

**GENERAL SPECIFICATION**

**FOR**

**PLUMBING AND DRAINAGE INSTALLATION**

**IN**

**GOVERNMENT BUILDINGS**

**OF**

**THE HONG KONG SPECIAL ADMINISTRATIVE REGION**

2012 EDITION  
(INCORPORATING CORRIGENDUM NO. GSPD01-2012)



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



## **PREFACE**

This General Specification aims to lay down the technical requirements of materials and equipment, the standards of workmanship, the requirements on testing and commissioning as well as requirements on document submissions for Plumbing and Drainage Installation in Government Buildings of the Hong Kong Special Administrative Region (HKSAR).

The present edition (incorporating Corrigendum No. GSPD01-2012) of this General Specification was developed based on its 2012 edition 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). It incorporates updated international standards and codes as well as technological developments which find applications in Hong Kong. To be in line with the department's endeavour to reduce the environmental burden on our neighbours and to help preserving common resources while improving the quality of our service, the present edition has continued putting emphasis on green initiatives and initiatives for enhancement of client satisfaction on completed projects.

With the benefit of information technology, electronic version of this new edition is to be viewed on and free for download from the Architectural Services Department (ArchSD) Internet homepage. As part of the Government's efforts to limit paper consumption, hard copies of this General Specification will not be put up for sale.

The draft of the 2012 edition has been circulated to stakeholders within and external to the Government before finalization. Nevertheless, the ArchSD welcomes comments on its contents at anytime since the updating of this General Specification is a continuous process for the inclusion of any developments that can help meeting the needs of our community.

## **DISCLAIMER**

This General Specification is solely compiled for 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 General Specification for purposes other than that stated above. Users who choose to adopt this General Specification for their works are responsible for making their own assessments and judgment 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 General Specification or reliance placed on it.

The materials contained in this document may not be pertinent or fully cover the extent of the Installations in non-government buildings and there is no intimated or implied endorsement of the sales, supply and installation of the materials and equipment specified in this General Specification within the territory of the HKSAR.

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## PART A

### SCOPE AND GENERAL REQUIREMENTS

#### SECTION A1

##### SCOPE OF SPECIFICATION

#### **A1.1 INSTALLATIONS TO COMPLY WITH THIS GENERAL SPECIFICATION**

The Plumbing and Drainage Installations shall comply with this General Specification which details the intrinsic properties (including materials and workmanship) of the Installations in so far as it is not overridden by the Conditions, Particular Specification, Drawings and/or written instructions of the Architect.

#### **A1.2 SCOPE OF THE INSTALLATIONS**

This General Specification, Particular Specification, Tender Equipment Schedule and Drawings detail the performance requirements of the Installations. The Installations to be carried out in accordance with this General Specification shall include the design where specified, installation and supply of all materials necessary to form a complete installation including any necessary tests, adjustments, commissioning and maintenance as prescribed and all other incidental sundry components together with the necessary labour for installing such components, for the proper operation of the Installations.

#### **A1.3 TERMS AND DEFINITIONS**

In this General Specification, all words and expressions shall have the meaning as assigned to them under the Conditions unless otherwise provided herein. The following words or expressions shall have the meanings assigned to them except when the context otherwise requires:-

##### **A1.3.1 Terms and Definitions**

A/C	Air Conditioning
AISI	American Iron Steel Institute
ANSI	American National Standards Institute
Architect	The Architect or the Maintenance Surveyor or the Supervising Officer as defined in the Contract as appropriate

ArchSD	The Architectural Services Department, the Government of the Hong Kong Special Administrative Region
ASHRAE	American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BD	Buildings Department, the Government of the Hong Kong Special Administrative Region
BS EN	European Standard adopted as British Standard
BS	British Standards, including British Standard Specifications and British Standard Codes of Practice, published by the British Standards Institution
BSB	The Building Services Branch of the Architectural Services Department, the Government of the Hong Kong Special Administrative Region
Building Contractor	The Contractor employed by the Employer for the execution of the Works or the Specialist Contractor separately employed by the Employer to execute the Specialist Works as appropriate.
CCMS	Central Control and Monitoring System
CFC	Chlorofluorocarbon
CIBSE	The Chartered Institution of Building Services Engineers
Conditions	The General Conditions of Contract for Building Works together with the Special Conditions of Contract as defined in the Contract, the Sub-contract for Building Works as defined in the Nominated Sub-contract as appropriate
DDC	Direct Digital Controllers
DIN	German Industry Standard
E&M	Electrical & Mechanical
EMC	Electro-magnetic Compatibility

EMSD	Electrical and Mechanical Services Department, the Government of the Hong Kong Special Administrative Region
EPD	Environmental Protection Department, the Government of the Hong Kong Special Administrative Region
EPDM	Ethylene propylene diene monomer (M-class)
FRC	Fire Resistance Construction
FRR	Fire resistance rating as defined in the Code of Practice for Fire Safety in Buildings published by Buildings Department, the Government of the HKSAR;
FSD	Fire Services Department, the Government of the Hong Kong Special Administrative Region
G.I.	Galvanized Iron
GRP	Glass Reinforced Plastics
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
IEC	International Electrotechnical Commission
Installations	The works or services for the Plumbing and Drainage Installation forming parts of the Works to be installed, constructed, completed, maintained and/or supplied in accordance with the Contract and includes Temporary Works
IP	Index of Protection
ISO	International Organisation for Standardization Publications
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LSOH	Low Smoke Zero Halogen
LPHW	Low Pressure Hot Water
L.V.	Low Voltage
MCC	Motor Control Centre

OD	Outside Diameter
O&M	Operation and Maintenance
PD Contractor	The Nominated Sub-contractor, the Specialist Sub-contractor, or the Sub-contractor employed by the Building Contractor or the contractor directly employed by the Employer as appropriate for the execution of the Installations in accordance with the Contract
Particular Specification	The specifications drawn up specifically for the Installations of a particular project
PN	Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers issued by Buildings Department
PVC	Polyvinyl Chloride
Proprietary brand name materials or products	The phrase “or alternative materials having equivalent functions or performance” shall be deemed to be included wherever materials or products are specified by proprietary brand names. Alternative materials or products of different brands or manufacture having equivalent functions or performance may substitute for the specified proprietary brand name materials or products if prior approval from the Architect has been obtained. If the PD Contractor intends to use the intellectual property rights of another party in performing his obligations under the Contract, appropriate licences shall be obtained from the relevant rights owners
RH	Relative Humidity
SAE	The Society of Automotive Engineers
Tender	The Contractor’s tender for the Contract or the Nominated Sub-contractor’s tender for the Nominated Sub-contract as appropriate
UL	Underwriters Laboratories
UPVC	Unplasticised Polyvinyl Chloride
UV	Ultra-violet
VSD	Variable Speed Drive

WRAS	Water Regulations Advisory Scheme (WRAS) of United Kingdom (UK)
WSD	The Water Supplies Department, the Government of the Hong Kong Special Administrative Region

#### **A1.4 SINGULAR AND PLURAL**

Words importing the singular only also include the plural and vice versa where the context requires.

## SECTION A2

### STATUTORY OBLIGATIONS AND OTHER REGULATIONS

#### **A2.1 STATUTORY OBLIGATIONS AND OTHER REQUIREMENTS**

The Installations shall conform in all respects with the followings:-

##### **A2.1.1 Statutory Obligations**

All Enactments and Regulations, in particular, the PD Contractor's attention is drawn to the followings:

- (a) Building Ordinance (Cap. 123);
- (b) Building (Administration) Regulations under Buildings Ordinance (Cap. 123);
- (c) Building (Construction) Regulations under Buildings Ordinance (Cap. 123);
- (d) Building (Standard of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations under Buildings Ordinance (Cap. 123);
- (e) Building (Planning) Regulations under Buildings Ordinance (Cap. 123);
- (f) Building (Refuse Storage and Material Recovery Chambers and Refuse Chutes) Regulations under Buildings Ordinance (Cap. 123);
- (g) Waterworks Ordinance (Cap. 102), and other subsidiary legislation made under the Ordinance;
- (h) Fire Service (Installations and Equipment) Regulations, Fire Services Ordinance (Cap. 95), and other subsidiary legislation made under the Ordinance;
- (i) Noise Control Ordinance (Cap. 400), and other subsidiary legislation made under the Ordinance;
- (j) Water Pollution Control Ordinance (Cap. 358), and other subsidiary legislation made under the Ordinance;
- (k) Air Pollution Ordinance (Cap. 311), and other subsidiary legislation made under the Ordinance;
- (l) Ozone Layer Protection (Cap. 403), and other subsidiary legislation made under the Ordinance;

- (m) Waste Disposal Ordinance (Cap. 354), and other subsidiary legislation made under the Ordinance;
- (n) Environmental Impact Assessment Ordinance (Cap. 499), and other subsidiary legislation made under the Ordinance; and
- (o) Land (Miscellaneous Provisions) Ordinance (Cap. 28), and other subsidiary legislation made under the Ordinance.

#### A2.1.2 Other Requirements

- (a) Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers issued by BD;
- (b) ProPECC issued by EPD;
- (c) Hong Kong Waterworks Standard Requirements for Plumbing Installations in Buildings and Circular Letters issued by WSD;
- (d) Handbook on Plumbing Installation for Buildings issued by WSD;
- (e) Codes of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment published by FSD;
- (f) Code of Practice for Fire Safety in Buildings published by BD;
- (g) Requirements and Circular Letters of FSD;
- (h) Code of Practice for the Electricity (Wiring) Regulations published by the EMSD;
- (i) Code of Practice for Energy Efficiency of Building Services Installation, issued by the EMSD;
- (j) General Specification for Building, issued by the ArchSD;
- (k) General Specification for Electrical Installation in Government Buildings, the Hong Kong Special Administrative Region, issued by the ArchSD;
- (l) General Specification for Fire Service Installation in Government Buildings, the Hong Kong Special Administrative Region, issued by the ArchSD;

- (m) Design Manual: Barrier Free Access 2008 published by BD;
- (n) Technical Memorandum to issue Air Pollution Abatement Notice to control Air Pollution from Stationary Processes;
- (o) Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites;
- (p) Technical Memorandum - Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters; and
- (q) Technical Memorandum on Environmental Impact Assessment Process.

