# طرح نگهداشت و افزایش تولید ۲۷ مخزن

# SPECIFICATION FOR SEWERAGE AND DRAINAGE

## نگهداشت و افزایش تولید میدان نفتی بینک

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| D02 | MAR. 2022 | AFD | R.Berlouie | M.Fakharian | M.Mehrshad | |
| D01 | FEB. 2022 | IFA | R.Berlouie | M.Fakharian | M.Mehrshad | |
| D00 | AUG. 2021 | IFC | R.Berlouie | M.Fakharian | M.Mehrshad | |
| **Rev.** | **Date** | **Purpose of Issue/Status** | **Prepared by:** | **Checked by:** | **Approved by:** | **CLIENT Approval** |

**Class:2** | **CLIENT Doc. Number: F0Z-707245**

**Status:**

**IDC: Inter-Discipline Check**
**IFC: Issued For Comment**
**IFA: Issued For Approval**
**AFD: Approved For Design**
**AFC: Approved For Construction**
**AFP: Approved For Purchase**
**AFQ:** Approved For Quotation
**IFI: Issued For Information**
**AB-R: As-Built for CLIENT Review**
**AB-A: As-Built –Approved**

## REVISION RECORD SHEET

| PAGE | D00 | D01 | D02 | D03 | D04 |
|---|---|---|---|---|---|
| 1 | X | X | X | | |
| 2 | X | X | | | |
| 3 | X | X | | | |
| 4 | X | X | | | |
| 5 | X | X | | | |
| 6 | X | X | | | |
| 7 | X | X | | | |
| 8 | X | X | | | |
| 9 | X | X | | | |
| 10 | X | X | | | |
| 11 | X | X | | | |
| 12 | X | X | | | |
| 13 | X | X | | | |
| 14 | X | X | | | |
| 15 | X | X | | | |
| 16 | X | X | | | |
| 17 | X | X | | | |
| 18 | X | X | | | |
| 19 | X | X | | | |
| 20 | X | | | | |
| 21 | X | | | | |
| 22 | X | | | | |
| 23 | X | | | | |
| 24 | X | | | | |
| 25 | X | | | | |
| 26 | X | | | | |
| 27 | X | | | | |
| 28 | X | | | | |
| 29 | X | | | | |
| 30 | X | | | | |
| 31 | X | | | | |
| 32 | X | | | | |
| 33 | X | | | | |
| 34 | X | | | | |
| 35 | X | | | | |
| 36 | X | | | | |
| 37 | X | | | | |
| 38 | X | | | | |
| 39 | X | | | | |
| 40 | X | | | | |
| 41 | X | | | | |
| 42 | X | | | | |
| 43 | X | | | | |
| 44 | X | | | | |
| 45 | | | | | |
| 46 | | | | | |
| 47 | | | | | |
| 48 | | | | | |
| 49 | | | | | |
| 50 | | | | | |
| 51 | | | | | |
| 52 | | | | | |
| 53 | | | | | |
| 54 | | | | | |
| 55 | | | | | |
| 56 | | | | | |
| 57 | | | | | |
| 58 | | | | | |
| 59 | | | | | |
| 60 | | | | | |
| 61 | | | | | |
| 62 | | | | | |
| 63 | | | | | |
| 64 | | | | | |
| 65 | | | | | |

| PAGE | D00 | D01 | D02 | D03 | D04 |
|---|---|---|---|---|---|
| 66 | | | | | |
| 67 | | | | | |
| 68 | | | | | |
| 69 | | | | | |
| 70 | | | | | |
| 71 | | | | | |
| 72 | | | | | |
| 73 | | | | | |
| 74 | | | | | |
| 75 | | | | | |
| 76 | | | | | |
| 77 | | | | | |
| 78 | | | | | |
| 79 | | | | | |
| 80 | | | | | |
| 81 | | | | | |
| 82 | | | | | |
| 83 | | | | | |
| 84 | | | | | |
| 85 | | | | | |
| 86 | | | | | |
| 87 | | | | | |
| 88 | | | | | |
| 89 | | | | | |
| 90 | | | | | |
| 91 | | | | | |
| 92 | | | | | |
| 93 | | | | | |
| 94 | | | | | |
| 95 | | | | | |
| 96 | | | | | |
| 97 | | | | | |
| 98 | | | | | |
| 99 | | | | | |
| 100 | | | | | |
| 101 | | | | | |
| 102 | | | | | |
| 103 | | | | | |
| 104 | | | | | |
| 105 | | | | | |
| 106 | | | | | |
| 107 | | | | | |
| 108 | | | | | |
| 109 | | | | | |
| 110 | | | | | |
| 111 | | | | | |
| 112 | | | | | |
| 113 | | | | | |
| 114 | | | | | |
| 115 | | | | | |
| 116 | | | | | |
| 117 | | | | | |
| 118 | | | | | |
| 119 | | | | | |
| 120 | | | | | |
| 121 | | | | | |
| 122 | | | | | |
| 123 | | | | | |
| 124 | | | | | |
| 125 | | | | | |
| 126 | | | | | |
| 127 | | | | | |
| 128 | | | | | |
| 129 | | | | | |
| 130 | | | | | |

