

**CONTEC**Comissão de Normalização  
Técnica**SC-04**

Civil Construction

**Construction of Wastewater  
Systems In Industrial Units****1<sup>st</sup> Amendment**

This is the 1<sup>st</sup> Amendment to PETROBRAS N-1601 REV. C and it is used to alter the text of the Standard in the parts indicated below:

NOTE 1 The news pages with the performed amendments are placed in its corresponding positions.

NOTE 2 The amended pages, indicated the date of the amendment, are placed at the end of this standard, in chronological order, and shall not be used.

**CONTENTS OF THE 1<sup>st</sup> AMENDMENT- 12/2014****- Section 2:**

Exclusion of ABNT NBR 9061.

**- Subsection 4.3:**Exclusion of ABNT NBR 9061 and include of [NR-18](#).**- Subsection 8.1:**

Exclusion of ABNT NBR 9061.

# **Construction Of Wastewater Systems In Industrial Units**

## **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**

Comissão de Normalização  
Técnica

## **SC - 04**

Civil Construction

## **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 07/2014) of PETROBRAS N-1601 REV. C 10/2013. 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 exigible conditions which shall be followed for the construction of systems used for drainage and/or final destination of liquid effluents from onshore units belonging to PETROBRAS.

1.2 This Standard is applied to procedures started as of its date of issuance.

1.3 This Standard contains Technical Requirements and Recommended Practices.

## 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.

[NR-18](#) - Condições e Meio Ambiente de Trabalho na Indústria da Construção;

PETROBRAS [N-38](#) - Critérios para Projetos de Drenagem, Segregação, Escoamento e Tratamento Preliminar de Efluentes Líquidos de Instalações Terrestres;

PETROBRAS [N-133](#) - Soldagem;

PETROBRAS [N-1644](#) - Construção de Fundações e de Estruturas de Concreto Armado;

PETROBRAS [N-1674](#) - Projeto de Arranjo de Instalações Industriais Terrestres de Petróleo, Derivados, Gás Natural e Álcool;

PETROBRAS [N-2238](#) - Reparo de Revestimento Anticorrosivo Externo de Tubos;

ABNT [NBR 5645](#) - Tubo Cerâmico para Canalizações;

ABNT [NBR 5688](#) - Tubos e Conexões de PVC-U para Sistemas Prediais de Água Pluvial, Esgoto Sanitário e Ventilação - Requisitos;

ABNT [NBR 6118](#) - Projeto de Estruturas de Concreto - Procedimento;

ABNT [NBR 7229](#) - Projeto, Construção e Operação de Sistemas de Tanques Sépticos;

ABNT [NBR 7362-1](#) - Sistemas Enterrados para Condução de Esgoto - Parte 1: Requisitos para Tubos de PVC com Junta Elástica;

ABNT [NBR 7661](#) - Tubos de Ferro Fundido Centrifugado de Ponta e Bolsa, para Líquidos sob Pressão, com Junta não Elástica;

ABNT [NBR 7675](#) - Tubos e Conexões de Ferro Dúctil e Acessórios para Sistemas de Adução e Distribuição de Água - Requisitos;

ABNT [NBR 8160](#) - Sistemas Prediais de Esgoto Sanitário - Projeto e Execução;

ABNT [NBR 8682](#) - Revestimento de Argamassa de Cimento em Tubos de Ferro Fundido Dúctil - Especificação;

ABNT [NBR 8890](#) - Tubo de Concreto de Seção Circular para Águas Pluviais e Esgotos Sanitários - Requisitos e Métodos de Ensaios;

ABNT [NBR 10160](#) - Tampões e Grelhas de Ferro Fundido Dútil - Requisitos e Métodos de Ensaios;

ABNT [NBR 10845](#) - Tubo de Poliéster Reforçado com Fibras de Vidro, com Junta Elástica, para Esgoto Sanitário - Especificação;

ABNT [NBR 15221-1](#) - Tubos de Aço - Revestimento Anticorrosivo Externo - Parte 1: Polietileno em Três Camadas;

DNIT [015/2006 - ES](#) - Drenagem - Drenos Subterrâneos - Especificação de Serviço;

DNIT [016/2006 - ES](#) - Drenagem - Drenos Sub-Superficiais.

**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 Standard, the definitions indicated in PETROBRAS [N-38](#), [N-1674](#), ABNT [NBR 7229](#) and ABNT [NBR 8160](#) are adopted, complemented by 3.1 to 3.8.

#### **3.1**

##### **channels**

open and surface conduits of varying cross-section shapes used for containing and conveying permanent waters at high flow rates

#### **3.2**

##### **drainage ditches**

open structures of varying cross-section shapes used for surface flow of liquid effluents.