#### A2.1.3 Safety Requirements

- (a) Occupational Safety and Health Ordinance (Cap. 509), and other subsidiary legislation made under the Ordinance;
- (b) Factories and Industrial Undertakings Ordinance (Cap. 59), and other subsidiary legislation made under the Ordinance;
- (c) Public Health and Municipal Services Ordinance (Cap. 132), and other subsidiary legislation made under the Ordinance;
- (d) Construction Sites (Safety) Regulations, Factories and Industrial Undertakings Ordinance (Cap. 59); and
- (e) Construction Site Safety Manual issued by the Works Branch of the Development Bureau, the Government of the HKSAR.

#### A2.1.4 Technical Standards

BS, BS EN, ISO Standards, IEC Standards and Codes of Practice, etc. shall be deemed to include all amendments, revisions and standards superseding the standards listed herein, which are published before the date of first tender invitation for the Contract or the Nominated Sub-contract (as appropriate) unless otherwise specified.

A summary of technical standards quoted in this General Specification to which the Installations shall comply is listed in Annex I.

## **A2.2 CASE OF CONFLICT**

The documents forming the Contract are to be taken as mutually explanatory of one another but in case of ambiguities or discrepancies the same shall be dealt with in accordance with the Conditions.

## SECTION A3

### EXECUTION OF INSTALLATIONS

#### **A3.1 THE INTERNATIONAL SYSTEM OF UNITS (SI)**

The International System of Units (Système International D'Unités) of weights and measures shall be used for all materials, equipment and measurements.

#### **A3.2 PROGRAMME OF INSTALLATIONS**

The PD Contractor shall submit to the Architect a detailed programme of the Installations within 4 weeks from the acceptance of his Tender showing the intended method, stages and order of work execution in coordination with the building construction programme, together with the duration he estimated for each and every stage of the Installations. The programme shall include at least the following:-

- (a) Dates for the placement of orders for equipment and materials;
- (b) Expected completion dates for builder's work requirements, i.e. when work site needs to be ready;
- (c) Delivery dates of equipment and materials to the Site;
- (d) Dates of commencement and completion of every stage of the Installations in line with the building construction programme, i.e. each floor level and/or zone area;
- (e) Dates of documents/drawings submissions to relevant Government departments to obtain the necessary approvals;
- (f) Dates of requirement of temporary facilities necessary for testing & commissioning;
- (g) Dates of water supply and drainage/sewage pipe connection;
- (h) Dates of completion, testing and commissioning; and
- (i) Short term programmes showing the detailed work schedules of coming weeks and months shall also be provided to the Architect. Programmes shall be regularly updated to reflect the actual progress and to meet the PD Contractors' obligations under the Contract.

In addition, detailed submission schedules for installation drawings, equipment and testing and commissioning shall be submitted to the Architect for approval. The formats and information to be included in the schedules shall be as directed by the Architect.

### **A3.3 BUILDER'S WORK**

All builder's work including openings or holes through building structure or partition walls; trenches, ducts and cutting; and all plinths, concrete bases, supports, ducts, etc. required for the Installations will be carried out as part of the building works by the Building Contractor at the expense of the Employer provided that the PD Contractor has submitted full details of such requirements within a reasonable time to the Architect for approval, so that due consideration may be given before the Building Contractor commences the building works in accordance with the building programme in the areas concerned. After obtaining the said approval of the Architect, the PD Contractor is required to mark out at the relevant locations of the Site the exact positions and sizes of all such works and to provide detailed information of such works to the Building Contractor to facilitate him to carry out the builder's works as the works proceed.

All "cutting-away" and "making-good" as required to facilitate the PD Contractor's works will be carried out by the Building Contractor, except for minor provisions required for the fixing of screws, raw plugs, redhead bolts, etc. which shall be carried out by the PD Contractor. The PD Contractor shall mark out on Site and/or supply drawings of all "cutting-away" to the Building Contractor within a reasonable time.

All expenses properly incurred and losses suffered by the Employer as a result of the PD Contractor's failure to comply with the above requirements are recoverable by the Employer from the PD Contractor as a debt under the Contract or via the Building Contractor as if it is a debt liable to the Building Contractor under the Sub-contract as appropriate.

The PD Contractor shall ensure that such works are essential for the execution of the Installations. In the event that any of such works is proved to be non-essential, unnecessary and/or abortive, the PD Contractor shall bear the full cost of such works including but not limited to any unnecessary or incorrect cutting-away and making-good and shall reimburse the Employer for all cost incurred in this connection are recoverable by the Employer from the PD Contractor as a debt under the Contract or via the Building Contractor as if it is a debt liable to the Building Contractor under the Sub-contract as appropriate.

Upon completion of the builder's works by the Building Contractor, the PD Contractor shall forthwith check and examine that all builder's works so executed have been completed in accordance with his requirements. If at any time it becomes apparent to the PD Contractor that any builder's works completed by the Building Contractor does not comply with his requirements in any respect whatsoever, the PD Contractor shall forthwith give notice in writing to the Architect and specify in details the extents and effects of such non-compliance in that notice. The PD Contractor is deemed to have satisfied with the builder's works after a period of 14 days from the date of completion of the builder's works if the above notice is not served to the Architect within such period. All additional expenditure properly incurred and all loss suffered in this connection by the Employer in having such works re-executed and rectified shall be recoverable by the Employer from the PD Contractor as a debt under the Contract or via the Building Contractor as if it is a debt liable to the Building Contractor under the Sub-contract as appropriate.

### **A3.4 COORDINATION OF INSTALLATIONS**

The PD Contractor shall coordinate the Installations with those works of the Building Contractor and any other contractors and sub-contractors of the Building Contractor. The PD Contractor shall note that the drawings supplied to him only indicate the approximate locations of the Installations. He shall make any modification reasonably required of his programme, work sequence and physical deployment of his work to suit the outcome of work coordination or as necessary and ensure that all cleaning, adjustment, test and control points are readily accessible while keeping the number of loops, cross-overs and the like to a minimum.

The PD Contractor shall pay particular attention to the building works programme and shall plan, coordinate and programme his works to suit and adhere to the building works in accordance with the building programme.

Any significant problems encountered during the coordination work, which are beyond the PD Contractor's control, shall promptly be reported to the Architect.

### **A3.5 COOPERATION WITH OTHER CONTRACTORS**

The PD Contractor shall cooperate at all times with the Building Contractor and all other contractors and sub-contractors of the Building Contractor in order to achieve efficient workflow on the Site.

Any significant problems beyond the PD Contractor's control shall promptly be reported to the Architect.

### **A3.6 SITE SUPERVISION**

The PD Contractor shall keep on the Site a competent and technically qualified site supervisor to control, supervise and manage all his works on Site. The site supervisor shall be vested with suitable powers to receive instructions from the Architect.

The site supervisor shall be technically competent and have adequate site experience for the Installations. The qualified and competent site supervisor shall have minimum 5 years on site experience for similar type of installation works. The PD Contractor shall also refer to the Particular Specification for other specific requirements, if any, on site supervision.

Approval by the Architect shall be obtained prior to the posting of the site supervisor on Site. The PD Contractor shall immediately replace the site supervisor whose experience, skill or competency is, in the opinion of the Architect, found to be inadequate for the particular work.

All tradesmen must be experienced in the trade and the work carried out shall be consistent with good practice in Hong Kong and to the satisfaction of the Architect. In this connection, the PD Contractor's attention is drawn to the Special

Conditions of Contract under the Contract for the requirements relating to Qualified Tradesmen and Intermediate Tradesmen.

The PD Contractor shall also employ a full time competent foreman on Site for each trade. All trade foremen shall be registered tradesmen of the relevant trade.

### **A3.7 SAMPLE BOARD**

Within 6 weeks of the acceptance of his Tender and prior to the commencement of the Installations, the PD Contractor shall submit to the Architect for approval a sample board of essential components proposed to be used in the Contract. However, the PD Contractor may request the Architect in writing for a longer period for submission if 6 weeks are practically insufficient.

Items displayed shall be deemed to be adequate for the Installations unless otherwise clearly indicated. Each sample, with clear numbering and labeling, shall be firmly fixed onto a rigid wooden or metal board. A list shall also be affixed on the sample board to show the item description, make and brand, country of origin and locations of installation (if not generally used). Samples rejected by the Architect shall be replaced as soon as possible. Upon approval of all items, the Architect will endorse the list on the sample board and the PD Contractor shall deliver the board to the site office for reference.

The board shall contain samples of all "compact" sized materials and accessories to be used in the Installations. Written approval of all samples and technical details shall be obtained from the Architect before commencement of any installation work.

In the context of this General Specification the term "compact" means any item that will fit into a 300 mm cube.

The following items shall be included in the sample board as a minimum:

- (a) Pipework, fitting and their support complete with fixing accessories;
- (b) Valves; and
- (c) Vibration isolator

Additional items may be required by the Architect and/or as specified.

### **A3.8 ADVICE OF ORDER PLACED**

The PD Contractor shall submit copies of all orders placed for major items of equipment and materials to the Architect for record.

### **A3.9 RECORD OF MATERIALS DELIVERY**

All materials and equipment delivered to Site shall be accurately listed and recorded in the site record books maintained by the Architect's Representative on Site.

Materials and equipment delivered to Site are the Employer's property. Such materials and equipment shall not be removed from Site without the prior approval of the Architect in writing.

Where the Building Contractor is in overall control of the Site, the Building Contractor may also be required to record details of all incoming/outgoing materials. In this case, the PD Contractor shall comply with the Building Contractor's arrangements.

### **A3.10 PROTECTION OF MATERIALS AND EQUIPMENT**

Unless the responsibility is clearly defined in the Contract that the protection on Site for delivered equipment, materials and installation is solely by other contractors, the PD Contractor shall be responsible for the safe custody of all materials and equipment as stored or installed by him. In addition, the PD Contractor shall protect all work against theft, fire, damage or inclement weather and carefully store all materials and equipment received on Site but not yet installed in a safe and secure place unless otherwise specified.

