure:

1. Separately impregnate the chopped strand mat side of the Paratape until it is properly impregnated. Excess of resin should be removed.
2. Apply the Paratape half way on the edge of the Parabeam® 3D Glass Fabric, with the chopped strand mat side towards the Parabeam® and the substrate.
3. Apply resin and distribute it evenly on top of the Paratape. De-air by means of a de-airing roller to complete the impregnation of the Paratape. Excess of resin should be removed.

The result is shown in figure 10.

Figure 10



SEAMS

The Parabeam® 3D Glass Fabric should be laid down in parallel direction ensuring seams are butted tightly together (maximum space of 6 mm) and not overlapping.
Immediately after the parallel application of a properly impregnated Parabeam® 3D Glass Fabric, a 100 mm wide Paratape is applied to bridge the seam and to ensure the continuity of the interstitial space.

The application procedure is as follows:

1. Bring the properly impregnated Parabeam® 3D Glass Fabrics as closely together as possible, however do not overlap. The maximum joint width should be 6 mm from selvedge to selvedge.
2. Separately impregnate the chopped strand mat side of the Paratape until it is properly impregnated. Excess of resin should be removed.
3. Apply the Paratape to the Parabeam seam with the impregnated chopped strand mat side towards the Parabeam. Just roll in length direction to avoid a depression in the seam.
4. Apply resin and distribute it evenly on top of the Paratape. De-air by means of a de-airing roller to complete the impregnation of the Paratape. Excess of resin should be removed.

The result is shown in figure 11.

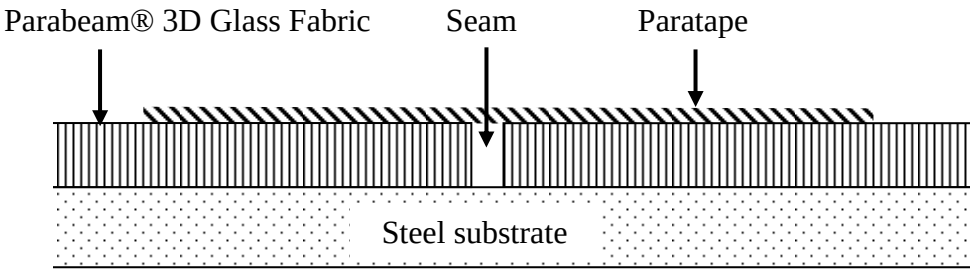


Figure 11

SURFACE TREATMENT

The application has had sufficient time to cure when it can be walked on without damage. At this stage any irregularities, projecting strands, rough edges or rough seams must be sanded smooth. In case some edges where not sealed while the Parabeam® laminate was still wet, these side edges should be ground smooth or razor cut to a 45-degree angle (figure 12). With the flexible grout the edges should be filled and sealed with Paratape.

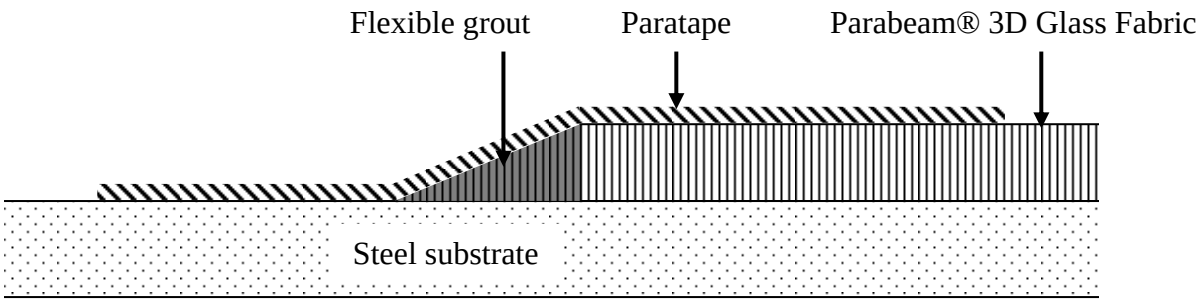


Figure 12

The corner sections can now be filled with flexible grout to make a smooth radius, which ensures an optimal application of the final corrosion barrier (figure 13).

