

**TESTING AND COMMISSIONING PROCEDURE**

**FOR**

**DRAINAGE INSTALLATION**

**IN**

**GOVERNMENT BUILDINGS**

**OF**

**THE HONG KONG SPECIAL ADMINISTRATIVE REGION**

2017 EDITION

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ARCHITECTURAL SERVICES DEPARTMENT  
THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION

## **PREFACE**

This Testing and Commissioning (T&C) Procedure aims to lay down the minimum testing and commissioning requirements to be carried out on Drainage Installation in Government Buildings of the Hong Kong Special Administrative Region (HKSAR). Such requirements are applicable to both new installations upon completion and existing ones after major alteration.

The present edition was developed by the Plumbing and Drainage Specialist Support Group that was established under the Building Services Branch Technical Information and Research & Development Committee of the Architectural Services Department (ArchSD). This T&C Procedure has made reference to the 2017 edition of the General Specification for Drainage Installation.

With the benefit of information technology, electronic version of this new edition is to be viewed on and free for download from the ArchSD Internet homepage. As part of the Government's efforts to limit paper consumption, hard copies of this T&C Procedure will not be put up for sale.

The ArchSD welcomes comments on this T&C Procedure at any time since the updating of this T&C Procedure is a continuous process to tie in with technological advances.

## **DISCLAIMER**

This T&C Procedure is solely compiled for use on Drainage Installation carried out for or on behalf of the ArchSD in Government buildings of the HKSAR.

There are no representations, either expressed or implied, as to the suitability of this T&C Procedure for purposes other than that stated above. The material contained in this T&C Procedure may not be pertinent or fully cover the extent of the installation in non-government buildings. Users who choose to adopt this T&C Procedure for their works are responsible for making their own assessments and judgement of all information contained here. The ArchSD does not accept any liability and responsibility for any special, indirect or consequential loss or damages whatsoever arising out of or in connection with the use of this T&C Procedure or reliance placed on it.

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# **Testing and Commissioning Procedure for Drainage Installation**

## **1. Introduction**

The procedures stated in this Testing and Commissioning (T&C) Procedure cover the activities in preliminary tests and inspections, functional performance tests and the commissioning of newly completed installations and existing ones after major alteration. They are so compiled to facilitate the work of Project Building Services Engineer (PBSE) and Project Site Staff, who are appointed as the Supervising officer's Representatives, in the following aspects with respect to testing and commissioning :-

- (a) To vet and approve the T&C procedures proposed and submitted by the contractor for the Drainage Installation (Drainage Contractor);
- (b) To witness those T&C procedures as specified; and
- (c) To accept the T&C certificates and other supporting data.

The Drainage Contractor shall carry out the T&C works as detailed in this T&C Procedure. Supplementary T&C plans may be proposed by the Drainage Contractor as appropriate and agreed by PBSE, e.g. for special equipment supplied and/or installed by the Drainage Contractor.

The administrative requirements for T&C works are in general as specified in the General Specification for Drainage Installation 2017 Edition and all current corrigenda/amendments thereto published before the date of first tender invitation for the Contract issued by the ArchSD (the General Specification).

All words and expressions shall have the meaning as assigned to them under the General Specification unless otherwise specified herein.

## **2. Objectives of the Testing and Commissioning Works**

The objectives of the T&C works are:-

- (a) To verify proper functioning of the equipment/system after installation;
- (b) To verify that the performance of the installed equipment/systems meet with the specified design intent and statutory requirements, if any, through a series of tests and adjustments; and
- (c) To capture and record performance data of the whole installation as the baseline for future operation and maintenance.

For the avoidance of doubt, depending on the specific demands of individual installation, the PBSE may require additional or substitute T&C works in regard to any elements in the Installations other than those indicated in this T&C Procedure.

### **3. Scope of the Testing and Commissioning Works**

#### **3.1 Tests and Inspections during Construction**

The purpose of these tests is to ensure that all components and systems are in a satisfactory and safe condition before start up. Preliminary adjustment and setting of equipment at this stage shall also be carried out at the same time to pave way for the coming functional performance tests.

Before carrying out any test, the Drainage Contractor shall ensure that the Installations comply with all relevant statutory requirements and regulations. The T&C works shall also comply with all site safety regulatory requirements currently in force. In particular, the Drainage Contractor shall note the following:-

- (a) Building Ordinance (Cap. 123), and other subsidiary legislation;
- (b) Electricity Ordinance (Cap. 406), and other subsidiary legislation;
- (c) Code of Practice for the Electricity (Wiring) Regulations published by EMSD;
- (d) Occupational Safety and Health Ordinance (Cap. 509), and other subsidiary legislation made under the Ordinance;
- (e) Factories and Industrial Undertakings Ordinance (Cap. 59), and other subsidiary legislation made under the Ordinance, including but not limited to Construction Sites (Safety) Regulations;
- (f) Electricity supply rules of the relevant power supply companies;
- (g) Code of Practice for Prevention of Legionnaires' Disease; and
- (h) Relevant Practice Notes on Drainage Works to all Authorised Persons issued by Buildings Department.
- (i) Buildings Energy Efficiency Ordinance (Cap 610)

#### **3.2 Functional Performance Tests**

The purpose of functional performance tests is to demonstrate that the Installations can meet the functional and performance requirements as specified in the Specification. Functional performance tests shall proceed from the testing of individual components to the testing of different systems in the Installations.

The Drainage Contractor may have to make temporary modifications as the tests proceed. The specific tests required and the order of tests will vary depending on the type and size of systems, number of systems, sequence of construction, interface with other installations, relationship with the building elements and other specific requirements as indicated in the Specification. The testing of systems may have to be carried out in stages depending on the progress of work or as proposed by the Drainage Contractor.

Any performance deficiencies revealed during the functional performance tests must be evaluated to determine the cause. After completion of the necessary corrective measures, the Drainage Contractor shall repeat the tests.

If any test cannot be completed because of circumstances that are beyond the control of the Drainage Contractor, it shall be properly documented and reported to the PBSE, who shall then liaise with the relevant parties to resolve the situation. The Drainage Contractor shall resume his testing work immediately upon the attainment of a suitable testing environment.

### **3.3 Statutory Tests and Inspections**

The Drainage Contractor shall arrange for statutory inspection by the Statutory Compliance Checking Unit (SCCU) of ArchSD, except for Design & Build Contracts, all underground pipework before it is backfilled or covered up or prior to concreting on any pipework to be embedded in any structure elements or concealed on any pipework by architectural features which cannot be easily removed for inspection after their installation.

The statutory test and inspection herein stated in this T&C Procedure shall make reference to the following regulations and practice notes:-

- (a) Relevant Regulations under the Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations, subsidiary legislation under Buildings Ordinance (Cap. 123);
- (b) Relevant Practice Notes for Authorised Persons, Registered Structural Engineers and Registered Geotechnical Engineers (i.e. PNAP), and Practice Notes for Registered Contractors issued by Buildings Department;
- (c) Relevant Practice Notes on Drainage Works to all Authorised Persons issued by Buildings Department.

### **3.4 Documentation and Deliverables**

The Drainage Contractor shall submit his proposed T&C procedures together with the Testing and Commissioning Progress Chart as shown in Annex I to PBSE for approval.

All inspection and T&C results shall be recorded by the Drainage Contractor in the appropriate test record forms. A complete set of these forms can be found in Annex II.