All cases of theft and fire must immediately be reported to the police, the Building Contractor, the Architect and the Architect's Representatives on Site with full details.

Where necessary the PD Contractor shall provide lockable steel container or other equally secure enclosures placed within a securely fenced-in compound provided by the Building Contractor on Site for the storage of materials and equipment.

The PD Contractor shall co-ordinate and arrange with the Building Contractor who shall provide clean, reasonably finished and lockable secure accommodation for the storage of sensitive and/or expensive items before installation.

If there is no Building Contractor, all the storage facilities and spaces shall be provided by the PD Contractor.

### **A3.11 EQUIPMENT DEVIATIONS**

Subsequent to the award of the Contract, and only in exceptional circumstances where it is demonstrated in writing by the PD Contractor that the original equipment offered cannot be obtained, the Architect may consider and accept, in writing, alternative equipment and materials proposed by the PD Contractor provided always that these are fully in compliance with the relevant Specifications and Drawings and do not impose any additional contractual or financial liabilities onto the Employer.

In the event that the approved alternative equipment or material is lower in price than the original offered equipment or material, the net difference in price between the original offered equipment or material and the approved alternative equipment or material with the executed quantities of the relevant work item shall be deducted from the Contract Sum in accordance with the Contract. The Contract Sum, however, shall not be adjusted where the approved alternative equipment or material is higher in price than the original offered equipment or material.

## SECTION A4

### DRAWINGS AND MANUALS

#### **A4.1 DRAWINGS IN ELECTRONIC FORMAT**

The PD Contractor shall provide drawings in electronic format as required in the following clauses. These drawings shall conform to the latest version of CAD Standard of Works Projects (CSWP) as posted in the website of the Works Branch, Development Bureau and in accordance with the latest version of CAD Manual for Architectural Services Department Projects. Should any technical conflict between the CSWP and the CAD Manual arise, the CSWP shall take precedence.

#### **A4.2 INSTALLATION DRAWINGS**

##### **A4.2.1 Drawing Submission Schedule**

The PD Contractor shall submit a detailed installation drawing submission schedule and programme to the Architect. The PD Contractor shall allow reasonable time in the programme for vetting of the installation drawings by the Architect and for drawing resubmissions as necessary.

The PD Contractor shall submit to the Architect a comprehensive "Submission Schedule" of installation drawings and builder's work drawings within 2 weeks after the acceptance of Tender, taking into account of the overall programme of the Installations including any Specialist Works and works by the utility undertakings. No equipment shall be delivered to the Site and no work shall be executed until the installation drawings have been approved by the Architect. The PD Contractor shall ensure that the installation drawings and builder's work drawings are progressively submitted in accordance with the approved "Submission Schedule".

The PD Contractor shall provide at least 6 hard copies and one electronic copy, unless otherwise specified in the Contract or the Sub-contract as appropriate, of the approved installation drawings to the Architect for distribution.

##### **A4.2.2 Size of Installation Drawings**

Drawings submitted by the PD Contractor shall only be of standard sizes from A0 to A4 or B1 size as stipulated in ISO 5457:1999.

PD Contractor's 'Installation Drawings' and/or 'Shop Drawings' shall be prepared to such scales that will clearly show all necessary details.

The drawings shall be prepared to the same sheet sizes and scales as used for the ultimate 'As-Installed' record drawings.

#### A4.2.3 Contents of Installation Drawings

In accordance with the provisions of this General Specification and as stated elsewhere in the Contract, the installation drawings must incorporate details of the actual plant and equipment items as approved by the Architect.

The PD Contractor shall ensure all installation drawings are accurate representation of the Installations, before submitting them to the Architect. All installation drawings shall be fully dimensioned and suitably scaled showing construction, sizes, weights, arrangements, operating clearances and performance characteristics.

- (a) "Installation drawings" shall generally include, but not limited to, the following:-
- Symbols and notations same as and compatible with the Drawings' standard;
  - Complete layout/assemblies including all necessary minor items and accessories;
  - Positions of all fixings, hangers and supports;
  - Maintenance spaces for all withdrawable items, such as coils, heater elements, thermometers, thermostats, fan shafts and fan blowers, cleaning and replacement of tubes, removal of guards, etc.;
  - Positions & sizes of all test holes, test pockets, thermostat pockets, thermometer pockets, bends and fittings, clearances to allow for the removal of inserted equipment where applicable;
  - Outline of insulation and clearances to allow for application thereof;
  - Outline of valve and similar insulation boxes and the clearances to be allowed for their removal thereof; and
  - Lifting points and safe working weights of each item. Note: These may be shown on separate drawings, if necessary, to avoid confusion.

(b) Pipework Installation Drawings

Prior to the commencement of any manufacture, fabrication, or installation, the PD Contractor shall submit to the Architect for technical appraisal installation drawings for the pipework installation. Generally, the drawings shall be drawn to a scale of not less than 1:50. Subject to the Architect's approval a scale of 1:100 may be adopted where the installation is a simple one.

The drawings shall indicate the location, with dimensions given, of all pipework in relation to the building structure and other pipework and equipment. The position of all valves, strainers, check valves, etc. shall be shown together with clearances necessary for removal of strainer baskets, internal parts of all valves, motors for motorized valves, solenoids, etc.

Positions and details of all hangers and supports shall be shown and the positions dimensioned.

Positions of thermostats, thermometers, test pockets and similar devices shall be shown and dimensioned including clearances required for their removal.

Details and outline of insulation and insulation boxes shall be shown including clearances required for removal of the boxes.

(c) Special Plant Rooms Co-ordination Work

Unless otherwise stated in the Contract, in the case of a plant room where the PD Contractor's equipment constitutes the major item involved (i.e. as in the case of pump room), the PD Contractor shall allow in the Tender for taking effective responsibility for the coordination of other services/building details within these specific areas. Furthermore the PD Contractor shall carry out this responsibility in co-operation with whoever has the responsibility for the overall project construction stage coordination.

Where necessary, the foregoing plant room co-ordination requirement shall include the preparation of plant room coordination drawings which other Contractors involved in the plant room are to comply with. The PD Contractor shall, also be responsible for the cross checking of other contractors' plant room installation drawings before work thereon proceeds.

#### A4.2.4 Builder's Work Drawings

Unless otherwise approved by the Architect, the PD Contractor shall submit to the Architect in accordance with the approved "Submission Schedule", 6 copies of drawings showing details of all builder's work required e.g. the weight and the load on each support of equipment. Such drawings shall clearly indicate the details and positions of all openings, trenches, ducts, drain and cutting required and construction details for plinths and equipment bases.

#### A4.2.5 Manufacturer's Shop Drawings

The manufacturer's shop drawings are drawings for equipment or plant to be manufactured by a specialist manufacturing supplier in their own workshops and places away from the Site.

The drawings shall show detailed construction, principal dimensions, weights and clearances for maintenance, etc. Immediately after placing of any order or at any event within 4 weeks unless otherwise approved in writing by the Architect, the PD Contractor shall forward to the Architect for comment, 4 copies of manufacturer's shop drawings indicating detailed construction, principal dimensions and weights, clearances for withdrawals and/or cleaning, etc. No work shall proceed on or off Site unless drawings requiring approval are so approved in writing by the Architect.

#### A4.2.6 Checking Drawings of Other Trades

The PD Contractor shall follow the design intent of the Drawings in planning and carrying out the work and shall cross check with other trades in order to verify the line, level, space and sequence in which the Installations is to be installed.

If directed by the Architect, the PD Contractor shall, without extra charge, make reasonable adjustments to the proposed installation drawing layouts as are necessary to prevent conflicts with the work of other trades or for the proper sequence of and execution of Works. Where such modifications are of a nature and of such unforeseen complexity that they involve unreasonably extra work not covered by the Contract, they may be covered by variation order to be issued by the Architect wherever such a requirement is justified.

### **A4.3 AS-BUILT DRAWINGS**

#### A4.3.1 Submission of As-built Drawings

The PD Contractor shall submit 3 sets of the first draft prints of as-built drawings within 28 days of the issuance of the

certification of completion in accordance with the Contract to the Architect for checking. The Architect after checking the above draft prints shall return one set of the marked up copies of these as-built drawings to the PD Contractor within 42 days from the date of submission of the PD Contractor's draft prints with comments. The PD Contractor shall within a further 28 days from the date of receiving the Architect's comments on the draft as-built drawings re-submit to the Architect for his approval another 3 sets of the second draft prints of as-built drawings with the Architect's comments incorporated. This process of submission and approval shall continue until the final approval of the Architect on these as-built drawing is obtained.

The final approved as-built drawings shall be in 3 sets of hard copy and 3 sets of electronic copies. These shall be submitted within 21 days from the date of final approval. Each electronic copy shall be in the form of CD-ROM, labeled, with cross reference to a printed list of files explaining the contents and purpose of each file and supplied in sturdy plastic containers.

The detailed requirements and the media of as-built drawings set out in the Contract shall be followed as appropriate.

#### A4.3.2 Size of As-built Drawings

As-built drawings shall only be of standard sizes of A0, A1 or B1 size as stipulated in ISO 5457:1999. Smaller size (A2 to A4) is accepted for installation drawings.

#### A4.3.3 Content of As-built Drawings

The PD Contractor shall ensure all as-built drawings are accurate representation of the Installations, before submitting them to the Architect. The as-built drawings required to be provided by the PD Contractor for various types of the Installations shall include, but not limited to the following:-

- (a) Plumbing and drainage layout plans such as pipe arrangement, valve arrangement, sanitary fitments arrangement, etc.;
- (b) System schematic diagrams; and
- (c) Installation details and assembly drawings such as pipework, sanitary fitments, etc.

"As-built" drawings shall complete with all details to be used for commissioning purposes. Any amendments noted on these drawings during the commissioning and test stage shall subsequently be transferred to the original "As-built" drawings once the amendments have been accepted by the Architect.

#### A4.3.4 Framed Drawings

The PD Contractor shall provide and install in the relevant major plant room glass-framed, non-fading prints of the following:-

- (a) Valve chart consisting of schematic diagrams showing the layouts and positions and identification of all valves with record of final settings/adjustment for regulating devices; and
- (b) Plant room record drawings showing all plant items, pipework and equipment.

