BS EN
976-2 : 1997

Underground tanks of glass-reinforced plastics (GRP) —

Horizontal cylindrical tanks for the non-pressure storage of liquid petroleum based fuels

Part 2. Transport, handling, storage and installation of single wall tanks

The European Standard EN 976-2 : 1997 has the status of a British Standard

ICS 23.020.10

National foreword

This British Standard is the English language version of EN 976-2 : 1997.

The UK participation in its preparation was entrusted to Technical Committee PRI/64, GRP tanks for underground petrol storage, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled 'International Standards Correspondence Index', or by using the 'Find' facility of the BSI Standards Electronic Catalogue.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 16, an inside back cover and a back cover.

This British Standard, having been prepared under the direction of the Sector Board for Materials and Chemicals, was published under the authority of the Standards Board and comes into effect on 15 December 1997

ISBN 0 580 28930 3

Amendments issued since publication

Amd. No.	Date	Text affected

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 976-2

July 1997

ICS 23.020.10

Descriptors: Petroleum products, storage, storage tanks, underground tanks, thermosetting resins, reinforced plastics, glass reinforced plastics, specifications, transportation, installation, certification

English version

Underground tanks of glass-reinforced plastics (GRP) — Horizontal cylindrical tanks for the non-pressure storage of liquid petroleum based fuels — Part 2: Transport, handling, storage and installation of single wall tanks

Réservoirs enterrés en plastiques renforcés de verre (PRV) — Réservoirs cylindriques horizontaux pour le stockage sans pression de carburants ou combustibles pétroliers liquides — Partie 2: Transport, manutention, stockage et installation de réservoirs à simple paroi

Unterirdische Tanks aus textilglasverstärkten Kunststoffen (GFK) — Liegende zylindrische Tanks für die drucklose Lagerung von flussigen Kraftstoffen auf Erdölbasis — Teil 2: Transport, Handhabung, Zwischenlagerung und Einbau einwandiger Tanks

This European Standard was approved by CEN on 1997-06-21. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 976-2 : 1997 E

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 210, GRP tanks and vessels, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 1998, and conflicting national standards shall be withdrawn at the latest by January 1998.

The 4 Parts of this European Standard cover the construction and installation requirements of horizontal, cylindrical GRP tanks used for the underground non-pressure storage of petroleum based fuels, e.g. petrol and diesel fuel storage in service stations, heating oil storage for buildings.

The 4 Parts are:

Part 1:	*Requirements and test methods for single wall tanks*
Part 2:	*Transport, handling, storage and installation of single wall tanks*
Part 3:	*Requirements and test methods for double wall tanks*
Part 4:	*Transport, handling, storage and installation of double wall tanks*

The standard is written in different parts in order to clearly define the involvement and responsibilities of different parties in the construction of the tank, its installation and the assurance of a good, safe performance during use.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Contents

1 Scope

This Part 2 of European Standard EN 976 specifies the requirements for the transportation, site handling, storage and installation of horizontal, cylindrical single wall tanks made of glass reinforced thermosetting resins used for the underground non-pressure storage of liquid petroleum based fuels, complying with the requirements of EN 976-1.

Ancillary equipment vital to the satisfactory operation of the installation comprising access chamber, cover and frame are also described.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

prEN 976-1 *Underground tanks of glass-reinforced plastics (GRP) — Horizontal cylindrical tanks for the non-pressure storage of liquid petroleum based fuels — Part 1: Requirements and test methods for single wall tanks*

3 Definitions

For the purposes of this standard the following definitions apply:

3.1 cylinder

Part of the tank that forms the cylindrical portion of the body.

3.2 end

Curved portions of the tank located at the ends of the cylindrical portion.

3.3 cylinder reinforcing ribs

Circumferential external ribs fully bonded to the cylinder or integrally formed with it.

3.4 compartment

Portion of the tank created by an internal partition.

3.5 manway

Hole in the uppermost portion of the cylinder or tank allowing access.

3.6 manway lid

Plate bolted to the manway.

3.7 access chamber

Chamber to provide access to the manway lid.

3.8 anchorage positions

Clearly marked positions on the tank which can be used as the location of the holding down straps used to anchor the tank.

3.9 anchorage points

Positions to which the holding down straps can be secured.

3.10 holding down straps

Straps used to hold down the tank.

3.11 backfill

Non-cohesive, granular material used to surround the tank and provide support and restraint.

3.12 excavation

Pit into which one or more tanks may be installed.

3.13 tank installer

Company responsible for the tank installation.

3.14 manufacturer

Company creating and selling the tank complying with EN 976-1.

3.15 sleepers; deadmen

Concrete beams laid parallel to the tank axis which allow the soil weight above the beams to be utilized in tank anchoring (see figure B.4).

3.16 lifting position

Position on the tank used for lifting purposes.

3.17 water table

Permanent, short term tidal or frequently changing water level below ground level at the tank location which marks the upper level of the zone of groundwater saturation.

3.18 high water table

Site with a water table having the depth below ground to the average seasonal water level of between 0 and 4 m.

3.19 tank

Tank complying with EN 976-1.

3.20 visual inspection

Examination of the tank by the unaided eye.

3.21 sheet pile

Timber or steel sheeting used to support the sides of an excavation.

4 Transport

The tank shall be placed on the transporter ensuring that it is not placed on any sharp protrusions that will cause damage. Suitable cradles or checks shall be used.

The tank shall be secured on the vehicle by means of GRP, nylon or similar non-metallic straps.

The straps shall only be tightened sufficiently so as to prevent tank movement. Care shall be taken not to overtighten the straps and cause damage of the tank.

5 Handling

When demounting the tanks from the transporter the tank shall only be lifted by devices provided by the tank manufacturer or at lifting positions marked on the tank using non-metallic straps or webbing, see figure 1.

Control of the tank whilst suspended shall be effected by the use of guide ropes.

6 Storage

If stored on site the tanks shall be stored on a level surface free from sharp protrusions and supported to prevent local damage. The storage location shall be selected so as to minimize accidental damage. Tanks shall be chocked.

