

Tank Base Surface Treatment

Procedure

This Standard replaces and cancels its previous revision.

The CONTEC - Authoring Subcommittee provides guidance on the interpretation of this Standard when questions arise regarding its contents. The Department of PETROBRAS that uses this Standard is responsible for adopting and applying the sections, subsections and enumerates thereof.

Technical Requirement: A provision established as the most adequate and which shall be used strictly in accordance with this Standard. If a decision is taken not to follow the requirement ("non-conformity" to this Standard) it shall be based on well-founded economic and management reasons, and be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by imperative nature.

Recommended Practice: A provision that may be adopted under the conditions of this Standard, but which admits (and draws attention to) the possibility of there being a more adequate alternative (not written in this Standard) to the particular application. The alternative adopted shall be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by verbs of a nonmandatory nature. It is indicated by the expression: **[Recommended Practice]**.

Copies of the registered "non-conformities" to this Standard that may contribute to the improvement thereof shall be submitted to the CONTEC - Authoring Subcommittee.

Proposed revisions to this Standard shall be submitted to the CONTEC - Authoring Subcommittee, indicating the alphanumeric identification and revision of the Standard, the section, subsection and enumerate to be revised, the proposed text, and technical/economic justification for revision. The proposals are evaluated during the work for alteration of this Standard.

"This Standard is exclusive property of Petróleo Brasileiro S. A. - PETROBRAS, internal application and PETROBRAS Subsidiaries and shall be used by its suppliers of goods and services under contracts or similar under the conditions established in Bidding, Contract, Agreement or similar.

The use of this Standard by other companies / organizations / government agencies and individuals is the sole responsibility of the users.."

CONTEC

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Introduction

PETROBRAS Technical Standards are prepared by Working Groups - WG (consisting specialized of Technical Collaborators from Company and its Subsidiaries), are commented by Company Units and its Subsidiaries, are approved by the Authoring Subcommittees - SCs (consisting of technicians from the same specialty, representing the various Company Units and its Subsidiaries), and ratified by the Executive Nucleus (consisting of representatives of the Company Units and its Subsidiaries). A PETROBRAS Technical Standard is subject to revision at any time by its Authoring Subcommittee and shall be reviewed every 5 years to be revalidated, revised or cancelled. PETROBRAS Technical Standards are prepared in accordance with PETROBRAS Technical Standard N-1. For complete information about PETROBRAS Technical Standards see PETROBRAS Technical Standards Catalog.

Foreword

This Standard is the English version (issued in 04/2014) of PETROBRAS N-1822 REV. C 12/2013, including its Amendment - 04/2014. In case of doubt, the Portuguese version, which is the valid document for all intents and purposes, shall be used.

1 Scope

1.1 This Standard establishes the conditions required for surface treatment of steel tank seating base for storage of oil and its products.

1.2 The base surface treatment is intended to protect the tank bottom plates against the soil moisture, establish a leak alarm system, and to ensure proper conditions of support.

1.3 In case of storage tanks for high temperature products which may affect the foundation elements, the base surface treatment is intended to provide thermal protection to those elements.

1.4 This Standard applies to services started as of its date of issuance.

1.5 This Standard contains only Technical Requirements.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies.

PETROBRAS [N-38](#) - Criterion for Design of Drainage, Segregation, Flow Preliminary Treatment of Liquid Effluents of Onshore Installations;

PETROBRAS [N-1618](#) - Thermal Insulation Material;

DNIT [031/2006-ES](#) - Pavimentos Flexíveis - Concreto Asfáltico;

DNIT [144/2010-ES](#) - Pavimentação Asfáltica - Imprimação com Ligante Asfáltico;

DNIT [146/2010-ES](#) - Pavimentação - Tratamento Superficial Simples com Ligante Asfáltico Convencional;

DNIT [152/2010-ES](#) - Pavimentação - Macadame Hidráulico;

DNIT [153/2010-ES](#) - Pavimentação Asfáltica- Pré-Misturado a Frio com Emulsão Catiônica Convencional;

ABNT [NBR 17505-2](#) - Armazenamento de Líquidos Inflamáveis e Combustíveis Parte 2: Armazenamento em Tanques, em Vasos e em Recipientes Portáteis com Capacidade Superior a 3 000 L;

API [STD 650:2013](#) - Welded Tanks for Oil Storage Eleventh.