# CONTENTS

## 1. INTRODUCTION

Binak oilfield in Bushehr province is a part of the southern oilfields of Iran, is located 20 km northwest of Genaveh city.

With the aim of increasing production of oil from Binak oilfield, an EPC/EPD Project has been defined by NIOC/NISOC and awarded to Petro Iran Development Company (PEDCO). Also PEDCO (as General Contractor) has assigned the EPC-packages of the Project to "Hirgan Energy - Design and Inspection" JV.

**GENERAL DEFINITION**

The following terms shall be used in this document.

| | |
|---|---|
| CLIENT: | National Iranian South Oilfields Company (NISOC) |
| PROJECT: | Binak Oilfield Development – General Facilities |
| EPD/EPC CONTRACTOR (GC): | Petro Iran Development Company (PEDCO) |
| EPC CONTRACTOR: | Joint Venture of : Hirgan Energy – Design & Inspection(D&I) Companies |
| VENDOR: | The firm or person who will fabricate the equipment or material. |
| EXECUTOR: | Executor is the party which carries out all or part of construction and/or commissioning for the project. |
| THIRD PARTY INSPECTOR (TPI): | The firm appointed by EPD/EPC CONTRACTOR (GC) and approved by CLIENT (in writing) for the inspection of goods. |
| SHALL: | Is used where a provision is mandatory. |
| SHOULD: | Is used where a provision is advisory only. |
| WILL: | Is normally used in connection with the action by CLIENT rather than by an EPC/EPD CONTRACTOR, supplier or VENDOR. |
| MAY: | Is used where a provision is completely discretionary. |

## 2. SCOPE

This specification covers the minimum requirement of the Sanitary and drainage system and issues for Binak Oil fields project.

## 3. NORMATIVE REFERENCES

The design shall be in accordance with this specification and with the requirement and recommendations of the latest editions and supplements of the following documents:

### 3.1. LOCAL CODES AND STANDARDS

| | |
|---|---|
| IPS-E-CE-110 | Soil Engineering |
| IPS-C-CE-112 | Earthworks |
| IPS-C-CE-342 | Water supply and Drainage System |
| IPS-M-CE-345 | Material Standards for Water supply & Sewerage Equipment |
| IPS-E-CE-380 | Sewerage and Surface water Drainage System |
| IPS-E-CE-390 | Rain and Fuel Water Drainage of Building |

### 3.2. INTERNATIONAL CODES AND STANDARDS

- **AMERICAN WATER WORKS ASSOCIATION STANDARDS (AWWA)**

| | |
|---|---|
| AWWA | American Water Works Association Standards |

- **AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):**

| | |
|---|---|
| ASTM F 1142 | Standard Specification for Manhole Cover Assembly, Bolted, Semi-Flush, Oiltight and Watertight |
| ASTM F 1143 | Standard Specification for Manhole Cover Assembly, Bolted, Raised, Oiltight and Watertight |
| ASTM F 1143 | Standard Specification for Manhole Cover Assembly, Bolted, Semi-Flush, Oiltight and Watertight, Hinged |

- **BRITISH STANDARD INSTITUTED (BSI)**

| | |
|---|---|
| BS-EN 752-2017 | Drains and Sewer System Outside Buildings |
| BS 6367 | Code of practice for Drainage of Roofs and paved Areas |
| BS 8005 | Part 0 and 1, Sewerage |
| BS 8301 | Code of practice for Building Drainage |

## 3.3. APPLICATION OF STANDARDS AND CODES

Design shall comply with the requirements of the IPS standards and BS standards listed in section 3.1 & 3.2 .Design shall also comply with requirements of other codes where specifically required in this specification.