Data recorded in other formats may also be acceptable subject to prior approval of the PBSE. Upon completion of all the required T&C works, the Drainage Contractor shall complete and sign a testing and commissioning certificate as shown in Annex II to the effect that the agreed T&C works have been duly carried out.

A functional performance test report covering all measured data, data sheets, and a comprehensive summary describing the operation of the system at the time of the functional performance tests shall be prepared and submitted to the PBSE. Deviations in performance from the Specification or the design intent shall be



recorded, with a description and analysis included.

Where required in the Specification, the Drainage Contractor shall conduct a final evaluation of the performance of the Installations, the results of which shall be included in the commissioning report.

### **3.5 Other Requirements**

3.5.1 Systems shall be properly commissioned to demonstrate that all the equipment deliver the designed capacities and that water flow rate is properly balanced in accordance with the design. Prior to any commissioning works, the Drainage Contractor shall check the completion of the associated builder's work and the building services installations, to ensure that commissioning can be proceeded without obstruction.

Where necessary, after the proper testing and commissioning of the Installations, the Drainage Contractor shall notify the appropriate authority as specified in the Specification, through the PBSE of the completion of the Installations and its readiness for final inspection.

3.5.2 All aspects of the commissioning procedure shall follow the recommendations including but not limited to:-

- (a) Preliminary checks to ensure that all systems and system components are in a satisfactory and safe condition before commencement;
- (b) Preliminary adjustment and setting of the system components consistent with eventual design performance;
- (c) Final regulation and demonstration that the installation delivers the correct rate of flow of fluids at the conditions specified in the Contract documents.

3.5.3 Progressive Commissioning

The Drainage Contractor shall not wait for completion of every part of the work but shall arrange for a progressive commissioning programme to achieve practical overall completion and have the whole work ready to be handed over by a date to suit the Contract completion date or any other agreed programme date.

## **4. Testing and Commissioning Procedures**

### **4.1 Foul Water Drainage Installation – Underground System**

4.1.1 Water Test

- (a) Scope and Applicability

The scope of the test is to verify effective performance of the complete pipelines which comprise pipes, manholes, chambers

and/ or structures against leakage. During the test, pipelines will be filled with water under an approved test pressure and time interval. The loss of water inside the pipelines will be recorded and compared with the maximum permissible loss. The result will be used to reflect the performance of the pipelines against water leakage.

The test shall be applicable for pipelines with internal diameter up to and including 300mm.

(b) Test Pressure

Test pressure of 1.5m head shall be applied at high end of the pipelines under test, while test pressure at low end shall not exceed 6m head. Steeply graded pipes shall be tested by dividing into sections.

(c) Test Interval

Test interval shall be a minimum of 30 minutes or otherwise approved by PBSE.

(d) Procedure

The sequence of test shall be as follows:-

- (1) Remove all obstructions, debris and superfluous matter from the pipelines;
- (2) Secure all drain stoppers and/or bags in the end of the pipelines and all associated branches under test;
- (3) Fill water to the pipelines at least two hours before the test to allow for water absorption;
- (4) Record the test pressure at high end and low end upon test start;
- (5) Measure the loss of water inside the pipelines.

(e) Details on Test Certificate

All test certificates shall be signed by the Drainage Contractor and by the PBSE or his representative who has witnessed the test. All test certificates shall contain the following particulars:-

- Date of test
- Weather
- Temperature
- Test pressure
- Test interval
- Part-plan drawing identifying pipelines under test
- Result of test

- Name of Drainage Contractor's representative in charge of test
- Name of Supervising Officer's Representative at witness the test

#### 4.1.2 Air Test

##### (a) Scope and Applicability

The scope of the test is to verify effective performance of the pipelines against leakage. During the test, pipelines will be filled with air under an approved test pressure and time interval. The loss of air pressure inside the pipelines will be recorded and compared with the maximum permissible loss. The result will be used to reflect the performance of the pipelines against leakage.

The test shall be applicable for pipelines with internal diameter exceeding 300mm.

##### (b) Test Pressure

Test pressure of 100mm of water shall be applied for the test.

##### (c) Test Interval

Test interval shall be a minimum of 5 minutes or otherwise approved by PBSE.

##### (d) Procedure

The sequence of test shall be as follows:-

- (1) Remove all obstructions, debris and superfluous matter from the pipelines;
- (2) Seal the end of all the pipelines and associated branches under test by expanding drain plugs or inflatable canvas or rubber test bags;
- (3) Connect a U-tube manometer to the pipelines;
- (4) Inject air to the pipelines at least five minutes before the test to allow for stabilisation of the air temperature and pressure inside the pipe;
- (5) Measure the air pressure inside the pipelines upon test start;
- (6) Measure the loss of air pressure inside the pipelines.

##### (e) Acceptance criteria

Without further pumping, the head of water should not fall by

more than 25 mm in a period of 5 minutes for a 100 mm water gauge test pressure.

(f) Details on Test Certificate

All test certificates shall be signed by the Drainage Contractor and by the PBSE or his representative who has witnessed the test. All test certificates shall contain the following particulars:-

- Date of test
- Weather
- Temperature
- Test pressure
- Test interval
- Part-plan drawing identifying pipelines under test
- Result of test
- Name of Drainage Contractor's representative in charge of test
- Name of Supervising Officer's Representative at witness the test

## 4.2 Foul Water Drainage Installation – Aboveground System

### 4.2.1 Water Test

(a) Scope and Applicability

The scope of the test is to verify effective performance of the pipelines against leakage. During the test, each drainage stack will be charged with water at the level **below** the lowest sanitary appliances to see if any leakage of water below the lowest sanitary appliance to be observed.

(b) Procedure

The sequence of test shall be as follows:-

- (1) Seal the lower end of the pipeline being tested with plugs;
- (2) Fill the pipeline with water to flood level of the lowest sanitary appliance at least five minutes to see if any leakage of water to be observed;

(c) Details on Test Certificate

All test certificates shall be signed by the Drainage Contractor and by the PBSE or his representative who has witnessed the test. All test certificates shall contain the following particulars:-

- Date of test
- Weather
- Temperature
- Part-plan drawing identifying drain points and pipelines under test
- Result of test
- Name of Drainage Contractor's representative in charge of test
- Name of Supervising Officer's Representative at witness the test

#### 4.2.2 Air Test

##### (a) Scope and Applicability

The scope of the test is to verify effective performance of the pipelines against leakage. During the test, pipelines will be filled with air under an approved test pressure and time interval applicable to each drainage stack at the level **above** the lowest sanitary appliance. The loss of air pressure inside the pipelines will be recorded and compared with the maximum permissible loss. The result will be used to reflect the performance of the pipelines against leakage.

##### (b) Test Pressure

Test pressure of 38mm of water shall be applied for the test.

##### (c) Procedure

The sequence of test shall be as follows:-

- (1) Fully charge with the water seals of all the sanitary appliances;
- (2) Seal the end of all the pipelines with plugs at the pipeline being tested;
- (3) Connect a U-tube manometer to the pipelines;
- (4) Inject air to the pipelines at least five minutes before the test to allow for stabilisation of the air temperature and pressure inside the pipe;
- (5) Measure the air pressure inside the pipelines upon test start;
- (6) Measure if the air pressure of 38mm can be maintained for a period of not less than 5 minutes inside the pipelines.