NOTE For documents referred in this Standard and for which only the Portuguese version is available, the PETROBRAS department that uses this Standard should be consulted for any information required for the specific application.

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1

draining base

layer of granular material intended to provide formation to the tank base surface, allowing the draining from underground water, as well as the stabilization of the land, so as to allow the handling of materials and equipment during construction and assembly of the tank.

3.2

covering

layer of material meant for waterproofing the tank base, so as to protect the tank bottom plates against the soil aggressiveness.

4 General Conditions

The surface treatment of storage tank bases shall be designed considering the product temperature and foundation type of the tank.

4.1 Bases of Tanks Storing Non-Heated Products

On base of tanks storing non-heated products, which temperature in lower face of the tank bottom plate is below 70 °C, one of the solutions described in 4.1.1 to 4.1.4 shall be adopted.

4.1.1 Tanks in Direct Foundation with Reinforced Concrete Ring Under the Shell

The solution shown on Figure A.1 of Annex A shall be adopted.

4.1.2 Tanks in Direct Foundation with Reinforced Concrete Slab

The solution shown on Figure A.2 of Annex A shall be adopted.

4.1.3 Tanks with Pile Foundation with Reinforced Concrete Ring Under the Shell

The solution shown on Figure A.1 of Annex A shall be adopted.

4.1.4 Tanks in Pile Cap Foundation with Reinforced Concrete Slab

No specific treatment is required.

4.2 Bases of Tanks Storing Heated Products

On base of tanks storing heated products, which temperature in lower face of the tank bottom plate is 70 °C or above, one of the solutions described in items 4.2.1 to 4.2.4 shall be adopted.

4.2.1 Tanks in Direct Foundation with Reinforced Concrete Ring Under the Shell

The solution shown on Figure A.3 of Annex A shall be adopted.

4.2.2 Tanks in Direct Foundation with Reinforced Concrete Slab

The solution shown on Figure A.4 of Annex A shall be adopted.

4.2.3 Tanks with Pile Foundation with Reinforced Concrete Ring under the Shell

The solution shown on Figure A.3 of Annex A shall be adopted.

4.2.4 Tanks in Pile Cap Foundation with Reinforced Concrete Slab

The solution shown on Figure A.5 of Annex A shall be adopted.

4.3 Installation of Tank Bottom Accessories

For tank bottom accessories which installation interferes with surface treatment of tank, reinforced concrete pits shall be built, with details and sizes defined in the design. Reinforced concrete pits for tank bottom accessories shall be waterproof internally, if the cathodic protection of tank bottom requires so.

5 Specific Conditions

The elements composing the treatment of tank bases shall meet the requirements of API [STD 650:2013](#), in addition to the conditions below.

5.1 Draining Base

5.1.1 The draining base shall be applied on soil, with maximum permeability of 10^{-6} cm/s relating to water at 20 °C, as provided for in ABNT [NBR 17505-2](#), or on a geosynthetic system made of a High Density Polyethylene (PEAD) waterproof geomembrane and a non-woven geotextile mat to protect the geomembrane during compaction of draining base. The geomembrane shall be welded on a PEAD membrane built in the concrete ring of shell foundation.

5.1.2 For tanks in pile cap foundation with reinforced concrete slab, due to the huge stiffness of this structural system, which implies the lack of through-thickness cracks on the slab and, therefore, ensures its tightness, there is no need for soil treatment or use of waterproof geosynthetic in tank plot, regardless the permeability of local soil.

