TESTING AND COMMISSIONING PROCEDURE

FOR

PLUMBING AND DRAINAGE INSTALLATION

IN

GOVERNMENT BUILDINGS

OF

THE HONG KONG SPECIAL ADMINISTRATIVE REGION

2012 EDITION

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 Plumbing and 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 had incorporated the latest changes in corrigendum no. GSPD01-2012 for the 2012 edition of the General Specification for Plumbing and 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 content of 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 Plumbing and 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
Plumbing and Drainage Installation

1. Introduction

The procedures stated in this 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 Architect’s Representatives, in the following aspects with respect to testing and commissioning (T&C):

(a) To vet and approve the T&C procedures proposed and submitted by the contractor for the Plumbing and Drainage Installation (PD Contractor);

(b) To witness those T&C procedures as specified; and

(c) To accept the T&C certificates and other supporting data.

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

The administrative requirements for T&C works are in general as specified in the General Specification for Plumbing and Drainage Installation 2012 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 T&C 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 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 installation other than those indicated in this T&C Procedure.
3. Scope of the T&C 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 PD Contractor shall ensure that the Plumbing and Drainage Installation (Installations) complies 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 PD Contractor shall note the following:

(a) Electricity Ordinance (Cap. 406), and other subsidiary legislation;

(b) Code of Practice for the Electricity (Wiring) Regulations published by the EMSD;

(c) Occupational Safety and Health Ordinance (Cap. 509), and other subsidiary legislation made under the Ordinance;

(d) Factories and Industrial Undertakings Ordinance (Cap. 59), and other subsidiary legislation made under the Ordinance, including but not limited to Construction Site (Safety) Regulations;

(e) Electricity supply rules of the relevant power supply companies; and

(f) Code of Practice for Prevention of Legionnaires’ Disease.

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 General Specification and/or Particular Specification. Functional performance tests shall proceed from the testing of individual components to the testing of different systems in the Installations.

The PD 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 General Specification and/or Particular Specification. The testing of systems may have to be carried out in stages depending on the progress of work or as proposed by the PD Contractor.

Part of the tests may be required to be carried out in suppliers’ premises in accordance with the provisions in the General Specification and/or Particular Specification.
Any performance deficiencies revealed during the functional performance tests must be evaluated to determine the cause. After completion of the necessary corrective measures, the PD Contractor shall repeat the tests.

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

3.3 Commissioning and Statutory Inspections

Commissioning is the advancement of the Installations from the stage of static completion to full working conditions and to meet the performance requirements as specified in the General Specification and/or Particular Specification. This will include setting into operation and regulation of the Installations. Fine-tuning of the commissioned system shall be done by the PD Contractor to match system performance to the actual needs of the building occupier more closely.

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

Where practicable, the PD Contractor shall arrange for inspection by the Water Authority 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:-

(a) Relevant Regulations under the Waterworks Ordinance (Chapter 102), such as Waterworks Regulations (WW Reg.), Hong Kong Waterworks Standard Requirements for Plumbing Installation in Buildings (HKWSR);

(b) Relevant Regulations under the Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations Chapter 123 Subsidiary Legislation;

(c) Relevant Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers (i.e. PNAP), and Practice Notes for Registered Contractors issued by Buildings Department;

(d) Relevant Circular Letters to all Licensed Plumbers and Authorized Persons issued by Water Supplies Department.
3.4 Documentation and Deliverables

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

All inspection and T&C results shall be recorded by the PD 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 PD Contractor’s project engineer shall complete and sign a testing and commissioning certificate as shown in Part 1 & Part 2 of 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 General Specification and/or Particular Specification or the design intent shall be recorded, with a description and analysis included.

Where required in the General Specification and/or Particular Specification, the PD 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 General Commissioning 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 PD 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.

(a) Checking procedures on builder’s work:-

(i) Plant rooms are completed and free of construction debris;

(ii) All plant room doors are fitted and lockable;

(iii) Permanent power supply of sufficient capacity is available and the PD Contractor is operating a security access procedure to all plant areas to prevent unauthorised switching of plant.

(The normal security access system is one of "Permit to Work" arrangement and procedure proposed by the PD Contractor in
accordance with the guidelines on "Permit to Work" issued by the Labour Department.);

(iv) All builder’s work and building services installations in association with plumbing and drainage installation are satisfactorily completed;

(v) All external doors, all stairs and lobbies, and toilet doors are completed and securable;

(b) Checking procedures on plumbing and drainage installation

The PD Contractor shall ensure that:-

(i) Plant room access is restricted to authorised personnel only;

(ii) Provision of power supply for the T&C works; and

(iii) All functional and safety devices are installed and operational.

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 start up;

(b) Preliminary adjustment and setting of all plant and equipment consistent with eventual design performance;

(c) Energising and setting to work on all plants; and

(d) 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 PD 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.
3.6 General Testing Requirements

3.6.1 Witness by the PBSE

The final tests shall be carried out in the presence of the PBSE or his representative, in accordance with the requirements of witness T&C as stipulated in the Building Services Branch Instructions. The PD Contractor shall give at least 72 hours advance notice, in writing, when any part or parts of the installation will be tested.

3.6.2 Test Equipment and Labour

The PD Contractor shall provide all the necessary staff, skilled labour, testing gear (including pumps, tools, water flow instruments etc.) and attendants for all tests including those by Specialist employed under the Sub-contractor. The PD Contractor shall be solely responsible for the proper filling, emptying and flushing of the systems and pipes to be tested and shall make good any defects emerging from the tests, or made manifest under testing or re-testing, until the whole of the Installations is free from defect and is in complete working order to the satisfaction of the PBSE.

3.6.3 Tests under Operating Conditions

The PD Contractor shall include the hydraulic and functional performance tests under operating conditions, on the whole installation to the entire satisfaction of the PBSE.

4. T&C Procedures

4.1 Cold Water Supply Installation

4.1.1 Test and Inspections during Construction

Certain tests will be carried out on different systems of the installation during construction to ensure their suitability for operating at the design conditions. Certificates of such tests have to be issued together with certificates of any work tests.

4.1.1.1 Work Tests

(a) Work tests shall be carried out in accordance with the type normally associated with the specified item of equipment and to the standards as laid down in the General Specification and/or Particular Specification.

(b) Work static pressure tests shall be carried out for all items of plant and equipment, as laid down in the Specification and the Contract.
4.1.1.2 Weld in Piped Services

(a) The PBSE reserves the right to inspect at random 2% of the welded joints. Should any of the above welds prove faulty in materials or workmanship, further removal of welds may be ordered up to a total of 4% of the welded joints. If any of the welds fail the tests, it is sufficient to conclude that an operative is not consistent in standard. The PBSE may order any number of the operative’s welds to be removed. The PD Contractor shall be responsible for cutting out and repair of all such welds for inspection.

(b) At least 2 welds per operative shall be inspected. Each welder employed on the works shall be allocated an identification number and each site weld shall be stamped with the appropriate identification number to identify the operative.

(c) In addition to the above, each weld made on pipes and fittings having a nominal diameter of 350 mm and larger, and a 5% sample of all welds on pipes and fittings 300 mm diameter and below shall be inspected using an approved non destructive inspection process, e.g. radiographic or ultrasonic methods. The PD Contractor’s attention is drawn to the magnitude of this task, the constraints of the water mains, and the time frame within which testing must be carried out. Such non-destructive testing shall be carried out by specialized laboratories that both perform the tests and analyse the results.

4.1.1.3 Pre-commissioning Checks of Water Distribution System

4.1.1.3.1 System Cleanliness

Irrespective of the precautions taken during the construction stage to keep the internal surfaces of pipework clean, the following procedures shall be used to clean the system.

(a) divide the pipework system into self-draining sections so that the maximum possible flushing rate is achieved;

(b) isolate or bypass items which are particularly sensitive to dirt such as pumps, small bore coils and tubes. Washers, feed and other tanks which may have accumulated with deposits during manufacturing or installation shall also be isolated and flushed independently; and

(c) where make-up or feed tanks are used for flushing, ensure that the maximum possible pressure is sustained on the system during the flushing process. This may necessitate the provision of a temporary parallel feed of mains water into the tank where the ball valve has limited capacity. This T&C Procedure assumes that the connection of the section from the tank is at a high
point in the section being flushed. The flushing water wherever appropriate, shall be recirculated with suitable filtration to reduce the water demand and wastewater discharge.

(d) The PD Contractor shall ensure that:

(i) flushing is carried out from the upper to the lower sections of a multi-section system, flushing with the lowest point; initial flushing shall always be from small bore to large bore pipe;

(ii) the large bore outlet is not opened until the section being flushed is fully primed;

(iii) the maximum possible flow rates are used; and

(iv) flushing continues until the outflow runs clear.

Where facilities exist, cleaning of systems can be achieved by circulation of the medium in order to collect dirt at filters or other selected points in the system. Where circulation is achieved by the use of a pump, this action shall be deferred until the pump has been set to work in accordance with the relevant paragraph below. The circulating velocity shall be 1.5 times of normal water velocity in pipe.

4.1.1.3.2 State of the System

The PD Contractor shall check:

(a) that where special valve packing is required, e.g. grease in medium or high temperature system, this shall be in accordance with manufacturer’s instructions;

(b) that pressure tests have been completed throughout;

(c) that the system has been cleaned in accordance with para. 4.1.1.3.1;

(d) that permanent water connections have been made; and

(e) that water treatment is available if specified.

4.1.1.3.3 Check of System before Filling

The PD Contractor shall check:

(a) that probes, pockets, pressure gauges, siphons, orifice plates and taps, and air vents are installed;
(b) that drains and overflows are connected and free from blockage;

c) that connections to the appliances and fittings are correct in relation to the design water flow direction;

d) that control and non-return valves are installed the right way round;

e) that relief valves are installed as specified and are free to operate;

(f) that relief valve outlets are piped away to suitable drain points;

g) the expansion devices for alignment and freedom from obstruction;

(h) the presence of special pump priming devices where specified;

(i) that the strainer meshes are of the correct grade and material;

(j) that the changeover devices for duplex strainers are operative and that there are means of isolation for single strainers;

(k) that washers, tanks, nozzles and filters are clean;

(l) that tank covers are provided where specified;

(m) that drain cocks are closed and other valves are left open or closed according to the plan for filling;

(n) that the feed connection is in its correct location; and

(o) that all pipework and fittings are adequately supported, guided and/or anchored where applicable.