##### (d) Acceptance criteria

The air pressure of 38mm shall maintain constant for a period of not less than 5 minutes.

(e) Details on Test Certificate

All test certificates shall be signed by the Drainage Contractor and by the PBSE or his representative who has witnessed the test. All test certificates shall contain the following particulars:-

- Date of test
- Weather
- Temperature
- Test pressure
- Test interval
- Part-plan drawing identifying pipelines under test
- Result of test
- Name of Drainage Contractor's representative in charge of test
- Name of Supervising Officer's Representative at witness the test

4.2.3 System Performance Test

(a) Scope and Applicability

The scope of the test is to verify effective performance of the whole aboveground drainage system. During the test, water will be discharged from selected drain points to demonstrate the actual operation condition that water would be discharged simultaneously into the foul water drainage system during operational condition. Visual check on the whole drainage system will be carried out for any back-flowing. The result will be used to reflect whether the capacity of the foul water drainage system is adequate.

(b) Drain Point Selection

The number of drain points that will discharge simultaneously into foul water drainage system depends on nature and usage of the building under construction. The Drainage Contractor shall submit a T&C plan indicating quantity and location of drain points to be discharged for PBSE's approval prior to the performance test.

(c) Procedure

The sequence of test shall be as follows:-

- (1) Remove all obstructions, debris and superfluous matter from the drain points and pipelines;
  - (2) Discharge water into the selected drain points from water storage vessel simultaneously;
  - (3) Visual check the whole drainage system for any back-flowing.
- (d) Details on Test Certificate

All test certificates shall be signed by the Drainage Contractor and by the PBSE or his representative who has witnessed the test. All test certificates shall contain the following particulars:-

- Date of test
- Weather
- Temperature
- Part-plan drawing identifying drain points and pipelines under test
- Result of test
- Name of Drainage Contractor's representative in charge of test
- Name of Supervising Officer's Representative at witness the test

### **4.3 Surface Water Drainage Installation – Underground System**

#### **4.3.1 Water Test**

(a) Scope and Applicability

The scope of the test is to verify effective performance of the complete pipelines which comprise pipes, manholes, chambers and/ or structures against leakage. During the test, pipelines will be filled with water under an approved test pressure and time interval. The loss of water inside the pipelines will be recorded and compared with the maximum permissible loss. The result will be used to reflect the performance of the pipelines against water leakage.

The test shall be applicable for pipelines with internal diameter up to and including 300mm.

(b) Test Pressure

Test pressure of 1.5m head shall be applied at high end of the pipelines under test, while test pressure at low end shall not exceed 6m head. Steeply graded pipes shall be tested by dividing

into sections.

(c) Test Interval

Test interval shall be a minimum of 30 minutes or otherwise approved by PBSE.

(d) Procedure

The sequence of test shall be as follows:-

- (1) Remove all obstructions, debris and superfluous matter from the pipelines;
- (2) Secure all drain stoppers and/or bags in the end of the pipelines and all associated branches under test;
- (3) Fill water to the pipelines at least two hours before the test to allow for water absorption;
- (4) Record the test pressure at high end and low end upon test start;
- (5) Measure the loss of water inside the pipelines.

(e) Details on Test Certificate

All test certificates shall be signed by the Drainage Contractor and by the PBSE or his representative who has witnessed the test. All test certificates shall contain the following particulars:-

- Date of test
- Weather
- Temperature
- Test pressure
- Test interval
- Part-plan drawing identifying pipelines under test
- Result of test
- Name of Drainage Contractor's representative in charge of test
- Name of Supervising Officer's Representative at witness the test

#### 4.3.2 Air Test

(a) Scope and Applicability

The scope of the test is to verify effective performance of the



pipelines against leakage. During the test, pipelines will be filled with air under an approved test pressure and time interval. The loss of air pressure inside the pipelines will be recorded and compared with the maximum permissible loss. The result will be used to reflect the performance of the pipelines against leakage.

The test shall be applicable for pipelines with internal diameter exceeding 300mm.

(b) Test Pressure

Test pressure of 100mm of water shall be applied for the test.

(c) Test Interval

Test interval shall be a minimum of 5 minutes or otherwise approved by PBSE.

(d) Procedure

The sequence of test shall be as follows:-

- (1) Remove all obstructions, debris and superfluous matter from the pipelines;
- (2) Seal the end of all the pipelines and associated branches under test by expanding drain plugs or inflatable canvas or rubber test bags;
- (3) Connect a U-tube manometer to the pipelines;
- (4) Inject air to the pipelines at least five minutes before the test to allow for stabilisation of the air temperature and pressure inside the pipe;
- (5) Measure the air pressure inside the pipelines upon test start;
- (6) Measure the loss of air pressure inside the pipelines.

(e) Acceptance criteria

Without further pumping, the head of water should not fall by more than 25 mm in a period of 5 minutes for a 100 mm water gauge test pressure.

(f) Details on Test Certificate

All test certificates shall be signed by the Drainage Contractor and by the PBSE or his representative who has witnessed the test. All test certificates shall contain the following particulars:-

- Date of test

- Weather
- Temperature
- Test pressure
- Test interval
- Part-plan drawing identifying pipelines under test
- Result of test
- Name of Drainage Contractor's representative in charge of test
- Name of Supervising Officer's Representative at witness the test

#### **4.4 Surface Water Drainage Installation – Aboveground System**

##### 4.4.1 Air Test

###### (a) Scope and Applicability

The scope of the test is to verify effective performance of the pipelines against leakage. During the test, pipelines will be filled with air under an approved test pressure and time interval applicable to each drainage stack at the level above the lowest drain outlet(s). The loss of air pressure inside the pipelines will be recorded and compared with the maximum permissible loss. The result will be used to reflect the performance of the pipelines against leakage.

###### (b) Test Pressure

Test pressure of 38mm of water shall be applied for the test.

###### (c) Procedure

The sequence of test shall be as follows:-

- (1) Fully charge with the water seals of all the sanitary appliances;
- (2) Seal the end of all the pipelines with plugs at the pipeline being tested;
- (3) Connect a U-tube manometer to the pipelines;
- (4) Inject air to the pipelines at least five minutes before the test to allow for stabilisation of the air temperature and pressure inside the pipe;
- (5) Measure the air pressure inside the pipelines upon test start;

(6) Measure if the air pressure of 38mm can be maintained for a period of not less than 5 minutes inside the pipelines.

(d) Acceptance criteria

The air pressure of 38mm shall remain constant for a period of not less than 5 minutes.

(e) Details on Test Certificate

All test certificates shall be signed by the Drainage Contractor and by the PBSE or his representative who has witnessed the test. All test certificates shall contain the following particulars:-

- Date of test
- Weather
- Temperature
- Test pressure
- Test interval
- Part-plan drawing identifying pipelines under test
- Result of test
- Name of Drainage Contractor's representative in charge of test
- Name of Supervising Officer's Representative at witness the test

#### 4.4.2 System Performance Test

(a) Scope and Applicability

The scope of the test is to verify effective performance of the whole aboveground drainage system. During the test, water will be discharged from selected drain points to demonstrate the actual operation condition that water would be discharged simultaneously into the storm water drainage system during operational condition. Visual check on the whole drainage system will be carried out for any back-flowing. The result will be used to reflect whether the capacity of the storm water drainage system is adequate.