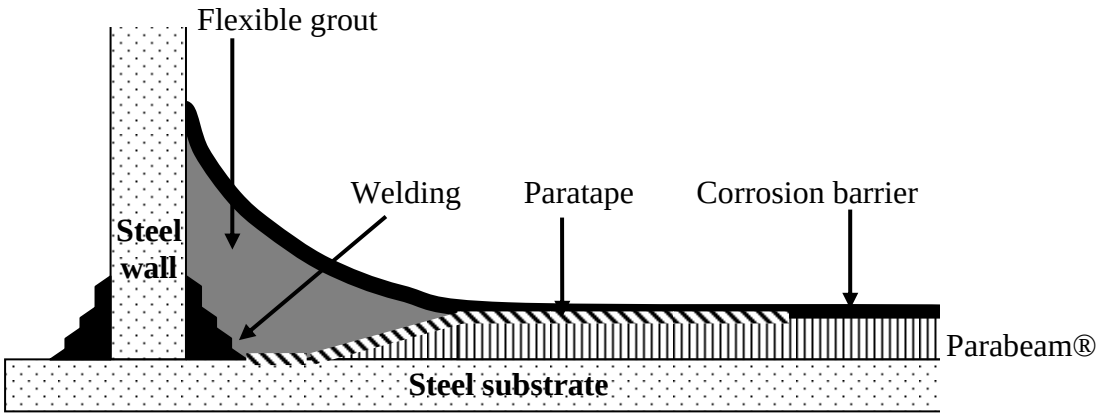


Figure 13

Next, the entire floor area should be vacuumed using a bristle brush attachment to remove all loose particles. Sweep or blow-down cleaning alone is not acceptable.

MONITORING PLATES

When the monitoring plates are not welded to the substrate, it is now the time to install the monitoring plates onto the Parabeam® 3D laminate.

For the UST's there are two options:

1. Drill a hole in the top face of the Parabeam® and laminate a nipple on it. Connect it by a tube through the man way out (figure 14).