As an alternative to the above codes, design may be carried out in compliance with the relevant American Codes and Standards (ASTM). In this case the significant requirements of the British Codes are to be incorporated in the design.

## 3.4. OTHER REFERENCES

The publications by The U.S. Bureau of Reclamation have been used as a major reference, other references are as follow:


- Chow, V.T., 1950. "Open channel hydraulics", Mc Graw Hill, N.Y.
- Chow, V.T., 1964. "Handbook of applied hydrology", Mc Graw Hill, N.Y.
- Davis, C.V. & Sorensen, K.E., 1969. "Handbook of Applied Hydraulics", Mc Graw Hill, N.Y. F.A.O., 1988. FAO Irrigation and Drainage Papers. "No. 44, Design and Optimization of irrigation distribution networks", United Nations, Rome.
- U.S.B.R., 1974. “Design of Small Dams”, Colorado.
- U.S.B.R., 1978. "Engineering Monograph No. 25", Colorado.
- U.S.B.R., 1967. "Design of Channel and Related Structures", Colorado.
- French, R.H., 1986. "Open Channel Hydraulics", Mc Graw Hill, N.Y.

### 3.5. DESIGN

Design Calculation shall be based on the following:

- Charts for the Hydraulic Design of channels and Pipes, (Metric Edition), Hydraulics Research Ltd.
- Simplified Tables of External Loads on Buried Pipelines, Transport and Road Research Laboratory.
- BS 6367, Code of Practice for Drainage of Roofs and Paved Areas.
- BS 8301, Code of Practice for Building Drainage.

## 4. UNITS

This document is based on International System of Units (SI), except where otherwise noted.

## 5. DESIGN PHILOSOPHY FOR SEWERAGE

Sewerage systems shall be designed to carry the agreed quantities of effluent from the points of origin to the points of discharge. The system should be cost effective, require minimum maintenance and provide ease of maintenance.

Systems shall be designed for self-cleaning gravity flow operation with a consistent hydraulic gradient from source to outfall.

It is controlled and specified that all changes to basic engineering, including the removal or resizing of equipment, are in accordance with the project design philosophy drainage philosophy and be consistent with relevant and common standards

## 6. DEFINITION OF DRAINAGE SYSTEM

The following systems shall be considered:

- Non-contaminated sewer system
- Accidentally contaminated sewer system
- Oily water sewer system
- Sanitary sewer system
- Non-contaminated surface water run-off
- Process closed drains

## 6.1. NON-CONTAMINATED SEWER SYSTEM

Non-contaminated process waste effluents from process and utilities areas such as:

- Process units : Wash down from non-oily equipment
- Utility areas : Wash down from non-oily equipment
  Fresh water drains
  Cooling water drains

The non-contaminated process waste effluents will be collected in an underground drain network and - sent directly to the surface water system.

## 6.2. OILY WATER SEWER SYSTEM

This underground system shall collect wastewater, which is continuously oil contaminated during normal operations:

- Purges and open drains from equipment in process and utilities areas
- Accidental spillages associated to specific equipment (contained by curbed areas)
- The diesel tanks bounded areas (in case of pollution)

This system shall also collect rainwater runoff, Firewater or wash down from curbed areas in process and utilities areas. This effluent shall be sent to the oily water separator. Treated effluent shall be discharged by gravity to the surface water system.

## 6.3. SANITARY SEWER SYSTEM

The upstream limit of the Sanitary sewer system covered by this specification shall be the external side of a manhole located at approximately 1 meter from the external face of the building. This manhole and all the upstream part of the Sanitary sewer system including grease interceptor shall be developed as a part of the building plumbing system.

The Sanitary sewer system shall be a closed system, which shall receive all Sanitary wastes from the plant buildings, including foul and kitchen wastes. Kitchen wastes shall pass through a grease

interceptor before entry into the sewer system. Wastes from toilet areas shall be collected in a manhole located immediately outside each building. The system shall be designed preferably for gravity flow to the septic tanks.

### 6.4. NON-CONTAMINATED SURFACE WATER RUN-OFF

This system shall collect rainwater on roads, car parks, roofs of buildings (except in process and utilities areas), and unconstructed areas.
The water shall be collected by a system of ditches located in the plant area and shall discharge into the existing flood way.