#### **3.3**

##### **ditches in Steps (Energy Dissipators)**

open conduits of varying cross-section shapes built in steps, which are used for reducing the flow of waters in areas involving large differences in level

#### **3.4**

##### **galleries**

closed and underground conduits of varying cross-section shapes, which are used for conveying waters at high flow rates

#### **3.5**

##### **ground water drainage system**

drainage elements for conveying percolation water, ground water and water springs comprised of permeable trenches or perforated pipes

#### **3.6**

##### **temporary storm water drainage system**

drainage system whose purpose is to protect cuts and fills against erosion caused by rainfall during earth-moving activities as well as to allow drainage during the civil construction and assembly phases

**3.7****temporary ground water drainage system**

system whose purpose is to convey effluents from the lowering of the water table and/or from water springs during excavation, earth-moving, and foundation construction activities

**3.8****sump**

dry well excavated into the ground and not watertight, which guides the penetration of wastewater into the soil

**4 General Conditions**

4.1 For the purposes of this Standard the satisfied the requirements of items below complemented by PETROBRAS [N-2238](#), ABNT [NBR 5645](#), [NBR 5688](#), [NBR 7362-1](#), [NBR 7661](#), [NBR 7675](#), [NBR 8682](#), [NBR 10160](#) e [NBR 10845](#).

4.2 Excavation work shall be done according to the location, alignment, and slope specified in the design, which shall be topographically checked.

4.3 Excavations shall comply with the provisions in [NR 18](#).

4.4 Excavation bottoms shall be leveled according to the elevations indicated in the design.

**NOTE** When the natural terrain presents a work rate which does not withstand the weight of the structure to be built, the soil immediately below shall be replaced, so as to reach the work rate specified in the design. If replacement of the soil is not technically or economically viable, piling shall be constructed for the constructive elements.

4.5 Backfilling and compaction of the soil shall comply with PETROBRAS [N-1644](#).

4.6 Compaction of the backfill layers over pipes, galleries and protection plates for water crossings shall be performed manually or with the use of lightweight mechanical equipment, provided its influence on such structures is considered.

4.7 When water is found in the excavation, it shall be drained by direct pumping or by lowering the water table.

4.8 The cuts and fills necessary to bring the tank basins within the required grade shall be undertaken with a minimum slope of 1.0 % in the first 15 m, towards the collection point, and, from there onwards, 0.5 % when no other value is indicated in the design, and the final earthwork for handing over the job shall be done after the construction of drainage boxes and ditches.

4.9 Concrete structures of drainage systems shall be built in accordance with PETROBRAS [N-1644](#) and ABNT [NBR 6118](#).

4.10 For laying the various types of piping, besides the relevant technical standards the manufacturers' recommendations shall be followed.

## **5 Specific Conditions**

### **5.1 Construction of Piping Drainage**

#### **5.1.1 Materials**

Piping materials shall be in accordance with the design specifications.

#### **5.1.2 Execution**

5.1.2.1 For ditching purposes, the dimensions indicated in Figures A.1 and A.2 of Annex A shall be observed.

5.1.2.2 Pipes shall be laid on a bed of sandy material at least 5 cm thick.

5.1.2.3 Bells and spigots shall be duly cleaned before the pipe laying operation, according to the manufacturer's prescriptions.

5.1.2.4 At junctions with boxes, the pipe end shall extend 25 mm beyond the inner face of the wall and sealing of joints shall be done in such a manner as to ensure the tightness of the unit with the use of waterproofing additive.

5.1.2.5 When concrete or ceramic pipes are specified for clean storm water, joints shall be sealed with burlap soaked in cement slurry, tamped and capped with cement and sand mortar with a ratio of 1:3 by volume, and be well compacted.

5.1.2.6 When the design specifies concrete pipes for contaminated waters, the design shall follow the specifications of ABNT [NBR 8890](#) and the bell and spigot connection shall be made with nitrile rubber gasket.

5.1.2.7 When the design specifies ductile or nodular cast iron pipes for oily or contaminated waters, the bell and spigot connection shall be made with nitrile rubber gasket.

5.1.2.8 Welded connections of carbon steel pipes shall comply with PETROBRAS [N-133](#).

5.1.2.9 Steel pipes and the respective joints shall be protected against corrosion in accordance with ABNT [NBR 15221-1](#).

5.1.2.10 Pipe ends shall be protected during construction with a temporary plug so as to prevent the ingress of foreign elements.

## **5.2 Construction of Drainage by Means of Ditches**

### **5.2.1 Materials**

The materials used for the construction of ditches shall comply with the design specifications. The following materials are used:

- a) reinforced cast-in-place concrete;
- b) precast reinforced concrete elements;
- c) semicircular gutter in plain concrete (only for clean storm water system);
- d) semicircular gutter in reinforced concrete (only for clean storm water system);
- e) sealed stone masonry (only for clean storm water system);
- f) soil-cement (only for clean storm water system);
- g) precast reinforced concrete plates (only for clean storm water system).

### **5.2.2 Construction**

5.2.2.1 Pre-formed ditches shall be laid on a bed of sandy material at least 5 cm thick. At the option of PETROBRAS, in sections with a large slope or where the type of soil might allow landslides, the design shall provide for the laying and filling of sections of side walls of those ditches in lean concrete with the thickness to be determined by the detailed design.

5.2.2.2 In cast-in-place reinforced concrete drainage ditches, installation shall be on lean concrete at least 5 cm thick.

5.2.2.3 The width of the ditch bottom for cast-in-place reinforced concrete drainage ditches shall be prepared in accordance with Figures A.3 and A.4 of Annex A.