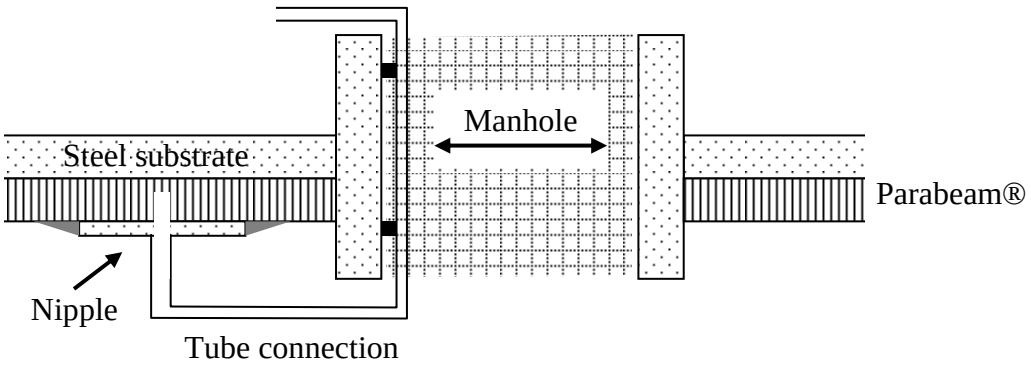


Figure 14

2. A hole drilled from the inside out through the Parabeam® and the steel substrate and next to the man way (figure 15).

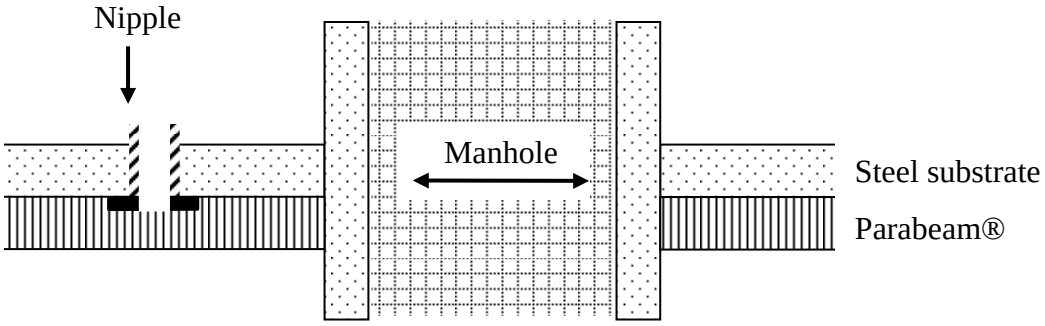


Figure 15

For AST's there are two options:
1. As described in figure 7.
2. Drill a hole in the top face of the Parabeam® and laminate a nipple on it. Connect it with a tube and lead it through the cargo to the outside tank wall (figure 16), To fasten the nipple tightly apply 3 layers of CSM over the nipple and 70 mm around it as shown in figure 17.

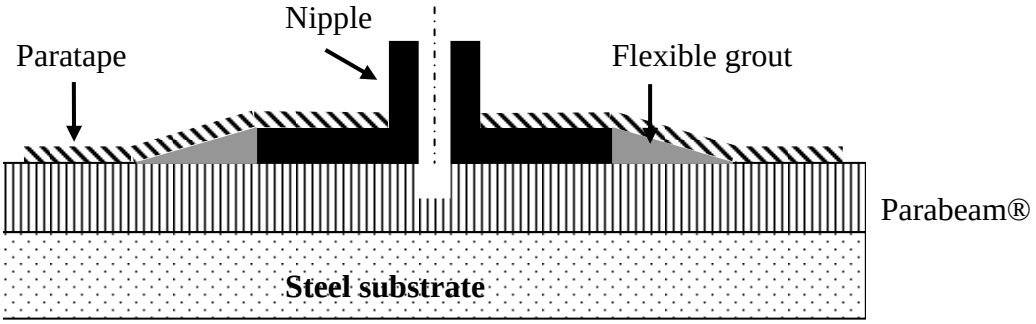


Figure 16

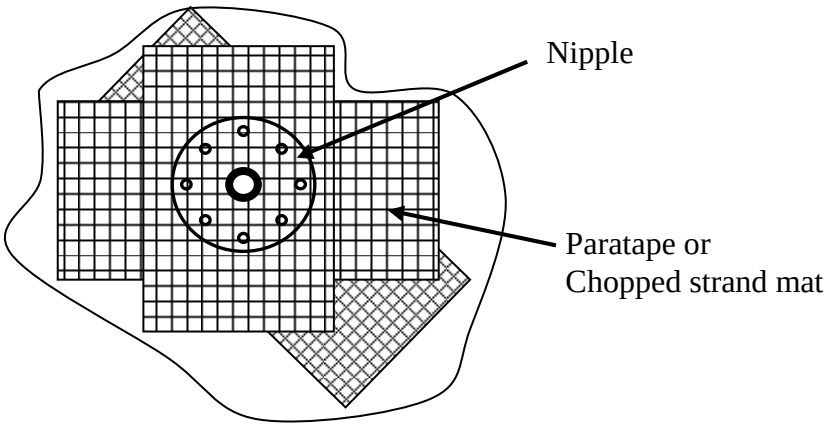


Figure 17

Final repairs, including filling air pockets and Paratape seams should be completed now. It is recommended that at this time, prior to the application of the final corrosion barrier, an additional 150 g/m² resin / coating is applied to the entire surface.
This process has proven to close the very small pinholes in the Parabeam® surface. Once this layer has been allowed to cure a final visual inspection should be performed to confirm the integrity.

CORROSION BARRIER

The final corrosion barrier based on a coating or a glass fibre - resin laminate can now be applied to achieve a gas tight layer and to build the proper chemical resistance towards the tank cargo. A final top coating follows a glass fibre - resin laminate.
The preferred test method to check for positive cure, before applying the corrosion barrier is time-at-temperature as outlined on the resin / coating manufacturers product data sheet. Depending on the technology of the specified corrosion barrier and the coating or laminate thickness as recommended by the supplier, a Barcol hardness testing can be used to confirm the appropriate cure. To be acceptable, the application should be free of obvious defects such as sags, runs, blisters, pinholes, air-entrapment, fish-eyes, overspray, projecting fibres, and any other foreign matter entrapment.