(b) Drain Point Selection

The number of drain points that will discharge simultaneously into storm water drainage system depends on nature and usage of the building under construction. The Drainage Contractor shall submit a T&C plan indicating quantity and location of drain points to be discharged for PBSE's approval prior to the performance test.

(c) Procedure

The sequence of test shall be as follows:-

- (1) Remove all obstructions, debris and superfluous matter from the drain points and pipelines;
- (2) Discharge water into the selected drain points from water storage vessel simultaneously;
- (3) Visual check the whole drainage system for any back-flowing.

(d) Details on Test Certificate

All test certificates shall be signed by the Drainage Contractor and by the PBSE or his representative who has witnessed the test. All test certificates shall contain the following particulars:-

- Date of test
- Weather
- Temperature
- Part-plan drawing identifying drain points and pipelines under test
- Result of test
- Name of Drainage Contractor's representative in charge of test
- Name of Supervising Officer's representative at witness the test

## **4.5 Sump/ Sewage Water Pump Installation**

### **4.5.1 Pump**

4.5.1.1 Prior to Pump Started-Up, the Drainage Contractor shall check that:-

- (a) all normally open isolating and regulating valves are fully open and that all normally close valves are closed;
- (b) the direction sign of all non-return valves is along the same discharge direction of associated pumps;
- (c) the horizontal or vertical alignment of all flexible joints is within the tolerances recommended by manufacturers' installation guideline;
- (d) fully open the return and close the flow valve on the pump, close valves on standby pump. Closing the flow valve on the duty pump will limit the initial starting current, which is

usually excessive at the first time a pump is running due to bearing stiffness.

#### 4.5.1.2 Running of Pump Set

- (a) check the pump pressure developed by means of the pump altitude gauges against the design pressure. If excessive pressure is developed at this stage, the cause shall be investigated and rectified; and
- (b) adjust the discharge valve so that the flow as determined roughly from the pump characteristic is between 100 and 110 per cent of the design value. Note that the motor full load current is not exceeded.
- (c) the pump shall be run in accordance with the manufacturer's recommendations and shall be under fairly continuous observation. It shall not be left running outside normal working hours unless attended;
- (d) check that the bearings and motor temperature remain steady, that no noise or vibration develops and that no bolts or fixing works is loose;
- (e) after 8 hours of running, check if any irregularities observed according to manufacturer's instructions.  
(Remark: Observations afterwards may then become less frequent, but it is advisable, while commissioning other parts of the system later, to check the pump from time to time.)

#### 4.5.1.3 Standby Pump

- (a) on installations with a standby pump, this standby pump shall also be commissioned;
- (b) this pump can be checked against the other duty pump. In the unlikely event of failure of the duty pump, commissioning can continue using standby pump; and
- (c) carry out a full diagnosis of the reasons for the failure of the duty pump before energising the standby pump to ensure that any contributory causes are remedied.

#### 4.5.1.4 Regulation of Water Flow

##### Principles of water flow rate measurement and registration

- (a) the installation location of the devices have to follow the manufacturers' recommendation in order to obtain accurate flow measurement results. The devices may be a venturimeter, an orifice plate, a control valve with known calibrated flow characteristics, a calibrated regulation valve,

electromagnetic flow sensors or any device with a constant flow coefficient and calibration chart;

- (b) referring to the following figure, the pressure drop across the device is proportional to the square of the water flow rate. Hence the actual-to-design water flow is given by;

$$\frac{Q_1}{Q_2} = \sqrt{\frac{\Delta P_1}{\Delta P_2}}$$

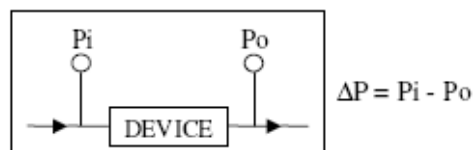
where

$\Delta P_1$  = Actual pressure drop in kPa

$\Delta P_2$  = Design pressure drop in kPa

$Q_1$  = Actual water flow rate in m<sup>3</sup>/s

$Q_2$  = Design water flow rate in m<sup>3</sup>/s



- (c) water flow regulation is achieved by varying the water flow across the device followed by measuring the pressure drop across it until the actual-to-design flow rate is within the tolerance acceptable by the PBSE.

#### 4.5.1.5 Demonstration

The Drainage Contractor shall perform dummy testing by inputting at least 20 sets of water flow rates or as specified in the Particular Specification to test the stability of the system and the timing required for adjusting. The values of the dummy testing water flow rates shall be submitted for approval at least 2 weeks before T&C.

### 4.5.2 Hydraulic Testing for Sump/ Sewage Water Pipework System

#### 4.5.2.1 General

All water distribution pipework systems shall be hydraulically tested in sections as installation work progresses.

#### 4.5.2.2 Test Pressure

The hydraulic test pressure shall be 1.5 times the maximum static pressure for 12 hours if it does not exceed 1.5MPa or 1.3 times the maximum static pressure for 12 hours if it exceeds 1.5MPa.

#### 4.5.2.3 Precautions

Before hydraulic tests are carried out, all safety valves, gauges, etc. shall be effectively isolated or removed. This safety equipment shall be effectively tested at their design working pressure during commissioning of the installation.

#### 4.5.2.4 Method of Testing

For a satisfactory and acceptable test, the pressure shall be maintained for a period of at least one hour or as otherwise stated in the Particular Specification, without loss of pressure or loss of water or leakage after all weak joints, defective fittings and pipes disclosed by the initial application of the test are rectified. During the final testing period, the PBSE or his representative shall be invited to witness the tests. All sections of the work under test shall be accessible for inspection and selected welds shall be hammer tested.

#### 4.5.2.5 Hydraulic Test Certificates

Certificates of all hydraulic tests made on the Site shall be forwarded to the PBSE for approval. A separate and duplicated set of the Drainage Contractor's installation/shop drawings shall be provided for the purpose of keeping accurate records of site tests. One copy will be kept by the PBSE's representative on the Site and the other retained by the Drainage Contractor.

#### 4.5.2.6 Details on Test Certificate

All test certificates shall be signed by the Drainage Contractor's authorised site representative and by the PBSE or his representative who has witnessed the tests. All test certificates shall contain the following particulars :-

- Date of test
- Apparatus or section under test
- Makers number (if any)
- Nature, duration and conditions of test
- Result of test
- Name of Drainage Contractor's representative (in block letter) in charge of test
- Name of Employer's representative at witness the test

A blank test certificate form shall be submitted by Drainage Contractor for PBSE's approval prior to carrying out the actual test on the Site.

## 4.6 Calibrated Equipment/ Instruments

4.6.1 A list of testing equipment/instruments proposed by the Drainage Contractor to be used for T&C (Annex III) must be agreed with the PBSE prior to commissioning the work.