7 Tank certification

Prior to installation the installer shall obtain from the manufacturer (or third party certification body) a certificate certifying that the tank complies with EN 976-1.

8 Installation procedure

8.1 Preliminary checks

Prior to the commencement of installation, the native soil conditions should be determined and recorded and the installation type selected as defined in annex B. The type of ground will determine the dimensions of the excavation, the need for any earth work support or geotextiles.

The paths of underground or overhead services shall be identified and where necessary diverted prior to the commencement of work.

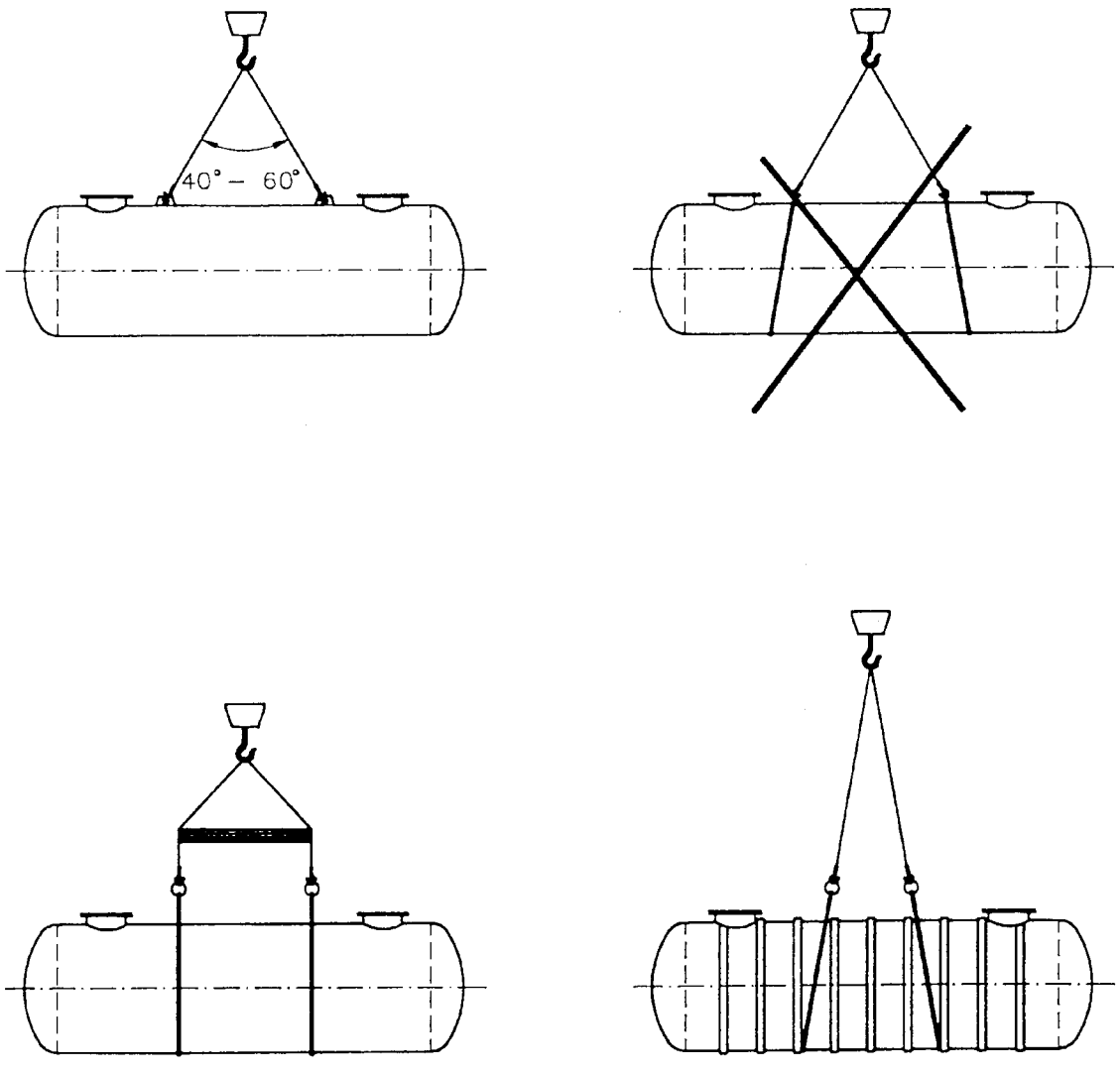


Figure 1. Handling of tanks

8.2 Preparation of the excavation

Set out the excavation. Begin the excavation taking care not to undermine existing structures nor damage underground services.

All excavated material shall be removed from the immediate vicinity of the excavation to ensure it does not contaminate the backfill.

Keep the excavation dry by using pumps where necessary.

Level the excavation base.

8.3 Ground works

When the ground has been classified as unstable then preventative measures such as 'battering back' or sheet piling should be taken to prevent inward collapse of the side walls into the excavation.

When sheet piling is used care shall be taken to ensure that neither tank nor back fill material is disturbed by sheeting removal. Voids behind the sheeting and voids created by sheeting removal must be filled with backfill compacted to required density. It is advised to pull the sheeting in stages as backfilling progresses to allow the backfill to be properly placed and compacted against the native pit walls.

8.4 Excavation dimensions

a) Stable soils

The excavation shall be large enough to provide a minimum of 450 mm between the excavation sides and the walls and ends of the tank(s) and 450 mm between tank(s).

b) Unstable soils

The excavation shall be large enough to provide a minimum of 1/2 diameter between the excavation sides and the walls and ends of the tanks and 450 mm between tanks, except when permanent sheet piles are used to confine the excavation.

The excavation shall provide for the minimum cover (see **8.19**) of backfill above the tanks and minimum 200 mm below. The maximum allowable cover above the tanks is 2 m. The depth shall take into account any falls provided in the delivery pipework.

See table 1 and figures 2 and 3.