5.1.3 The material of draining base shall be selected among the following options:

- a) crushed stone ($d_{\max} = 25$ mm) + sand;
- b) washed coarse gravel ($d_{\max} = 25$ mm) + sand;
- c) clean coarse sand.

5.1.4 In order to establish the leak alarm system, the draining base shall be connected to the outer side of ring through drain pipes, enveloped in non-woven geotextile, with maximum spacing of 15 m.

5.1.5 The draining base shall be performed on the regularized and compacted land, with slopes and other characteristics defined in design. The compaction shall be executed with plain rollers or with a hand-operated vibrating plate.

5.1.6 The use of crushed stone and sand, or washed coarse gravel and sand, shall be performed according to the provisions of DNIT [152/2010-ES](#), as hydraulic macadam.

5.2 Covering

One of the following options shall be adopted to compose the covering:

- a) bituminous coating;
- b) cement and sand mortar;
- c) plain concrete.

NOTE Bituminous coating shall be only applied on draining base made of crushed stone + sand or coarse gravel + sand.

5.2.1 Bituminous Coating

A priming layer shall be applied before the bituminous coating, according to provisions of DNIT [144/2010-ES](#). On the priming, one of the following covering types shall be applied:

- a) simple surface treatment, with reverse penetration (TSS), according to DNIT [146/2010-ES](#);
- b) bituminous concrete, according to the provisions contained in DNIT [031/2006-ES](#);
- c) pre-mixed while cold, following the provisions contained in DNIT [153/2010-ES](#).

5.2.2 Covering with Cement and Sand Mortar

A layer of cement and sand shall be applied according to the specifications and execution method indicated in design.