Glazing shall be polished plate of not less than 6 mm thickness mounted in natural finish, extruded and anodised aluminium frames with the prints mounted on acid free mounting board and the whole backed with marine grade plywood not less than 8 mm thick.

### **A4.4 OPERATION AND MAINTENANCE (O&M) MANUAL**

#### A4.4.1 General

The PD Contractor shall refer to the Specifications for any other requirements in O&M Manual.

The O&M Manual is for use by the maintenance agent of the completed Installations. It shall contain detailed technical information covering both operation and maintenance aspects of the Installations.

#### A4.4.2 Presentation

All manuals shall be written in English, unless otherwise specified. The text of descriptive parts shall be kept concise while at the same time ensure completeness. Diagrammatic materials shall also be supported by comprehensive descriptions.

The manuals shall comprise A4 size loose-leaf, where necessary, A3 size folded loose-leaves. The loose-leaf shall be of good quality paper that is sufficiently opaque to avoid "show-through". Unless otherwise specified in the Contract, the manuals shall be bound in durable loose-leaf 4 ring binders with hard covers. The manuals shall have labels or lettering on the front cover and spine. The Architect's approval shall be obtained on this at the draft manual stage. The electronic copy of manuals including the technical literatures shall be in PDF format readable by Acrobat Reader Freeware.

#### A4.4.3 Checking and Approval

The PD Contractor shall submit 3 sets of the first draft of O&M Manuals together with a list of recommended spare parts for one year's operation and a list of special tools, both complete with prices to the Architect for comment within 28 days of the issuance of the certificate of completion in accordance with the Contract.

The Architect will check the drafts and return them to the PD Contractor within 42 days from the date of submission with comments necessary for a final and approved set of document. The PD Contractor shall then make all necessary amendments to the documents and resubmit them to the Architect within 21 days from the date of receipt of comments.

Unless otherwise approved, the PD Contractor shall submit 4 sets of hard copies (one of which shall be the original) and one set of electronic copy of the final approved O&M Manuals in CD-ROM within 21 days from the date of approval by the Architect.

#### A4.4.4 Structure and Contents of O&M Manual

The detailed requirements, structure and contents of the O&M Manual shall be as specified in elsewhere in the Contract and shall include the following information under separate sections where appropriate:-

(a) Project Information

This shall include:-

Project title, site address, contract no., contract title, contractor/sub-contractor name, address, contact persons and their telephone/fax nos., contract commencement date, substantial completion date and expiry date of Maintenance Period.

(b) System Description

This shall include:-

- Type(s) of system(s) and equipment installed;
- Design criteria, design data and parameters;
- Locations of the major equipment, and what they serve;
- Description of operation and functions of the equipment; and
- General operating conditions and expected performance where applicable.
- List of installed equipment

(c) Spare Parts and Special Tools Lists

This shall include:-

- List of Spare Parts supplied by the PD Contractor: Item descriptions, supplied quantities, model nos., manufacturer's serial or reference nos. and storage locations; and
- Manufacturers'/suppliers' recommendations for spare parts and special tools with item description, unit rate, recommended stock quantities as well as the agents for the spare parts and special tools.

(d) Manufacturers' Certificates/Guarantees

This shall include:-

- Manufacturers' certificates such as factory test certificates, laboratory test reports and guarantees and any others where required for the equipment and plants, etc.; and
- Originals of Statutory Inspection Certificate for various installations, such as surveyor's test certificates for high pressure vessel, lifting devices/appliances, etc.

(e) Safety Precautions for Operation & Maintenance

State, where applicable, hazard warnings and safety precautions of which the operation and maintenance staff need to be aware:-

- Mandatory requirements relating to safety;
- Known hazards against which protection measures shall be taken; and
- Known features or operational characteristics of the installed equipment or systems which may cause hazard and the related safety precautions.

(f) Operation Instructions

Instructions for operation, under both normal and emergency conditions, of the installed system which shall comprise:-

- An outline of the operating mode;

- Precautions necessary to overcome known hazards;
- Means by which any potentially hazardous equipment can be made safe;
- Emergency shut off of water supply; and
- Changeover to standby equipment /pipework.

(g) Maintenance Instructions

Manufacturers' and the PD Contractor's recommendations and instructions for the maintenance of the installed system and equipment. Clear distinction should be made between planned tasks (preventive maintenance) and fault repair tasks (corrective maintenance). Instructions shall be given on each of the following, as appropriate:-

- Nature of deterioration, and the defects to be looked for;
- Isolation and return to service of system and equipment;
- Dismantling and reassembly;
- Replacement of components and assemblies;
- Dealing with hazards which may arise during maintenance;
- Adjustments, calibration and testing; and
- Special tools, test equipment and ancillary services.

(h) Maintenance Schedules

Proposed maintenance schedules for all the preventive maintenance tasks identified above. The schedules shall be based on both manufacturers' recommendations and other authoritative sources (e.g. statutory or mandatory requirements) and should include:-

- Routine servicing;
- Inspections;
- Tests and examinations; and
- Adjustments and calibration.

The frequency of each task may be expressed as specific time intervals, running hours or number of completed operations as appropriate. Collectively, the schedules will form a complete maintenance cycle, repeated throughout the whole working life of the Installations.

(i) Drawing Lists

This shall include:-

- A complete list of as-built drawings identified with drawing number/reference;
- A brief description for these drawings.

(j) Contact addresses and telephone numbers of suppliers of major equipment.

A4.4.5 Intellectual Property Rights

The Government shall become the absolute and exclusive owner of the Operation and Maintenance Manuals and all intellectual property rights subsisting therein free from all encumbrances.

In the event that the beneficial ownership of any intellectual property rights subsisting in the above Manuals are vested in anyone other than the PD Contractor, the PD Contractor shall procure that the beneficial owner shall grant to the Employer a transferable, non-exclusive, royalty-free and irrevocable licence (carrying the right to grant sub-licences) to utilize the intellectual property rights in the manuals for the purposes contemplated in the Contract. For the avoidance of doubt such purposes shall, but not limited to, include providing free copying of the materials in the manuals by any subsequent owner or user of the Installations, and/or any party responsible for the operation and maintenance of the Installations in connection with any subsequent alteration, extension, operation and maintenance of the Installations.

## **PART B**

### **INSTALLATION METHODOLOGY**

#### **SECTION B1**

##### **INSTALLATION OF PLUMBING SYSTEMS**

#### **B1.1 GENERAL**

The Scope of Installations under this section shall include the complete plumbing installation for fresh, flush, fire service pipework systems as shown on the Drawings and as specified, including but not limited to:

- B1.1.1 Fresh and flush water pipework installations commencing from the government mains at the entry of Site boundary to individual sanitary fixtures, gas water heaters and taps. Part of the plumbing installation inside pump room, including the pumpset, ball float valve etc., will be carried out by other Sub-contractor for fire service and water pump installation where shown on the Drawings or as specified. The installation of gas water heater, if applicable, will be carried out by a separate gas water heater contractor;
- B1.1.2 Fire service water pipework installation commencing from the government mains at the entry of the Site boundary including the up-feed pipes to the fire service roof/transfer tanks. Part of the plumbing installation inside pump room, including the pumpset, ball float valve etc., will be carried out by other contractor for fire service and water pump installation where shown on the Drawings or as specified; and
- B1.1.3 Extend and connect the fresh, flush and fire service water pipes to the government mains outside the Site boundary, if applicable. Where shown in the Drawings or as specified, connection shall be made to existing in-service supply mains of adjacent building blocks instead of government mains.

The complete installation shall mean, not only the major items of equipment and apparatus conveyed in this Specification, but all the incidental sundry components necessary for the complete execution of the works and for the proper operation of the installation with their labour charges, whether or not these supply components are mentioned in detail in the Contract.

The PD Contractor shall make all necessary applications to WSD and attend upon their representative for the purpose of tests and inspections for the plumbing installation.

## **B1.2 HANDLING AND STORAGE**

- B1.2.1 Materials shall be stored properly in accordance with the manufacturer's instructions to afford maximum protection against weather, corrosion, mechanical damage and other causes prior to installation.
- B1.2.2 Pipes shall be stored with closed ends. The exposed end of pipework shall be covered throughout the erection.
- B1.2.3 Pipes and fittings shall be stored under cover and clear of a leveled, well-drained and maintained hard-standing ground. Do not rest pipes on their sockets.
- B1.2.4 Rubber jointing rings shall be stored in protective bags. Plastic pipes and fittings under storage shall not be exposed to sunlight to avoid any deformation.
- B1.2.5 Pipes and fittings shall be cleaned before erection to remove all scale, burrs, furs, sand, slag etc. Damaged pipes or fittings shall be removed from the Site immediately.

## **B1.3 FIXING PIPES AND FITTINGS**

### **B1.3.1 General Details**

Pipes and fittings shall be inspected before fixing.

Avoid crimping and restricting the diameter of tubes when forming bends in pipes.

Provide air vents of automatic type at high points as shown on the Drawings.

### **B1.3.2 Protection to Movement and Expansion**

Make adequate provision to control and/or allow for thermal movement in the length of pipes and gutters.

Provide expansion joints in plastic pipes by means of loops or other methods in accordance with the manufacturer's recommendation.

Provide solar protection or insulation for pipes running at roof top by shelter or by painting them white.

### **B1.3.3 Pipework Arrangement**

Water pipes shall not run over electrical switchgear; inside transformer room, switch room, generator room, meter room, telephone equipment room, PABX room, riser duct for electrical services, or any other rooms containing electrical hazard.

Unless otherwise approved, do not embed pipes in concrete or grout in or install in such a way as to make alterations difficult at a later date.

Pipes requiring protection against corrosion shall be fixed with 40 mm (minimum) clearance between the pipe, structure or adjacent surfaces.

Pipework shall not be casting in or build into chases in walls and floor unless otherwise approved by the Architect. Where this is unavoidable and approved, pipes shall be wrapped in an approved protective tape.