8.5 Geotextiles

In cases of unstable ground as defined in annex B, clause **B.4**, or where ground water conditions could lead to migration of the backfill material, a geotextile filter fabric shall be installed. The geotextile shall be laid in accordance with the geotextile manufacturer's instructions.

The geotextile shall extend under any base slab a minimum of 300 mm. Alternatively, the geotextile can be placed over the base slab a minimum of 1000 mm and covered by backfill. Where sleepers are used the geotextile shall pass underneath the sleepers and cover the entire excavation base. Ensure that the geotextile extends to the highest level anticipated for the backfill material. A minimum 300 mm overlap shall be provided where geotextiles are overlapped.

8.6 Tank anchoring

When the ground load above the tank is calculated as insufficient to prevent tank uplift (a final total cover depth of 0,7 tank diameter is usually sufficient to prevent flotation of a single tank installation), then anchoring shall be provided by methods such as base slabs or sleepers. The number of anchoring points on each side of the tank shall be equal to the tank anchoring positions indicated on the tank.

8.7 Concrete base slabs

Cast a reinforced concrete base into the bottom of the excavation. An example of a concrete base is given in annex B, clause **B.1**. Incorporate in or beneath the slab the holding down straps or holding down devices to align with the appropriate positions as indicated on the tank.

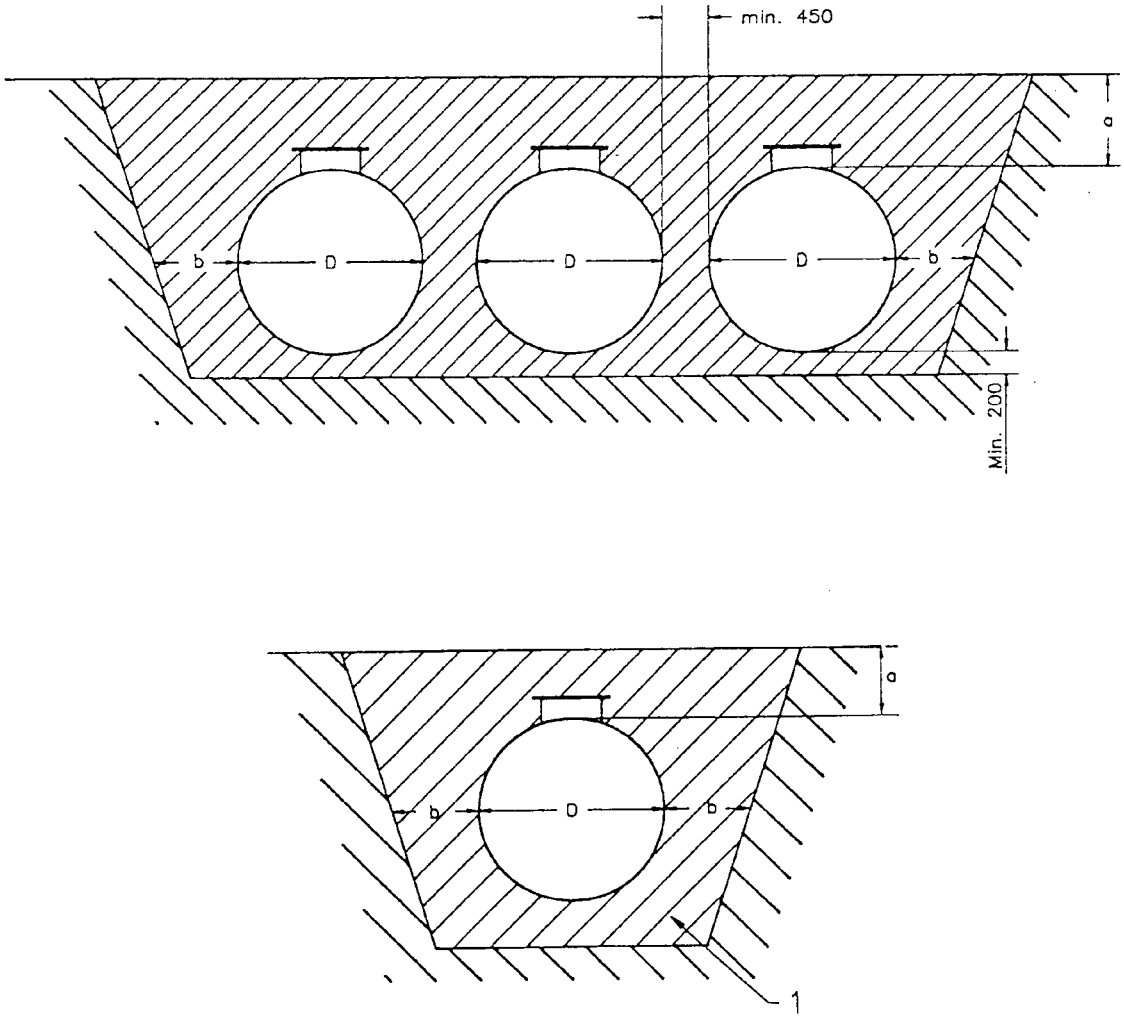
8.8 Sleepers

Sleepers shall be constructed of concrete. Examples are given in annex B, clause **B.5**. They shall provide sufficient size to prevent tank uplift after backfilling. Each sleeper shall have a minimum of two anchoring points and the total number of such points provided by the sleepers shall be equal to the number of anchorage points indicated on the tank as specified in subclause 4.8 of EN 976-1. Sleepers shall be placed outside the tank diameter.

Table 1. Excavation dimensions

Normal installation		**Installation with traffic load**	
a	500 to 2 000 mm (min. 200 mm backfill)	650 to 2 000 mm (backfill plus reinforced concrete)	1 000 to 2 000 mm (backfill plus asphalt or paving slabs)
b	Stable soil: min. 450 mm Unstable soil: min. 1/2 diameter	Stable soil: min. 450 mm Unstable soil: min. 1/2 diameter	

NOTE. Traffic load is based on a single wheel load of 8 tons.