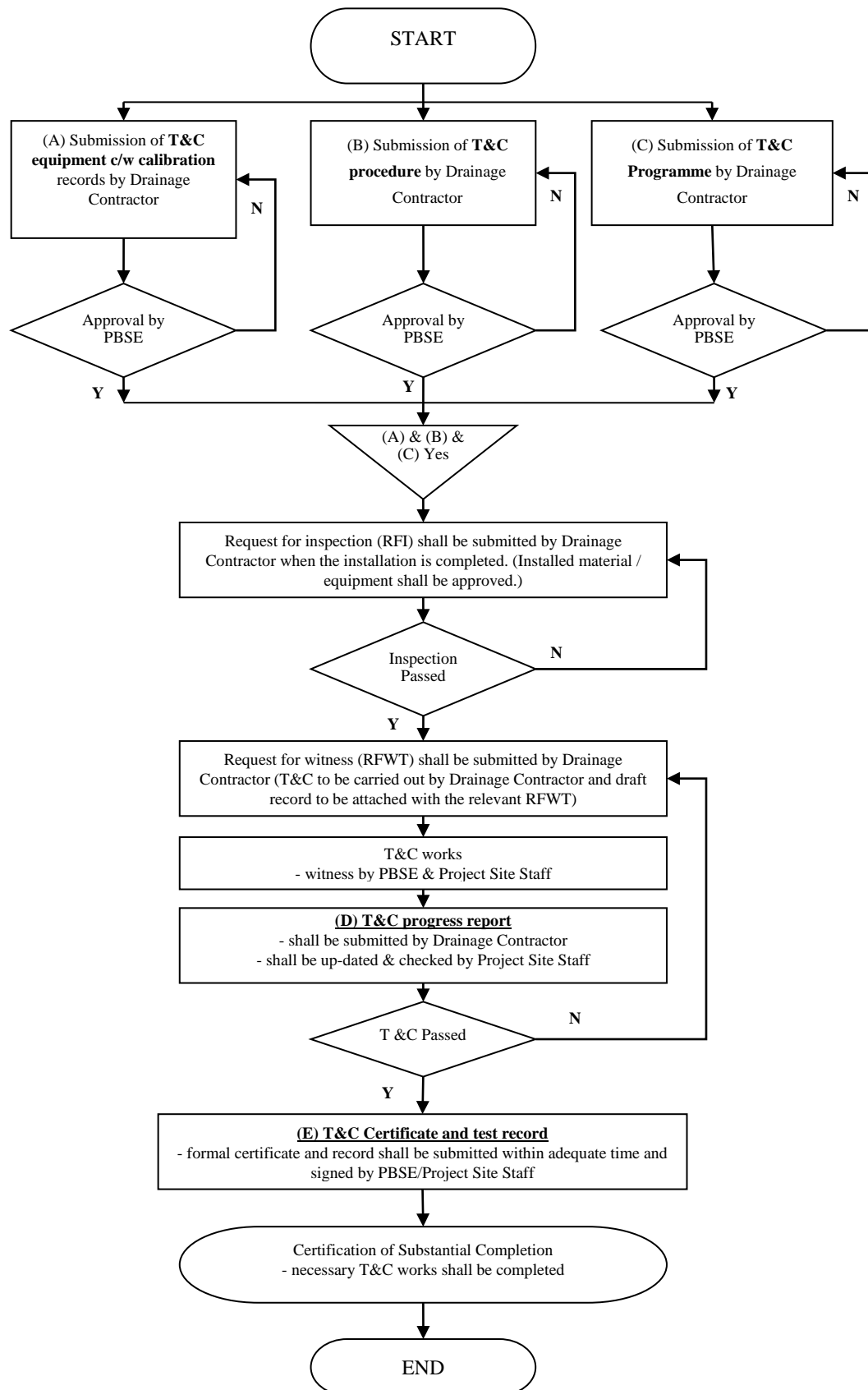
4.6.2 If the Drainage Contractor proposes use of equivalent modern electronic test equipment/ instruments, the suitability of which shall be approved by the PBSE for the purpose and shall be calibrated to ascertain accuracy and reliability before use if approved. The suggested items of equipment/ instruments & accessories necessary to comply with the T&C objectives, but not limited to, are:-

- (a) inclined manometer in not less than 0.1 Pa (0.0005 in. of water) divisions;
- (b) combined inclined and vertical manometer 0-2000 Pa (0-10 in. of water);
- (c) pitot tubes (size 450 mm (18-in.) and 1200 mm (48-in.) long tube);
- (d) clamp-on ampere meter with voltage scales;
- (e) pressure gauges (Manifold & Single);
- (f) dial push/pull pressure gauge.



## Testing and Commissioning Progress Chart for Drainage Installation

### Flow Chart for Testing and Commissioning Procedure





## Testing and Commissioning Certificate on Drainage Installation

### Part 1: Details of Project

- 1.1 Project title (with location): \_\_\_\_\_
- 1.2 \*P.W.P./Project No.: \_\_\_\_\_
- 1.3 \*Contract/Sub-contract/Quotation No.: \_\_\_\_\_
- 1.4 \*Contractor/Sub-contractor: \_\_\_\_\_
- 1.5 Date of Test: \_\_\_\_\_
- 1.6 Name of PBSE: \_\_\_\_\_
- 1.7 Name of PCOW: \_\_\_\_\_
- 1.8 Name of PBSI: \_\_\_\_\_
- 1.9 Name of PEMI: \_\_\_\_\_

### Part 2: Declaration

- 2.1 I certify that the Drainage Installation as specified in the \*Contract/Sub-contract/Quotation at the above location has been inspected, tested and commissioned in accordance with this Testing and Commissioning (T&C) Procedure (*Note 1*) and/or any other procedure(s) as agreed between the PBSE and the Drainage Contractor. The results are satisfactory in the aspects as mentioned in Part 3 and/or as recorded in Part 4 of this Certificate, except as indicated in the COMMENTS item(s).
- 2.2 I also certify that site tests have been performed in accordance with the requirements set out in this T&C Procedure and that the results are satisfactory. A record of the tests has been prepared and submitted to the PBSE.

Name of Drainage Contractor's Representative: _____	Signature: _____
Designation / Post of Drainage Contractor's Representative: _____	Date signed: _____
Name and Stamp of Drainage Contractor: _____	Telephone No.: _____

#### Note

- T&C Procedure refers to the Testing and Commissioning Procedure for the Drainage Installation.
- The Drainage Contractor's Representative signing this Certificate must be a person or representative authorised by the Drainage Contractor.

\* Delete if not applicable

Items tested/  
checked by  
Drainage  
Contractor

Items  
witnessed by  
PBSE/PCOW/  
PBSI/PEMI

### Part 3: Items Inspected and Tested

#### 3.1 **Underground Drainage System**

##### 3.1.1 Pre-commissioning Checks

###### (I) Check on drawings and visual inspection:

- |    |  |              |              |
|----|--|--------------|--------------|
| a) | The as-built drainage installation has been accorded with the approved drainage plan.  | *Yes/No/N.A. | *Yes/No/N.A. |
| b) | The site photos submitted for each section of drain pipe and manhole requested for inspection.   | *Yes/No/N.A. | *Yes/No/N.A. |
| c) | The pipe materials have been accorded with approved drainage plan.   | *Yes/No/N.A. | *Yes/No/N.A. |
| d) | Actual installation tally with the approved standard / non-standard modification.  | *Yes/No/N.A. | *Yes/No/N.A. |
| e) | The drain and sewer pipes under building structure or carriageway, in addition to soft and yielding grounds have been provided with adequate support and concrete bed/surround as specified in the drawings.         | *Yes/No/N.A. | *Yes/No/N.A. |
| f) | The relieving arches or beams have been provided to protect drains and sewers under a building.  | *Yes/No/N.A. | *Yes/No/N.A. |
| g) | The manholes schedule indicated with manhole types, cover levels, invert levels, vent pipe size, discharge pipe size, invert pipe(s) size have been submitted and checked against the as-built drawings.             | *Yes/No/N.A. | *Yes/No/N.A. |
| h) | The double sealed manhole covers have been provided for manholes inside or under a building.   | *Yes/No/N.A. | *Yes/No/N.A. |
| i) | The manholes have been fitted with cast iron and airtight covers.  | *Yes/No/N.A. | *Yes/No/N.A. |
| j) | The number of inlets has been corresponded to plans and junction of branch drain with another drain obliquely at an angle of not more than 60° in direction of flow.   | *Yes/No/N.A. | *Yes/No/N.A. |
| k) | The junction of every branch drain shall be made within a manhole at an angle of not more than 60° in the direction of flow of the discharge drain pipe, and shall be above the invert of such discharge drain pipe. | *Yes/No/N.A. | *Yes/No/N.A. |
| l) | No double layering of inlet drain pipe to a manhole.   | *Yes/No/N.A. | *Yes/No/N.A. |