Pipework installation shall avoid contact between certain dissimilar metals in particular avoid the direct contact of copper with galvanized iron or steel pipes. If unavoidable use gunmetal joints between dissimilar metals.

#### B1.3.4 Bends and Offsets of Copper Pipework

Offsets shall be achieved using 45° in preference to 90° bends.

Bends and offsets of up to 90° shall only be formed for pipe sizes from 15 mm to 35 mm provided they:

- (a) Have a minimum centre line radius of more than or equal to 3.5 times the pipe diameter;
- (b) Are only formed using tools specifically designed for that purpose, i.e. spring benders and formers;
- (c) Are free of deformation that may restrict water flow.

Bends and offsets of up to 30° and have a minimum centre line radius of more than or equal to 3.5 times the pipe diameter shall only be formed in pipe sizes less than or equal to 54 mm by heat bending/ annealing techniques without the need for bending tools.

Do not remove or damage the polyethylene sheath where bends are formed in copper pipes with factory applied polyethylene sheath.

Terminate factory applied polyethylene sheath at a consistent/uniform distance not more than 10 mm from the connecting compression type fitting body.

#### B1.3.5 Pipe Sleeves

Where pipes pass through walls, beams and floor/ceiling slabs, pipe sleeve shall be provided and fixed with uniform annular clearance to allow for expansion and movement of pipe.

For pipes passing through walls and beams, pipe sleeves shall be fixed that flush with the finished surfaces.

For pipe passing through floor slabs, pipe sleeves shall be fixed in position with 100 mm projection above finished floor level and flush with the underside of the floor.

For metal sleeves used in walls and slabs between fire compartments, the sleeves shall be filled for its full length of annular space between the sleeve and the pipe with non-flammable mineral wool or approved equivalent materials. Caulk both ends with fire-rated mastic sealant which is durable and effective in sound insulation to maintain the required FRR of the walls/floor slabs.

For pipes passing through external basement walls where there is ground water pressure, use puddle flanges cast in basement wall for pipe connection.

## **B1.4 JOINTING PIPES AND FITTINGS**

### **B1.4.1 General**

All pipe joints shall be carried out in accordance with the manufacturer's instructions. Pipe joint shall not be made in the thickness of any wall, floor and ceiling unless otherwise approved by the Architect.

Particular care shall be taken to ensure that joints are not built in and if bends are necessary they shall be made bends and not jointed bends.

Expansion joint shall be provided for all pipework passing through any building expansion joint.

Jointing rings, couplings and adaptors shall be of types recommended by the manufacturer of the pipes being jointed.

Cut ends of pipes and gutters clean and square, and chamfer internally or externally if required using equipment appropriate to the material.

Jointing material shall not project into the bore of pipes or fittings.

For push-in joint, caulk gaskin firmly into sockets.

#### B1.4.2 Jointing of Galvanized Steel Pipes

Galvanized steel pipes of sizes up to and including 100 mm shall be jointed with screwed fittings. Screwed flanges shall be employed only for connection to flanged valves or equipment.

Galvanized steel pipes of sizes of 150 mm and above shall be jointed with screwed flanges.

Do not joint steel pipes by welding unless approved.

Screwed fittings shall have pipe threads complying with BS 21: 1985 or BS EN 10226-1: 2004. Screwed joints shall have tapered threads and shall be made with approved jointing material.

#### B1.4.3 Jointing of Copper Pipes

Unless otherwise specified in Particular Specification or Drawings, compression type fittings, solder (end feed or integral) capillary fittings or brazed capillary fittings shall be used for copper pipe sizes less than or equal to 54 mm diameter. For pipe size larger than 54 mm diameter, solder (end feed or integral) capillary fittings shall be used for jointing. For pipe size larger than 108 mm, brazed capillary fittings shall be used for jointing.

For copper pipe joint by compression type fittings, written confirmation from the manufacturer on suitability of the compression type fittings for use with hot water piping system in 80°C under the required working and maximum pressure shall be submitted to the Architect for examination and approval for use.

Soldering alloys for copper and copper alloy fittings shall comply with Table 6 Section II and III of BS EN 1254-1: 1998 and shall be of lead-free. Non-corrosive type of flux recommended by the solder alloy manufacturer shall be used.

Brazing alloys for copper and copper alloy capillary fittings shall comply with Table 6 in Section VI of BS EN 1254-1: 1998 with 2% nominal silver content and shall be of cadmium-free. Flux shall not be used for brazing copper-to-copper joints. For joints other than copper-to-copper, type of flux recommended by the brazing alloy manufacturer shall be used.

Use dielectric fittings or epoxy coated flange with gasket for connecting copper pipe to galvanized steel or ductile iron pipe or cast iron valve.

Fit "clip-on" type preformed polyethylene sheaths to cover the capillary type joints and fittings after jointing of the pipework.

The following procedures shall be followed for jointing copper pipes with soldering: -

- (a) Remove copper oxide and dirt from pipe spigot and fitting socket prior to the application of soldering flux.
- (b) Apply flux sparsely and remove excess flux prior to heating.
- (c) Clean pipe joints with a damp cloth on completion to remove flux residues.

The following procedures shall be followed for jointing copper pipes with copper alloy capillary fittings by brazing: -

- (a) Apply flux to the tube spigot and fitting socket when brazing.
- (b) Remove residual flux after brazing.

#### B1.4.4 Jointing of Stainless Steel Pipes

Jointing of stainless steel pipe shall be by mechanical joint or other jointing approved by the Architect.

#### B1.4.5 Jointing of Ductile Iron Pipes

All ductile iron pipes shall be jointed with screwed flanges or flanged fittings. Flanges shall comply with BS EN 1092-2: 1997 PN16 as minimum.

#### B1.4.6 Jointing of UPVC Pipes

UPVC pipe shall be solvent joint using spigot and socket end and fittings. Solvent shall be recommended by the manufacturer.

Unless otherwise approved by the Architect, interchangeability shall not be allowed between different plastic pipe manufacturer's products.

### **B1.5 PIPEWORK SUPPORT**

#### B1.5.1 General

Pipework shall be supported in such a manner as to allow adequate movement for expansion and contraction.

Pipes on flat roofs shall be supported at least 150 mm above roof finish on concrete blocks and pipe brackets or PVC sleeves.

Pipe brackets shall be of stainless steel to BS EN 10088-3: 2005 number 1.4301 or SAE Grade 304 or other approved material. The pattern shall suit the type of pipe and the surface to which they are to be fixed, including where appropriate:

- (a) Flanged ends for building in;
- (b) Plain round ends for fixing in drilled holes with an approved adhesive;
- (c) Approved expanding bolts or stud anchors for fixing to concrete, brickwork etc.;
- (d) Threaded ends for fixing to steelwork, or wood, as required;
- (e) Holed face plates for screwing to wood or plugs.

Bolts, nuts and washers for pipe brackets shall be of stainless steel to BS EN 10088-3: 2005 number 1.4301 or SAE Grade 304 or other approved materials.

Pipework bracket inside pump room shall not be anchored on wall or ceiling as far as practicable. If unavoidable, neoprene or rubber vibration isolation pad of 8 mm thick between the pipe and bracket for those pipe brackets mounted on wall, and vibration isolator for those pipe bracket mounted to ceiling or steel support frames, shall be added.

Do not connect pipe brackets to copper pipes by means of brazing or soldering.

Pipe bracket shall be lined with plastic which fitted between the pipe and the bracket for UPVC pipes and copper pipes.

#### B1.5.2 Pipe Bracket Intervals

Pipe bracket shall be installed at intervals not exceeding those shown in Table B1.5.2 for straight runs, and with not less than one bracket per length of pipe. Short length of pipe can be without pipe bracket if approved by the Architect. All brackets shall be equally spaced.

Table B1.5.2 - Spacing of Pipe Fixing

Pipes	Nominal Size (mm)	Maximum Spacing (mm)	
		Vertical pipes	Horizontal pipes
Cast iron and ductile iron	All	3000	1750
Steel	Up to 15	2400	1800
	20 and 25	3000	2400
	32	3000	2700
	40 and 50	3600	3000
	65 and 80	4500	3600
	125 and 150	5400	4500
Copper	15 to 22	1800	1200
	28	2400	1800
	35 and 42	3000	2400
	54	3000	2700
	76 and 108	3600	3000
UPVC	Up to 25	1500	750
	32	1800	900
	40 and 50	2000	1000
	65 to 150	2500	1200

Additional pipe brackets shall be provided next to cast iron valve installed in UPVC pipe. Also, additional pipe brackets shall be provided at turning point of UPVC flush water pipe riser and down pipe.

## **B1.6 THERMAL INSULATION**

B1.6.1 Thermal insulation to the requirements as specified in this Specification or other parts of the Contract shall be applied to hot water supply pipework and fittings.

B1.6.2 Pipework insulation shall include all pipework, valves, flanges, fittings, pumps and other plant items whether specifically mentioned or not.

## **B1.7 VALVES**

B1.7.1 Unless otherwise specified, install the valve in accordance with manufacturer's recommendations.

B1.7.2 Non-return valve shall be installed in such a manner that the water flow direction is in an upward direction.

B1.7.4 Drain the pipework thoroughly prior to the installation of the flushing valve into service.

- B1.7.5 No pipe sealant or plumbing grease shall be allowed on any flushing valve components or couplings unless otherwise specified in the manufacturer's literature.
- B1.7.6 The flushing valve shall be installed with its outlet connecting to a vertical down pipe.
- B1.7.7 Valves and taps installed in public areas, not intended for public use, shall be housed in vandal resistant and corrosion resistant enclosures.

## **B1.8 CISTERNS AND TANKS**

### **B1.8.1 Connection of Pipes**

Generally, when connecting pipes to cisterns and tanks, ensure that cisterns and tanks are properly supported to avoid undue stress on the pipe connections. Correctly position holes for the connection of pipes to cisterns and tanks. Remove all debris and fillings. Holes in cisterns and tanks shall not be formed by flame cutters.