4.1.1.3.4 Mechanical Checks

(a) Pumps

The PD Contractor shall check:-

(1) the external cleanliness of the pumps, remove and clean and replace all strainers;

(2) that the flow direction is correct;
(3) that all components, bolts, fixings, tie bars etc., are secured;

(4) that the impellers are free to rotate;

(5) the level and plumb of pump and motor shaft and slide rails; (direct drive pumps require particular attention in this respect);

(6) the anti-vibration mountings for correct deflection;

(7) that the correct drivers are fitted;

(8) that the pipework imposes no strain at the pump connections;

(9) the securing and alignment of pulleys and couplings;

(10) the belt tension and match;

(11) the cleanliness of the bearings;

(12) that the lubricant is fresh and of the correct grade;

(13) that the coolant is available at the bearings when specified;

(14) that glands are correctly packed and the gland nuts are finger-tight only, pending adjustment to correct drip rate after start-up; and

(15) that drive guards are fitted and the access for speed measurement is provided.

(b) Pump Panel

The PD Contractor shall check:-

(1) that all internal control panels are properly installed;

(2) that all components, bolts, fixings, tie bars etc., are secured;

(3) that equipment is dust-free and in good order;

(4) that cables and terminals have good protection; and
(5) that conduits and wirings are of appropriate size.

c) Motorized Valves and Float Switches

The PD Contractor shall check:-

(1) that the valves are installed the correct way round;
(2) that the valve spindles are free to move;
(3) for freedom from excessive looseness;
(4) the fit of pins;
(5) the rigidity of the mountings;
(6) the stiffness of the linkage members;
(7) the tightness of locking devices; and
(8) the bearing lubrication.

4.1.3.5 Electrical Checks

Prior to the initial running of any electrically driven pump, valve or electric water heater, the following procedures shall be adopted.

a) With all Electrical Supplies Isolated

The PD Contractor shall check:-

(1) the local isolation of motor and control circuits;
(2) that there are no unshrouded live components within the panels;
(3) that the panels and switchgears are clean;
(4) that the motor and surrounding areas are clean and dry;
(5) that the transit packing has been removed from contactors and other equipment;
(6) that there is no mechanical damage to switchgears and that thermostats are of a suitable range to operate at ambient temperature, see para. 4.2.1.2;
(7) that all mechanical checks on the pump and motor or valve are completed, see para. 4.1.5.4;
(8) that all connections are tight on busbars and wirings;
(9) that the internal links on the starter are correct;
(10) that all power and control wirings have been completed in detail to the circuit diagram, paying special attention to circuit for start-delta connected or specially wound motors;
(11) that the fuse ratings are correct;
(12) that the starter overloads are set correctly in relation to the motor name-plate full load current;
(13) that the dashpots are charged with the correct fluid and the time adjustments and levels are identical;
(14) that insulation tests on the motor have been performed satisfactorily;
(15) that the adjustable thermal cut-outs are set correctly (check manufacturers’ test certificates); and
(16) that all cover plates are fitted.

(b) With the Electrical Supply Available

The PD Contractor shall check:

(1) check that the declared voltage range is available on all supply phases;

(2) where motor powers are substantial or reduced voltage starting or complex interlocks are involved, the control circuit logic and the starter operation shall be tested before the motor is rotated. The supply shall first be isolated by the withdrawal of the 2 power fuses not associated with the control circuit or the disconnection of cables. The “red” phase shall be used for control circuit normally. The control circuit fuse must be checked to ensure that it is rated to give the correct discriminatory protection to the control circuit cables. The control circuit shall be activated and the starter operation observed. Adjust the timers. Check for positive operation of all contactors, relays and interlocks. Finally, open the isolators, reinstate the power connections and close the isolators;
(3) where small motors have direct-on-line starting and simple control circuits, the starter operation, etc., shall be checked when first starting the motor; and

(4) never energise electronic valve motors until the checks in para. 4.1.3.4(c) have been completed.

4.1.3.6 System Filling

All water tanks shall, after erection, be filled with water and shall remain filled for at least 24 hours during which all joints shall be carefully examined. Any defect shall be rectified immediately and the test repeated.

Before finally charging, the water systems shall be thoroughly flushed and all strainers, filters, etc. cleaned or replaced.

Charge the system with water by filling from the bottom upwards forcing the air to high points – for venting to atmosphere. Careful consideration shall be given to the stage of valves and air vents before and during filling to avoid air-locks and excessive spillage. Take care not to exceed the working pressure of the system when filling from a high pressure source. When the whole system is filled, disconnect the filling source, open the permanent supply and adjust the tank level.

4.1.3.7 Hydraulic testing for water distribution pipe work system

(a) General

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

(b) Test Pressure

The hydraulic test pressure shall be 1.5 times the maximum working pressure.

(c) 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.
(d) 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.

(e) 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 PD 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 PD Contractor.

(f) Details on Test Certificate

All test certificates shall be signed by the PD Contractor’s authorized 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 PD 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 PD Contractor for PBSE’s approval prior to carrying out the actual test on the Site.

4.1.2 Functional Performance Tests

4.1.2.1 Pump

4.1.2.1.1 Prior to Pump Started-Up, the PD 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.

4.1.2.1.2 Initial Running of Electrically Driven Centrifugal Pump Set

4.1.2.1.2.1 Initial Start

On activating the motor starter, the PD Contractor shall check that:-

(a) the direction and speed of rotation of the motor shaft are correct;

(b) the motor, pump and drive are free from vibration and undue noise;

(c) the motor running current on all phases are balanced and do not exceed motor nameplate rating. The flow valve can be opened at this point to raise the running current to say 50 per cent of the name-plate full load current;

(d) there is no sparking at the commutator or slip rings for d.c. or slip ring motors;

(e) there is no overheating of the motor (see BS EN 60947-4-1 [2004] and BS EN 60034-3 [2005]);

(f) there is no seepage of lubricant from the housing;

(g) the water flow to water-cooled bearings is sufficient;

(h) the motor running current are correctly matching with the speed as specified by manufacturer’s pump data sheet on multi-speed motors.

4.1.2.1.2.2 Initial Run

(a) a light load shall be sustained until the Commissioning Engineer is satisfied from the checks listed in para.
4.1.2.1.2.1 and from motor insulation test readings that further load may be applied. Repetitive starting of the motor shall be avoided to prevent over-stressing of the fuses, switchgear and motor;

(b) gradually open the discharge valve from closed position until the motor current reaches either the design value or the motor full load current, whichever is the lower;

(c) 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

(d) 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.

4.1.2.1.2.3 Running-in Period

(a) 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;

(b) check that the bearings and motor temperature remain steady, that no noise or vibration develops and that no bolts or fixing works is loose;

(c) close the valves to the vulnerable units to avoid blockage at the coils of terminal units;

(d) vent all high points from time to time;

(e) adjust the gland nuts of the pump glands to give the correct drip rate; (not applicable to mechanical seals.) and

(f) after 8 hours of running, check all strainers. If these are clean, regulation can commence. Otherwise, clean the strainers and run again for at least 8 hours and then re-check.

(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.)
4.1.2.1.2.4 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 energizing the standby pump to ensure that any contributory causes are remedied.

4.1.2.1.3 Regulation of Water Flow

4.1.2.1.3.1 Principles of water flow rate measurement & 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 venturi-meter, 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
\[\Delta P_1 = \text{Actual pressure drop in kPa}\]
\[\Delta P_2 = \text{Design pressure drop in kPa}\]
\[Q_1 = \text{Actual water flow rate in m}^3/\text{s}\]
\[Q_2 = \text{Design water flow rate in m}^3/\text{s}\]

(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.
4.1.2.1.4 Demonstration

The PD 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.

4.1.3 Commissioning and Statutory Inspections

4.1.3.1 Licensed Plumber (LP)

Provided that all pipes and fittings intended to be installed are approved by the Water Authority, the LP shall be engaged by the PD Contractor and required to submit Application Form WWO46 (Part I and II) to WSD for notification before commencement of plumbing work.

Application Form WWO46 (Part IV) shall be submitted to WSD by LP for notification of final inspection of the plumbing work after the completion of the plumbing work.

4.1.3.2 Connection Pipe Provision

The PD Contractor shall arrange all necessary inspections and approvals from the statutory authorities, i.e. Water Supplies Department (WSD), in accordance with the Waterworks Ordinance (Chapter 102).

4.1.3.3 Water Meter / Check Meter Provision

The PD Contractor shall arrange all necessary inspections and approvals from the statutory authorities, i.e. Water Supplies Department (WSD), in accordance with the Waterworks Ordinance (Chapter 102).

4.1.3.4 Water Storage Cistern Provision

The PD Contractor shall arrange all necessary inspections and approvals from the statutory authorities, i.e. Water Supplies Department (WSD), in accordance with the Waterworks Ordinance (Chapter 102).

4.1.3.5 Cleaning and Disinfection

All water distribution pipework and water storage tanks shall be thoroughly flushed clean to remove rust, sludge and sediment upon commissioning. Portable water distribution pipework and associated water storage tanks shall be further disinfected before they are put into operation, to remove organic matter which encourages the growth of biofilms and subsequently deterioration of water quality.

The PD Contractor shall submit a cleaning and disinfection plan indicating the scope of work, detail of the compartmentation if any, work schedule, method statement for the disinfection work, procedures and
equipment for checking and testing, location of sampling, method statement for the de-chlorination, etc. for PBSE’s approval prior to carrying out the disinfection work.