5.2.2.4 Precast drainage ditches shall be laid from downstream to upstream.

5.2.2.5 At junctions of drainage ditches with boxes, the end of the drainage ditches shall internally face the wall of the box and joints shall be sealed with cement and sand mortar with a 1:3 ratio by volume, and be well compacted. In the case of drainage ditches for contaminated waters, the mortar used shall contain waterproofing additive.

5.2.2.6 Expansion joints and constructive joints shall be built in accordance with the design. For the clean storm water system, constructive joints may be built in cement and sand mortar with a 1:3 ratio by volume. **[Recommended Practice]**

5.2.2.7 For the other drainage systems, the constructive joints of reinforced concrete elements shall be built with hardware and in-situ concrete placement. The expansion joints of the different drainage systems of the clean storm water system shall be built of material resistant to the action of hydrocarbons.

## **5.3 Boxes**

### **5.3.1 Materials**

The materials used for the construction of all boxes for all drainage systems shall be in accordance with the design specifications. The following materials are used:

- a) cast-in-place reinforced concrete;
- b) precast reinforced concrete;
- c) concrete and mixed masonry (only for clean storm water system).

### **5.3.2 Construction**

5.3.2.1 For boxes of the clean storm water system up to 1.25 m deep, in a consistent terrain, the excavation area may be equal to the outside area of the box, with the excavation wall serving as an external form of cast-in-place concrete boxes. **[Recommended Practice]**

5.3.2.2 For the other drainage systems, it shall be done externally, regardless of the type of terrain.

5.3.2.3 Precast boxes shall be laid on a bed of lean concrete or sandy material, prepared and carefully leveled before being connected to piping and the excavation area for installation of this type of box shall present a sufficient clearance to allow precast elements to be lowered.

5.3.2.4 Boxes cast in situ shall be built at the same time as drainage pipes are laid or drainage ditches are built so as to form a monolithic junction.

5.3.2.5 In mixed boxes, the bottom and cover shall be built in reinforced concrete.

5.3.2.6 Mixed boxes may be built only for the clean storm water system. The walls of those boxes shall be built in solid brick masonry laid with cement and sand mortar with a 1:4 ratio by volume, and its internal coating and, when necessary, the external coating, shall be prepared with cement and sand mortar with a 1:3 ratio by volume, with waterproofing additive. **[Recommended Practice]**

5.3.2.7 For the other drainage systems the boxes shall always be made of reinforced concrete.

5.3.2.8 The space between the walls of the box and the excavation shall be filled with sandy and/or clayey material and be gradually compacted.

## **5.4 Channels**

### **5.4.1 Materials**

The materials used for the construction of channels shall be in accordance with the design specifications. The following materials are generally used:

- a) cast-in-place reinforced concrete;
- b) precast reinforced concrete;
- c) precast reinforced concrete plates (only for clean storm water system);



- d) masonry of stones, laid with cement and sand mortar (only for clean stormwater system);
- e) cyclopean concrete (only for clean storm water system);
- f) soil-cement (only for clean storm water system);
- g) gabion structure(only for clean storm water system).

## **5.4.2 Construction**

5.4.2.1 Expansion joints and constructive joints shall be built in accordance with the design. For the clean storm water system, constructive joints may be built of cement and sand mortar with a 1:3 ratio by volume. **[Recommended Practice]**

5.4.2.2 For the other drainage systems, constructive joints of reinforced concrete elements shall be made with hardware and in-situ concrete placement and expansion joints of different drainage systems of the clean storm water system shall be made of material resistant to the action of hydrocarbons.

5.4.2.3 Precast plates shall be laid from downstream to upstream.

## **5.5 Galleries**

### **5.5.1 Materials**

The materials used for the construction of galleries shall be in accordance with the design specifications. The following materials are used:

- a) cast-in-place reinforced concrete;
- b) precast reinforced concrete elements;
- c) concrete and mixed masonry (only for clean storm water system);
- d) corrugated steel plates (only for clean storm water system).

### **5.5.2 Open-Air Construction**

5.5.2.1 At crossings over streets and internal avenues, the covering on the top part of galleries for mechanical protection of the structure shall be at least 60 cm thick. At the option of PETROBRAS, the depth may be smaller provided the gallery is protected by concrete elements on the top surface and a study is conducted of the distribution of pressures.

5.5.2.2 Expansion joints and constructive joints shall be built in accordance with the design. For the clean storm water system, constructive joints may be built in cement and sand mortar with a 1:3 ratio by volume. **[Recommended Practice]**

5.5.2.3 For the other drainage systems, constructive joints of reinforced concrete elements shall be built with hardware and in-situ concrete placement and the expansion joints of different drainage systems of the clean storm water system shall be made with material resistant to the action of hydrocarbons.

5.5.2.4 In mixed galleries (concrete and masonry), the bottom and cover slabs shall be made of reinforced concrete.

5.5.2.5 Galleries in corrugated steel plate shall be internally and externally protected against corrosion.

## **5.6 Drainage Ditches in Steps (Energy Dissipators) - Materials**

The materials used for construction of drainage ditches in steps shall be in accordance with the design specifications. The following materials are used:

- a) cast-in-place reinforced concrete;
- b) stone masonry (only for the clean storm water system);
- c) brick masonry (only for the clean storm water system);
- d) soil-cement (only for the clean storm water system).