1 Backfill

Figure 2. Installation depth and distance to excavation side, front view

8.9 Visual inspection and leaktightness test

The tank shall be visually inspected for signs of defects or physical damage. Where local safety regulations permit then the tank shall be pressurized compartment by compartment to 20 kPa maximum. The entire tank outer surface shall be covered with a soapy water solution (1 l of water with 12 ml of household dishwashing detergent). In freezing conditions, 1 l of automotive windshield washer solution for 1 l of water may be substituted. Soap the entire tank and fittings.

The test pressure shall be maintained for at least 30 min to ensure there are no leaks as indicated by soap bubbles or a drop in pressure. An air gauge with 2,5 kPa or 5 kPa increments shall be used or a manometer so that changes in pressure can be easily observed. Do not use a vacuum gauge. Any defect or damage shall be referred to the tank manufacturer.

8.10 On site repair

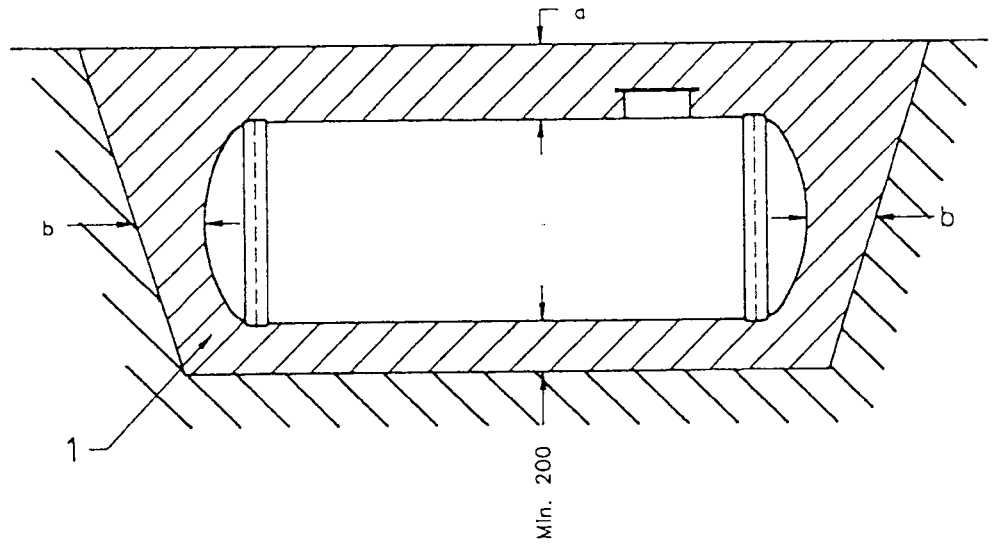
Tanks suitable for repair may be repaired on site only by the tank manufacturer who shall follow a written repair and quality control procedure.

8.11 Lifting the tank

Use all lifting positions provided or marked on the tank (see figure 1). Lift and locate the tanks on the backfill bed in their correct positions and at their required level.

8.12 Level test

Ensure that the top of the tank is at the correct inclination and at the design depth relative to the site datum (reference) level. Correct if required by adjusting the backfill material but maintaining the minimum bed stipulated in **8.4**.