4.3.5.1 Methodology of Disinfection

4.3.5.1.1 Upstream Pipework before Water Meter

The PD Contractor shall arrange all necessary cleaning and disinfection of the water pipework upstream of the water meter, i.e. from the incoming fresh water mains to the water meter/check meter of the premise, to the satisfaction of Water Supplies Department (WSD).

The cleaning and disinfection requirements and procedures shall follow Water Supplies Department (WSD)'s current guidelines on cleaning and disinfection. Details of WSD's guidelines are available at the following:

WSD’s guide for fresh water mains of inside services

WSD’s guide for fresh water storage tanks

The potable water supply installation shall be filled completely with a homogeneous solution of chloride of lime for disinfection. The concentration of the solution has to meet the requirement that when the water piping is filled up with water, the free chlorine in the water will be at least 30 p.p.m. The potable water supply installation shall be under disinfection for 24 hours. Persons undertaking the disinfection shall be suitable trained and qualified.

4.3.5.1.2 Downstream Pipework after Water Meter

The PD Contractor shall arrange all necessary cleaning and disinfection of the potable water supply pipework downstream after the water meter/check meter and water storage tanks not more than 7 days before hand over the water supply system to users for operation. Where the potable water supply system is not brought into use immediately after disinfection, it shall be disinfected before use unless it has been flushed weekly to maintain a flow of water.

The methodology of disinfection for downstream pipework after the water meter shall follow BS 8558:2011. The potable water supply installation shall be filled completely with chlorinated water at an initial concentration of 50 p.p.m. for a contact period of one hour. If the free residual chlorine measures at the end of the contact period is less
than 30 p.p.m. the disinfection process shall be repeated. Persons undertaking the disinfection shall be suitable trained and qualified.

After disinfection, the PD Contractor shall flush the water pipework thoroughly with potable water. Flushing shall be continued until there is no evidence of the disinfectant being present, or is below an acceptable level which is allowed by WSD.

4.1.3.5.2 Discharge of disinfectant solution

Before water containing high-residual free chlorine is discharged to drain, it shall be de-chlorinated. Any discharge of the disinfectant solution shall comply with the Water Pollution Control Ordinance (Cap. 358). The PD Contractor shall submit a method statement for the de-chlorination to PBSE for approval.

4.1.3.5.3 Compartmentation of System for Disinfection

The PD Contractor shall conduct disinfection of the entire potable water supply installation and it can be divided by different compartmentation for disinfection if considered necessary for suiting the prevailing site condition or in case of different stage(s) or portion(s) of handover, etc. The proposed compartmentation of potable water supply installation for disinfection shall be stated in the disinfection plan and submitted to PBSE for approval prior to conducting the disinfection work on the Site.

System, or parts of systems shall not be used during the disinfection process and all outlets shall be marked with “DISINFECTION IN PROGRESS, DO NOT USE”. In this respect, the Licensed Plumbers should allow sufficient time to carry out sampling and analysis. After disinfection, the entire potable water supply installation should be flushed thoroughly with potable water.

4.1.3.5.4 Sampling and Analysis

The PD Contractor shall conduct sampling and analysis for the quality of the potable water supply system upon completion of disinfection and flushing of the whole system or of different compartmentation as described in 4.1.3.5.2

(i) Samples shall be taken at the following locations upon substantial completion of the potable water distribution system:-

- all farthest points of use in the water piping system from the water supply tank;
inlet and outlet of all water supply tanks;
both inlet and outlet to water treatment equipment,
such as water filtration device, ultra-violet
disinfection unit where the water is used for drinking
or food preparation purposes;
beginning, middle and end of distribution branches;
supply points to kitchens;
hot water supply points.

The following procedures shall be used for taking water
sampling at the water taps or water pump outlets:

remove from the tap any attachments that may cause
splashing. Using a clean cloth, wipe the outlet to
remove any dirt;
turn on the tap at maximum flow and let the water
run for 1–2 minutes;
sterilize the tap for a minute with the flame from a
gas burner or an ignited alcohol-soaked cotton-wool
swab;
carefully turn on the tap and allow the water to flow
for 1–2 minutes at a medium flow rate. Do not
adjust the flow after it has been set;
take out a bottle and carefully unscrew the cap or
pull out the stopper;
while holding the cap and protective cover face
downwards (to prevent entry of dust, which may
contaminate the sample), immediately hold the
bottle under the water jet, and fill;
left a small air space in the bottle to make shaking
before analysis easier;
place the stopper in the bottle or screw on the cap
and fix the brown paper protective cover in place
with the string.

(ii) Sampling Report form should be made reference in
Annex IV and used to record the sampling data
collected. The PD Contractor shall submit the sampling
report form to PBSE for approval prior to sampling
collection.

4.1.3.5.5 Regular Flushing of pipework

Where the potable water supply installation is not brought
into use immediately after commissioning, the PD
Contractor shall arrange disinfection before put into
operation, unless it has been flushed weekly to maintain a
flow of water.

If the water supply installation is partially handed over for
operation by the users, the PD Contractor shall
continuously flush the remaining portion of the system at regular interval until the whole system has been handed over for operation to the user or after the issue of Handover Certificate by the Architect.

4.1.3.5.6 Record of cleaning and disinfection

The PD Contractor shall maintain properly the record of dates of cleaning and disinfection of the potable water supply installation and provide the record including the approved method statements of the cleaning and disinfection during handover. A notice plate/board should be provided to record the dates of cleaning of the water tanks and securely fixed at a conspicuous location easily accessible and visible by the building management staff.

4.1.3.6 Vibration Tests

Testing for equipment vibration is necessary as an acceptance check to determine whether equipment is functioning properly and to ensure that objectionable vibration and noise are not transmitted. As the vibration acceptance test is based on root mean square (r.m.s) velocity (mm/s) only, frequency measurement is not required. Vibration measurement shall be taken after the equipment had been running for 2 weeks.

(a) record the operating speeds of the equipment (i.e. driving speed of motor) indicated on the nameplates, drawings or measured by speed-measuring device;

(b) determine acceptance criteria from the Particular Specification or as indicated below;

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Allowable rms velocity, mm/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumps</td>
<td>3.3</td>
</tr>
</tbody>
</table>

(c) perform visual and audible checks for any apparent rough operation of the equipment or any defective bearings, misalignment, etc;

(d) calibrate the vibration measuring instrument according to the user’s manual;

(e) measure and record in vibration at bearings of driving and driven components in horizontal, vertical and, if possible, axial directions. There shall be at least one axial measurement for each rotating component (fan motor, pump motor);

(f) indicate other relevant information including date of measurement, type, model and calibration date of the instrument used as well as other observations in the measurement process; and
(g) re-calibrate the instrument after the measurement.

4.2 Hot Water Supply Installation

4.2.1 Hot Water Boiler and Calorifier System

T&C of hot water boiler and calorifier system shall follow the T&C Procedure for Steam Boiler and Calorifier as published by the Architectural Services Department.

4.2.2 Solar Water Heating System

T&C of solar hot water heating system shall follow the T&C Procedure for Air-conditioning, Refrigeration, Ventilation and Central Monitoring and Control System Installation as published by the Architectural Services Department.

4.2.3 Hot Water Supply Distribution System

T&C of the whole hot water supply distribution system, except the Hot Water Boiler and Calorifier System as stipulated in Clause 4.2.1 and the Solar Water Heating System as stipulated in Clause 4.2.2 shall follow the Cold Water Supply Installation as stipulated in Clause 4.1, including the cleaning and disinfection of potable water supply installation and water storage tank as described in clause 4.1.3.5.

4.3 Flushing Water Supply

4.3.1 Flushing Water Supply Distribution System

T&C of the whole flushing water supply distribution system shall follow the Cold Water Supply Installation as stipulated in Clause 4.1, except that disinfection of the pipework and water storage tanks is not required.

4.4 Foul Water Drainage Installation – Underground System

4.4.1 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 PD Contractor’s authorised site representative 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 PD Contractor’s representative in charge of test
- Name of Employer’s representative at witness the test
4.4.2 Smoke Test

(a) Scope and Applicability

The scope of the test is to verify effective performance of the pipelines against leakage. During the test, pipelines which are sealed at both ends and will be filled with smoke generated by the cartridge or smoke machine approved by PBSE.

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

(b) Acceptance criteria

The pipelines shall be completely smoke tight.

(c) Details on Test Certificate

All test certificates shall be signed by the PD Contractor’s authorised site representative 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 interval
- Part-plan drawing identifying pipelines under test
- Result of test
- Name of PD Contractor’s representative in charge of test
- Name of Employer’s representative at witness the test

4.4.3 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 stabilization 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 smoke 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 PD Contractor’s authorised site representative 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 PD Contractor’s representative in charge of test
- Name of Employer’s representative at witness the test
4.4.4 Test for Manhole

(a) Scope and Applicability

The scope of the test is to verify effective performance of the manhole against leakage. During the test, manhole will be filled with water under an approved water level and time interval. The fall in water inside the manhole will be recorded and compared with the maximum permissible fall. The result will be used to reflect the performance of the manhole against leakage.

The test shall be applicable for all types of manholes with all sizes.

(b) Water Level

The minimum water level to be maintained under the test shall be equal to invert level of the incoming drain pipe or otherwise approved by PBSE.

(c) Test Interval

Test interval shall be a minimum of 30 minutes with at least 20 hours for absorption period before the test.

(d) Procedure

The sequence of test shall be as follows:-

1. Remove all obstructions, debris and superfluous matter from the manhole;
2. Seal the end of all connection pipes of the manhole under test by expanding drain plugs or inflatable canvas or rubber test bags;
3. Fill water to the manhole at least 20 hours before the test to allow for absorption period;
4. Record the water level upon test start;
5. Measure the fall of water level inside.

(e) Details on Test Certificate

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

- Date of test
- Weather
4.5 Foul Water Drainage Installation – Aboveground System

4.5.1 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) Connect a manometer to the pipelines;

(3) 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;

(4) Static head shall not exceed 1.2m at the high point of the test and maximum 2.4m at the low point.