Tested / Checked by: (Name of Drainage Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by: (Name(s) of * PBSE/PCOW/PBSI/PEMI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	

	Items tested/ checked by Drainage Contractor	Items witnessed by PBSE/PCOW/ PBSI/PEMI
m) The invert level of all inlet pipes is the same as the bottom level of such manhole or made goods with other acceptable measures (i.e. drop pipe, etc.) to allow smooth flow of drain.	*Yes/No/N.A.	*Yes/No/N.A.
n) The benching formed above the level of drainage channel in manholes to fall towards such channels at a gradient of 1:2 or a drop pipe has been provided falling to the channel.	*Yes/No/N.A.	*Yes/No/N.A.
o) The benching and internal surfaces of manholes have been rendered with cement mortar to provide a smooth and impervious surface.	*Yes/No/N.A.	*Yes/No/N.A.
p) The channels have been constructed inside the manholes with diameter not less than that of the largest drainage inlet into and not more than that of the outlet of the manhole.	*Yes/No/N.A.	*Yes/No/N.A.
q) The additional drainage channel with 2 number of drainage outlets has been provided for area applying the standard modification B(C)R35.	*Yes/No/N.A.	*Yes/No/N.A.
r) The fire stop has been provided for drainage pipes passing through fire compartments in accordance with the approved shop drawings.	*Yes/No/N.A.	*Yes/No/N.A.
s) The sufficient loading manhole / channel covers have been provided to different functioning area in accordance with the approved drainage plan.	*Yes/No/N.A.	*Yes/No/N.A.
t) The floor drains, rain water outlets, vertical gratings have been installed at pavement or channels with appropriate type of grating covers in accordance with the approved drainage plan.	*Yes/No/N.A.	*Yes/No/N.A.
u) The channel covers types and details installed on site comply with the approved drainage plan.	*Yes/No/N.A.	*Yes/No/N.A.
<b>(II) <u>Check for preparation of Water and Air Test:</u></b>		
v) Proper means of access shall be provided to the area of work and the sides of any trench or excavation in which work is to be tested adequately supported and free from hazards.	*Yes/No/N.A.	*Yes/No/N.A.
w) Where a water test is to be applied, drain stoppers and bags have been properly secured in position and provision made for the final removal of the stopper or bag from surface level by means of a strong cord.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by: (Name of Drainage Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by: (Name(s) of * PBSE/PCOW/PBSI/PEMI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	

	Items tested/ checked by Drainage Contractor	Items witnessed by PBSE/PCOW/ PBSI/PEMI
x) Buried underground drainage pipe shall be embedded away from the slope area unless or otherwise approved by the Architect. (APP-76)	*Yes/No/N.A.	*Yes/No/N.A.
y) No buried underground drainage pipe shall be embedded in the structural elements unless or otherwise approved by the Architect. (APP-105)	*Yes/No/N.A.	*Yes/No/N.A.
z) The drain and sewer pipes have been laid on concrete bed of not less than 100mm thick and at less 150mm wider than the diameter of pipe.	*Yes/No/N.A.	*Yes/No/N.A.
aa) Haunching with concrete by full width of the concrete bed is provided.	*Yes/No/N.A.	*Yes/No/N.A.
bb) All obstructions, debris and superfluous matter have been removed from sections of pipeline, inspection chambers, manholes, or similar underground chambers.	*Yes/No/N.A.	*Yes/No/N.A.
cc) When a chemical cleaning agent is used to remove deposits of cement mortar from the surfaces of benching and channel inverts, protective clothing, including gloves and eyeshields, shall be provided for operatives using or handling the chemicals. On completion of the work, all treated surfaces shall be thoroughly hosed down.	*Yes/No/N.A.	*Yes/No/N.A.
dd) The pipes, joints and fittings including internal and external coatings are cleaned immediately before and after jointing to ensure free of deleterious materials.	*Yes/No/N.A.	*Yes/No/N.A.
ee) For cast iron pipes, joints and fittings, the width of gaps at joints is checked as per manufacturer's recommendations and the elastomeric joint rings are checked in position by metal feeler after jointing. For vitrified clay pipes, it is checked with approved gaskin and mortar bedding at collar positions.	*Yes/No/N.A.	*Yes/No/N.A.
ff) Before any test is applied, a disc or ball type profile testing device shall be passed through all drains and private sewers between inspection chambers, manholes or other suitable points of access and through all accessible branch drains.	*Yes/No/N.A.	*Yes/No/N.A.
gg) All pipes under test are marked with nominal size, name of manufacturer or Trade Mark, manufacturing standard with colour and intervals required.	*Yes/No/N.A.	*Yes/No/N.A.
hh) All pipes under test are under correct alignment, level and length.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by: (Name of Drainage Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by: (Name(s) of * PBSE/PCOW/PBSI/PEMI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	

	Items tested/ checked by Drainage Contractor	Items witnessed by PBSE/PCOW/ PBSI/PEMI
ii) All pipes, joints and fittings under test are without damage.	*Yes/No/N.A.	*Yes/No/N.A.
jj) When concrete bed, haunch and surround are used for the pipes, concrete work shall be complied with specifications.	*Yes/No/N.A.	*Yes/No/N.A.
kk) Joints between pipes are completed with methodology complying manufacturer's recommendations or specifications of contract documents or approved equipment and materials by PBSE.	*Yes/No/N.A.	*Yes/No/N.A.
ll) Terminal manhole and invert levels shall be complied with DSD's requirements.	*Yes/No/N.A.	*Yes/No/N.A.
mm) Size of connection pipe shall be complied with DSD's requirements.	*Yes/No/N.A.	*Yes/No/N.A.
nn) Temporary covers for the provision of all drain points are checked and securely covered up to ensure free of ingress of cement in the pipeline, in particular where in-situ construction method is used.	*Yes/No/N.A.	*Yes/No/N.A.
<b>3.1.2 <u>Water Test</u></b> (Applicable to pipelines up to and including 300mm internal diameter)		
a) Gravity pipelines for drainage shall be tested either after the pipes have been jointed and granular bedding has been placed and immediately before haunch or surround is placed of fill material is deposited, or after the pipes have been jointed on cradles and immediately before concrete bedding, haunch or surround is placed.	*Yes/No/N.A.	*Yes/No/N.A.
b) Pipelines are filled with water before test for an interval of two hours as approved by PBSE to allow initial water absorption.	*Yes/No/N.A.	*Yes/No/N.A.
c) A test pressure of 1.5m head is applied at high end of the pipelines under test and is maintained for an interval of 30 minutes or otherwise as approved by PBSE. (Remark: Test pressure at low end shall not exceed 6m head)	*Yes/No/N.A.	*Yes/No/N.A.
d) Measure the loss of water inside the pipelines under test and check if it is not more than 1 Litre per hour per metre of nominal diameter per linear metre run of pipe or otherwise within the acceptance range as specified in the contract. (Using Standard Form for Underground Pipe Water Test in Annex II)	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by: (Name of Drainage Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by: (Name(s) of * PBSE/PCOW/PBSI/PEMI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	