1 Backfill

Figure 3. Installation depth and distance to excavation side, side view

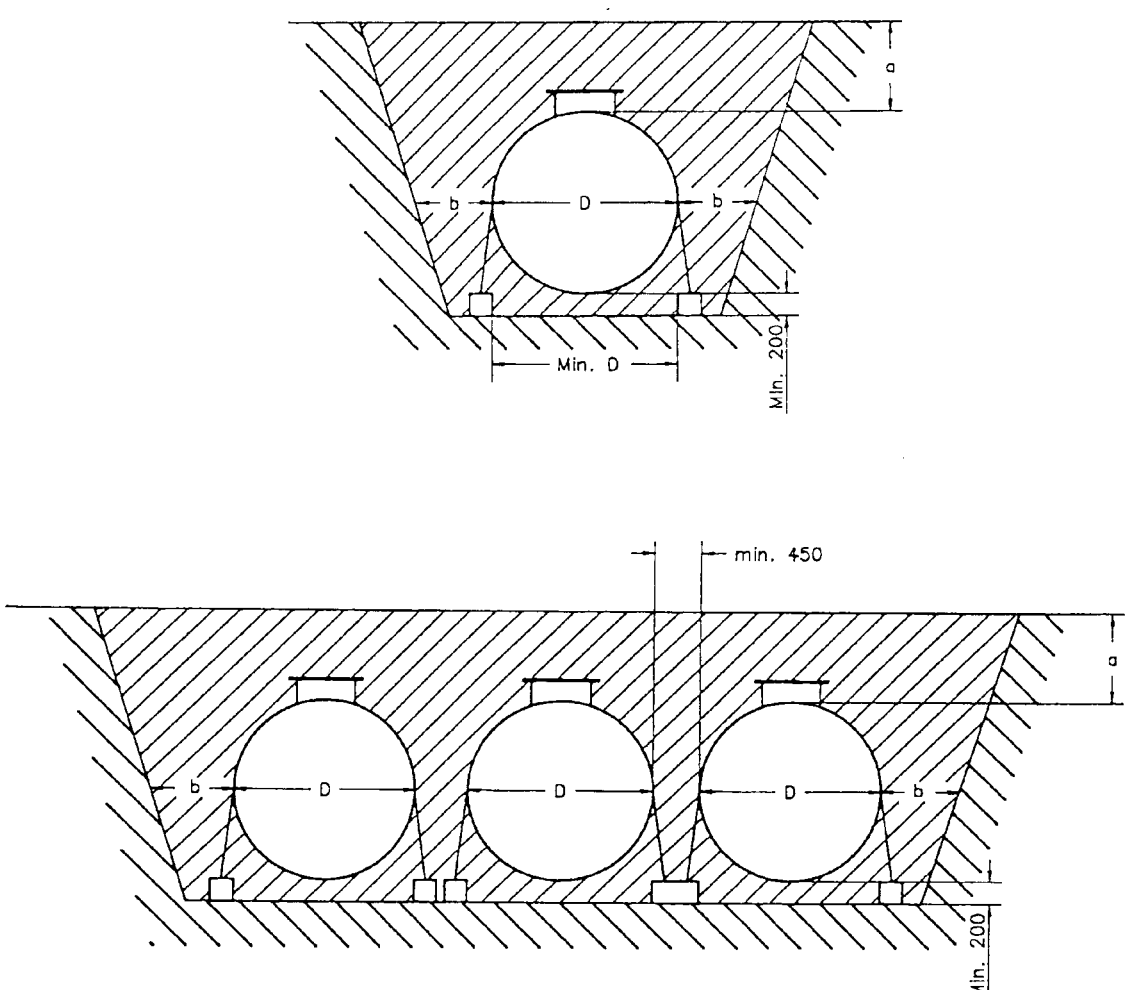


Figure 4. Tank anchoring

8.13 Tank diameter

Before backfill the vertical diameter of the tank shall be measured at a point close to the longitudinal centre. This may be carried out at a manway or fitting when available, otherwise entry into the tank is necessary. Any other required reference dimensions may also be taken.

8.14 Anchoring

When anchoring is used position the holding down straps as directed by the tank manufacturer tightening them evenly on both sides of the tanks to prevent rotation and to give a snug fit on the bed to prevent any tank movement.

8.15 Backfill materials

The recommended backfill materials are gravel or stone crushings. Ease of proper placement and the achievement of good tank support with minimal compactive effort make these materials ideal tank backfill. In some geographic areas, however, gravel materials may not be available and sand may then be used as an alternative backfill material. Use of sand backfill will require additional skill and care on the part of the installer and considerably more effort in backfill placement and compaction. Suitable backfill material descriptions are given in annex A, clause **A.1**.

The gravel backfill material shall be placed evenly around all sides of the tank and compacted using non-metallic probes. Metallic probes shall not be used unless to the manufacturer's recommended design. Backfill shall be properly compacted, particularly underneath the tank sides and end caps. If sand is used, it shall be mechanically compacted at 300 mm intervals to a minim of 95 % standard proctor density. This process shall be continued until the backfill material has been raised to the level of the manway neck. More detailed backfilling procedures are given in annex B, clause **B.2** for gravel materials and clause **B.3** for sand.

If the water level in the excavation cannot be kept below the tank base level, ballasting of the tank with liquid may be carried out. The liquid level in the tank shall not exceed the level of the water level in the excavation.

NOTE. Tanks installed without full top cover, even if strapped down may float if the excavation becomes flooded. Therefore, if there is an interruption in the backfilling operation such that a tank remains without full top cover, it should be ballasted with liquid to prevent flotation.

8.16 Pressure test

A pressure test shall be applied to the tank to ensure its soundness and that no damage has occurred during transport, handling and installation.

Recognized methods of testing include:

a) a hydraulic test at 10 kPa for 60 min;

b) filling the tank with water and applying air pressure at 10 kPa for 60 min;

c) air pressure at 35 kPa for a minimum of 60 min.

The pressure reading shall be taken from a gauge sited on the tank top. The gauge shall be of such a size that losses of pressure can be readily indicated. A pressure relief valve set to 40 kPa shall be provided.

NOTE. It is recommended that a calibrated gauge with a 150 mm dial size and a maximum pressure reading of 50 kPa is used. Alternatively a water manometer may be used with a diameter of 10 mm and graduations marked in centimetres.

8.17 Dimensional tests

Remeasure the tank's vertical diameter when the tank is backfilled to grade to ensure that it has not changed by + 2,0 % or −1,0 %; variation outside this figure indicates incorrect backfilling. Horizontal deflection may also be measured.

8.18 Completion of installation

When the testing has been satisfactorily concluded fit the access chamber, if used (see annex A, clause **A.4**) to the tank and commence the connection of ancillary piping. Test the piping in the normal way and continue backfilling to provide a minimum thickness of backfill material of 500 mm above the tank body.

If the pipework pressure exceeds 35 kPa then the pipework shall be isolated from the tank.

8.19 Completion of top cover and surfaces

Tanks subject to traffic load shall have a minimum cover of 850 mm backfill plus 150 mm of asphalt or paving slabs laid on 50 mm of sand, or 500 mm backfill and 150 mm reinforced concrete slab. Asphalt and concrete slabs shall extend a minimum 300 mm beyond the tank in all directions.

Tanks not subject to a traffic load require a minimum of 500 mm of backfill.

Annex A (normative)

Installation components requirements

A.1 Backfill material

The material shall be clean and graded and free-flowing, free from ice, snow, clay, organic materials and completely free from oversize heavy objects that may damage the tank if dropped from a loading skip. The minimum bulk density shall be 1 500 kg/m^3.

Gravel

The backfill material shall not have more than 3 % passing a 2,4 mm screen. The material shall be well-rounded pea gravel with a mix of particle size not less than 3 mm and not more than 20 mm.

Stone crushings

Stone crushings with particle size of not less than 3 mm nor more than 16 mm, of which not more than 3 % shall pass a 2,4 mm screen.

Sand

Sand shall be well graded and shall have less than 8 % passing a 75 μm screen with the largest particle size less than 3 mm.

Sand/gravel mixtures

Mixtures of sand and gravel may be used provided that the constituent parts comply with those for gravel, stone crushings and sand described above.

Sand gravel mixtures shall be compacted in accordance with the details given in clause **B.3**.

A.2 Anchorage points

Anchorage points shall be constructed from 20 mm diameter steel bars bent to shape and located with the feet under the base reinforcement. They shall not be located underneath the edge of the tank nor within 150 mm of the edge of the base.

All exposed metal parts shall be hot dip galvanized and site coated or protected against corrosion by an alternative appropriate method.

Alternatively, the anchor straps can be taken under or through the base, emerging on the top face at the anchor point positions; in such cases the straps shall be vertical.