## 7. DRAINAGE OF SPECIFIC EQUIPMENT OR AREAS

### 7.1. TRANSFORMER BAYS

Transformer bays will be infilled with gravel, with sufficient capacity in the voids to contain the nonflammable insulant in case of a transformer rupture.

In case of pollution, effluent shall be discharged in the oily water sewer system.

### 7.2. LABORATORY (IF REQUIRED)

Sinks and drains from laboratory shall be connected to the oily water sewer.

## 8. DESIGN

No consideration for future expansion of the project shall be taken into account for the design.

### 8.1. RAIN WATER ($Q_R$)

Rainwater flow shall be designed using the following formula:

$Qr = CIA$

**Qr = Rain water flow m3/h.m**

**C = run-off coefficients:**

| | |
|---|---|
| for roof of buildings and /or structures | 0.90 |
| for roads and paving | 0.90 |
| for natural soil (either in cut, either in fill) | 0.40 |

**I=rainfall intensity $m^3/h.m^2$**

**The following preliminary data shall be considered**:

| Duration of rainfall (min) | I (m/h) |
|---|---|
| 15 | 0.09 |
| 30 | 0.06 |
| 60 | 0.04 |

Minimum concentration time to be considered in the design is 8 min

**A=drained surface area m2**

## 8.2. FIRE FIGHTING/COOLING WATER (QF)

Maximum firefighting/cooling water quantities are: 150 m3/h, although this figure is dependent on the final firewater demand calculation, refer to safety discipline Specification and document. Firewater shall be considered as uniformly spread over the totality of the concerned area.

A reduction of 30 percent on the values is to be considered for blowing away and evaporation.

## 8.3. PROCESS WATER (NON-CONTAMINATED) (QP)

For the miscellaneous process streams, the quantity of non-contaminated process water (Qp) to be taken into account for the design of drainage system shall be 20 $m^3/h$. This figure is to be checked and revised as necessary during detailed design when specific Vendor information becomes available.

## 8.4. SANITARY SEWER

The flow in sanitary sewers shall be determined using the "discharge unit" method described in the British Standard BS 8301.

## 8.5. PIPE DESIGN

Sloped pipes shall be considered in general. Horizontal pipes may be considered for flooded sections of sewers, Pipe diameters shall be designed using the Manning-Strickler formula:

$V=K\ R2/3\ I1/2$

$Q=SV$

With:

V=effluent velocity m/s

K=Manning coefficient: 90 for steel and concrete pipes ,100 for GRP pipes

R=hydraulic radius of pipe m

I = slope of pipe m/m (or head loss in case of filled pipes)

Q=effluent flow: m3/s

S= wetted section: m2

Pipes shall be designed with maximum filling of:

- 100 % of pipe diameter for all sewers except Sanitary sewer
- 50 % of pipe diameter for Sanitary sewer
- Minimum size for Sanitary sewer pipes shall be 150 mm.

## 8.6. DITCHES AND CHANNELS DESIGN

Open drain channels shall be designed using the Manning-Strickler formula:

$Q=K\ S\ R\ 2/3\ I\ 1/2$

Q: flow m3/s
K: Manning coefficient = 65

R: hydraulic radius m

I: incline (slope) % or m/m

S: wetted section m2

Minimum width at bottom of channel shall be 0.40 m.

Channels shall be rectangular channels. Bottom and sides of channels shall be concrete lined. A free board of 150 mm shall be considered for all ditches.

Open ditches along roads shall be covered with steel grating or concrete slabs, or separated from the road by crash barriers or kerbs, where considered hazardous for the road traffic. Regular accesses for pedestrians, bicycles shall also be provided across these ditches.

## 8.7. MANHOLES

Manholes on sewers shall be provided as follows:

- At changes in pipe direction in vertical and horizontal planes.
- At changes in main sewer diameter
- At junction with incoming pipes that do not have cleaning access within 10 m
- At a maximum spacing of 50 m inside units and 100 m outside units.

Venting of manhole shall be provided as follows:

- At each manhole in the oily water sewer system
- At head of each run for the Sanitary sewer system

- Water seals shall be provided at inlet pipe entry to manhole for the oily and accidentally oily water sewer system and chemical sewer systems.
- Double compartment manholes shall be considered when diameter of pipes is 2000 mm
- Manholes for the Sanitary sewer system shall be designed to ensure there is no stagnation of effluent in the manhole. The bottom of manholes in the Sanitary sewer system shall be benched with mortar or lean concrete. The benching shall rise vertically from the channel piece to a height of the soffit of the sewer and slope up to the edge of the manhole at 1 in 30

## 8.8. CLEAN OUTS

Clean outs shall be provided on the oily water sewer and Sanitary sewer systems to facilitate rodding of sewers. Clean outs shall be provided at:

- The head of sewers unless a catch basin or manhole is provided
- Changes in direction of sewers in excess of 45° where no manhole is provided
- Any other location where rodding access is required.