Connect steel pipes to steel or glass fibre reinforced plastics cisterns and tanks by either:

- (a) backnuts and washers both inside and outside
- (b) by using bolted or welded flanged connections
- (c) as recommended by the manufacturer

Connect plastic pipes to steel or glass fibre reinforced plastics cisterns by a backnut to the inside. Use corrosion resistant support washers on both the inside and outside of the cistern or tank.

Connect copper pipes to GRP cisterns or tanks in a similar manner.

Do not connect copper pipes to steel cisterns or tanks.

Connect pipes to concrete tanks with short thread flanged connections having a puddle flange either cast or welded on. Ensure that the connections are properly aligned both in the horizontal and vertical planes when being cast into the concrete. Compact around the puddle flange to ensure a water tight joint.

### **B1.8.2 Connection of Overflow Pipes**

Overflow pipes shall be one pipe size larger than the inlet pipe and in no case less than 25 mm diameter and shall be extended to terminate in conspicuous positions.

The top of the overflow pipe shall be not less than 25 mm below the invert of the inlet pipe or the face of the outlet nose of the ball float valve.

#### B1.8.3 Tank Covers

Certain access covers and frames may be supplied by the Government, as scheduled on the Drawings.

Fit FRP or stainless steel access covers and frames to water tanks.

Fit double sealed access covers to potable water tanks.

Bed and haunch access cover frames in cement mortar.

### **B1.9 WORKS OUTSIDE SITE BOUNDARY**

The PD Contractor shall make all necessary provisions for the connection of water supply mains from town mains to this Installation.

WSD shall be notified accordingly to inspect completed pipework and valve pit prior to back filling.

### **B1.10 PROTECTION OF WORKS**

#### B1.10.1 Sealing the System

Ends of pipes and openings shall be sealed off to prevent entry of foreign matter into the system during construction. Access covers and cleaning eyes shall be fitted when the works proceed.

#### B1.10.2 Valves and Taps

House valves and taps installed in public areas or those not intended for public use in vandal-resistant and corrosion-resistant enclosures.

#### B1.10.3 Underground Pipework

Underground pipework shall be protected against corrosion and mechanical damage.

Pipework shall be cleaned after joining and to be treated with two coats of good quality bituminous paint and wrap it with petrolatum tape for protection against corrosion due to water, salts and soil organics, and rest it on sand or sieved soil before the trench is backfilled.

All underground pipework shall be pressure tested before the application of bituminous paint and petrolatum tape.

#### B1.10.4 Pipework Passing under Road

Pipes crossing under roads shall be passed through in ducts of similar construction to cable ducts as Clause 24.30 of General Specification for Building.

Where top of the underground pipework is less than 900 mm from finish level of roads for vehicles, the pipework shall be surrounded by concrete.

### **B1.11 CLEANING AND DISINFECTION OF INSTALLATIONS**

#### B1.11.1 General

The plumbing installation pipework and water storage tanks shall be thoroughly flushed clean to remove rust, sludge and sediment upon commissioning. Potable water distribution pipework and associated water storage tanks shall be further disinfected upon completion of cleaning.

Disinfection of plumbing installation for potable use shall be carried out not more than 7 days before hand over the installation to users for operation. Where the plumbing installation for potable use is not brought into use immediately after commissioning, it shall be disinfected before use unless it has been flushed weekly to maintain a flow of water.

#### B1.11.2 Methodology of Cleaning and Disinfection

The PD Contractor shall carry out the cleaning and disinfection in accordance to the requirements as stipulated in the Testing and Commissioning Procedure for Plumbing and Drainage Installation in Government Buildings Hong Kong issued by the Building Services Branch, Architectural Services Department and to the satisfaction of the Water Authority.

For pipework downstream of the water tank or downstream of the water meter for the case of direct feed system, the disinfection process shall in accordance to BS 8558: 2011.

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, procedures and equipment for checking and testing, location of sampling, method statement for the de-chlorination, etc. for the Architect's approval prior to carrying out the work.

Any discharge of disinfectant solution or used water for disinfection shall comply with the Water Pollution Control Ordinance (Cap. 358). The PD Contractor shall submit a method statement for the de-contamination of used water to the Architect for approval.

## SECTION B2

### INSTALLATION OF ABOVE GROUND DRAINAGE SYSTEMS

#### **B2.1 GENERAL**

B2.1.1 Foul water drainage above ground shall be installed generally to BS EN 12056-2: 2000.

B2.1.2 Bolted access doors or inspection units shall be provided to all branches and bends (other than ventilating and anti-syphon pipes) and at the foot of main soil stacks. Access doors to cast iron soil stacks shall be fitted with stainless steel or gunmetal bolts.

#### **B2.2 HANDLING AND STORAGE**

B2.2.1 Store rubber jointing rings in protective bags and do not expose them to sunlight. Avoid any deformation.

Do not expose plastic pipes and fittings to sunlight and avoid any deformation.

B2.2.2 Store pipes, gutters and fittings under cover and clear of a leveled, well-drained and maintained hard-standing ground.

B2.2.3 Stack pipes without resting them on their sockets.

B2.2.4 Prevent entry of foreign matter into any system by sealing off ends of pipes and openings during construction.

#### **B2.3 FIXING PIPES AND FITTINGS**

B2.3.1 General Details

Inspect pipes and fittings inside and out before fixing. Reject any which are defective.

Fix pipes and fittings securely with fixings and fastenings appropriate to the location and the material.

Do not cast in or build pipes into chases in walls and floors unless approved by the Architect, in which case: -

(a) Coat all pipes which come into direct contact with concrete with an approved protective tape;

(b) Ensure that there are no joints in straight pipes built in other than elbows and tees.

Avoid crimping and restricting the diameter of tubes when forming bends in pipes.

Do not fix roof outlet gratings until after all other work at roof level is completed. Outlets that are contaminated in any way shall be replaced.

Surface Channel and floor drain shall be flush with the walkway surface.

Bolted access doors or inspection units shall be provided at all branches and bends other than ventilating and anti-syphon pipes, and at the foot of main soil stacks. The access doors or inspection units shall be fitted to cast iron soil stacks with stainless steel or gunmetal bolts and rubber gaskets.

Unless expressly authorised by the Architect, interchangeability shall not be allowed between different plastic pipe manufacturer's products.

Pipes requiring protection against corrosion shall be fixed with 40mm (minimum) clearance between the pipe, structure or adjacent surfaces. Avoid fixing such pipes at internal angles.

Vertical pipes in situations which are accessible to rodents shall be placed at least 100 mm away from any adjacent wall or pipe to a minimum height from ground level of 1500 mm.

#### B2.3.2 Protection to Movement and Expansion

Make adequate provision to control and/or allow for thermal movement in the length of pipes and gutters depending on material specified and in accordance with details shown on the Drawings.

Provide expansion joints in plastic pipes by means of loops or other methods in accordance with the manufacturer's recommendations.

Provide solar protection for pipes running at roof top by shelter or by painting them white.

#### B2.3.3 Pipework Arrangement

Unless otherwise approved by the Architect, pipes shall not run over electrical switchgear; inside transformer room, switch room, generator room, meter room, telephone equipment room, PABX room, riser duct for electrical services, or any other rooms containing electrical hazard.

The routing and arrangement of pipework shall allow the replenishment of sealing trap of floor drains by diverting waste water from waste fitments.

The arrangement of pipework shall prevent cross flow of foul water at the tee inlets of branch pipe or stack pipe. Tee fittings shall not be double junction type.

The arrangement of pipework shall prevent backflow of foul water to the trap. The level of the trap outlet shall be at least 200mm higher than the foul water branch pipe or stack pipe tee inlet being connected with.

Size of ventilating stack pipe at highest floor shall be the same size as soil stack at lowest floor.

Cross vent between ventilating stack pipe and foul water stack pipe shall be provided at least in an interval of every 5 floors.

Metallic pipework shall be used at the bottom of UPVC pipe stack to prevent hydraulic jump.

#### B2.3.4 Fixing Plastic Gutters

Fix gutters with screwed gutter brackets as follows: -

- (a) At 1000 mm (maximum) centres; and
- (b) Generally to falls of 1 in 300 (minimum).

#### B2.3.5 Fixing UPVC Two-way Floor Drain Outlet

Fix UPVC two-way floor drain outlet as follows: -

- (a) Cast in UPVC horizontal drain pipe at the correct level fall and alignment as shown on the Drawings and to suit the thickness of wall and floor finishes;
- (b) Fix UPVC adaptor unit to the horizontal drain pipe. Cut the length of spigot if necessary where it connects onto the hopper of the drain pipe to suit the thickness of wall finishes, and ensure to maintain a minimum 8 mm of overlap between the spigot and the connecting hopper of the drain pipe;
- (c) Fix UPVC adjustable horizontal grating unit to the adaptor. Cut down the height of the unit if necessary to suit the finished floor level;
- (d) Ensure the fixing as mentioned above are to manufacturer's recommendations and all joints are watertight;

- (e) Seal the joints between the adaptor unit and wall tiles, and the joints between adjustable horizontal grating unit and floor tiles;
- (f) Install gratings to adaptor unit and adjustable horizontal grating unit with stainless steel screws.

## **B2.4 JOINTING PIPES AND FITTINGS**

### **B2.4.1 General**

Carry out all pipe joints in accordance with the manufacturer's instructions and do not allow jointing material to project into bore of pipes or fittings.

Cut ends of pipes and gutters clean and square, chamfering internally or externally if required using equipment appropriate to the material.

Joint pipes with gaskin and cold caulking compound.

Joint gutters with jointing compound and bolt together.

Jointing rings, couplings and adaptors shall be of types recommended by the manufacturer of the pipes being jointed.

Joint plastic pipe and gutters in accordance with the manufacturer's recommendations.

### **B2.4.2 Jointing of Cast Iron Spigot and Socket Pipes**

Joint pipes with cold caulking compound in accordance with manufacturer's instruction.

### **B2.4.3 Jointing of Cast Iron Spun Spigot Pipes**

Joint pipes with flexible joints in accordance with the manufacturer's recommendations. Pipes shall not be jointed with molten lead.

### **B2.4.4 Jointing of Steel Pipes**

Joint steel pipes with screwed sockets with jointing compound or pipe thread tape. Cutting threads with a tapered die. Threads found to be cut too deep will be rejected.