A.3 Anchor straps

Anchor straps shall be manufactured from GRP, nylon or similar non-metallic material offering resistance to the environment and adequate restraint to resist the buoyancy which would be generated by an empty tank fully surrounded by backfill.

The straps are to be located in the positions shown on the tank by the manufacturer.

A.4 Access chamber

Any access chamber, if provided, shall exclude ground water, retain fuel spillage and allow free access to the manway lid.

It shall not transfer traffic loads from the surface to the tank.

The cover from the access chamber shall be supported from the traffic slab and sealed to prevent the ingress of surface water into the chamber.

Annex B (informative)

Installation recommendations

B.1 Concrete base-construction

Where a base is required, it should consist of a minimum of 200 mm reinforced concrete comprising two layers of light reinforced mesh (200 × 200 pitch, 7 mm diameter wires, 3,02 kg/m^2), of a minimum strength of 21 N/mm^2 after 28 days, to be laid level on 50 mm sand blinding. Where ground conditions require, sulfate resisting concrete should be used. The base slab should extend a minimum of 300 mm beyond the sides of the tank and should at least be equal to the overall length of the tank.

B.2 Installation procedure for pea shingle or crushed stone backfills (gravel)

Bed

Provide a minimum of 200 mm of gravel backfill bedding over excavation bottom or concrete slab. Place tanks on bed and anchor.

Backfilling

Use same materials as bedding. Place first 300 mm lift evenly around tanks. Backfill must be pushed completely beneath tank bottom between ribs and under end caps to provide necessary support. A long handled probe can be used to penetrate backfill and push it between all ribs and at 3 to 5 points under end caps. Place another 300 mm lift of backfill evenly around tanks. Repeat the probing of backfill.

After completion of second lift, backfill can be brought to top of tanks or grade without additional handwork. (Compaction may be required for slab support).

Note that in tight areas in straight-walled excavations, it will be difficult to properly probe the gravel without entering the excavation. Use of a special curved probe may be necessary.

The following procedure is the most effective for the curved probe.

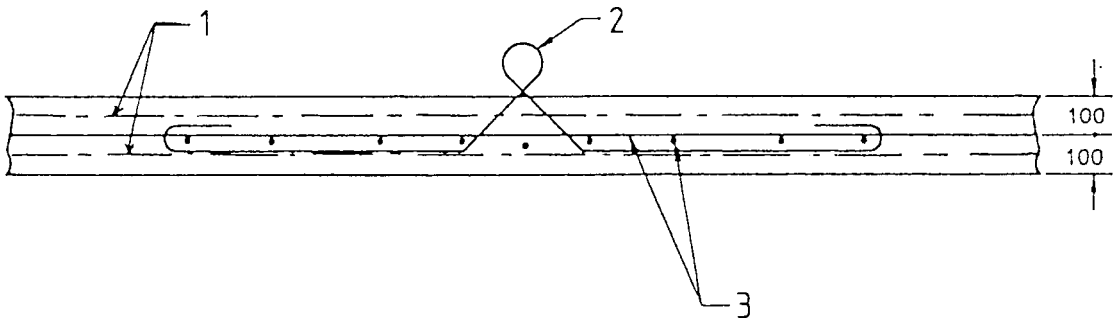
a) After setting the tank on the gravel bed, probe the entire tank bottom and around the end caps.

b) Place the first 300 mm lift of backfill.

c) Probe the entire tank bottom and end caps again.

d) Place the second 300 mm lift of backfill.

e) Switch to straight probe section and probe tank again.



Concrete C 25

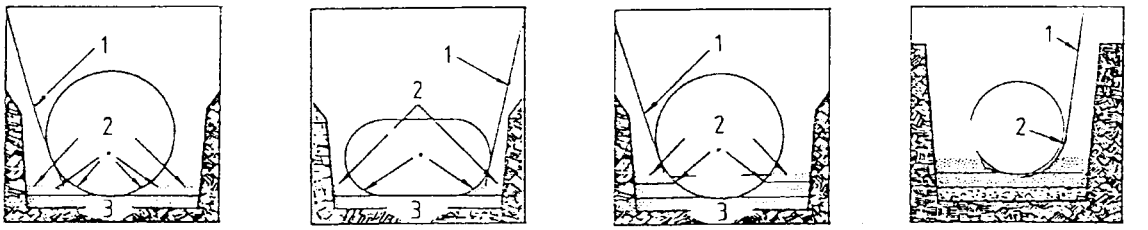
Deformed bars KS 40

1 Mesh layers

2 Lug, diameter 20 mm, hot dip galvanized and site coated

3 Deformed bars, 12 mm diameter, 150 mm spacing both ways

Figure B.1 Concrete base



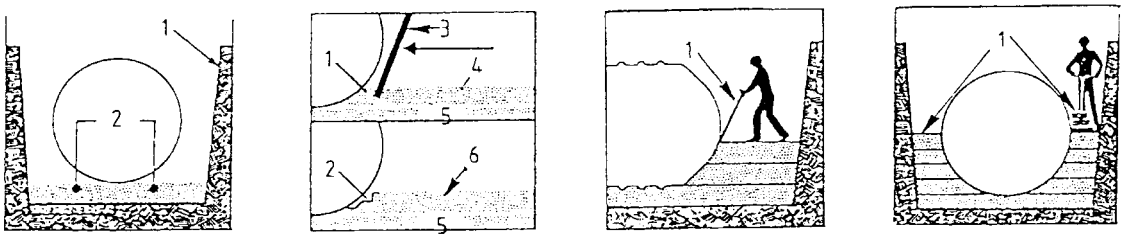
1 Long-handled probe
2 First 300 mm lift of backfill
3 200 mm bed

1 Long-handled probe
2 First 300 mm lift of backfill
3 200 mm bed

1 Long-handled probe
2 Second 300 mm lift of backfill
3 200 mm bed

1 Long-handled probe
2 Curved probed section

Figure B.2 Installation procedure using gravel backfill



1 Slope determined by soil stability
2 Compacted bedding

1 RIGHT Tank firmly supported
2 WRONG Poor tank support
3 Board to push backfill
4 First lift of backfill
5 Bed
6 Backfill

1 Use board to manually compact sand under end cap

1 Mechanically compacted sand in lifts

Figure B.3 Installation procedures using mechanically compacted sand backfill

B.3 Installation procedures using mechanically compacted sand backfill

NOTE 1. The mechanically compacted sand procedure requires the tank installers to enter the tank excavation to compact the sand. Appropriate safety procedures should be taken (shore or cut back the excavation walls) whenever entering tank excavation to protect against collapsing excavation walls.