## **5.7 Ground Water Drainage Systems**

### **5.7.1 Materials**

The materials used for the construction of drain trenches shall be in accordance with the design specifications. The following materials are used:

- a) perforated ceramic pipes;
- b) drain trenches of crushed stone contained by sand filters or polyester screens;
- c) perforated PVC pipes;
- d) perforated plain concrete pipes.

NOTE Other materials may be used provided they are approved by the job supervisors.

### **5.7.2 Execution**

5.7.2.1 In those cases in which perforated pipes are used, they shall be protected by filters built in accordance with 5.7.2.2 or with synthetic blankets.

5.7.2.2 The filtering material used for covering perforated or porous pipes and the filler material for underground drains shall be comprised of selected granular material, such as quartzose sand, round pebbles or crushed stone, and be free from organic matter, clay clods or other materials. They shall observe the grain sizes indicated in 5.1.5 of DNIT [015/2006 - ES](#) and in accordance with 5.1.2 of DNIT [016/2006 - ES](#).

5.7.2.3 Bell and spigot pipes shall be installed from downstream to upstream, with the bell on the side opposite to the slope.

5.7.2.4 The ends of PVC pipes shall be connected according to the manufacturer's instructions and in such a manner as to ensure flow continuity.

5.7.2.5 The application of filters in drain trenches using synthetic blankets shall be made according to Figure A.5 of Annex A.

5.7.2.6 The top part of the filter shall be sealed and the rest of the trench shall be filled with clayey material, as indicated in Figure A.5 of Annex A.

5.7.2.7 All filling materials shall be gradually compacted.

## **5.8 Sump**

### **5.8.1 Materials**

The materials used for the construction of sumps shall be in accordance with the design specifications. The following materials are used:

- a) stone masonry;
- b) brick masonry;
- c) pipes with perforated, precast concrete rings;
- d) prefabricated in PVC.

### **5.8.2 Construction**

In those cases in which there is no storm water collection system or water courses, the flow of water collected by the drainage system shall occur through sumps or infiltration ditches in accordance with the design indications.

## **6 Temporary Drainage Systems**

### **6.1 Temporary Storm Water Drainage Systems**

#### **6.1.1 Materials**

The materials used for construction of temporary storm water drainage systems shall be in accordance with the design specifications. The following materials are generally used:

- a) soil-cement;
- b) compacted soil;
- c) plain concrete gutters;
- d) stone or brick masonry;
- e) mortar sprayed on a "Déployée" type screen or expanded plate.

#### **6.1.2 Construction**

6.1.2.1 Drainage shall be performed in accordance with the design to be prepared for the temporary purpose, considering the sequence of the project schedule. This design may be dispensed with at the option of PETROBRAS.

6.1.2.2 In case there is no design, the temporary drainage system shall be built complying fully or in part with the definitive drainage design. In any situation, there shall be prior approval by the job supervisors.

6.1.2.3 In regions with frequent and intense rainfall, the walls of the temporary drainage ditches of compacted soils shall be reinforced with coatings and/or shorings.

## **6.2 Temporary Ground Water Drainage Systems**

### **6.2.1 Materials and Execution**

In accordance with the provisions in item 5.7 of this Standard.

## **7 Acceptance and Rejection**

7.1 The maximum allowable tolerances in relation to the design for the services contained in this Standard are as follows:

- a) location: 1 cm;
- b) leveling: 0.5 cm;
- c) alignment: 5 % of pipe diameter or drainage ditch width.

7.2 All closed piping and galleries shall be tested for tightness before their respective ditches are closed, with injection of water or smoke pressurized at 0.2 kgf/cm<sup>2</sup> g. or at a different pressure established by the job supervisor(s) according to the operational characteristics of the drainage systems.

**NOTE** For the clean storm water system, the tightness test may be dispensed with at the discretion of the job supervisor(s).

## **8 Safety**

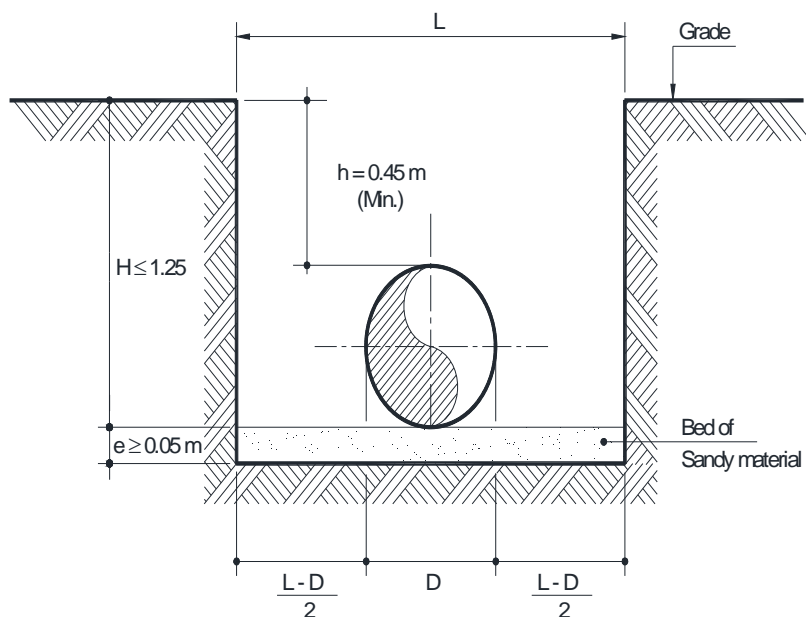
8.1 The requirements set forth in 18.6 of [NR-18](#) and the requirements for Permissions to Work (PT) shall be fully met.