INSPECTION AND REPAIRS

When the lining is put in service a thorough inspection has to be carried out. After an extensive visual check an air tightness check has to be carried out.

AIR TIGHTNESS INSPECTION AND DETECTION

After finishing the lining application the lining must be tested extensively to make sure that the hollow interstice is airtight. For this purpose the interstice must be pressurised and by means of a precise gauge a possible pressure drop must be checked. The Helium test is described in option 2 and is a very accurate alternative. In case a pressure drop is noticed, the following options can be used to find the breach.

Option 1: The pressure – soap test
Pressurise the Parabeam® interstitial space and wet the area with a soapy water solution using a mop or spray gun application. Air bubbling will identify the leak (figure 18).

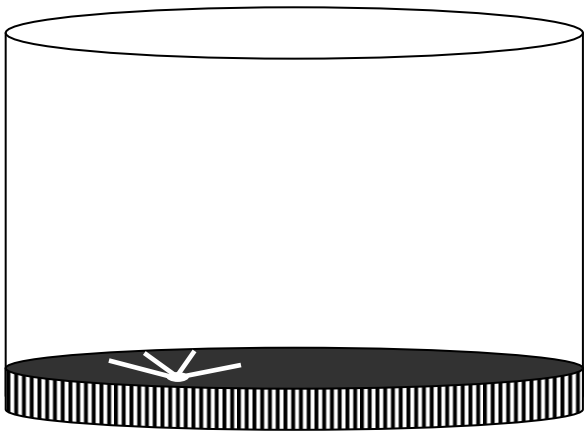


Figure 18

Option 2: The Helium test
Pull vacuum on the Parabeam® interstitial space through the leak detection attachment nozzle. Lead the air stream through helium detection equipment. The sensitivity for Helium registration of this type of equipment is very high. Spray the Parabeam® lining with Helium gas and stay in contact with the registration equipment. The smallest breach will immediately be registered, since the inert Helium gas is a very small atom and will penetrate very easy through any breach.

SMALL AREA REPAIRS

All repairs can be carried out with cold techniques, thus reducing risks to people working in these tanks. Once a leak is located the surface around the breach should be ground back to a surface area of approximately 15-cm around the breach with an abrasive disc on a power

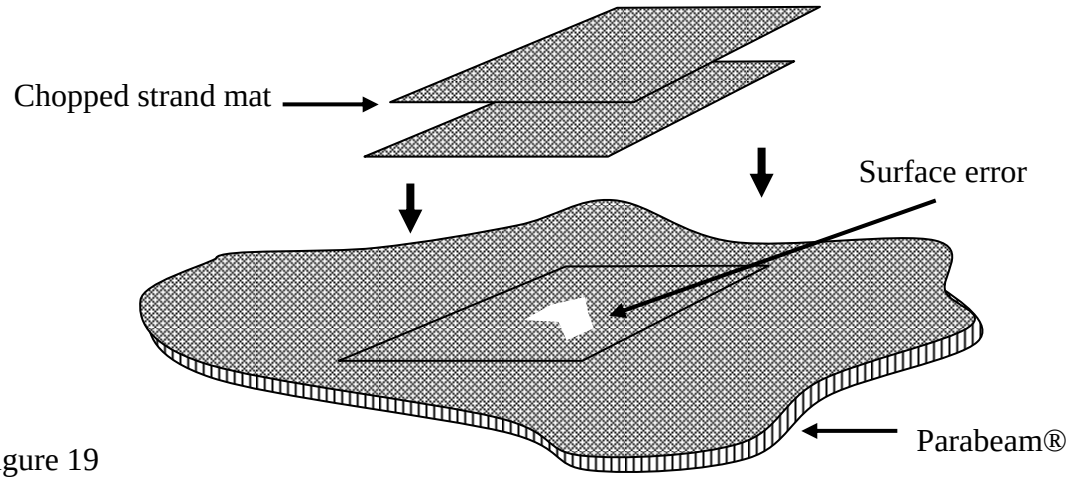


Figure 19

grinder. This procedure as shown in figure 19 must create a uniform rough profile and remove all gloss. The prepared surface should be vacuum cleaned. Depending on the size the damaged area can be repaired with either a fast-set patch version of the specified resin / coating system or 3 layers of 300 g/m² chopped strand mat (CSM) uniformly wetted with the specified resin / coating system. The CSM is rolled with a ribbed roller to remove entrapped air from the laminate. The fast-set repair patch should be allowed to cure and than pressure tested to check the integrity. Once the integrity is confirmed, the repair patch should be equalised by sanding and finished with the corrosion barrier.