NOTE 2. Because of the need to achieve high levels of compaction, extreme care should be taken to monitor the installation to confirm and measure proper compaction.

Bed

Provide a minimum 300 mm level backfill bed over the excavation bottom or concrete slab.

The bedding should be smooth and level.

Compact the sand bed for the entire length and width of the tank. Place the tanks in the excavation on the compacted backfill bed.

Backfilling

Use the same materials as the bedding for the backfill. Place the first 300 mm lift evenly around the tanks.

Hand shovel the sand between the ribs and under the end caps. Use a 50 mm 100 mm board to push and compact the sand under the tank between the ribs and under the end caps. It is very important to ensure good manual compaction under the end cap and tank bottom. Considerable manual effort is required to achieve good placement and compaction. The first two lifts will require this manual probing and compaction.

After compacting the first 300 mm layer, more sand can be added in 300 mm lifts. At each 300 mm layer of sand, the sand should be well tamped with a mechanical plate vibrator (operation at 2 000 to 3 000 vibrations per min). Ideal sand compaction normally occurs when the moisture ranges from 10 % to 18 % by mass. Compact to a minimum of 95 % standard Proctor density.

Backfilling over tanks

Place sand backfill over the tank top. It is recommended that the sand backfill be compacted in 300 mm lifts to a minimum of 95 % standard Proctor density to provide support for the traffic pad and for the product lines in the tank area.

B.4 Classification of ground conditions

See table B.1.

B.5 Sleepers — Construction

See figure B.4.

B.6 Concrete bases for tank anchoring

See figure B.5.

Table B.1 Classification of ground and installation conditions

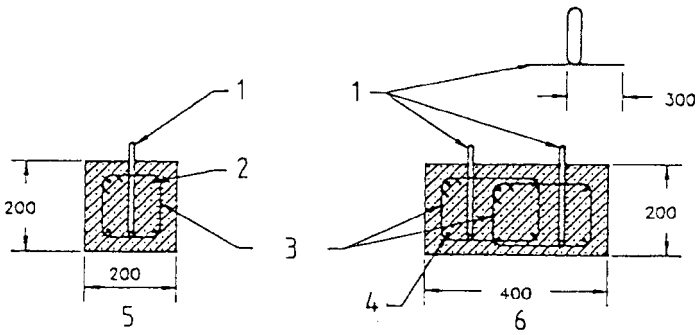
Installation categories	**I**	**II**	**III**	**IV**	**V**
NATIVE SOIL					
Soil description*	very good	good	fair	poor	very poor
Minimum cohesion (kPa)	36	18	12	6	< 6
Minimum bearing capacity (kPa)	168	45	24	12	< 12
Minimum soil modulus (MPa)	2,8	1,7	1,4	0,7	< 0,7
Minimum SPT blow counts**	18	12	5	2	< 2
CLASS 1 TANK EXCAVATION					
Pit walls	very stable	stable	unstable	unstable	unstable
Minimum tank to tank (mm)	450	450	450	450	450
Minimum tank to pit wall (mm)	450	450	0,5*D*	0,5*D*	450
Geotextile required	no	no	no	yes	yes
Permanent sheet piles required	no	no	no	no	yes
CLASS 2 TANK EXCAVATION					
Pit walls	very stable	stable	unstable	unstable	unstable
Minimum tank to tank (mm)	450	450	450	450	450
Minimum tank to pit wall (mm)	450	0,5*D*	0,5*D*	0,5*D*	450
Geotextile required	no	no	no	yes	yes
Permanent sheet piles required	no	no	no	no	yes

* More detailed soil description:

Very good: very stiff clays, dense sands, rock;
Good: stiff clays and medium to dense sands;
Fair: soft to medium clays or loose granular soils;
Poor: very soft to soft clays and very loose to loose sands;
Very poor: weaker than IV, typically very fluid.

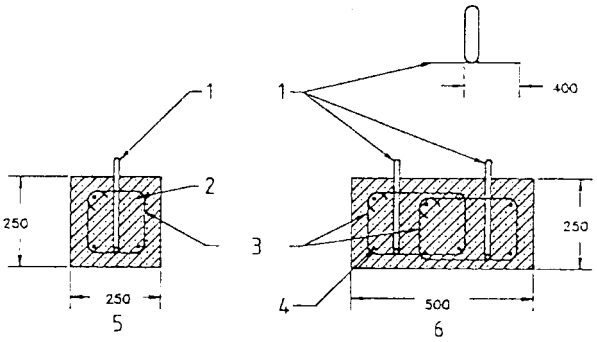
** SPT: standard penetration test.