	Items tested/ checked by Drainage Contractor	Items witnessed by PBSE/PCOW/ PBSI/PEMI
e) If the subject pipeline under test is failed, it shall be clearly recorded and marked up on the part-plan as appropriate. The defects shall be made good and re-test shall be arranged until all sections are tested to be order.	*Yes/No/N.A.	*Yes/No/N.A.
<b>3.1.3 Air Test</b> (Application to pipelines exceeding 300mm internal diameter)		
a) The end of the pipelines and all associated branches under test are sealed by expanding drain plugs or inflatable canvas or rubber test bags.	*Yes/No/N.A.	*Yes/No/N.A.
b) Air is pumped inside the pipelines until a test pressure of slightly greater than 100mm of water is registered on a U-tube manometer which is connected to the pipelines.	*Yes/No/N.A.	*Yes/No/N.A.
c) Five minutes shall be allowed for stabilisation of the air temperature, and the air pressure shall be adjusted to 100mm of water before carrying out the test.	*Yes/No/N.A.	*Yes/No/N.A.
d) The air pressure inside the pipelines shall be read from the U-tube at the end of the five minutes period and check if loss in air pressure shall not maintain less than 75mm of water, or otherwise specified in the contract. (Using Standard Form for Underground Pipe Air Test in Annex II)	*Yes/No/N.A.	*Yes/No/N.A.
e) If the subject pipeline under test is failed, it shall be clearly recorded and marked up on the part-plan as appropriate. The defects shall be made good and re-test shall be arranged.	*Yes/No/N.A.	*Yes/No/N.A.

### 3.2 Above Ground Drainage System

#### 3.2.1 Pre-commissioning Checks

##### (I) Check on drawings and visual inspection:

a) The as-built drainage installation has been accorded with the approved drainage plan.	*Yes/No/N.A.	*Yes/No/N.A.
b) The site photos submitted for each section of drain pipe and manhole requested for inspection.	*Yes/No/N.A.	*Yes/No/N.A.
c) The pipe materials have been accorded with approved drainage plan.	*Yes/No/N.A.	*Yes/No/N.A.
d) Actual installation tally with the approved standard / non-standard modification.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by: (Name of Drainage Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by: (Name(s) of * PBSE/PCOW/PBSI/PEMI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	



	Items tested/ checked by Drainage Contractor	Items witnessed by PBSE/PCOW/ PBSI/PEMI
e) The additional drainage channel with 2 number of drainage outlets has been provided for area applying the standard modification B(C)R35.	*Yes/No/N.A.	*Yes/No/N.A.
f) The fire stop has been provided for drainage pipes passing through fire compartments in accordance with the approved shop drawings.	*Yes/No/N.A.	*Yes/No/N.A.
g) The sufficient loading manhole / channel covers have been provided to different functioning area in accordance with the approved drainage plan.	*Yes/No/N.A.	*Yes/No/N.A.
h) The floor drains, rain water outlets, vertical gratings have been installed at pavement or channels with appropriate type of grating covers in accordance with the approved drainage plan.	*Yes/No/N.A.	*Yes/No/N.A.
i) The channel covers types and details installed on site comply with the approved drainage plan.	*Yes/No/N.A.	*Yes/No/N.A.
<b>(II) <u>Check for preparation of Water and Air Test:</u></b>		
j) Where a water test is to be applied, drain stoppers and bags have been properly secured in position and provision made for the final removal of the stopper or bag from surface level by means of a strong cord.	*Yes/No/N.A.	*Yes/No/N.A.
k) All obstructions, debris and superfluous matter have been removed from sections of pipeline, inspection eye, or similar underground chambers.	*Yes/No/N.A.	*Yes/No/N.A.
l) When a chemical cleaning agent is used to remove deposits of cement mortar from the surfaces of, protective clothing, including gloves and eyeshields, shall be provided for operatives using or handling the chemicals. On completion of the work, all treated surfaces shall be thoroughly hosed down.	*Yes/No/N.A.	*Yes/No/N.A.
m) Before any test is applied, device shall be passed through all drains and private sewers between inspection chambers, manholes or other suitable points of access and through all accessible branch drains.	*Yes/No/N.A.	*Yes/No/N.A.
n) All pipes under test are marked with nominal size, name of manufacturer, manufacturing standard with colour and intervals required.	*Yes/No/N.A.	*Yes/No/N.A.
o) All pipes under test are under correct alignment, level and length.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by: (Name of Drainage Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by: (Name(s) of * PBSE/PCOW/PBSI/PEMI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	

	Items tested/ checked by Drainage Contractor	Items witnessed by PBSE/PCOW/ PBSI/PEMI
p) All pipes under test are without damage.	*Yes/No/N.A.	*Yes/No/N.A.
q) Joints between pipes are completed methodology complying with manufacturer's recommendations or specifications of contract documents.	*Yes/No/N.A.	*Yes/No/N.A.
r) Temporary covers for the provision of all drain points are checked and securely covered up to ensure free of ingress of cement in the pipeline, in particular where in-situ construction method is used.	*Yes/No/N.A.	*Yes/No/N.A.
<b>3.2.2 <u>Water Test for drainage stack</u></b>		
Leakage of water is observed at the stack below the lowest sanitary appliance.	*Yes/No/N.A.	*Yes/No/N.A.
<b>3.2.3 <u>Air Test for drainage stack</u></b>		
Leakage of water is observed at the stack above the lowest sanitary appliance.	*Yes/No/N.A.	*Yes/No/N.A.
<b>3.2.4 <u>Water Test for individual drain points</u> (including discharge point of sanitary fitment, floor drain, planter drain, rainwater outlet, movement joint drain outlet, etc.)</b>		
a) The selected index point or optimal first point of drain outlet for filling-in water.	*Yes/No/N.A.	*Yes/No/N.A.
b) The water stored in the storage vessels are discharged into the index point or optimal first point.	*Yes/No/N.A.	*Yes/No/N.A.
c) The sections under test are examined by vision to check if any leakage water.	*Yes/No/N.A.	*Yes/No/N.A.
d) If the subject sections of pipeline under test are failed, it shall be clearly recorded and marked up on the part-plan as appropriate. The defects shall be made good and re-test shall be arranged until all sections are tested to be order.	*Yes/No/N.A.	*Yes/No/N.A.
<b>3.2.5 <u>Cleaning of installation after completion of testing and commissioning</u></b>		
a) For drain pipe not exceeding 300mm dia., a mandrel 750mm long and 12mm dia. or less to remove obstruction in the pipeline and make good for smoothening the invert.	*Yes/No/N.A.	*Yes/No/N.A.
b) For drain pipe exceeding 300mm dia., high pressure water jet or similar approved method is used to wash away debris in manholes and chambers.	*Yes/No/N.A.	*Yes/No/N.A.