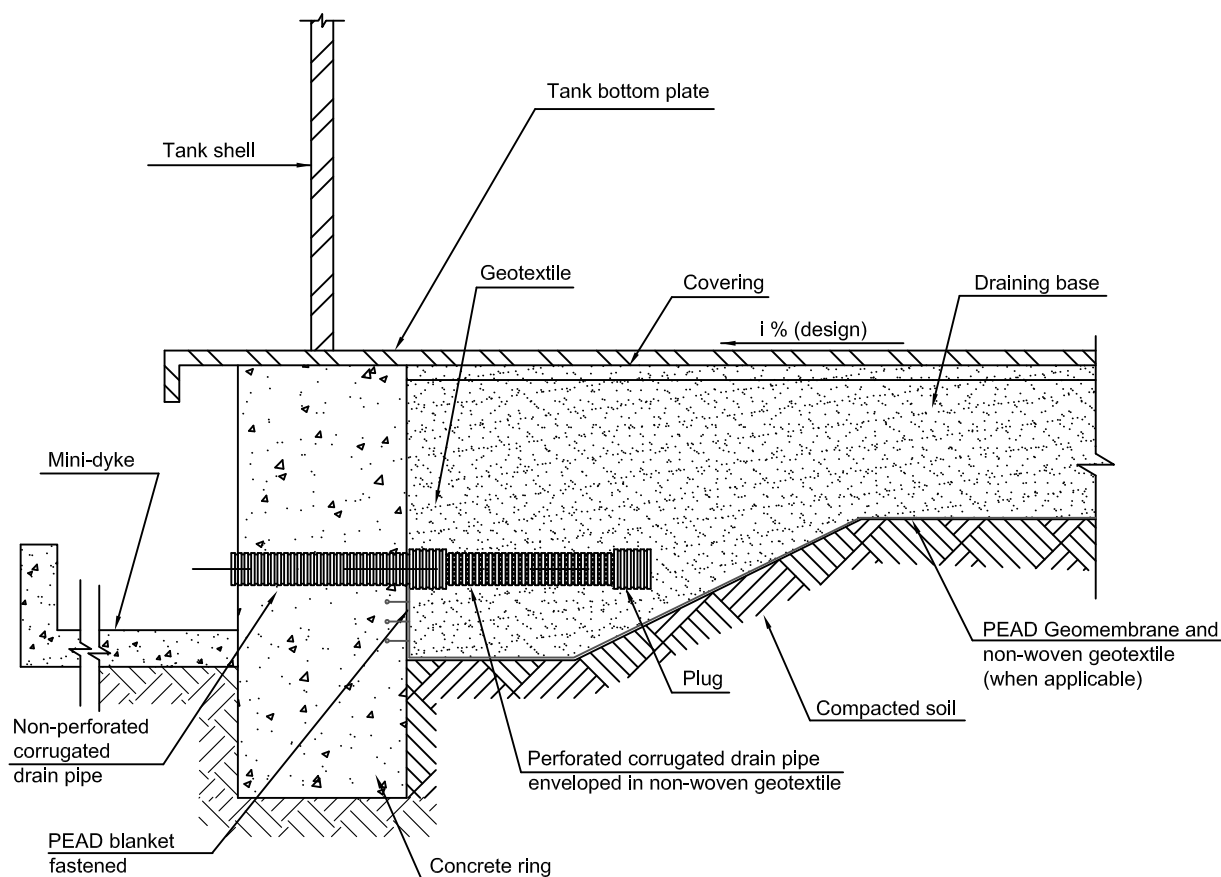
5.2.3 Covering with Plain Concrete

A layer of plain concrete shall be applied according to the specifications and execution method indicated in design.

5.3 Thermal Insulation

In cases of tank bases that store heated products, which temperature in lower face of tank bottom plate is 70 °C or above, a thermal insulation layer shall be applied, according to the provisions of standard PETROBRAS [N-1618](#).