8.2 Rock excavation and dismantling work shall be conducted by a responsible technician legally qualified for those activities.

8.3 Excavation and earth moving on a right of way where there might be other buried piping shall be preceded by drilling for identification. Upon confirmation of the existence of buried facilities, a specific design to ensure that no damage will occur to those facilities shall be presented.

8.4 Excavations in areas with the possibility of leakage of gas and flammable or toxic substances shall be continuously monitored.

8.5 The ditching procedure shall consider and pay special attention to escape ramps or ladders and the guaranteed slope stability.

**Annex A - Figures**


D = Pipe outside diameter

L = Ditch Width

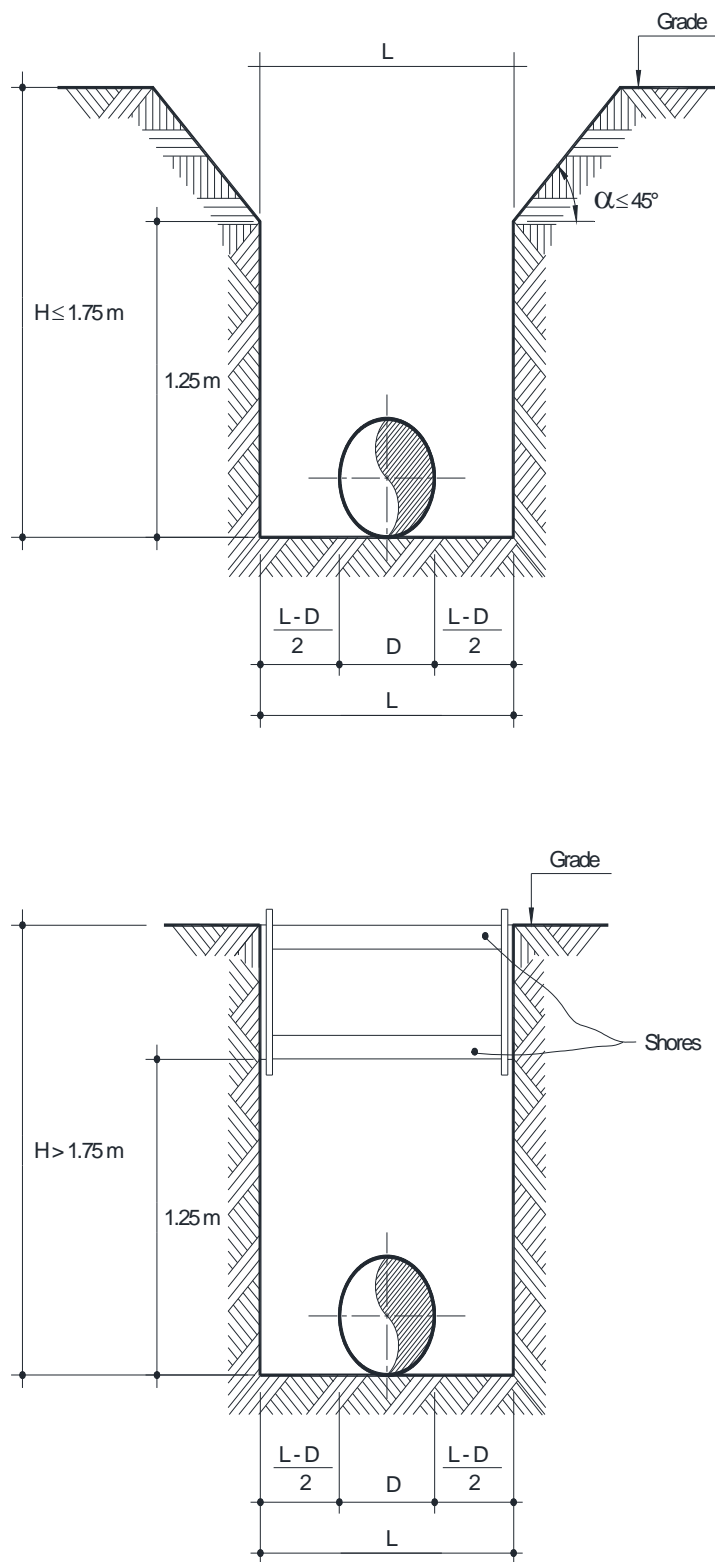
$D \leq 0.40 \text{ m}$ $L = 0.80 \text{ m}$ $0.40 < D \leq 0.80 \text{ m}$ $L = D + 0.60 \text{ m}$ $D > 0.80 \text{ m}$ $L = D + 0.40 \text{ m}$
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NOTE 1 Thickness of covering (h) when crossing streets and internal avenues shall be at least 60 cm when it is not indicated in the design.