Tested / Checked by: (Name of Drainage Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by: (Name(s) of * PBSE/PCOW/PBSI/PEMI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	

Items tested/  
checked by  
Drainage  
Contractor

Items  
witnessed by  
PBSE/PCOW/  
PBSI/PEMI

### 3.3 Sump/ Sewage Water Pump Installation

(To be checked by PBSI/PEMI)

- |    |   |              |              |
|----|---|--------------|--------------|
| a) | A standby pump set for both fixed water pump system and booster water pump system shall be provided.  | *Yes/No/N.A. | *Yes/No/N.A. |
| b) | Water pumps and motors are run at the designed discharge water pressure and operating electrical current.   | *Yes/No/N.A. | *Yes/No/N.A. |
| c) | Water pumps are run at an acceptable noise and vibration levels.  | *Yes/No/N.A. | *Yes/No/N.A. |
| d) | Water pump control switches and indicating lights function properly.  | *Yes/No/N.A. | *Yes/No/N.A. |
| e) | The protective devices of water pump function properly.   | *Yes/No/N.A. | *Yes/No/N.A. |
| f) | The temperatures of the water pump bearings at running condition are normal.  | *Yes/No/N.A. | *Yes/No/N.A. |
| g) | The temperatures of the pump motors at running condition are normal.  | *Yes/No/N.A. | *Yes/No/N.A. |
| h) | Non-return valves connected to the pumps function are installed properly.   | *Yes/No/N.A. | *Yes/No/N.A. |
| i) | A full way gate valve shall be provided on the drain-off pipe.  | *Yes/No/N.A. | *Yes/No/N.A. |
| j) | Prior to pump start-up, the contractor shall check the horizontal or vertical alignment of all flexible joints is within the tolerances recommended by the manufacturers' installation guideline. | *Yes/No/N.A. | *Yes/No/N.A. |
| k) | <u>Measurement</u>  |              |              |

Location: \_\_\_\_\_ No.: \_\_\_\_\_

	<u>Designed</u>	<u>Measured</u>	Remarks
Volume flow rate (l/s)			
No flow head (kPa)			
Full flow head (kPa)			
Starting current (A)			
Running current (A)			

Tested / Checked by: (Name of Drainage Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by: (Name(s) of * PBSE/PCOW/PBSI/PEMI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	

Items tested/ checked by Drainage Contractor	Items witnessed by PBSE/PCOW/ PBSI/PEMI
---	--

Electrical Wiring

- |    |   |              |              |
|----|---|--------------|--------------|
| l) | The electrical wiring system shall be tested satisfactorily in accordance with the T&C Procedure No. 2 for Electrical Installation and to Electricity Ordinance requirements. | *Yes/No/N.A. | *Yes/No/N.A. |
| m) | Starter overloads are set currently in relation to the motor name-plant full load current.  | *Yes/No/N.A. | *Yes/No/N.A. |
| n) | All conductors shall be correctly and securely connected and identified.  | *Yes/No/N.A. | *Yes/No/N.A. |
| o) | Methods of protection against direct contact shall be properly applied.   | *Yes/No/N.A. | *Yes/No/N.A. |
| p) | Isolation and switching devices are properly and correctly installed.   | *Yes/No/N.A. | *Yes/No/N.A. |
| q) | Protective devices and monitoring devices are properly and correctly installed and set (e.g. MCB, control fuse, ammeter & voltmeter).   | *Yes/No/N.A. | *Yes/No/N.A. |
| r) | The electric circuits, fused, switches, terminals, bonding, etc. are properly and correctly labelled.   | *Yes/No/N.A. | *Yes/No/N.A. |
| s) | Danger notices, warning notices, schematic diagrams, instructions and similar information are correctly and adequately provided.  | *Yes/No/N.A. | *Yes/No/N.A. |

Pump Panels

- |     |   |              |              |
|-----|---|--------------|--------------|
| t)  | All internal control panels are properly earthed.   | *Yes/No/N.A. | *Yes/No/N.A. |
| u)  | Nuts and bolts are tightened and connected properly.  | *Yes/No/N.A. | *Yes/No/N.A. |
| v)  | Equipment dust-free and in good order.  | *Yes/No/N.A. | *Yes/No/N.A. |
| w)  | All cables and terminals have good protection.  | *Yes/No/N.A. | *Yes/No/N.A. |
| x)  | All conduits and wirings are of appropriate size.   | *Yes/No/N.A. | *Yes/No/N.A. |
| y)  | All level switch/ level sensor (i.e. low level cut-in, low level cut-out, high level cut out) are set correctly and performed properly. | *Yes/No/N.A. | *Yes/No/N.A. |
| z)  | All indication lamps are performed properly.  | *Yes/No/N.A. | *Yes/No/N.A. |
| aa) | Buzzer is set correctly in relation to the system / equipment failure and performed properly.   | *Yes/No/N.A. | *Yes/No/N.A. |

Tested / Checked by: (Name of Drainage Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by: (Name(s) of * PBSE/PCOW/PBSI/PEMI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	



**Part 4: Test Record attached to the Test Certificate**

**4.1 Test Data**

Proforma for recording following data can be found in the succeeding pages and these shall be properly filled in before submission to the PBSE with any relevant comments related to site conditions.

- Underground Pipe Water Test in Drainage Installation
- Underground Pipe Air Test in Drainage Installation

**Proforma for Underground Pipe Water Test in Drainage Installation**

Contract No . : \_\_\_\_\_  
 Contract Title : \_\_\_\_\_  
 Name of Drainage Contractor/Sub-contractor : \_\_\_\_\_  
 Pressure applied: 1.5m water head with 100mm dia. stand pipe (test for 30 minutes)  
 Permissible loss: See 'Table A' below

Date of Test: \_\_\_\_\_  
 Weather: \*Sunny/ Rainy/ Windy  
 Temperature: \_\_\_\_\_ °C  
 Attached part-plan No. \_\_\_\_\_

Pipe section no.	Location		Type of system	Type of material	Pipe dia. (mm)	Pipe length (m)	Outgoing pipe invert	Incoming pipe invert	Pipe gradient in 1 : x	Start time	Finish time	Permissible water loss (mm)	Actual water loss (mm)	Result (Pass/Fail)
	From	to												

Notes:

\* Delete if not applicable

**Table A – Acceptance criteria for permissible loss**

Nominal pipe dia. (mm)	Litres lost per meter run of section of pipeline tested
100	0.05
150	0.08
225	0.12
<u>Note:</u> The figures are equivalent to a loss of One L/h per metre dia. of pipe per metre run of pipeline	

**Proforma for Underground Pipe Air Test in Drainage Installation**

Contract No . : \_\_\_\_\_

Date of Test: \_\_\_\_\_

Contract Title : \_\_\_\_\_

Weather: \*Sunny/ Rainy/ Windy \_\_\_\_\_

Name of Drainage Contractor/Sub-contractor : \_\_\_\_\_

Temperature: \_\_\_\_\_ °C

Permissible loss: 25 mm drop max. for 100mm water gauge test pressure (for 5 minutes) \_\_\_\_\_

Attached part-plan No. \_\_\_\_\_

Pipe section no.	Location		Type of system	Type of material	Pipe dia. (mm)	Pipe length (m)	Outgoing pipe invert	Incoming pipe invert	Pipe gradient in 1 : x	Start time	Finish time	Permissible water loss (mm)	Actual water loss (mm)	Result (Pass/Fail)
	From	to												

Notes:

\* Delete if not applicable