(c) Details on Test Certificate

All test certificates shall be signed by the PD Contractor’s authorised site representative 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 PD Contractor’s representative in charge of test
- Name of Employer’s representative at witness the test
4.5.2 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) 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. 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 stabilization 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) Details on Test Certificate

All test certificates shall be signed by the PD Contractor’s authorised site representative 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
4.5.3 Functional 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 PD 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 PD Contractor’s authorised site representative 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
4.6 Surface Water Drainage Installation – Underground System

4.6.1 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 PD Contractor’s authorised site representative 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 PD Contractor’s representative in charge of test
- Name of Employer’s representative at witness the test

4.6.2 Smoke Test

(a) Scope and Applicability

The scope of the test is to verify effective performance of the pipelines against leakage. During the test, pipelines which are sealed at both ends and will be filled with smoke generated by the cartridge or smoke machine approved by PBSE.

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

(b) Acceptance criteria

The pipelines shall be completely smoke tight.

(c) Details on Test Certificate

All test certificates shall be signed by the PD Contractor’s authorised site representative 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 interval
- Part-plan drawing identifying pipelines under test
- Result of test
- Name of PD Contractor’s representative in charge of test
- Name of Employer’s representative at witness the test
4.6.3 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 smoke 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 stabilization 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 PD Contractor’s authorised site representative 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 PD Contractor’s representative in charge of test
- Name of Employer’s representative at witness the test

4.6.4 Test for Manhole

(a) Scope and Applicability

The scope of the test is to verify effective performance of the manhole against leakage. During the test, manhole will be filled with water under an approved water level and time interval. The fall in water inside the manhole will be recorded and compared with the maximum permissible fall. The result will be used to reflect the performance of the manhole against leakage.

The test shall be applicable for all types of manholes with all sizes.

(b) Water Level

The minimum water level to be maintained under the test shall be equal to invert level of the incoming drain pipe or otherwise approved by PBSE.

(c) Test Interval

Test interval shall be a minimum of 30 minutes with at least 20 hours for absorption period before the test.

(d) Procedure

The sequence of test shall be as follows:

1. Remove all obstructions, debris and superfluous matter from the manhole;

2. Seal the end of all connection pipes of the manhole under test by expanding drain plugs or inflatable canvas or rubber test bags;
(3) Fill water to the manhole at least 20 hours before the test to allow for absorption period;

(4) Record the water level upon test start;

(5) Measure the fall of water level inside.

(e) Details on Test Certificate

All test certificates shall be signed by the PD Contractor’s authorised site representative 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 water level
- Test interval
- Part-plan drawing identifying manhole under test
- Result of test
- Name of PD Contractor’s representative in charge of test
- Name of Employer’s representative at witness the test

4.7 Surface Water Drainage Installation – Aboveground System

4.7.1 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 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) Connect a manometer to the pipelines;

(3) 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;

(4) Static head shall not exceed 1.2m at the high point of the test and maximum 2.4m at the low point.
(c) Details on Test Certificate

All test certificates shall be signed by the PD Contractor’s authorised site representative 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 PD Contractor’s representative in charge of test
- Name of Employer’s representative at witness the test

4.7.2 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) 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) 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 stabilization 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) Details on Test Certificate

All test certificates shall be signed by the PD Contractor’s authorised site representative 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 PD Contractor’s representative in charge of test
- Name of Employer’s representative at witness the test

4.7.3 Functional 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 PD 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 PD Contractor’s authorised site representative 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 PD Contractor’s representative in charge of test
- Name of Employer’s representative at witness the test

4.8 Calibrated Equipment

4.8.1 The PD Contractor shall supply the calibrated equipment relevant for T&C of the installation works as stipulated in the Particular Specification for Supply of Inspection, Measuring and Testing Equipment or the General Specification whichever appropriate. The equipment shall be calibrated by the recognised laboratories accredited with the Hong Kong Laboratory Accreditation Scheme (HOKLAS) or other worldwide-recognised laboratories during the active period of the Contract.

4.8.2 A list of equipment proposed by the PD Contractor to be used for T&C must be agreed with the PBSE prior to commissioning the work. All equipment requiring periodic calibration shall have this carried out before the work commences. Data sheets of such testing instrument showing manufacturer’s name, model number, latest date of calibration and correction factors shall be submitted to the PBSE for record. If any item requires re-checking the accuracy because of the time that has elapsed since the previous calibration, this shall be carried out prior to commencing the work.

4.8.3 Calibrated instruments (within 1 year validity) shall as and where necessary be provided and used by the PD Contractor. Alternatively the PD Contractor may propose the use of equivalent modern electronic test equipment, the suitability of which shall be approved by the PBSE for the purpose. The suggested items of instruments & accessories necessary to comply with the T&C objectives are:-

(a) vibration meter to ISO 2954 [1975] for vibratory velocity in mm/s measurement, completed with vibration transducer (accelerometer), Accelerometer Sensitivity: 1pC/ms-2±2% Resolution: 6%;

(b) inclined manometer in not less than 0.1 Pa (0.0005 in. of water) divisions;
(c) combined inclined and vertical manometer 0-2000 Pa (0-10 in. of water);

(d) pitot tubes (size 450 mm (18-in.) and 1200 mm (48-in.) long tube);

(e) a tachometer, which shall be the high quality, direct contact, self-timing type;

(f) clamp-on ampere meter with voltage scales;

(g) pressure gauges (Manifold & Single);

(h) dial push/pull pressure gauge.
Annex I

Testing and Commissioning Progress Chart
“Plumbing and Drainage Installation”

Flow Chart for T&C Procedure

START

(A) Submission of T&C equipment c/w calibration records by PD Contractor
- Approval by PBSE
  - Y
  - N

(B) Submission of T&C procedure by PD Contractor
- Approval by PBSE
  - Y
  - N

(C) Submission of T&C Programme by PD Contractor
- Approval by PBSE
  - Y
  - N

(A) & (B) & (C) Yes

Request for inspection (RFI) shall be submitted by PD Contractor when the installation is completed. (Installed material / equipment shall be approved.)

Inspection Passed

N

Y

Request for witness (RFWT) shall be submitted by PD Contractor (T&C to be carried out by PD Contractor and draft record to be attached with the relevant RFWT.)

T&C works
- witness by PBSE & Project Site Staff. (benchmarks on % of witness to be refer to B.S.B. Instruction No. 5 &5A of 2000)

(D) T&C progress report
- shall be submitted by PD Contractor.
- shall be up-dated & checked by Project Site Staff

T &C Passed

N

Y

(E) T&C Certificate and test record
- formal certificate and record shall be submitted within adequate time and signed by PBSE/Project Site Staff.

Certification of Substantial Completion
- necessary T&C works shall be completed.
(refer to B.S.B. Instruction No. 4 of 2003)

END
## T&C Progress Chart for Plumbing & Drainage Installation

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<td>7.2</td>
<td>Air Test</td>
<td>4.7.2</td>
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<td>7.3</td>
<td>Functional Performance Test</td>
<td>4.7.3</td>
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Notes
* Delete if not applicable
Testing and Commissioning Certificate
on
Plumbing and 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 PBSE:
1.6 PBSI:

Part 2: Declaration

2.1 I certify that the Plumbing and 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 Plumbing and Drainage (PD) 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 Part 3 & 4 of this T&C Procedure and that the results are satisfactory. A record of the tests has been prepared and submitted to the PBSE.

<table>
<thead>
<tr>
<th>Name of PD Contractor’s Representative:</th>
<th>Signature:</th>
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<table>
<thead>
<tr>
<th>Designation / Post of PD Contractor’s Representative:</th>
<th>Date signed:</th>
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<table>
<thead>
<tr>
<th>Name and Stamp of PD Contractor:</th>
<th>Telephone No.:</th>
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</table>

Note:

2. The PD Contractor’s Representative signing this Certificate must be a person or representative authorized by the PD Contractor.

*Delete if not applicable
**Part 3: Items Inspected and Tested**

### Cold Water Supply Installation

#### 3.1 Pre-commissioning Checks

**a)** General Requirements as indicated in the T&C Procedure have been complied.  
*Yes/No/N.A.  Yes/No/N.A.

**b)** Licensed Plumber to carry out the plumbing work and undertake the correctness of the installation to WSD has been appointed.  
*Yes/No/N.A.  Yes/No/N.A.

**c)** Commencement of Plumbing Work – Application Form WWO46 (Part I and II) shall be submitted to WSD for notification.  
*Yes/No/N.A.  Yes/No/N.A.

**d)** All pipes and fittings intended to be installed are approved by the WSD.  
*Yes/No/N.A.  Yes/No/N.A.

**e)** Completion of Plumbing Work – Application Form WWO46 (Part IV) shall be submitted to WSD by the Licensed Plumber for notification of final inspection of the plumbing work.  
*Yes/No/N.A.  Yes/No/N.A.

#### 3.1.2 Connection Pipe

**a)** Size of the Connection Pipe shall be adequate to supply all plumbing installations. (HKSWR 8.8 & 8.15)  
*Yes/No/N.A.  Yes/No/N.A.

**b)** All Piping including the Connection Pipe before meter positions shall be exposed or laid in a proper service duct. (HKSWR 1.2, 7.3 & 8.8)  
*Yes/No/N.A.  Yes/No/N.A.

#### 3.1.3 Water Meter/Check Meter Position

**a)** Meters on indirect supply systems shall be sited at roof level or at other convenient locations and housed in meter rooms/boxes.  
*Yes/No/N.A.  Yes/No/N.A.

**b)** Check meter positions will be required at the connections to the common inside service and to the sump tank.  
*Yes/No/N.A.  Yes/No/N.A.

**c)** Proper drainage, lighting and flood prevention facilities shall be provided at the water meter room. (WW Reg 27, HKWSR 1.4, 1.5, 1.11, 1.12, 1.16, 7.7, 7.10, 8.9 & 8.16)  
*Yes/No/N.A.  Yes/No/N.A.