NOTE 2 The bed of sandy material shall only be used for bottoms of ditches excavated in rocky ground or grounds containing a large amount of pebbles or stones. In those cases, besides the layer of sandy material, the space up to 25 cm above the top generatrix of pipe shall be filled with material free from stones.

NOTE 3 For piping in which sealing of joints is necessary, an extra width of 0.50 m shall be adopted.

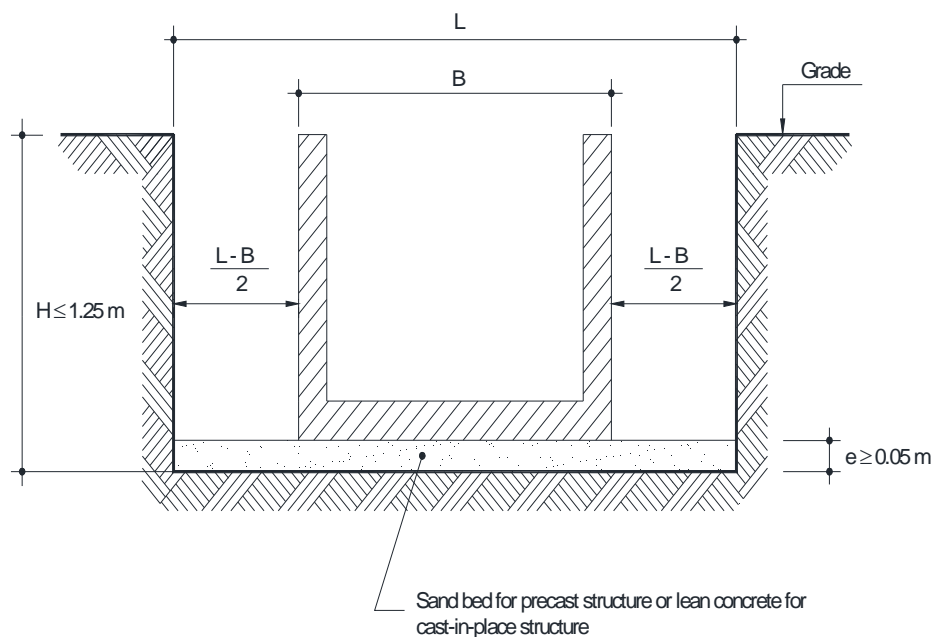
**Figures A.1 - Excavation Boxes For Installation Of Drainage At A Depth Up To 1.25 M**



NOTE 1 I - as per Figure A.1.

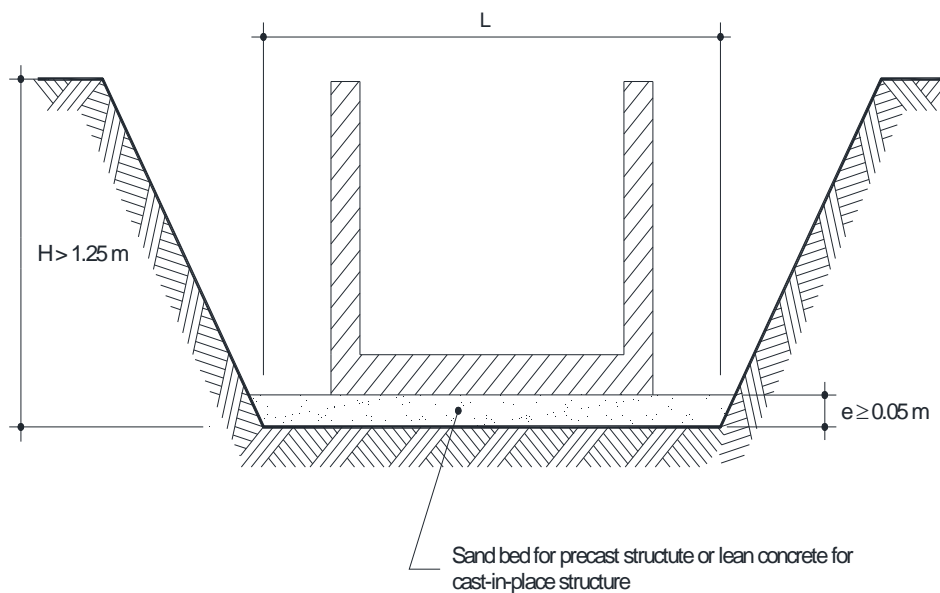
NOTE 2 For piping requiring sealing of joint, an extra width of 0.50 m shall be adopted for excavation heights up to 1.50 m and 0.70 m for heights over 1.50 m.