Alternative 1
Diameter 1600



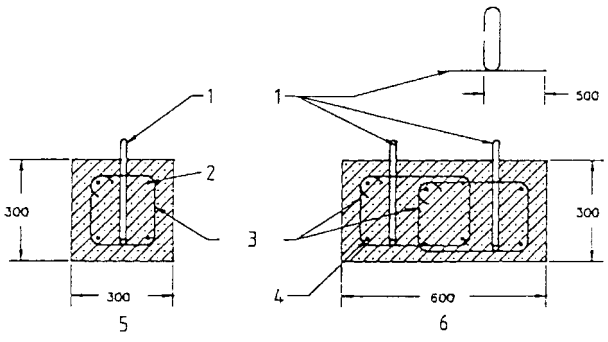
1 Lug, diameter 12, hot dip galvanized and site coated
2 Deformed bars, diameter 10, 4 pieces
3 Round steel, diameter 6, centre to centre spacing 100
4 Deformed bars, diameter 10, 8 pieces
5 Single
6 Double

Alternative 2
Diameter 2000



1 Lug, diameter 16, hot dip galvanized and site coated
2 Deformed bars, diameter 12, 4 pieces
3 Round steel, diameter 8, centre to centre spacing 125
4 Deformed bars, diameter 12, 8 pieces
5 Single
6 Double

Alternative 3
Diameter 2000



1 Lug, diameter 20, hot dip galvanized and site coated
2 Deformed bars, diameter 16, 8 pieces
3 Round steel, diameter 8, centre to centre spacing 150
4 Deformed bars, diameter 16, 8 pieces
5 Single
6 Double

Concrete C 25 Concrete cover 30 mm Round steel St 37 Deformed bars KS 40

Dimensions in mm

Figure B.4 Sleepers

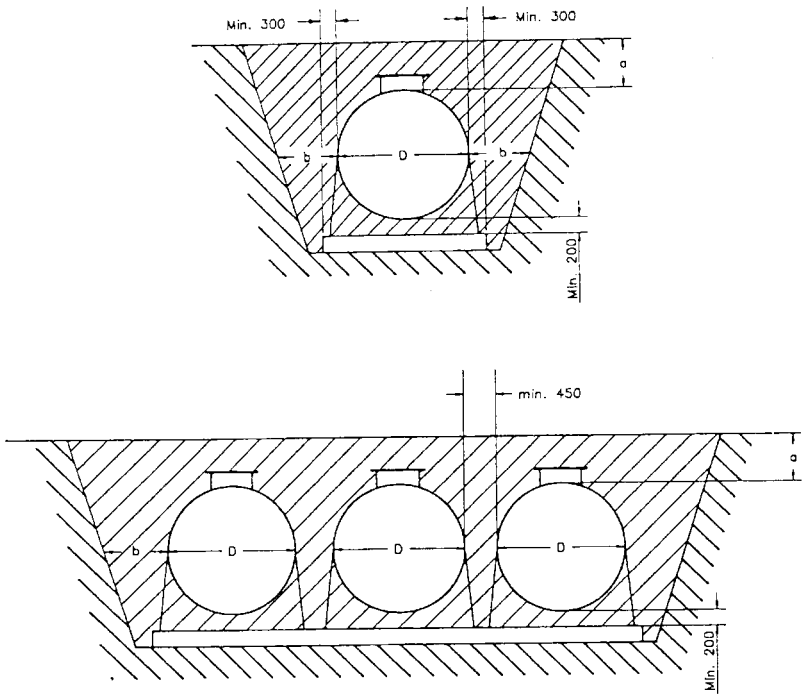


Figure B.5 Concrete bases for tank anchorage

Annex C (informative)

Installation checklist

Read the preceding installation instructions, then fill in the information below. As the tank installation progresses, fill in each applicable inspection, testing and installation checklist item below, initialling the item as its conditions are satisfactorily met (refer to installation instructions for details).

When the checklist is complete one copy should be given to the customer, one to the manufacturer and one to the Regulatory Body or the Certification Body.

Site owner:	.....	Installation date(s):	
Site address:	.....	.....	
Installation contractor:	.....	.....	
Installation supervisor:	.....	.....	

Manufacturer		Manufact. no.		Year of manufact.			
Tank type	A / B	Tank class	1 / 2	Tank grade	1 / 2		

PRIOR TO INSTALLATION		Verified by:
A) Visual inspection:	No evidence of holes, cracks, deep grazings/scratches and delamination.	.....
B) Leaktightness testing:	No drop of pressure and no soap bubbles at..... kPa within ..... min.	.....
C) Backfill material	1 Peak shingle, grain size..... to..... mm.	.....
	2 Crushed stone, grain size ..... to ..... mm.	.....
	3 Other material:	.....
D) Excavation size:	Excavation dimensions are correct per installation document form for stable/unstable walls.	.....
E) Excavation conditions:	1 Dry excavation. Ground water elevation not anticipated to reach tank and area not subject to flooding.	.....
	2 Wet excavation. Ground water elevation expected to reach tank or area subject to flooding.	.....
F) Traffic load:	1 Traffic loading anticipated (requires deep burial).	.....
	2 No traffic loading (allows normal burial).	.....

DURING INSTALLATION:		Verified by:
A) Bedding:	Backfill material bed is level and ..... mm at minimum over native soil or slab prior to setting tank in place.	.....
B) Wall spacing:	Tank set in place with correct spacing from wall and other tanks.	.....
C) Wet excavation anchoring:	Deadmen or base and holding down straps positioned and secured.	.....
D) Backfilling:	Backfill material tamped and compacted to fill all voids around tank.	.....
E) Wet excavation installation:	Tank properly ballasted during backfill.	.....
F) State of tank burial:	Tank buried at proper depth to conform to wet or dry hold, traffic or no traffic conditions.	.....

INSTALLATION TESTING		Verified by:
A) Inside inspection (tanks with manways):	1 No backfill voids (especially around bottom third tank) after the first 600 mm of backfill by gently tapping a blunt wooden object against the tank wall and listening for hollow sounding areas.	.....
	2 No signs (cracks, holes, delaminations) of physical damage and of indentations (partial deformations) by visual inspection	.....
B) Pressure test:	No drop of pressure at ..... kPa within ..... min using a	
	.....	.....
C) Deflection test:	Measurement of the vertical interior diameter as close to the centre as possible inside the tank/through an opening at the vertex line of the tank:	
	– on the bedding prior to backfilling D_1 = ...mm;	
	– after backfilling to subgrade D_2 = ... mm;	
	calculating a vertical deflection of $D_2 - D_1$ = ...mm;	

REMARKS

1. Measurement of horizontal deflection .....

2. .....

.....

_____ _____

Place and date Installation supervisor

Customer:

Manufacturer:

Regulatory body/Certification body:

Enclosed:

blank

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