Annex A - System for Base Surface Treatment of Tanks



NOTE 1 If the design provides fixed reference electrodes to measure the electric potential, they shall be installed before performing the surface treatment.

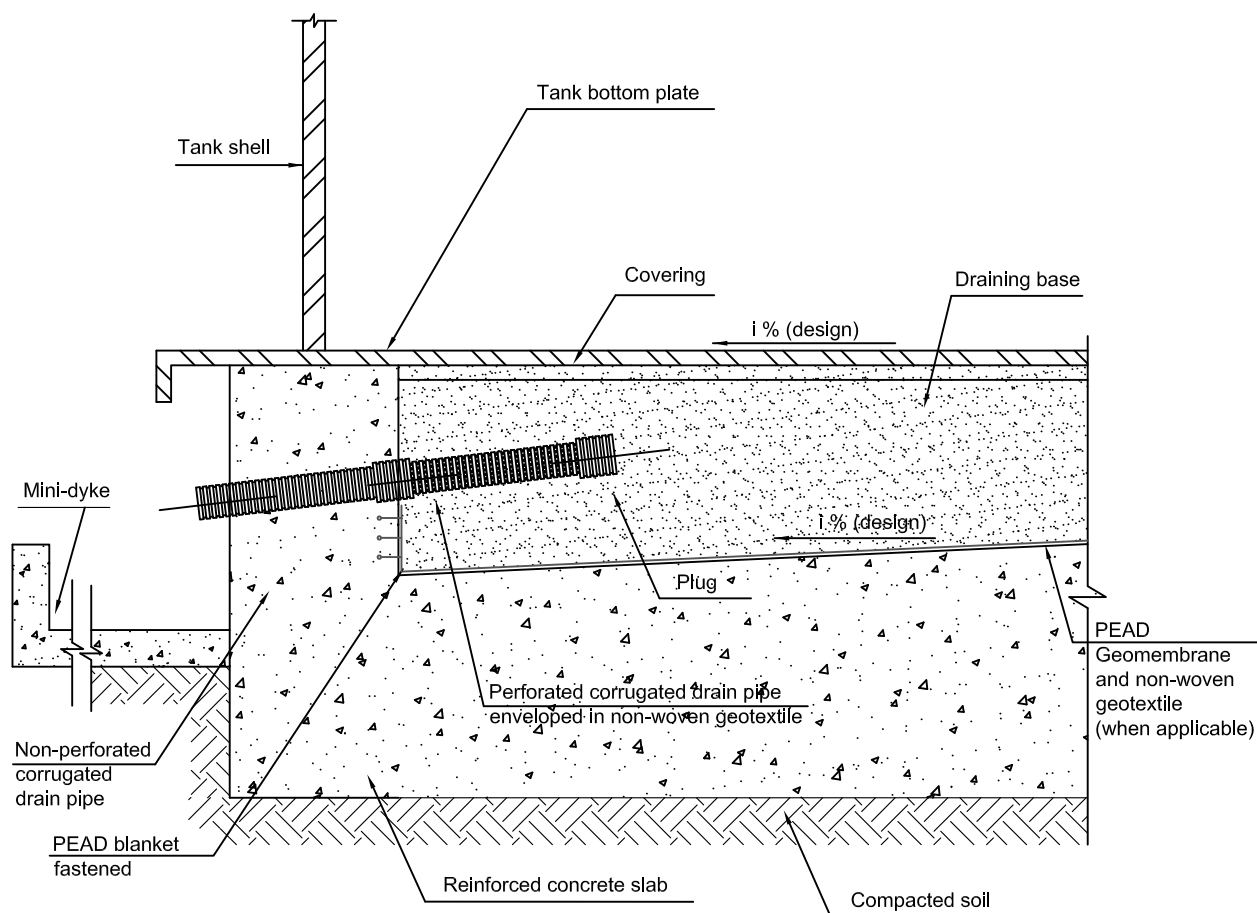
NOTE 2 The dimensions and characteristics of materials shall be defined in design.