LARGE AREA REPAIRS

Approximately 5-cm around the damaged area the Parabeam® top deck layer including the vertical piles is ground out with an abrasive disc or by means of blasting to achieve a uniform profile for a proper bonding. Ideally the bottom layer of the Parabeam® Laminate will be left firmly adhered to the substrate.

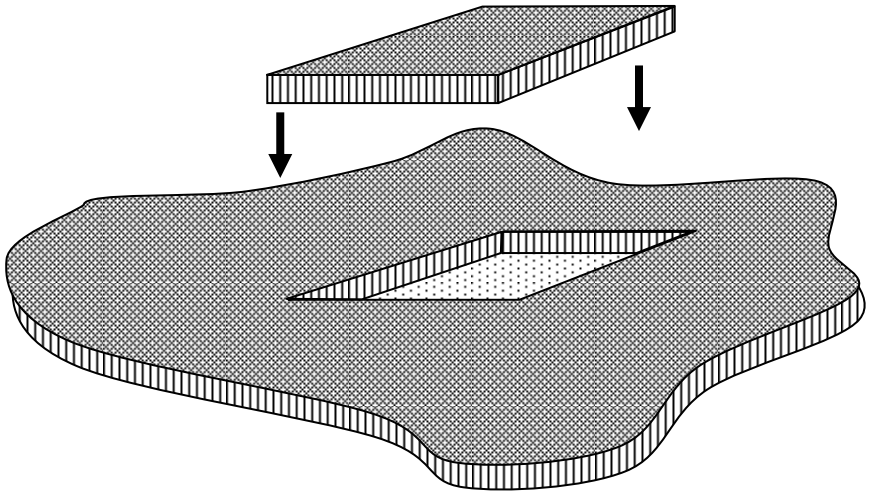


Figure 20

Preferably the removed area should be rectangular for an easy shaping of the Parabeam® 3D Glass Fabric piece. Grind back a 15-cm larger surface area around the removed Parabeam® Laminate with an abrasive disc on a power grinder to achieve a uniform rough profile for a proper bonding.
Cut a piece of Parabeam® 3D Glass Fabric in exactly the right shape under a 30° angle with warp and weft direction. This will prevent fraying of the edges. Separately impregnate this piece of Parabeam® 3D Glass Fabric and wet out the substrate surface. Put the pre-impregnated laminate into the patch area and roll with a longitudinally grooved aluminium roller, for a good contact between the substrate and the Parabeam® Laminate. Immediately apply the Paratape all around the seams according to the seam instruction, and leave it to cure. Apply 3 layers of 300 g/m² chopped strand mat (CSM) over total repaired area. The CSM is rolled with a ribbed roller to remove entrapped air from the laminate. See Figure 20. Once the integrity is confirmed, the repair patch should be equalised by sanding and finished with the corrosion barrier.

SEAM REPAIRS

In case a seam is filled with an excess of resin, the seam could be blocked. The cured resin must be removed by grinding and the seam must be covered with Paratape (figure 21, 22, 23).