## 8.9. COVER

Buried drainage piping shall have the following minimum cover of soil:

- In areas inaccessible to traffic: 0.60 m

- In areas accessible to traffic and at road crossings 1.2 m

The load on the pipes shall be equalized for lines crossing traffic roads, e.g., by means concrete slab. Steel plate, pipe sleeves or culvert. The pipes shall be kept centrally in the sleeves by distance pieces welded to the pipe or fixed to the sheeting if the line is insulated for low temperature service.

The minimum clear distance between buried piping operating at ambient temperature and electric and instrument cables shall be 300 mm. Buried lines operating above 60 °C shall be insulated in order to limit the outside temperature to a maximum of 60 °C. The clear distance between lines with an outside temperature of 60 °C and electric and instrument cables shall be 600 mm.

### 8.10. U/G PIPES OUTSIDE PAVED AREA

U/G piping outside paved area shall be direct buried.

### 8.11. U/G PIPES WITHIN PAVED AREA

U/G pipes shall be direct buried. U/G closed drain piping may be directly buried provided that U/G piping routes are clearly marked on the paving to allow easy identification of pipe routing.

## 9. MATERIALS

### 9.1. DITCHES

- Rain water ditches
- Non-contaminated water ditches

Concrete shall be in accordance with document "BK-GNRAL-PEDCO-000-ST-SP-0001" "Specification for Concrete Works".

### 9.2. PIPES

- Non-contaminated sewer system: HDPE pipes in accordance with Project Piping Classes.
- Oily water sewer system: Carbon steel pipes in accordance with Project Piping Classes
- Process and chemical sewer systems: Carbon Steel pipes in accordance with Project Piping Classes

- Sanitary sewer system: HDPE pipes in accordance with Project Piping Classes.

### 9.3. MANHOLES

- Manholes shall be constructed in situ reinforced concrete
- For the Sanitary sewer system and the non-contaminated sewer system, the use of precast concrete rings on an in situ reinforced concrete base and with a pre-cast reinforced concrete cover slab may be considered
- Manhole covers shall be ductile iron and selected to suit the class of loading relevant to their location.

## 10. CONSTRUCTION

### 10.1. SETTING OUT

Before any work begins, EPC Contractor shall submit for Client's approval, his proposals for setting out the work and for controlling the locations and levels of the drainage systems to the dimensions and levels shown on drawings.

### 10.2. EXCAVATION

Excavation in trench shall be carried out to ensure that the drains can be laid in straight lines to the required gradients and invert levels as indicated on the drawings.
Trench base shall be free of any protrusions and hard spots, and any unsuitable material shall be removed, and replaced with compacted suitable material.
All excavations shall be kept free from water from whatever source so that the works shall be constructed in dry conditions. Ground water shall be maintained not less than 0.50 m below the bottom of excavation, in accordance with project document "BK-GNRAL-PEDCO-000-CV-SP-0004" "Specifications for Earth Works".

Excavations shall be adequately supported, taking into account the nature of the ground to be excavated, any adjacent structures and any other relevant information relating to the stability of the excavation in order to ensure protection of workers.

Every precaution shall be taken to prevent slips and falls of excavated or other material into the excavations. In the event of slips or falls occurring, or in the event of excavation being made in excess of that which is necessary or practical, resulting in voids being formed, then such voids shall be filled in accordance with document " BK-GNRAL-PEDCO-000-CV-SP-0004 " " Specifications for Earth Works ".

Excavated materials shall not be deposited within 1 m of the edge of the excavation and the proximity and height of the excavated material shall be controlled so as to prevent danger to workmen, instability or damage to other structures and services.

Excavated materials designated, as surplus to requirements or material deemed unsuitable as fill shall be loaded and removed to an approved off-site tip.