NOTE 3 The mini-dyke shall be designed as per PETROBRAS [N-38](#).

NOTE 4 There shall be at least one drain per tank.

NOTE 5 The blanket under the draining base shall be properly fixed on the inner face of reinforced concrete slab.

Figure A.1 - System for Base Surface Treatment of Tanks Storing Non-Heated Products in Direct Foundation with Reinforced Concrete Ring under the Shell and Tanks Storing Heated Products in Direct Foundation with Reinforced Concrete Ring under the Shell



NOTE 1 If the design provides fixed reference electrodes to measure the electric potential, they shall be installed before performing the surface treatment.

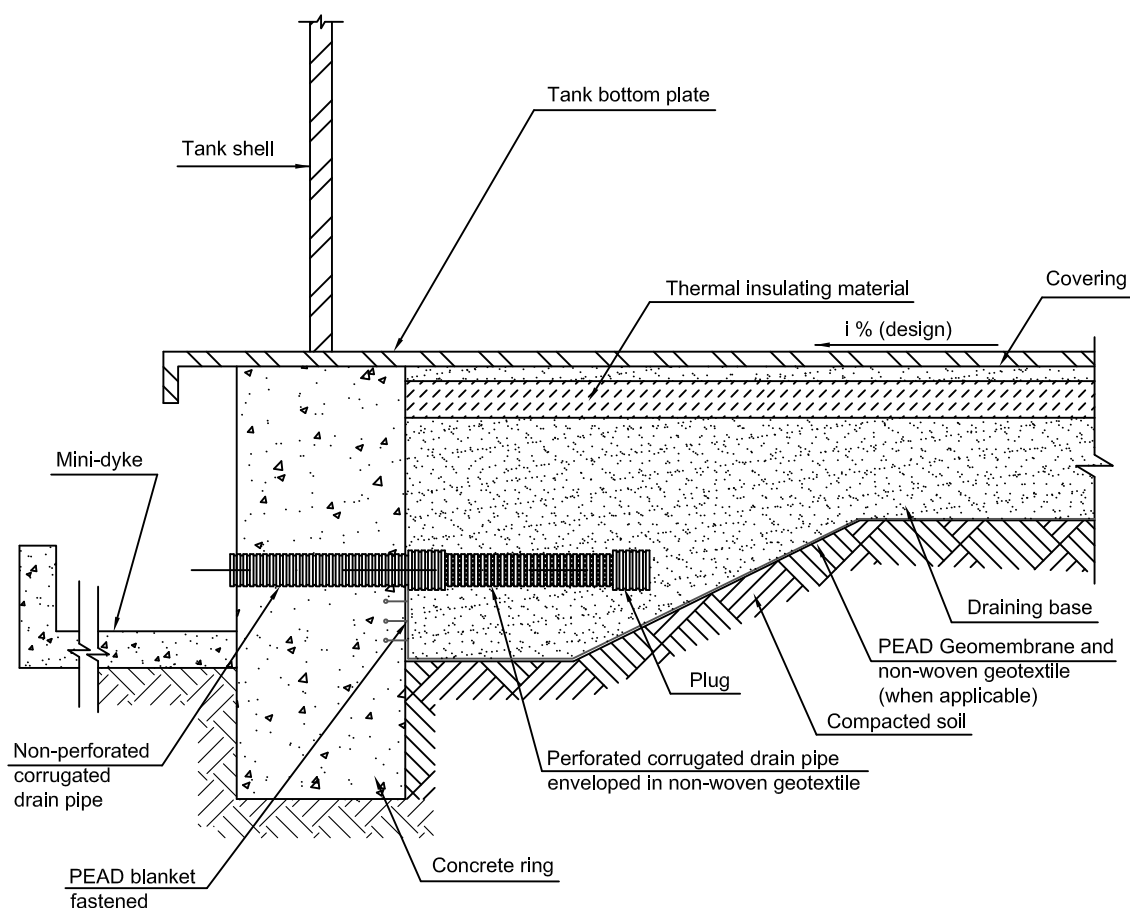
NOTE 2 The dimensions and characteristics of materials shall be defined in design.

NOTE 3 The mini-dyke shall be designed as per PETROBRAS [N-38](#).

NOTE 4 There shall be at least one drain per tank.

NOTE 5 The blanket under the draining base shall be properly fixed on the inner face of reinforced concrete slab.

Figure A.2 - System for Base Surface Treatment of Tanks Storing Heated Products in Direct Foundation with Reinforced Concrete Slab



NOTE 1 If the design provides fixed reference electrodes to measure the electric potential, they shall be installed before performing the surface treatment.