**d)** All domestic units shall be separately metered (HKWSR 1.1).  
Water supplies for metering types are classified into domestic, construction, shipping and trade purposes.  
*Yes/No/N.A.  Yes/No/N.A.

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e) A standard meter position shall be provided with bushes or reducers at both sides of the meter position and with a distance piece of hollow tube with conspicuous holes drilled through the body placed in between. A longscrew (connector) shall be provided immediately after the bush or reducer at the delivery side. *Yes/No/N.A. *Yes/No/N.A.

f) Meters shall be arranged in groups and sited at convenient locations in communal area and housed in meter rooms/boxes. (HKWSR 1.3, 1.4, 1.5, 1.12, & 7.7) *Yes/No/N.A. *Yes/No/N.A.

g) Brass fittings shall be used at meter position if copper, lined galvanized steel or thermal plastic materials are used inside service. PVC-U fittings shall be used at meter position if PVC-U materials are used as inside service. (HKWSR 10.3) *Yes/No/N.A. *Yes/No/N.A.

3.1.4 Water Storage Cistern

a) Every cistern shall be located so as to minimize the risk of contamination of the stored water. (WW Reg. Sch. 2 Pt III Para 4 & 9, HKWSR 4.6, 4.7 & 4.10) *Yes/No/N.A. *Yes/No/N.A.

b) Every cistern shall be constructed of concrete, galvanized steel or other approved material. Fibreglass storage cisterns for potable water shall be of an approved type. (WW Reg Sch 2 Pt III Para 2 & 3, HKWSR 4.11 & 8.19) *Yes/No/N.A. *Yes/No/N.A.

c) Cisterns shall be fitted with a ball valve controlled inlet in the case of a gravity supply or with an automatic control switch in the case of a pumped supply. *Yes/No/N.A. *Yes/No/N.A.

d) Ball valves of the water cistern are readily accessible. *Yes/No/N.A. *Yes/No/N.A.

e) An overflow pipe of one commercial size larger than the inlet pipe, and in no case less than 25 mm diameter, shall be fitted to each cistern and shall be extended to terminate in a conspicuous position in a communal area easily visible and accessible by the occupants. *Yes/No/N.A. *Yes/No/N.A.

f) The overflow pipe was submerged inside the storage cistern and sited above the inlet. (HKWSR 4.3) *Yes/No/N.A. *Yes/No/N.A.

g) A stop valve shall be provided on the outlet of every cistern and provision shall be made for a drain off pipe to enable the cistern to be emptied. *Yes/No/N.A. *Yes/No/N.A.
### Annex II

<table>
<thead>
<tr>
<th>Items tested/checked by PD Contractor</th>
<th>Items witnessed by PBSE/PBSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>h) Safe access shall be provided to all cisterns by means of a secure permanent ladder or readily available portable ladder.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>i) A grating and a self-closing non-return flap shall be provided at the overflow pipe outside the storage cistern.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>j) Double sealed covers with locking devices shall be provided for all storage cisterns other than cisterns for flushing and fire-fighting purposes. (WW Reg Sch 2 Pt III Para. 5, 6, 7 &amp; 10, HKWSR 4.1, 4.2, 4.3, 4.4, 4.5, 4.6 &amp; 4.8)</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>k) Cistern shall be fitted with a ball valve and a fullway gate valve at the inlet in the case of a gravity supply or with an automatic control switch and without any stop valve in the case of a pumped supply.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>l) Float switches in the water tanks for controlling the water pumps function properly.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>m) High and low water level indications for the water tanks function properly.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>n) Size of the water pump suction water pipe from the water tank is matched with the size of the pump suction inlet.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>o) Each water pump is provided with an independent suction pipe from supply tank.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>p) Strainers are cleaned in water tank.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>q) Cleaning and disinfection of each water storage tank not more than 7 days in advance before handed over.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
</tbody>
</table>

### 3.1.5 Water Pumps

<table>
<thead>
<tr>
<th>Items</th>
<th>PD Contractor</th>
<th>PBSE/PBSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) A standby pump set for both fixed water pump system and booster water pump system shall be provided. (HKWSR 3.3)</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
<td></td>
</tr>
<tr>
<td>b) Water pumps and motors are run at the designed discharge water pressure and operating electrical current.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
<td></td>
</tr>
<tr>
<td>c) Water pumps are run at an acceptable noise and vibration levels.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
<td></td>
</tr>
<tr>
<td>d) Water pump control switches and indicating lights function properly.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
<td></td>
</tr>
<tr>
<td>e) The protective devices of water pump function properly.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
<td></td>
</tr>
</tbody>
</table>

---

### Tested / Checked by:
(Name of PD Contractor’s Representative)

Signature -

Post: 

Tel. No.: 

Date: 

### Witnessed by:
(Name(s) of * PBSE/Project Site Staff)

Signature -

Post: 

Tel. No.: 

Date: 

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<tr>
<td>(Name of PD Contractor’s Representative)</td>
<td>(Name(s) of * PBSE/Project Site Staff)</td>
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**Annex II**

3.1.6 **Electrical Wiring**

a) 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.

b) All conductors shall be correctly and securely connected and identified.

c) Methods of protection against direct contact shall be properly applied.

d) Isolation and switching devices are properly and correctly installed.

e) Protective devices and monitoring devices are properly and correctly installed and set (e.g. MCB, control fuse, ammeter & voltmeter).

f) The electric circuits, fused, switches, terminals, bonding, etc. are properly and correctly labelled.

g) Danger notices, warning notices, schematic diagrams, instructions and similar information are correctly and adequately provided.

3.1.7 **Pump Panels**

a) All internal control panels are properly earthed.

b) Nuts and bolts are tightened and connected properly.

c) Equipment dust-free and in good order.

d) All cables and terminals have good protection.

e) All conduits and wirings are of appropriate size.
### Annex II

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<thead>
<tr>
<th>Tested / Checked by:</th>
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<th>Items witnessed by</th>
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<tbody>
<tr>
<td>(Name of PD Contractor’s Representative)</td>
<td>PD Contractor</td>
<td>PBSE/PBSI</td>
</tr>
<tr>
<td><strong>Piping</strong></td>
<td></td>
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</tr>
<tr>
<td>a) Pipes and fittings shall be conform to Part I of Schedule 2 of the Waterworks Regulations.</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>b) Hydraulic tests are performed satisfactorily for water tightness of all sections of the pipework.</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>c) Pipes on a fresh water inside service shall be made of cast iron, ductile iron, PVC-U, polybutylene, steel or copper or any approved material.</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>d) No pipe shall be less than 20 mm diameter, except that a branch pipe may be 15 mm diameter if the pipe run is short and the pipe supplies only one draw-off point. (WW Reg Sch. 2 Pt. I Para. 2)</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>e) All pipework before meter positions shall be exposed or laid in proper service duct. (HKWSR 1.2, 2.2, 3.1, 7.3 &amp; 8.8)</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>f) The piping which solely serve a particular flat/unit shall not run through other flats/units as far as practicable.</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>g) A loose jumper type stopcock shall be provided and placed with spindle in the vertical position before the meter position.</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>h) Fullway gate valves shall be fitted before meter positions when the meters are sited at roof level.</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>i) Cisterns shall be fitted with a ball valve and a fullway gate valve at the inlet in the case of a gravity supply or with an automatic control switch and without any stop valve in the case of a pumped supply.</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>j) Fullway gate valve shall be provided on the outlets of every cistern.</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>k) Spring taps, of non-concussive type and of approved pattern, shall be used for public or communal lavatory basins.</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>l) For connections larger than 40 mm diameter, a gate valve shall be provided before the meter position and a non-return or check valve fitted on the delivery side as close as possible to the meter. (HKWSR 1.10, 1.14, 1.15, 2.4, 3.4, 4.1, 4.2, 7.5, 7.8, 7.9, 7.11, 8.11, 8.12 &amp; 8.17)</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
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m) Individual stop valves shall be provided at all draw-off points or at a series of draw-off points if situated close together. *(HKWSR 1.7 & 7.13)*

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<th>Items tested/ checked by PD Contractor</th>
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<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
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n) Boundary valves shall be provided at the connection points as close to the lot boundary as possible. *(HKWSR 1.11, 1.16, 3.7, 7.10, 8.16 & 9.5)*

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<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
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</table>

o) Tee-branch valve(s) shall be provided for the conditions:
   (i) for all underground water pipes;
   (ii) if the main pipe is a communal inside service;
   (iii) in a flushing system if the main pipe serves more than one domestic unit or commercial floor. *(HKWSR 1.9, 2.10, 3.13, 5.13, 6.15, 7.16 & 8.7)*

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<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
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p) Stop valve shall be provided to the supply pipe serving the series of draw-off points. *(HKWSR 1.7)*

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<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
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q) Dead legs and stagnant corners shall be avoided.

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<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
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r) The number and length of spur of the piping shall be minimized.

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<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
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</table>

s) Purge valves is provided at the pipe ends of all unavoidable spurs or stagnant points for weekly purging.

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<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
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</table>

t) When infra-red sensor operated automatic taps are used as inside services, a stop cock or gate valve must be installed at the upstream of each fitting for manual isolation of water supply.

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<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
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</tbody>
</table>

u) Self-closing taps, of non-concussive type and of approved pattern, shall be used for the public or communal lavatory basins.

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<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
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v) Flow rate of each draw-off tap, shower fitting and float-operated valve shall be the same as the specified requirement.

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<tr>
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<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
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</table>

w) All pipework is properly electrically bonded for equipotential bonding.

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<tr>
<th>Items tested/ checked by PD Contractor</th>
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<tbody>
<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
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</table>

3.1.9 Setting-out Check and Balancing

a) All piping are properly flushed and ensure no foreign objects trapped inside.

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<tr>
<th>Items tested/ checked by PD Contractor</th>
<th>Items witnessed by PBSE/PBSI</th>
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</thead>
<tbody>
<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
</tbody>
</table>
b) The equipment associated with the system has undergone the mechanical and electrical checks and the results are satisfactory.  