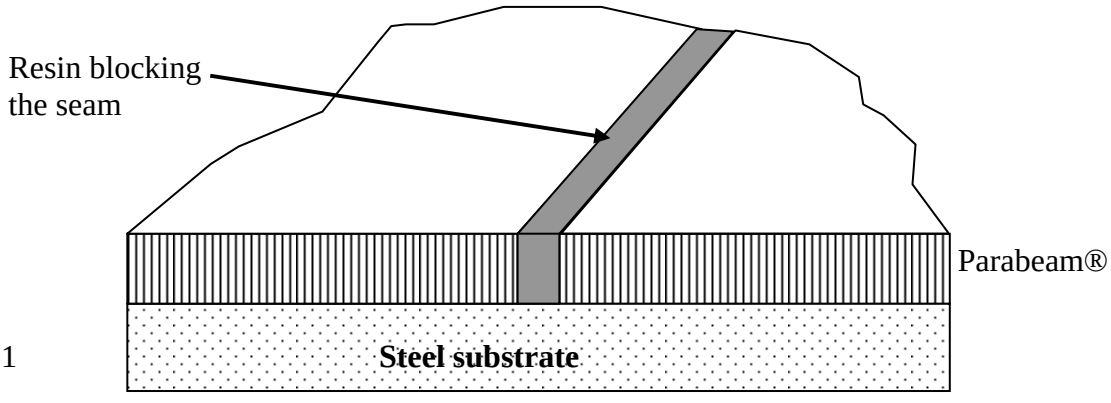


Figure 21

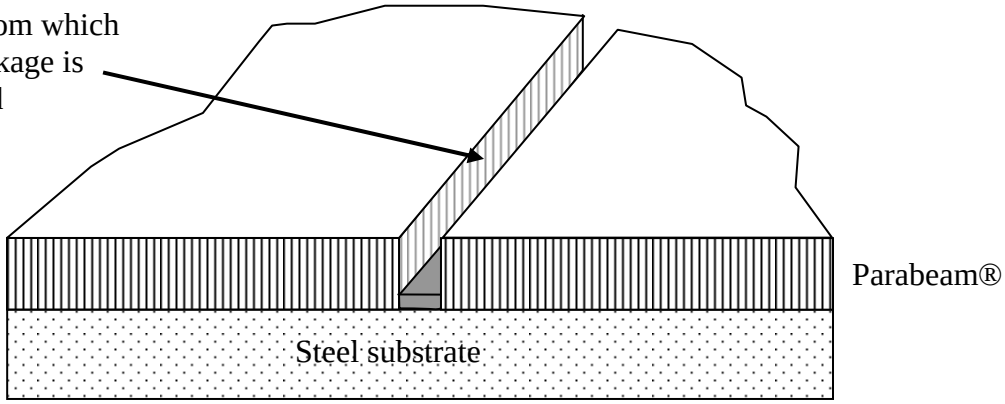


Figure 22

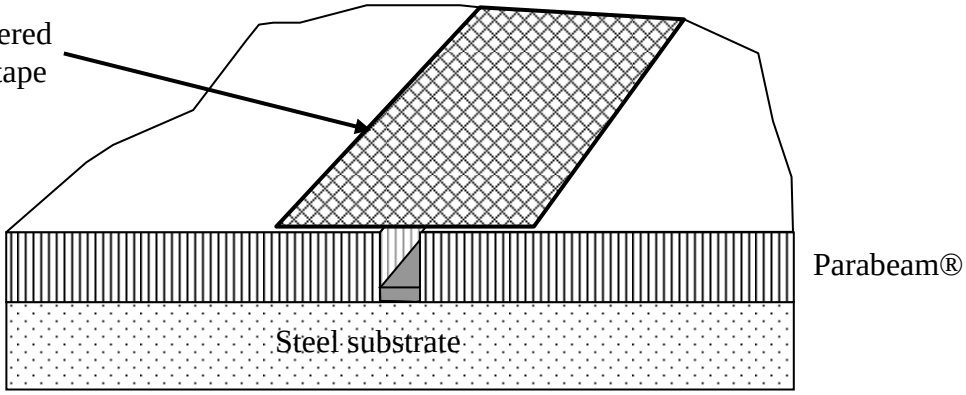


Figure 23

OPERATIONAL GUIDELINES

DELIVERY INSPECTION

The last person to leave the tank before installing manways or covers should be the inspector, who can conduct a final inspection of system integrity. The Parabeam® lining should be pressure tested at the specified pressure to ensure a full air tightness of the interstitial space. The inspector should also examine the tank for mechanical damage caused by removing equipment or other irregularities.