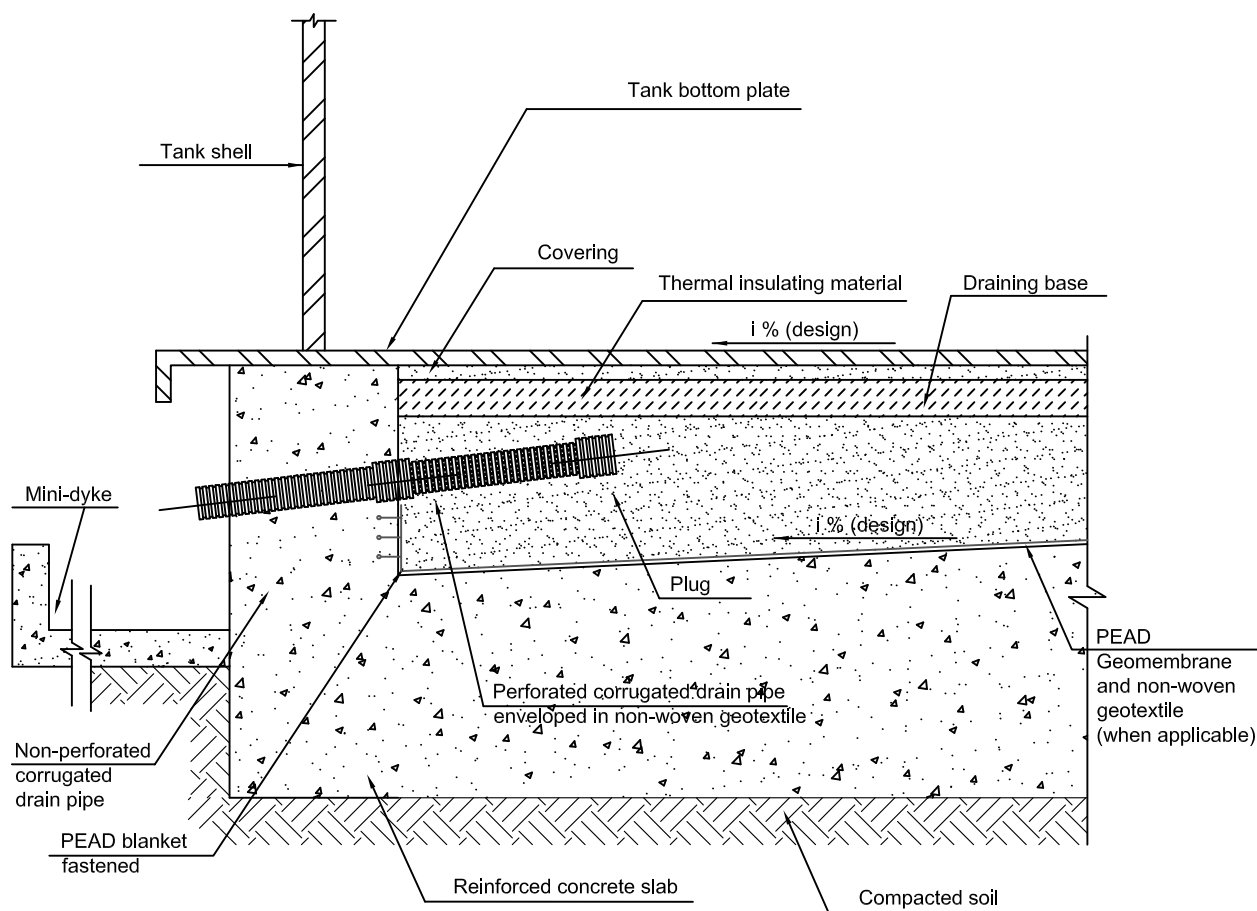
NOTE 2 The dimensions and characteristics of materials shall be defined in design.

NOTE 3 The mini-dyke shall be designed as per PETROBRAS N-38.

NOTE 4 There shall be at least one drain per tank.

NOTE 5 The blanket under the draining base shall be properly fixed on the inner face of reinforced concrete slab.

Figure A.3 - System for Base Surface Treatment of Tanks Storing Heated Products in Direct Foundation with Reinforced Concrete Ring under the Shell and Tanks with Pile Foundation in Reinforced Concrete Ring under the Shell



NOTE 1 If the design provides fixed reference electrodes to measure the electric potential, they shall be installed before performing the surface treatment.