<table>
<thead>
<tr>
<th>Items tested/checked by PD Contractor</th>
<th>Items witnessed by PBSE/PBSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
</tbody>
</table>

c) Valves are closed in clockwise direction.  

d) Pressure reducing valve sets function properly.  

e) By-pass arrangement shall be incorporated with the provision of a second pressure reducing valve, except for fire service installations for ease of replacement.  

<table>
<thead>
<tr>
<th>Items tested/checked by PD Contractor</th>
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</thead>
<tbody>
<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
</tbody>
</table>

f) Pressure indicator shall be installed at the Pressure Reducing Valve system for pressure monitoring.  

<table>
<thead>
<tr>
<th>Items tested/checked by PD Contractor</th>
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</tr>
</thead>
<tbody>
<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
</tbody>
</table>

g) Automatic air release valves function properly.  

<table>
<thead>
<tr>
<th>Items tested/checked by PD Contractor</th>
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</tr>
</thead>
<tbody>
<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
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</table>

h) The hot-water draw-off point shall be at the left hand side.  

<table>
<thead>
<tr>
<th>Items tested/checked by PD Contractor</th>
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</tr>
</thead>
<tbody>
<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
</tbody>
</table>

i) The water flow rates of the system have been regulated and balanced in accordance with this T&C Procedure. The results are satisfactory meeting the specified requirements.  

<table>
<thead>
<tr>
<th>Items tested/checked by PD Contractor</th>
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</tr>
</thead>
<tbody>
<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
</tbody>
</table>

j) Cleaning and disinfection of the potable cold water piping system is conducted not more than 7 days in advance before hand over.  

<table>
<thead>
<tr>
<th>Items tested/checked by PD Contractor</th>
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</tr>
</thead>
<tbody>
<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
</tbody>
</table>

k) The potable cold water piping system is flushed thoroughly after disinfection.  

<table>
<thead>
<tr>
<th>Items tested/checked by PD Contractor</th>
<th>Items witnessed by PBSE/PBSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
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</tbody>
</table>

l) The disinfectant solution is de-chlorinated.  

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
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</table>

m) After disinfection of the potable cold water piping system as described in clause 3.1.9(k), the system is maintained for regular flushing weekly until hand over to clients for operation.  

<table>
<thead>
<tr>
<th>Items tested/checked by PD Contractor</th>
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<tbody>
<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
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</table>

n) Proper record of cleaning and disinfection is provided during handover.  

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<tr>
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<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
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3.1.10 Comments  

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<tr>
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<tr>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
</tbody>
</table>
3.2 Hot Water Supply Installation

Installation of hot water mixing valves is approved by WSD provided that both the cold and hot water are drawn from the same source, i.e. both hot and cold water supplied from a common storage cistern, or under direct mains pressure.

3.2.1 Water Heater

The following types of water heaters may, with the written permission of the WSD, be connected direct to a main:

(i) non-pressure type water heaters where no restriction of flow can be effected beyond the inlet control valve; *Yes/No/N.A. *Yes/No/N.A.

(ii) cistern type water heaters; *Yes/No/N.A. *Yes/No/N.A.

(iii) instantaneous water heaters where the guaranteed test pressure of the water heater is at least 1½ times the static head available at the water heater; *Yes/No/N.A. *Yes/No/N.A.

(iv) electric water heaters of the thermal storage type:
   a. having a storage capacity not exceeding 200 litres; *Yes/No/N.A. *Yes/No/N.A.
   b. having a guaranteed test pressure at least 1½ times the static head available at the water heater; *Yes/No/N.A. *Yes/No/N.A.
   c. and not being provided with an individual expansion pipe but complying with WWReg Sch 2 Pt IV Para 11.; *(WWReg Sch 2 Pt IV Para 1(2)(a)(b)(c) & (d)) *(WWReg Sch. 2 Pt. IV & HKWSR Chapter 5 & 6) *Yes/No/N.A. *Yes/No/N.A.

3.2.2 Non-centralized Hot Water System

a) Unvented type electric thermal storage water heaters shall comply with HKWSR Clause 5.11 and equip with safety devices that comply with Electrical Products (Safety) Regulation. *Yes/No/N.A. *Yes/No/N.A.

b) Storage cistern of pressure type thermal storage heaters, other than unvented heaters shall be equipped with a vented pipe. *Yes/No/N.A. *Yes/No/N.A.
c) Water released out of the relief valves of unvented electric thermal storage type water heaters shall be discharged to a safe and visible location. *Yes/Yes/N.A.

### 3.2.3 Centralized Hot Water System

a) The centralized hot water systems utilizing a boiler and cylinder shall be provided with a vent or an expansion pipe taken from the highest point of the cylinder or calorifier. *Yes/Yes/N.A.

b) Safety valve or pressure relief valve shall be provided to the boiler or to the primary flow pipe. *Yes/Yes/N.A.

c) Screwed plug with a removable key shall be provided at the lower part of the system for the purpose of draining down or emptying the system. *Yes/Yes/N.A.

d) Cleaning and disinfection of each water storage type calorifier is done not more than 7 days in advance before handed over. *Yes/Yes/N.A.

e) Cleaning and disinfection of the potable hot water piping system is conducted not more than 7 days in advance before hand over. *Yes/Yes/N.A.

f) The portable hot water piping system is flushed thoroughly after disinfection. *Yes/Yes/N.A.

g) The disinfectant solution is de-chlorinated. *Yes/Yes/N.A.

h) After disinfection of the potable hot water piping system as described in clause 3.2.2(e) of Annex II, the system is maintained for regular flushing weekly. *Yes/Yes/N.A.

i) Proper record of cleaning and disinfection is provided during handover. *Yes/Yes/N.A.

### 3.2.4 Comments

*Yes/Yes/N.A.
### 3.2.5 Solar Hot Water Heating System

**Location:**  
No: Designed Data  

#### Visual Inspections

<table>
<thead>
<tr>
<th>Item</th>
<th>PD Contractor</th>
<th>PBSE/PBSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe Work Pressure Test Records Acceptable</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Panels Securely Fixed on Support</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Panel Absorber Surfaces Has Obvious Sign of Oxidation or Decolourization</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Pipe Work, Heat Exchangers and Solar Hot Water Calorifier Are Well Insulated and With UV Protection Layer</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Hydraulic System Has Been Balanced</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>All Valves Setting Are Appropriate</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>All Electrical/Signal Connections of Sensors, Controllers and Data Acquisition Devices Are Properly Connected</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>All Sensors Are Properly Installed</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>All Sensors Have Been Calibrated</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>All Sensors’ Location Appropriate</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Automatic Air Vent Location Appropriate</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>All Labels &amp; Signage Are Provided</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
</tbody>
</table>

#### Measurements

<table>
<thead>
<tr>
<th>Measurement</th>
<th>PD Contractor</th>
<th>PBSE/PBSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector Panel Array</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Solar Collector Type</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Solar Collector Gross Area of Each Panel (mm x mm)</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Solar Collector Net Area (Absorber Area) of Each Panel (mm x mm)</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>No. of Solar Collector Panels Connected In Series Within A Bank</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
</tbody>
</table>
### Solar Hot Water Heating System (cont’)

<table>
<thead>
<tr>
<th>Item</th>
<th>PD Contractor</th>
<th>PBSE/PBSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Solar Collector Panels Bank Connected In Parallel Within The Array</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Panel Tilted Angle</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Panel Array Orientation</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Water Flow Rate of Solar Panel Array</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Panel Array Entering Water Temperature</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Panel Array Leaving Water Temperature</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Panel Array Pressure Drop</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Ambient Air Temperature</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Wind Speed</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Solar Irradiation</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>Chemical Treatment</td>
<td>*Yes/No/N.A.</td>
<td>*Yes/No/N.A.</td>
</tr>
<tr>
<td>-                      (chemical)</td>
<td>(ppm)</td>
<td></td>
</tr>
<tr>
<td>-                      (chemical)</td>
<td>(ppm)</td>
<td></td>
</tr>
<tr>
<td>-                      (chemical)</td>
<td>(ppm)</td>
<td></td>
</tr>
</tbody>
</table>

### Measurements

**System Controller**
- Circulation Pump Auto Start-Stop Setting: -

**Temperature Different Between Solar Panel Output and Water Tank for Pump On**
- (°C)          *Yes/No/N.A.  *Yes/No/N.A.  

**Temperature Different Between Solar Panel Output and Water Tank for Pump Off**
- (°C)          *Yes/No/N.A.  *Yes/No/N.A.  

---

### Annex II

<table>
<thead>
<tr>
<th>Tested / Checked by: (Name of PD Contractor’s Representative)</th>
<th>Signature - ( )</th>
<th>Post :</th>
<th>Tel. No. :</th>
<th>Date :</th>
</tr>
</thead>
<tbody>
<tr>
<td>Witnessed by: (Name(s) of * PBSE/Project Site Staff)</td>
<td>Signature - ( )</td>
<td>Post :</td>
<td>Tel. No. :</td>
<td>Date :</td>
</tr>
</tbody>
</table>
### Solar Hot Water Heating System (cont')

#### Location: No: Designed Data

**Measurements**

**Calorifier**

- **Calorifier Storage Volume** (m³) *Yes/No/N.A.  *Yes/No/N.A.
- **Vent Type (Vented/ Unvented)** *Yes/No/N.A.  *Yes/No/N.A.
- **Calorifier Shell/lining Materials**
- **Pressure/Temperature Relief Valve Setting**
  - Purging Temperature (°C) *Yes/No/N.A.  *Yes/No/N.A.
  - Purging Pressure (kPa) *Yes/No/N.A.  *Yes/No/N.A.
- **Auxiliary Heater Type** *Yes/No/N.A.  *Yes/No/N.A.
- **Auxiliary Heater Rating** (kW) *Yes/No/N.A.  *Yes/No/N.A.
- **Over Temperature Thermostat Setting** (°C) *Yes/No/N.A.  *Yes/No/N.A.
- **Calorifier Maximum Heat Transfer Capacity** (kW) *Yes/No/N.A.  *Yes/No/N.A.
- **Pressure Drop of Calorifier Heating Loop** (kPa) *Yes/No/N.A.  *Yes/No/N.A.
- **Insulation Type** *Yes/No/N.A.  *Yes/No/N.A.
- **Insulation Thickness** (mm) *Yes/No/N.A.  *Yes/No/N.A.