## 10.3. PREPARATION / COMPACTION

The bottom of the excavation shall be levelled and trimmed to receive the permanent works. The bottom of the excavation shall be mechanically compacted at natural moisture content, using a vibrating plate or suitable sized roller and any soft spots or pockets of unsuitable material exposed shall be excavated and replaced in accordance with document " BK-GNRAL-PEDCO-000-CV-SP-0004" Specifications for Earth Works "

Precautions shall be taken to protect the bottom of the excavation and, should the bottom of the excavation material become unsuitable either by exposure to weather conditions, water, or due to a lapse of time between excavation and subsequent works, or due to any other reasonably foreseeable event, it shall be removed and replaced as above.

## 10.4. VISUAL INSPECTION OF EXCAVATION

The material at pipe bedding level shall be inspected for soft spots or depressions. Soft spots or material, which does not meet the bearing capacity requirements, shall be removed to a depth determined acceptable by Client and filled with compacted suitable material.

## 10.5. OVER-EXCAVATION

If a foundation is excavated deeper than the level shown on the drawings, then the over excavated depth shall be filled with suitable material and re-compacted.

## 10.6. INSTALLATION OF PIPES AND FITTINGS

Granular pipe bedding material (round sand 1/8 or equivalent) shall be placed evenly on the prepared trench base to continuously support the pipe on at least 120°, at the required gradient with minimum 150mm thickness.

All pipes shall be laid true to line and level as indicated on the drawings. Each pipe shall be checked for correct position before laying the next pipe. All temporary supports of the pipes during laying shall be removed before backfilling.

No pipes shall be jointed together prior to being laid in the trench, All pipe and fittings shall be jointed strictly in accordance with the manufacturer's instructions.

Branches and drain lines for future use shall be temporarily sealed off with proper stoppers, to prevent the ingress of extraneous matter. Clean outs shall be located where shown on the drawings and constructed in accordance with Project Standard drawings.

## 10.7. BACKFILLING

Backfilling of the pipe trenches and manholes shall not commence until the sewer system has been successfully tested and accepted. This may be carried out in sections as work proceeds.

After testing, further bedding material shall be placed by hand up to the horizontal diameter of the pipe and compacted by hand ramming.

A layer of sand 1/8 or equivalent shall be placed up to 200 mm above the crown of the pipe, and compacted by hand ramming, A cushion layer 300 mm deep of selected fill shall then be placed above the sand layer.

The remaining backfill shall be built up with suitable fill in layers not exceeding 200 mm loose thickness, each layer thoroughly compacted by hand, to give the required cover over the crown of the pipe. Each subsequent layer shall be compacted by light mechanical equipment.

The backfill in trenches crossing permanent roads shall be thoroughly compacted and the road pavement temporarily reinstated and maintained until settlement has ceased.

Backfilling around manholes shall generally be as for trenches. Care shall be taken to raise the fill equally all around the chamber.

### 10.8. CONCRETE WORK

Manhole construction shall be in accordance with the Standard Drawings. Concrete (manhole, pits) shall be in accordance with document "BK-GNRAL-PEDCO-000-ST-SP-0001" "Specification for Concrete Works".

## 11. INSPECTION AND TESTING

### 11.1. DRAINS AND SEWERS

Drains and sewers shall be water tested. The pressure tests shall be applied after laying and before backfilling, and again after completion of backfilling, compacting, and surface reinstatement.

For water tests, the pipeline shall support a water head of 1.20 m at its upper end and not more than 2.40 m at its lower end. Steep gradients on sewers will require testing in sections to limit water heads to these figures.

Before water tests are carried out. Pipes shall be filled and maintained with water for a 6 hours duration, Duration of test shall be 30 min. after which the water level shall be adjusted to the initial value. Volume of water for this adjustment shall be measured. It shall be less than the following values:

| | **Material** | **Concrete** | **GRP Carbon Steel** |
|---|---|---|---|
| | Nominal Diameter | | 100 to 1000 mm |
| Quantity of water added | Pipe ($l/m^2$ of pipe) | Not applicable | 0.04 |
| | Manhole ($l/m^2$ of wall) | 0.50 | Not applicable |

## 11.2. MANHOLES AND INSPECTION CHAMBERS

Manholes and inspection chambers shall be water tested. All pipes entering the manhole chamber shall be temporarily sealed. The chamber shall be filled with clean water to a level 1.50 m above crown of outlet pipe or to top of chamber if less than 1.50 m deep.
24 hours shall be allowed for initial absorption and topped up to test level before commencing test.

Water level shall be maintained within 60 mm of original level for 30 minutes.