**Figures A.2 - Excavation Boxes For Installation Of Drainage Piping At A Depth Over 1.25 M**



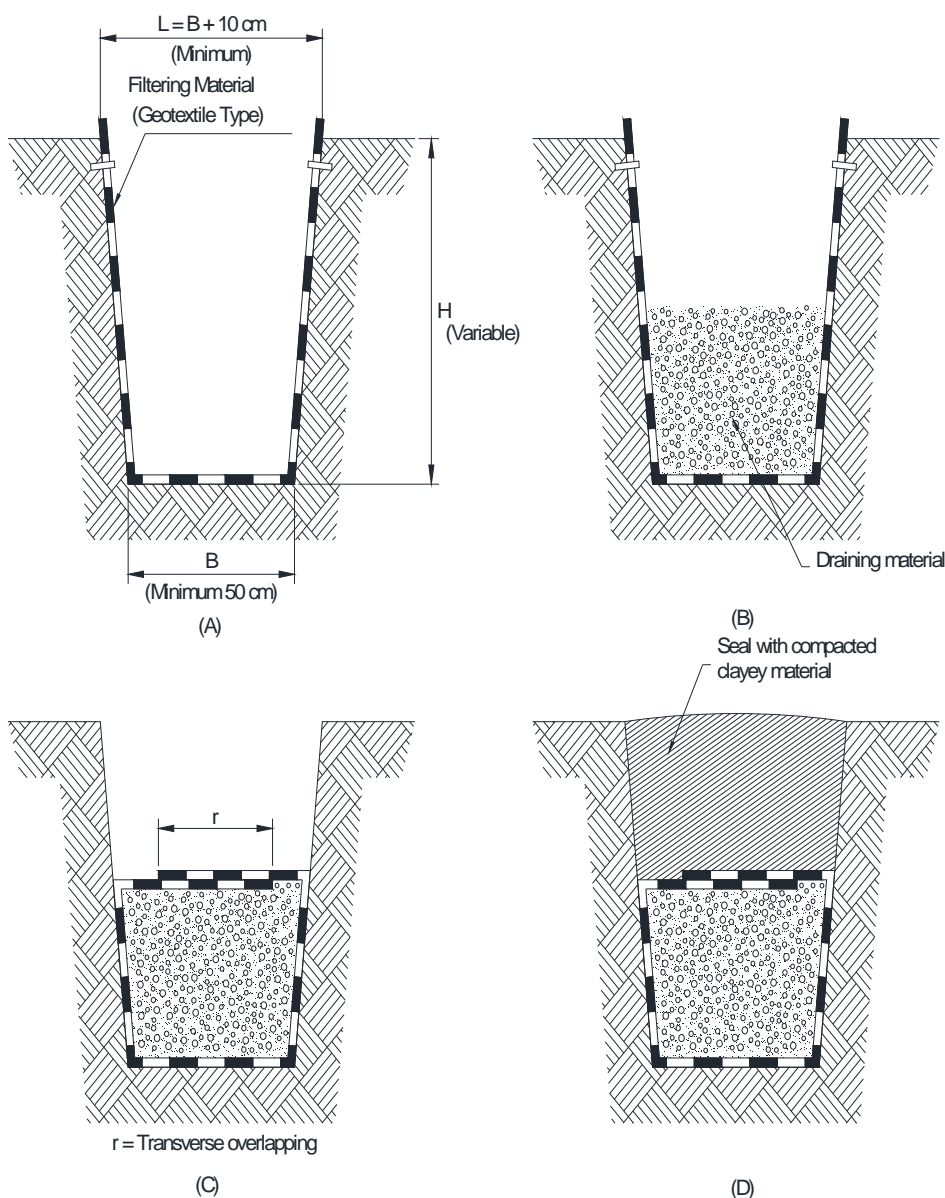
NOTE L - as per Figure A.1.

**Figures A.3 - Drainage Ditches - Excavation Box For A Depth Up To 1.25 M**



NOTE L - As per Figure A.1.

**Figures A.4 - Drainage Ditches - Excavation Box For A Depth Over 1.25 M**



- (A) Digging of trench with removal of organic material and gravel from bottom, compaction of bottom and placement of synthetic mat on trench walls with 5 mm u-bent iron fastening devices.
- (B) Filling of ditch with compacted draining material. during tamping operation, use hand tampers and take necessary precautions to maintain integrity of filtering material (MAT).
- (C) Folding and sewing of mat with a transverse overlapping of at least 20 cm complementing enveloping. overlapping of mat on longitudinal joints shall be at least 20 cm when there is a seam or 50 cm if seamless.
- (D) The remainder of trench space shall be filled with compacted clayey material.

NOTE Trench to be filled in the upstream to downstream direction with materials specified in design.

**Figures A.5 - Placement Of Filters Of Polyester Blankets In Drain Trenches (Execution Sequence)**



INDEX OF REVISIONS	
<b>REV. A</b>	
There is no index of revisions.	
<b>REV. B</b>	
Affected Parts	Description of Alteration
1.2 and 1.3	Included
2	Revised
3	Revised
4.7	Revised
5	Revised
6	Revised
7	Revised
8	Revised
FIGURE A.2	Revised
FIGURE A.5	Revised
<b>REV. C</b>	
Affected Parts	Description of Alteration
2	Revised
3	Revised
4.1	Inclusão
5.1.2.9	Revised
5.7.2.2	Revised

ABNT [NBR 8890](#) - Tubo de Concreto de Seção Circular para Águas Pluviais e Esgotos Sanitários - Requisitos e Métodos de Ensaio;