**Measurements**

**Circulation Pumps**

- **Voltage** (V) *Yes/No/N.A.  *Yes/No/N.A.
- **Current** (A) *Yes/No/N.A.  *Yes/No/N.A.
- **Power** (W) *Yes/No/N.A.  *Yes/No/N.A.
- **Flow Rate** (l/s) *Yes/No/N.A.  *Yes/No/N.A.
- **Pump Head** (kPa) *Yes/No/N.A.  *Yes/No/N.A.
### 3.3 Flushing Water Supply Installation

#### 3.3.1 Connection Pipe

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>a)</td>
<td>Size of the Connection Pipe shall be of 40mm diameter minimum for flushing water supply. (HKSWR 8.8 &amp; 8.15)</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>b)</td>
<td>All Piping including the Connection Pipe before meter positions shall be exposed or laid in a proper service duct. (HKSWR 1.2, 7.3 &amp; 8.8)</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
</tbody>
</table>

#### 3.3.2 Water Meter/Check Meter Position

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>a)</td>
<td>Salt water supply for flushing water system will not be metered, but a space reserved for meter position shall be provided.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>b)</td>
<td>Proper drainage, lighting and flood prevention facilities shall be provided at the water meter room. (WW Reg 27, HKWSR 1.4, 1.5, 1.11, 1.12, 1.16, 7.7, 7.10, 8.9 &amp; 8.16)</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
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#### 3.3.3 Water Storage Cistern

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<tr>
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<tbody>
<tr>
<td>a)</td>
<td>Cisterns shall be fitted with a ball valve controlled inlet in the case of a gravity supply or with an automatic control switch in the case of a pumped supply.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>b)</td>
<td>Ball valves of the water cistern are readily accessible.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>c)</td>
<td>An overflow pipe of one commercial size larger than the inlet pipe, and in no case less than 25 mm diameter, shall be fitted to each cistern and shall be extended to terminate in a conspicuous position in a communal area easily visible and accessible by the occupants.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>d)</td>
<td>The overflow pipe was submerged inside the storage cistern and sited above the inlet. (HKWSR 4.3)</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>e)</td>
<td>A stop valve shall be provided on the outlet of every cistern and provision shall be made for a drain off pipe to enable the cistern to be emptied.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>f)</td>
<td>Safe access shall be provided to all cisterns by means of a secure permanent ladder or readily available portable ladder.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>g)</td>
<td>A grating and a self-closing non-return flap shall be provided at the overflow pipe outside the storage cistern.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
</tbody>
</table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>(Name(s) of * PBSE/Project Site Staff)</td>
<td>( )</td>
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</tr>
</tbody>
</table>

**Items tested/checked by PD Contractor** | **Items witnessed by PBSE/PBSI**
--- | ---
| h) | Cistern shall be fitted with a ball valve and a fullway gate valve at the inlet in the case of a gravity supply or with an automatic control switch and without any stop valve in the case of a pumped supply. | *Yes/No/N.A. | *Yes/No/N.A. |
| i) | Float switches in the water tanks for controlling the water pumps function properly. | *Yes/No/N.A. | *Yes/No/N.A. |
| j) | High and low water level indications for the water tanks function properly. | *Yes/No/N.A. | *Yes/No/N.A. |
| k) | Size of the water pump suction water pipe from the water tank is matched the size of the pump suction inlet. | *Yes/No/N.A. | *Yes/No/N.A. |
| l) | Each water pump is provided with an independent suction pipe from supply tank. | *Yes/No/N.A. | *Yes/No/N.A. |
| m) | Strainers are cleaned in water tank. | *Yes/No/N.A. | *Yes/No/N.A. |

3.3.4 **Water Pumps**

| a) | A standby pumpset for both fixed water pump system and booster water pump system shall be provided. (HKWSR 3.3) | *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 properly. | *Yes/No/N.A. | *Yes/No/N.A. |
| i) | A fullway gate valve shall be provided on the drain-off pipe. (HKWSR 4.2) | *Yes/No/N.A. | *Yes/No/N.A. |
### 3.3.5 Electrical Wiring

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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>a)</td>
<td>The electrical wiring system shall be tested satisfactorily in accordance with the T&amp;C Procedure No. 2 for Electrical Installation and to Electricity Ordinance requirements.</td>
</tr>
<tr>
<td>b)</td>
<td>All conductors shall be correctly and securely connected and identified.</td>
</tr>
<tr>
<td>c)</td>
<td>Methods of protection against direct contact shall be properly applied.</td>
</tr>
<tr>
<td>d)</td>
<td>Isolation and switching devices are properly and correctly installed.</td>
</tr>
<tr>
<td>e)</td>
<td>Protective devices and monitoring devices are properly and correctly installed and set (e.g. MCB, control fuse, ammeter &amp; voltmeter).</td>
</tr>
<tr>
<td>f)</td>
<td>The electric circuits, fused, switches, terminals etc. are properly and correctly labelled.</td>
</tr>
<tr>
<td>g)</td>
<td>Danger notices, warning notices, schematic diagrams, instructions and similar information are correctly and adequately provided.</td>
</tr>
</tbody>
</table>

### 3.3.6 Pump Panels

<p>| | |</p>
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>All internal control panels are properly earthed.</td>
</tr>
<tr>
<td>b)</td>
<td>Nuts and bolts are tightened and connected properly.</td>
</tr>
<tr>
<td>c)</td>
<td>Equipment dust-free and in good order.</td>
</tr>
<tr>
<td>d)</td>
<td>All cables and terminals have good protection.</td>
</tr>
<tr>
<td>e)</td>
<td>All conduits and wirings are of appropriate size.</td>
</tr>
</tbody>
</table>

### 3.3.7 Flushing Devices (WSD Circular No. 4/2000)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Valve Type Flushing Cistern/ Dual Flush Cistern.</td>
</tr>
</tbody>
</table>

The valve sealing of the flushing cistern shall be easily replaceable.

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<tbody>
<tr>
<td>b)</td>
<td>The flushing volume of the flushing devices shall be compatible with the toilet bowl to ensure that effective clearance can be achieved by a single flush of water.</td>
</tr>
</tbody>
</table>

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**Tested / Checked by:**  
(Name of PD Contractor’s Representative)  
Signature -  
Post :  
Tel. No. :  
Date :  

**Witnessed by:**  
(Name(s) of * PBSE/Project Site Staff)  
Signature -  
Post :  
Tel. No. :  
Date :
c) The maximum flushing cistern volume including that of dual flush cisterns shall not exceed 7.5 litre per flush. *Yes/No/N.A. *Yes/No/N.A.
d) For dual flush devices, the reduced flushing volumes shall not be more than two-third of its larger flushing volume. *Yes/No/N.A. *Yes/No/N.A.
e) The component of all valve flushing devices shall be resistant to salt water corrosion. *Yes/No/N.A. *Yes/No/N.A.

### 3.3.8 Flushing Valve

a) Installation of filter before flushing valves is required. *Yes/No/N.A. *Yes/No/N.A.
b) The cartridge and other valve components shall be easily replaceable. *Yes/No/N.A. *Yes/No/N.A.
c) The valve components shall be resistant to salt water. *Yes/No/N.A. *Yes/No/N.A.
d) The flushing volume of the flushing valves shall be adjusted to suit the toilet bowl to ensure that effective clearance can be achieved by a single flush. *Yes/No/N.A. *Yes/No/N.A.
e) Flushing valves shall be used within the range of working pressures specified by the manufacturer. *Yes/No/N.A. *Yes/No/N.A.
f) The maximum flushing volume of the flushing valves to be installed shall not exceed 7.5 litres. *Yes/No/N.A. *Yes/No/N.A.
g) Flushing valves shall be set to be height which is operated by hand except for those operated by foot. *Yes/No/N.A. *Yes/No/N.A.

### 3.3.9 Piping

a) Pipes and fittings shall be conform to Part I of Schedule 2 of the Waterworks Regulations. *Yes/No/N.A. *Yes/No/N.A.
b) Hydraulic tests are performed satisfactorily for water tightness of all sections of the pipework. *Yes/No/N.A. *Yes/No/N.A.
c) Pipes on salt water inside service shall be made of salt water resistant materials. *Yes/No/N.A. *Yes/No/N.A.
d) Final connection of the underground watermains to both newly installed fresh water and flush water supply, utmost clear identification for the connection shall be made by the Licensed Plumber and arranged WSD for inspection before they put into operation. *Yes/No/N.A. *Yes/No/N.A.
e) All pipework is properly electrically bonded for equipotential bonding, except non-metallic material is used, such as PVC pipe. *Yes/No/N.A. *Yes/No/N.A.

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<th>Tested / Checked by:</th>
<th>Signature -</th>
<th>Post :</th>
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<tr>
<td>(Name of PD Contractor’s Representative)</td>
<td>( )</td>
<td>Tel. No. :</td>
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<th>Signature -</th>
<th>Post :</th>
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<tbody>
<tr>
<td>(Name(s) of * PBSE/Project Site Staff)</td>
<td>( )</td>
<td>Tel. No. :</td>
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</table>

Architectural Services Department

Annex II

Issue Date: 8 August 2012

BSB-Standard Form No: Page 17 of 27

3.3.10 Setting-out Check and Balancing

a) All piping are properly flushed and ensure no foreign objects trapped inside.  
   *Yes/No/N.A. *Yes/No/N.A.

b) The water inside service has been properly cleaned to WSD’s requirement and then filled with water.  
   *Yes/No/N.A. *Yes/No/N.A.

c) The equipment associated with the system has undergone the mechanical and electrical checks and the results are satisfactory.
   *Yes/No/N.A. *Yes/No/N.A.

d) Valves are closed in clockwise direction.  
   *Yes/No/N.A. *Yes/No/N.A.

e) Pressure reducing valve sets function properly.  
   *Yes/No/N.A. *Yes/No/N.A.

f) By-pass arrangement shall be incorporated with the provision of a second pressure reducing valve, except for fire service installations for ease of replacement.
   *Yes/No/N.A. *Yes/No/N.A.

g) Pressure indicator shall be installed at the Pressure Reducing Valve system for pressure monitoring.  
   *Yes/No/N.A. *Yes/No/N.A.

h) Automatic air release valves function properly.
   *Yes/No/N.A. *Yes/No/N.A.