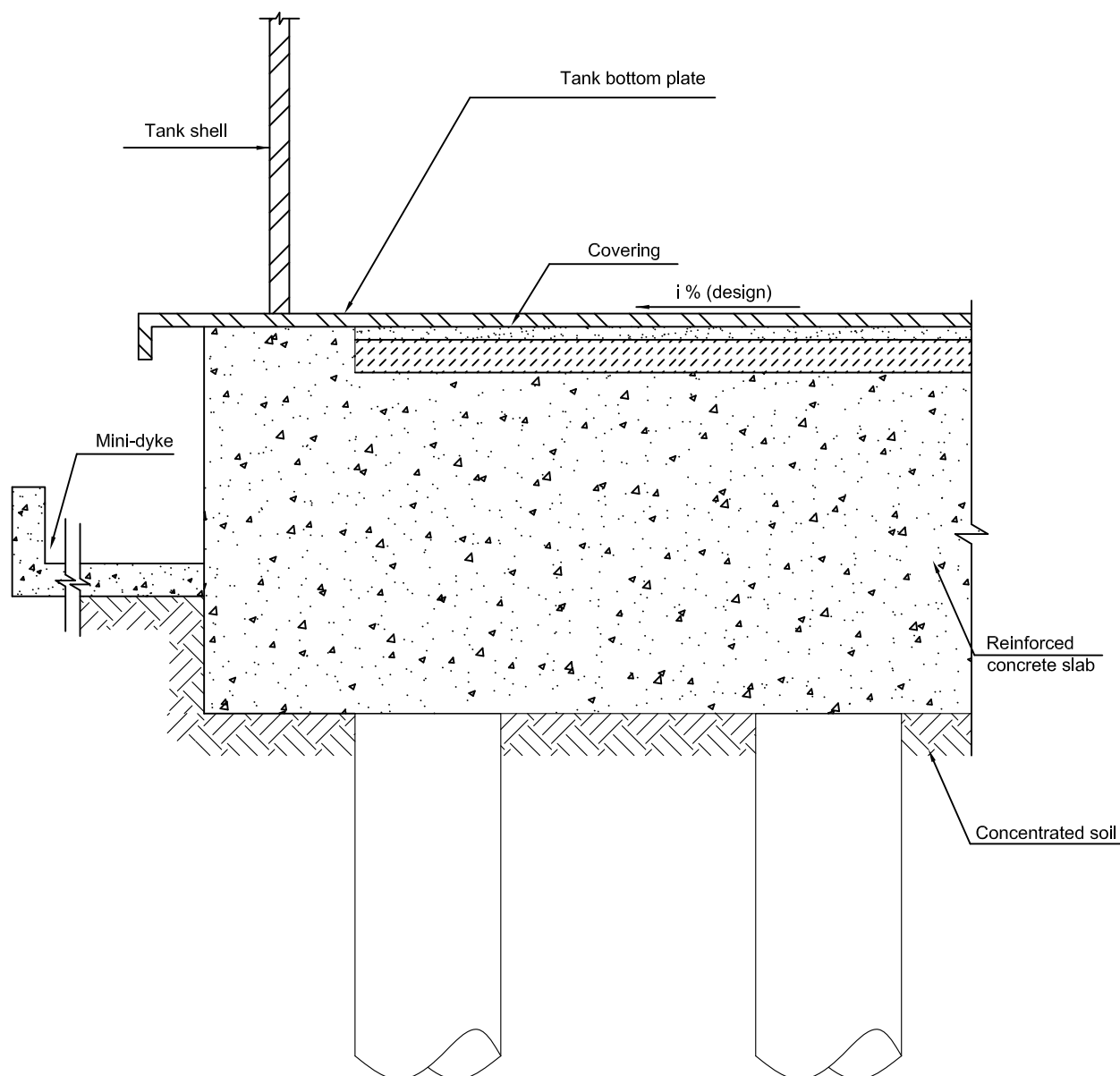
NOTE 2 The dimensions and characteristics of materials shall be defined in design.

NOTE 3 The mini-dyke shall be designed as per PETROBRAS N-38.

NOTE 4 There shall be at least one drain per tank.

NOTE 5 The blanket under the draining base shall be properly fixed on the inner face of reinforced concrete slab.

Figure A.4 - System for Base Surface Treatment of Tanks Storing Heated Products in Direct Foundation with Reinforced Concrete Slab



NOTE 1 If the design provides fixed reference electrodes to measure the electric potential, they shall be installed before performing the surface treatment.

NOTE 2 The dimensions and characteristics of materials shall be defined in design.

NOTE 3 The mini-dyke shall be designed as per PETROBRAS [N-38](#).

Figure A.4 - System for Base Surface Treatment of Tanks Storing Heated Products with Direct Foundation in Reinforced Concrete Slab

REV. A and B

There is no index of revisions

REV. C

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