LEAK DETECTION SYSTEMS

Applying leak detection to the storage tank facilities is a key advantage for both the owners and the environment. The advantages are listed below:

- Added value of early warning leak detection
- Fail save preventive control
- Minimises product value loss
- Minimises environmental damage
- Strongly reduced risk in liability claims

Many different leak detection techniques can be applied in this composite laminate for constant leak monitoring. Several combinations of techniques are also possible, which together can increase detection reliability. In principle any one of the following techniques can be utilised.

- Hydrostatic
  This system is widely used for underground storage tanks. The interstitial space is filled with liquid, with help of a vacuum. At the top of the tank a sensor is positioned to measure the liquid level. In case of a liquid loss either through the inside wall or the outside wall of the tank, the liquid level will drop and the sensor will alarm.
  The system is easy to understand and simple to install. The system monitors both the internal and external wall. The disadvantage is that the liquid has to be anti freeze, which makes the liquid environmentally unfriendly.
- Pressure
  The Parabeam® interstitial space allows a pressure leak detection system, since it is an integrally bonded system. The interstitial space is pressurised and the leak detector continuously measures the pressure level. If the pressure drops, the alarm goes of.
  The system monitors both the internal and external wall, and it is very environmental friendly. The system is used in underground and aboveground tanks. The maximum pressure level is depending on the lining construction. This also determines the maximum height of the tank, where it can be installed in.
  For detailed information please refer to the equipment manufacturer.
- Vacuum
  A vacuum is applied in the Parabeam® interstitial space. A leak detector continuously measures the vacuum level. If the pressure rises, the alarm goes of.
  The system monitors both the internal and external wall, and it is very environmental friendly. The system is used in underground and aboveground tanks.
  For detailed information please refer to the equipment manufacturer.
- Liquid sensor
  The sensor is installed in the Parabeam® interstitial space at the deepest point. When the stored liquid enters the internal wall through a breach the liquid will run to the deepest point and will be detected by the sensor. In case of a breach in the external wall normally no liquid will enter, and consequently no alarm will be given. In case groundwater could enter it is recommended to install a water sensor as well, to be able to know if groundwater or the stored liquid causes an alarm.

TECHNICAL DATA SHEET

Parabeam® 3D Glass Fabric with epoxy or vinylester resin

Fabric type			87136	87136
Resin type			epoxy	vinylester / polyester
Roll quantity		(m^2)	30	30
Roll length		(m)	40	40
Roll width		(mm)	750	750
Laminate thickness		(mm)	3.3	3.3
Face thickness		(mm)	0.35	0.35
Core thickness		(mm)	2.6	2.6
Fabric weight		(g/m^2)	755	755
Resin / coating weight		(g/m^2)	855	1000
Laminate weight		(g/m^2)	1610	1755
Glass type			E	E
Yarn finish			silan	silan
Thermal conductivity	[λ]	(W/mK)	0.06	0.06
Thermal resistance	[R]	(m^2K/W)	0.05	0.05
Perpendicular to the faces:				
Compressive strength	[σ_c]	(MPa)	3.8	8
Compressive modulus	[E_c]	(MPa)	38	50
Parallel to warp direction:				
Core shear strength	[τ]	(MPa)	0.6	0.7
Core shear modulus	[G_c]	(MPa)	3	12
Tensile strength	[σ_t]	(MPa)	175	225
Tensile modulus	[E_t]	(MPa)	11000	15000
Compressive strength	[σ_c]	(MPa)	70	110
Compressive modulus	[E_c]	(MPa)	8000	13000
Flexural modulus	[E_b]	(MPa)	4500	10000
Parallel to weft direction:				
Core shear strength	[τ]	(MPa)	1.3	1.5
Core shear modulus	[G_c]	(MPa)	16	80
Tensile strength	[σ_t]	(MPa)	190	250
Tensile modulus	[E_t]	(MPa)	12000	16000
Compressive strength	[σ_c]	(MPa)	110	176
Compressive modulus	[E_c]	(MPa)	17000	16000
Flexural modulus	[E_b]	(MPa)	6000	13000

All data are indicative and Parabeam assumes no kind of responsibility for the contents.