3.4 Underground Drainage System

3.4.1 Pre-commissioning Checks

a) 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.

b) 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.

c) Buried underground drainage pipe shall be embedded away from the slope area unless or otherwise approved by the Architect. (PNAP 183)
   *Yes/No/N.A. *Yes/No/N.A.

d) No buried underground drainage pipe shall be embedded in the structural elements unless or otherwise approved by the Architect. (PNAP 230)
   *Yes/No/N.A. *Yes/No/N.A.

e) 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.
<table>
<thead>
<tr>
<th>Test No</th>
<th>Test Description</th>
<th>PD Contractor</th>
<th>PBSE/PBSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>f)</td>
<td>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.</td>
<td>Yes/No/N.A.</td>
<td>Yes/No/N.A.</td>
</tr>
<tr>
<td>g)</td>
<td>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.</td>
<td>Yes/No/N.A.</td>
<td>Yes/No/N.A.</td>
</tr>
<tr>
<td>h)</td>
<td>All pipes under test are marked with nominal size, name of manufacturer, manufacturing standard with colour and intervals required.</td>
<td>Yes/No/N.A.</td>
<td>Yes/No/N.A.</td>
</tr>
<tr>
<td>i)</td>
<td>All pipes under test are under correct alignment, level and length.</td>
<td>Yes/No/N.A.</td>
<td>Yes/No/N.A.</td>
</tr>
<tr>
<td>j)</td>
<td>All pipes under test are without damage.</td>
<td>Yes/No/N.A.</td>
<td>Yes/No/N.A.</td>
</tr>
<tr>
<td>k)</td>
<td>When concrete bed, haunch and surround are used for the pipes, concrete work shall be complied with specifications.</td>
<td>Yes/No/N.A.</td>
<td>Yes/No/N.A.</td>
</tr>
<tr>
<td>l)</td>
<td>Joints between pipes are completed methodology complying with manufacturer’s recommendations or specifications of contract documents.</td>
<td>Yes/No/N.A.</td>
<td>Yes/No/N.A.</td>
</tr>
<tr>
<td>m)</td>
<td>Terminal manhole and invert levels shall be complied with DSD’s requirements.</td>
<td>Yes/No/N.A.</td>
<td>Yes/No/N.A.</td>
</tr>
<tr>
<td>n)</td>
<td>Size of connection pipe shall be complied with DSD’s requirements.</td>
<td>Yes/No/N.A.</td>
<td>Yes/No/N.A.</td>
</tr>
<tr>
<td>o)</td>
<td>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.</td>
<td>Yes/No/N.A.</td>
<td>Yes/No/N.A.</td>
</tr>
</tbody>
</table>
3.4.2 Water Test  
(Applicable to pipelines up to and including 300mm internal diameter)

Gravity pipelines for drainage shall be tested at the following times:

(a) 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,

(b) After haunch and surround has been placed and fill material has been deposited and compacted, and

(c) Not more than 7 days before the pipeline is handed over.

a) 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.

b) 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.

c) Measure the loss of water inside the pipelines under test and check if it is not more than 0.06 litre per hour per 100m length per 1mm of nominal diameter 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.

<table>
<thead>
<tr>
<th>Pipeline Dia. (mm)</th>
<th>Max. Permissible Loss (litres per metre run)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN 100 pipe</td>
<td>0.05</td>
</tr>
<tr>
<td>DN 150 pipe</td>
<td>0.08</td>
</tr>
<tr>
<td>DN 225 pipe</td>
<td>0.12</td>
</tr>
<tr>
<td>DN 300 pipe</td>
<td>0.15</td>
</tr>
</tbody>
</table>

d) 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.
### 3.4.3 Smoke/Air Test
(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) Smoke/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 stabilization 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.*

### 3.4.4 Test for Manhole

a) The end of all connection pipes of the manhole are sealed by expanding drain plugs or inflatable canvas or rubber test bags.

*Yes/No/N.A.*  *Yes/No/N.A.*

b) Water is filled inside the manhole until the required test level is registered.

*Yes/No/N.A.*  *Yes/No/N.A.*

c) Allow the water to stand for at least 20 hours to account for absorption period.

*Yes/No/N.A.*  *Yes/No/N.A.*

d) Measure the fall in water level over a 30 minutes’ period after the absorption period and check if it is within the acceptance range under specifications of contract.

*Yes/No/N.A.*  *Yes/No/N.A.*
### 3.5 Above Ground Drainage System

#### 3.5.1 Pre-commissioning Checks

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tr>
<td>a)</td>
<td>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.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>b)</td>
<td>All obstructions, debris and superfluous matter have been removed from sections of pipeline, inspection chambers, manholes, or similar underground chambers.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>c)</td>
<td>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.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
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<tr>
<td>d)</td>
<td>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.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>e)</td>
<td>All pipes under test are marked with nominal size, name of manufacturer, manufacturing standard with colour and intervals required.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>f)</td>
<td>All pipes under test are under correct alignment, level and length.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>g)</td>
<td>All pipes under test are without damage.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>h)</td>
<td>Joints between pipes are completed methodology complying with manufacturer’s recommendations or specifications of contract documents.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
<tr>
<td>i)</td>
<td>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.</td>
<td>*Yes/No/N.A. *Yes/No/N.A.</td>
</tr>
</tbody>
</table>

#### 3.5.2 Water Test for drainage stack

Leakage of water is observed at the stack below the lowest sanitary appliance. *Yes/No/N.A. *Yes/No/N.A.
### Annex II

<table>
<thead>
<tr>
<th>Items tested/checked by</th>
<th>Items witnessed by</th>
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<tbody>
<tr>
<td>PD Contractor</td>
<td>PBSE/PBSI</td>
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3.5.3 **Air Test for drainage stack**

Leakage of water is observed at the stack above the lowest sanitary appliance.

*Yes/No/N.A. *Yes/No/N.A.

3.5.4 **Water Test for individual drain points**

(including discharge point of sanitary fitment, floor drain, planter drain, rainwater outlet, movement joint drain outlet, etc.)

| 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. |

3.5.5 **Comments**

*Yes/No/N.A. *Yes/No/N.A.
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
- Vibration Test – Equipment Vibration Measurement Record
**Proforma for Underground Pipe Water Test in Drainage Installation**

Contract No. :

Contract Title :

Name of PD Contractor/Sub-contractor :

Date of Test: ______________

Weather: *Sunny/ Rainy/ Windy*  

Temperature: ______________°C  

Pressure applied: 1.5m water head with 100mm stand pipe (test for 30 minutes)  

Permissible loss: 0.06 litre per hour per 100m length per 1 mm of nominal diameter  

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

* Delete if not applicable
# Proforma for Underground Pipe Air Test in Drainage Installation

Contract No. :

Contract Title :

Name of PD Contractor/Sub-contractor :

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

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

* Delete if not applicable
**Proforma for Vibration Test – Equipment Vibration Measurement Record**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Indicated operation speed (rev/s)</th>
<th>Measured speed (rev/s)</th>
<th>Visual/ audible check</th>
<th>Vibration acceptance criteria (mm/s)</th>
<th>Vibration measured Horizontal</th>
<th>Vibration measured Vertical</th>
<th>Vibration measured Axial</th>
<th>Other observations/ remarks</th>
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<tr>
<td>Motor</td>
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<td>Equipment</td>
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<td>Motor</td>
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Attachment includes a sketch showing the positions of measuring points for each equipment.
# List of Calibrated Instrument Necessary for the T&C Works

<table>
<thead>
<tr>
<th>Type</th>
<th>Model</th>
<th>Serial No. of Instrument</th>
<th>Date of Calibration</th>
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Tested / Checked by:
(Name of PD Contractor’s Representative)
Signature -
Post:
Tel. No.:
Date:

Witnessed by:
(Name(s) of *PBSE/Project Site Staff)
Signature -
Post:
Tel. No.:
Date:

**Notes**
* Delete if not applicable
**Sampling Report**

This sampling report form is served as reference for water sampling and analysis as stipulated in this T&C Procedure and General Specification of Plumbing and Drainage Installation.

<table>
<thead>
<tr>
<th>Sampling reference no.:</th>
<th>Name of laboratory</th>
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</thead>
<tbody>
<tr>
<td>Sample point reference:</td>
<td>Sampling purpose:</td>
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<td>Sample point name:</td>
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<tr>
<td>Sample point location:</td>
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<td>Weather conditions:</td>
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</tr>
<tr>
<td>Time of sampling:</td>
<td>Date of sampling:</td>
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<tr>
<td>Bottle type:</td>
<td>Preservation and storage:</td>
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<td>Field tests</td>
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<td>Storage in transit:</td>
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<tr>
<td>Sampler’s name:</td>
<td>Signature:</td>
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<tr>
<td>Sampler’s contact no.:</td>
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<tr>
<td>Analysis required:</td>
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<td>Hazards:</td>
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<td>Sampler’s comments:</td>
<td></td>
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<tr>
<td>Time received in laboratory:</td>
<td>Date:</td>
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<td>Received by:</td>
<td>Signature:</td>
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<tr>
<td>Laboratory comments:</td>
<td></td>
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<td>Special instructions to the analyst:</td>
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</table>

(*Remark: This form is made reference to BS ISO 5667-21:2010)