Paint all threaded surfaces with one coat of non-toxic anti-corrosion epoxy base polymide primer or red oxide primer and one coat compatible finish.

#### B2.4.5 Jointing Steel Pipes to Cast Iron Pipes

Joint steel pipes to sockets of cast iron pipes with cold caulking compound in accordance with manufacturer's instruction.

#### B2.4.6 Jointing Pipes to Clay Pipe Sockets

Joint cast iron pipes to clay spigot and socket pipes with gaskin and cement and sand 1:2.

Joint steel pipes to clay spigot and socket pipes with gaskin and cement and sand 1:2.

#### B2.4.7 Jointing of UPVC Pipes

Fix and joint UPVC pipes in accordance with the manufacturer's recommendations. Joint UPVC pipes to pipes of other materials with proprietary adapters.

Screw threads to UPVC pipes shall not be allowed unless otherwise ordered by the Architect. Where screw connections are required, screwed adapter bushes shall be used.

Proprietary adaptors shall be used for jointing plastic pipes to pipes of other materials.

#### B2.4.8 Joints Between Dissimilar Metals

Proper adaptors shall be used for making joints between different metals.

The contact between following dissimilar material shall be avoided: -

- (a) Aluminium alloys with copper alloys, nickel, lead or stainless steel;
- (b) Iron and steel with copper alloys;
- (c) Zinc with copper alloys. In particular avoid the direct contact of copper with galvanized iron or steel pipes.

If unavoidable, use gunmetal joints between the dissimilar metals.

### **B2.5 PIPEWORK SUPPORT**

#### B2.5.1 General

Support pipes on flat roofs and canopies at least 150 mm above roof and canopy finish on concrete blocks with pipe clamps.

Do not use branch pipes that connect to vertical pipes as pipe supports.

Corrosion-resistant fixings such as stainless steel brackets and connections or similar corrosion-resistant fixing supports shall be used. The fixings shall be properly anchored into solid wall.

Pipe brackets shall be of stainless steel to BS EN 10088-3: 2005 number 1.4301 or SAE Grade 304 or other approved material. The pattern shall suit the type of pipe and the surface to which they are to be fixed, including where appropriate:

- (a) Flanged ends for building in;
- (b) Plain round ends for fixing in drilled holes with an approved grout;
- (c) Approved expanding bolts or stud anchors for fixing to concrete, brickwork etc.;
- (d) Threaded ends for fixing to steelwork, or wood, or panel wall with plug as required;
- (e) Countersunk-holed face plates for screwing to wood or plugs, or panel wall with plug;
- (f) Brackets lined with resilient plastic at pipe clamps for plastic pipes, plastic coated pipes and cast iron pipes.

Bolts for cast iron and steel pipework shall be of brass, cadmium plated steel or other non-corrodible metal.

Bolts for soil stack access doors for cast iron and steel pipework shall be of stainless steel or gunmetal.

Wood screw shall be brass with countersunk heads and of a length sufficient to ensure a secure fixing.

Plugs for fixing to hard materials shall be of proprietary plastic, fibre, soft metal or similar material. Plugs for fixing to friable materials, plasterboard and the like shall be of proprietary fixings specially designed for the purpose. Plugs containing asbestos shall not be used.

#### B2.5.2 Pipe Bracket Intervals

Pipe bracket shall be installed at intervals not exceeding those shown in Table B2.5.2 for straight runs, and with not less than one bracket per standard length of pipe. All brackets shall be equally spaced.

Table B2.5.2 - Spacing of Pipe Fixing

Pipes	Nominal Size (mm)	Maximum Spacing (mm)	
		Vertical pipes	Horizontal pipes
Cast iron and ductile iron	All	3000	1750
Steel	Up to 15	2400	1800
	20 and 25	3000	2400
	32	3000	2700
	40 and 50	3600	3000
	65 and 80	4500	3600
	125 and 150	5400	4500
UPVC	Up to 25	1500	750
	32	1800	900
	40 and 50	2000	1000
	65 to 150	2500	1200

## B2.6 PIPEWORK PENETRATING BUILDING STRUCTURE

### B2.6.1 Pipes Through Walls and Floors

Where pipes pass through walls or floors:

- (a) Cast or build in UPVC sleeves to BS 3505: 1986 or BS EN ISO 1452-1: 2009 with 2 to 12 mm clearance to allow for expansion and movement of pipe.
- (b) Finish sleeves flush with finished face of walls and ceilings and projecting 100 mm above finished floor level.
- (c) Provide loose plastic or chromium plated cover plates, when specified, to ends of sleeves visible in completed work. Plates shall be 50 mm larger than the external diameter of pipe and either clipped to the pipe or screwed or plugged and screwed to the adjacent surfaces as shown in the Drawings.
- (d) If required to be water tight, point with approved mastic sealant.
- (e) No split PVC sleeves shall be permitted.

### B2.6.2 Pipes Through Fire Rated Walls and Floors

Where pipes pass through fire rated walls or floors which are not fire compartment walls or floor:

- (a) For metal pipes pass through fire rated walls or floors which are not fire compartment walls or floors, either of the following shall be used:
- (i) The installation shall be as Clause B2.6.1 but
    - Cast or built in galvanized mild steel pipe sleeves to BS EN 10255: 2004 with 20mm clearance.
    - Well caulk the voids between the pipes and the sleeves for the full length with mineral wool or approved equivalent material designed for fire separation purposes in compliance with the Code of Practice for Fire Safety in Buildings.
  - (ii) Firmly fix sealing system around the pipes to properly seal up the voids between the pipes and the fire rated walls or floors in compliance with the Code of Practice for Fire Safety in Buildings. The sealing system shall be tested to BS EN 1366-3: 2009 or BS 476-20: 1987.
- (b) For non-metal or plastic pipes pass through fire rated walls or floors which are not fire compartment walls or floors, firmly fix sealing system around the pipes to properly seal up the voids between the pipes and the fire rated walls or floors in compliance with the Code of Practice for Fire Safety in Buildings. The sealing system shall be tested to BS EN 1366-3: 2009 or BS 476-20: 1987.

Where pipes pass through fire compartment walls or floors:

- (a) For metal pipes pass through fire compartment walls or floors, suitable intumescent coating or sealant shall be used to maintain the required fire compartment. The sealing system shall be tested to BS EN 1366-3: 2009 or BS 476-20: 1987 and the installation of which shall be in accordance with the manufacturer's recommendations.
- (b) For non-metal or plastic pipes pass through fire compartment walls or floors, suitable fire collars shall be used. The fire collars shall be tested to BS EN 1366-3: 2009 or BS 476-20: 1987 with integrity not less than of the fire compartment walls or floors as prescribed under the relevant Building Regulation and the Code of Practice for Fire Safety in Buildings. The fire collars shall be fixed at underneath of fire compartment floors or walls or other locations around the pipes in accordance with the manufacturer's recommendations.

### B2.6.3 Pipes Through Basement Wall

Where pipes pass through external basement walls:

- (a) Cast or build in cast iron or 2.5 mm galvanized mild steel sleeve to BS EN 10255: 2004 after fabrication with 2 to 12 mm clearance.
- (b) Caulk space and point both ends with approved mastic sealant.

### B2.6.4 Pipes Through Basement Wall with Ground Water Pressure

Where pipes pass through external basement walls where ground water pressure is significant:

- (a) Cast or build in short length of cast iron pipe as sleeve with split bolt on puddle flange and with socket on outside.
- (b) Well caulk socket around pipe with yarn and lead including a cast iron plug drilled to take long screw and backnuts if necessary.
- (c) Point inside with an approved mastic sealant.

### B2.6.5 Pipes Through Flat Roofs

Where pipes pass through flat roofs incorporating either asphalt or proprietary roofing waterproofing material:

- (a) Cast or build in cast iron or galvanized mild steel sleeve to BS EN 10255: 2004 with 2 to 12 mm clearance projecting 150 mm above roof finish.
- (b) Caulk space and point both ends with approved mastic sealant.
- (c) Cover tops of sleeves with lead collars as per roofing specification or as specified by pipe manufacturer.

## SECTION B3

### INSTALLATION OF UNDERGROUND DRAINAGE SYSTEMS

#### **B3.1 GENERAL**

- B3.1.1 This Section covers surface and foul water drainage below ground level.
- B3.1.2 Carefully examine each pipe before laying for evidence of damage with special emphasis on inspection of the jointing section. Remove all damaged pipes from Site as soon as possible.
- B3.1.3 During construction, plug open ends of pipes and maintain until completion, to prevent entry of debris.
- B3.1.4 Concrete shall be as specified in Section 6 of the General Specification for Building and used as follows:
- (a) Grade 20/20 - channels, manholes, inspection chambers, gullies, catchpits and all reinforced concrete work.
  - (b) Grade 10/20 - pipe bedding, pipe haunching, pipe surrounds and all other work.
  - (c) Grade 10/40 - filling.

#### **B3.2 HANDLING AND STORAGE**

##### **B3.2.1 General**

The PD Contractor shall transport, handle and store pipes, joints and fittings in accordance with the manufacturer's recommendations and: -

- (a) In a manner which will not result in their damage, deformation or contamination;
- (b) Protect pipes, joints and fittings from damage;
- (c) Handle pipes and fittings manually or by using lifting appliances or chains, wire rope or canvas slings of a type recommended by the manufacturer and agreed by the Architect and do not use hooks;
- (d) Place slings around the pipes and fittings and provide padding at the points of contact between pipes and fittings and metal lifting appliances and slings;

- (e) Do not subject pipes and fittings to rough handling, shock loading, or dropping and do not roll down ramps unless otherwise approved, in which case the ramps must be padded.

#### B3.2.2 Storing and Handling Pipes

Pipes shall be stored horizontally on a level surface and bottom supported by barrel or wedged timber bearers with their sockets overhanging. They shall be stored at least 75 mm above the ground on the bottom support. The bottom layers and the outer pipes in each layer shall be securely wedged to prevent sideways movement and stack collapse. Pipes shall not be stacked higher than 2m.

Spigot and socket pipes shall be stored with the sockets alternating and in such a manner that loads are not applied to the sockets.