ABNT [NBR 9061](#) - Segurança de Escavação a Céu Aberto - Procedimento;

ABNT [NBR 10160](#) - Tampões e Grelhas de Ferro Fundido Dúctil - Requisitos e Métodos de Ensaio;

ABNT [NBR 10845](#) - Tubo de Poliéster Reforçado com Fibras de Vidro, com Junta Elástica, para Esgoto Sanitário - Especificação;

ABNT [NBR 15221-1](#) - Tubos de Aço - Revestimento Anticorrosivo Externo - Parte 1: Polietileno em Três Camadas;

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#### 3.1

##### **channels**

open and surface conduits of varying cross-section shapes used for containing and conveying permanent waters at high flow rates

#### 3.2

##### **drainage ditches**

open structures of varying cross-section shapes used for surface flow of liquid effluents.

#### 3.3

##### **ditches in Steps (Energy Dissipators)**

open conduits of varying cross-section shapes built in steps, which are used for reducing the flow of waters in areas involving large differences in level

#### 3.4

##### **galleries**

closed and underground conduits of varying cross-section shapes, which are used for conveying waters at high flow rates

#### 3.5

##### **ground water drainage system**

drainage elements for conveying percolation water, ground water and water springs\_comprised of permeable trenches or perforated pipes

#### 3.6

##### **temporary storm water drainage system**

drainage system whose purpose is to protect cuts and fills against erosion caused by rainfall during earth-moving activities as well as to allow drainage during the civil construction and assembly phases

**3.7****temporary ground water drainage system**

system whose purpose is to convey effluents from the lowering of the water table and/or from water springs during excavation, earth-moving, and foundation construction activities

**3.8****sump**

dry well excavated into the ground and not watertight, which guides the penetration of wastewater into the soil

**4 General Conditions**

4.1 For the purposes of this Standard the satisfied the requirements of items below complemented by PETROBRAS [N-2238](#), ABNT [NBR 5645](#), [NBR 5688](#), [NBR 7362-1](#), [NBR 7661](#), [NBR 7675](#), [NBR 8682](#), [NBR 10160](#) e [NBR 10845](#).

4.2 Excavation work shall be done according to the location, alignment, and slope specified in the design, which shall be topographically checked.

4.3 Excavations shall comply with the provisions in ABNT [NBR 9061](#).

4.4 Excavation bottoms shall be leveled according to the elevations indicated in the design.

**NOTE** When the natural terrain presents a work rate which does not withstand the weight of the structure to be built, the soil immediately below shall be replaced, so as to reach the work rate specified in the design. If replacement of the soil is not technically or economically viable, piling shall be constructed for the constructive elements.

4.5 Backfilling and compaction of the soil shall comply with PETROBRAS [N-1644](#).

4.6 Compaction of the backfill layers over pipes, galleries and protection plates for water crossings shall be performed manually or with the use of lightweight mechanical equipment, provided its influence on such structures is considered.

4.7 When water is found in the excavation, it shall be drained by direct pumping or by lowering the water table.

4.8 The cuts and fills necessary to bring the tank basins within the required grade shall be undertaken with a minimum slope of 1.0 % in the first 15 m, towards the collection point, and, from there onwards, 0.5 % when no other value is indicated in the design, and the final earthwork for handing over the job shall be done after the construction of drainage boxes and ditches.

4.9 Concrete structures of drainage systems shall be built in accordance with PETROBRAS [N-1644](#) and ABNT [NBR 6118](#).

4.10 For laying the various types of piping, besides the relevant technical standards the manufacturers' recommendations shall be followed.

## **6.2 Temporary Ground Water Drainage Systems**

### **6.2.1 Materials and Execution**

In accordance with the provisions in item 5.7 of this Standard.

## **7 Acceptance and Rejection**

7.1 The maximum allowable tolerances in relation to the design for the services contained in this Standard are as follows:

- a) location: 1 cm;
- b) leveling: 0.5 cm;
- c) alignment: 5 % of pipe diameter or drainage ditch width.

7.2 All closed piping and galleries shall be tested for tightness before their respective ditches are closed, with injection of water or smoke pressurized at 0.2 kgf/cm<sup>2</sup> g. or at a different pressure established by the job supervisor(s) according to the operational characteristics of the drainage systems.

NOTE For the clean storm water system, the tightness test may be dispensed with at the discretion of the job supervisor(s).

## **8 Safety**

8.1 The requirements set forth in 18.6 of [NR-18](#), the prescriptions of ABNT [NBR 9061](#) and the requirements for Permissions to Work (PT) shall be fully met.

8.2 Rock excavation and dismantling work shall be conducted by a responsible technician legally qualified for those activities.

8.3 Excavation and earth moving on a right of way where there might be other buried piping shall be preceded by drilling for identification. Upon confirmation of the existence of buried facilities, a specific design to ensure that no damage will occur to those facilities shall be presented.

8.4 Excavations in areas with the possibility of leakage of gas and flammable or toxic substances shall be continuously monitored.

8.5 The ditching procedure shall consider and pay special attention to escape ramps or ladders and the guaranteed slope stability.