REFERENCES

AST CASE HISTORIES:

Project:	Two tank floors (2 x 110 m²) with diameter 12 m for diesel fuel in December 1994.
Laminate:	Primer (Derakane 8084) + 1 x 450 g/m² CSM + Parabeam 85132 + 1 x 450 g/m² CSM + topcoat (Derakane 470-36)
Contractor:	Gladstone-Lee Holdings Inc., Milton Ontario, Canada
Owner:	CP Rail Toronto Canada

Project:	One tank floor with diameter 12 m (110 m²), for unleaded fuel in November 1995.
Laminate:	Primer (Derakane 8084) + 2 x 450 g/m² CSM + Parabeam 85132 + 2 x 450 g/m² CSM + graphite conductive topcoat (Derakane 470-36)
Contractor:	Ferropan Bautenschutz ltd. International, Vienna, Austria
Owner:	Österreichische Mineral Verwaltung (ÖMV) in St. Valentin in Austria

Project:	One tank floor with diameter 25 m (490 m²), for naphtha in Mai 1997.
Laminate:	Primer (Derakane 8084) + 2 x 450 g/m² CSM + Parabeam 85132 + 2 x 450 g/m² CSM + topcoat (Derakane 470-36)
Contractor:	Poly Products b.v., Werkendam, Netherlands
Owner:	DOW plant in Terneuzen in the Netherlands

Project:	One tank lining on the floor, ceiling and walls (1200 m²) in a power plant for different chemicals in November 1997.
Laminate:	Primer + 1 x 450 g/m² CSM + Parabeam 85132 + 2 x 450 g/m² CSM + topcoat (Basf Palatal A430)
Contractor:	Fiberdur-Vanck GmbH, Bitburg-Staffelstein, Germany
Owner:	Leipzig in Germany

UST CASE HISTORIES:

Project:	5 rectangular concrete tanks each 3 x 3 x 3 m lined at the walls and the floors, for the water purification plant of Amsterdam in the Netherlands (225 m²). Tank content is Ferric chlorine
Laminate:	Primer + 1 x 450 g/m² CSM + Parabeam® 85132 + 2 x 450 g/m² CSM + topcoat. Resin Reichhold ISO-NPG
Contractor:	Poly Products b.v., Werkendam
Owner:	City of Amsterdam.

Project:	An underground unleaded fuel storage tank of 40 m^3 (internal surface 70 m^2) at a fuel station in Tarpoley England in October 1994.
Laminate:	Primer (Derakane 8084) + 2 x 450 g/m^2 CSM + Parabeam® # 87132 + 2 x 450 g/m^2 CSM + topcoat (Derakane 470-36)
Contractor:	King Tanktechnic ltd, Manchester, England
Owner:	Burmah Oil

Project:	An underground unleaded fuel storage tank of 30 m^3 at a fuel station in Sweden in march 1995.
Laminate:	See project 6, however with the Reichhold terephtalic polyester resin.
Contractor:	Falu Tank AB, Hedemora, Sweden.
Owner:	Shell

Project:	A 100 m^3 underground kerosene storage tank at airport Charles de Gaulles in Paris in May 1998.
Laminate:	See project 6, however with the DSM-BASF terephtalic resin.
Contractor:	PAV s.a., Vallet, France
Owner:	Total

Project:	A 80 m^3 underground kerosene tank at Brest airport in France in September 1996.
Laminate:	See project 6, and also with Derakane 8084 and 470-36.
Contractor:	Somaden s.a., Rognac, France
Owner:	Total

SUMMARY

The Parabeam® 3D Glass Fabric is the material of choice for an integral and reliable double wall lining with a leak detection system.

The Parabeam® 3D Glass Fabric provides:

- A highly cost-efficient double wall lining system
- Easy and quick to install with a minimum down time of the tank
- A very reliable and integrally bonded leak monitoring system
- Corrosion protection against aggressive chemical and thermal environments
- Secondary containment within the primary structure such as an AST or UST
- Extremely sensitive leak detection monitoring reducing risk of soil or groundwater contamination
- Extended service life and inspection / maintenance requirements
- The answer to double wall legislation