Pipes shall not be string out along the route of the pipeline unless otherwise approved.

Pipes shall not be rolled over rough ground.

Pipes off loaded on skids shall be suitably wrapped to avoid risk of damage to pipes.

Do not lift pipes by slings or chains passing through bore of pipe.

Pipes shall be stored under cover.

#### B3.2.3 Storage of UPVC Pipes, Joints and Fittings

Rubber jointing rings shall be stored in protective bags. Plastic pipes and fittings shall not be exposed to sunlight or to conditions which may affect the material.

#### B3.2.4 Storage of Bolts and Nuts

Bolts and nuts shall be packed in sealed containers.

#### B3.2.5 Storage of Elastomeric Joint Rings

Elastomeric joint rings shall be packed in bags. Lubricant for joints shall be stored in sealed containers and marked to identify the contents. The joint rings and lubricant shall not be exposed to conditions which may affect the materials.

#### B3.2.6 Storage of Anti-corrosion Tape and Joint Filler

Anti-corrosion tape and joint filler shall be stored in accordance with the manufacturer's recommendations and in a dry, weatherproof store with a raised floor.

#### B3.2.7 Storage of Granular Bedding Materials

Aggregates for granular bedding shall not be handled in a manner which will result in mixing of different types and sizes, or in contamination of the aggregates. Different types and sizes of aggregates shall be stored in separate stockpiles.

#### B3.2.8 Storage of Manholes, Chambers and Gullies

Units for manholes, chambers and gullies shall only be lifted at the lifting points recommended by the manufacturers. The units shall not subject to rough handling, shock loading or dropping.

The units shall be stored off the ground on level supports which will not result in their damage, deformation or contamination. Protection shall be provided to avoid damage of the units.

#### B3.2.9 Storage of Covers, Gratings and Kerb Overflow Weirs

Manhole covers, gully gratings, kerb overflow weirs and valves, including fittings shall be stored off the ground on level supports which will not result in their damage, deformation or contamination. Protection shall be provided to avoid damage of the units.

### **B3.3 SETTING OUT**

B3.3.1 The centerline of trench shall be set out accurately. Top width of trench shall be marked by means of suitable pegs and offset side check pegs.

B3.3.2 Temporary benchmarks in stable positions shall be established. Erect strong site rail, planed true, painted in contrasting colours fixed to rigid posts across center of each manhole. Indicate the centerline of pipeline on sight rail and its height related to an even dimension to invert level of pipe. At least three rails shall be provided on each gradient at maximum spacing of 30 m. Length of travellers used between sight rails at frequent intervals shall be checked.

B3.3.3 Before commencing excavation, invert levels of existing drains, sewers and manholes shall be checked against levels shown on drawings.

### **B3.4 EXCAVATION OF TRENCH**

#### B3.4.1 General

Unless otherwise specified, all excavation and earthworks shall be in accordance with Section 3 of the General Specification for Building.

Excavation shall only be commenced when the nature, location and size of existing utilities which may be affected by the excavation have been ascertained and the setting out details had been approved.

Excavation for drainage works shall be carried out after adjacent bulk excavation or filling is completed.

Excavated trench shall be kept free of water at all times. Material made unsuitable by inadequate construction drainage shall be replaced.

Trenchless excavation (pipe-jacking), if proposed, shall be approved by the Architect.

#### B3.4.2 Trench Width

Trench widths measured at the crown level shall not exceed those specified in Table B3.4.2. In addition, minimum side clearance from pipe to trench face on each side of pipeline shall be as follows: -

- (a) 150 mm for pipes up to and including 675 mm internal diameter.
- (b) 225 mm for pipes exceeding 675 mm internal diameter

Table B3.4.2 - Trench Widths

Pipe Size (mm)	Trench Width (mm)
100	600
150	600
200	700
225	700
250	750
300	750
375	1050
450	1150
525	1200
600	1350
675	1450
750	1500
900	1900
1050	2050
1200	2300
1350	2450
1500	2600
1650	2800
1800	2950

Trenches to be excavated for subsoil and cut off drains having pipes up to 150 mm diameter shall be to a width of at least four times the nominal diameter of the pipe. Trench width shall be the external diameter of the pipe plus 450 mm or as specified for pipes above 150 mm diameter.

Localized hard and soft spots or other obstructions in trench bottoms and under drainage structures shall be removed and replaced with compacted special filling material to Section 3 of the General Specification for Building.

## **B3.5 BEDDING AND LAYING OF PIPES**

### **B3.5.1 General**

Pipe shall be bedded within any individual drain length between any two drainage chambers.

The laying of pipes shall be proceeded without delay on completion of excavation. Brick or other hard material shall not be used under pipe for temporary support.

Pipes shall be laid in single, straight to line and true to gradient with sockets facing upstream starting at the downstream end of the trench.

Minimum 150 mm clearance shall be maintained around the pipelines passing through building foundations. Space around shall be filled with flexible material or fine sand. At least two flexible joints shall be provided to the pipelines for passing through the foundations.

Mortar for bedding covers or for rendering shall consist of one part cement and three parts clean well graded sand with just enough water to give plastic consistency.

Pipes, joints, fittings and valves, including internal and external coatings, shall be inspected immediately before and after pipelaying. Valves shall be inspected to ensure that they are in working order and are capable of being fully opened and closed. Deleterious material shall be removed and damage shall be repaired immediately before and after pipelaying.

### **B3.5.2 Granular Bedding**

Recycled or non-recycled granular bedding material shall be clean, hard, durable, crushed rock or crushed concrete, broken stone, hard brick, concrete, or other comparable hard inert, approved material to pass a 25 mm BS sieve, but shall be retained on a 5 mm BS sieve.

Granular bedding material shall be tested as follows: -

- (a) Apparatus to be used:
  - (i) Open ended cylinder 250 mm long and 150 mm diameter.
  - (ii) Metal rammer with a striking face 40 mm diameter and of total weight of 1.25 kg.
- (b) Stand the cylinder on a firm surface. Using a sample of material having a moisture content equal to that of the material at the time of use, pour the sample of material into the cylinder without supplementary compaction and strike off the material level with the top of the cylinder. Lift the cylinder clear of its contents and place on a fresh area of flat surface. Replace about one quarter of the material in the cylinder and tamp vigorously until no further compaction is evident. Repeat this process quarter by quarter until the whole of the material measured loose in the cylinder is compacted.
- (c) The final measurement from the top of the cylinder to the compaction surface divided by the height of the cylinder is the Compaction Fraction value.
- (d) The suitability for use shall be determined from Table 3.5.2

Table 3.5.2 - Compaction Fraction

Compaction Fraction	Suitability
0.10 or less	Material suitable
0.10 to 0.30	Material suitable but requires extra care in compaction. May not always be suitable if the pipe is subject to water logged conditions after laying.
Over 0.30	Material unsuitable

Granular bedding shall be compact and trim to correct gradient and shape under barrel and pipe sockets to ensure uniform support along whole barrel length. The granular bedding material shall be compact concurrently on each side of the pipe to specified level after laying, jointing and testing of pipeline.

### B3.5.3 Natural Bedding

Natural bed shall be accurately trimmed to provide uniform and solid bearing for pipes throughout the length of the barrels. Short recesses shall be formed in bed to clear sockets by minimum 50 mm.

### B3.5.4 Concrete Bedding, Haunch and Backfilling

Concrete bedding, haunch and backfilling to pipelines for drainage works shall be constructed as follows: -

- (a) Pipes shall be supported at the required level by Grade 10/20 precast concrete wedges, blocks or cradles or by other methods agreed by the Architect. One support shall be placed adjacent to each end of each pipe and the spacing between supports not to exceed 3 m. Compressible sheeting shall be placed between the pipes and supports.
- (b) Flexible joints shall be formed in concrete bed, haunch and surround at flexible joints in pipelines. Joint filler shall be placed next to the flexible joint in the pipeline and to extend for the complete thickness of the bed, haunch and surround. Precut the filler to the finished profile of concrete and pipe. Joint filler shall be 25 mm thick for pipes not greater than 1200 mm diameter and 50 mm thick for pipes greater than 1200 mm diameter.
- (c) Polythene sheeting or a blinding layer shall be placed on the trench bottom before concreting.
- (d) Concrete shall be placed evenly over the complete width of the end and over the complete length of the pipe being concreted up to a level of 25 mm below the underside of the pipe. Concrete shall be placed on one side of the pipe only and work under the pipe until the concrete spread under the pipe. Concrete shall be placed equally on both sides of the pipe to the specified level.
- (e) Pipes for drainage works which are within 1 m below the surface of a carriageway shall be protected with Grade 10/20 concrete surround.
- (f) Keep concrete and pipes damp until backfilling placed.
- (g) Do not commence backfilling for at least 24 hours from time of placing concrete.

If specified, place and secure reinforcement in position. Reinforcement shall not pass through flexible joints in the concrete bedding.

Unless otherwise specified, pipes for subsoil and cut-off drains shall be bedded on a 75 mm thick of Grade 15/20 concrete, which is to be brought up until at least one third of the depth of the pipe is supported and in the case of perforated pipes, no line of perforations is blocked. Pipes for subsoil and cut off drains shall be laid generally in accordance with the requirements for other drains.

#### B3.5.5 Subsoil Drain Bedding

Subsoil drain bedding shall be of granular or natural bedding where appropriate for bedding type specified. Flexible membrane waterproof underlay where specified shall be 500 grade plastics sheet or equivalent approved standard.

### **B3.6 BACKFILLING OF TRENCH**

#### B3.6.1 General

Backfilling generally shall be in accordance with Section 3 of the General Specification for Building.

Where pipes are not surrounded with concrete, backfill evenly up both sides of pipe and up to 300 mm above top of pipe with special filling material as Section 3 of General Specification for Building laid and hand compacted in 100 mm layers. Backfill the remainder of the trench with general filling material as Section 3 of General Specification for Building unless otherwise specified.

Keep uniform the depth of fill over the full length of the pipeline being backfilled. Do not tip or push backfill material into the trench by mechanical plant.

#### B3.6.2 Backfilling

Backfilling material shall be compacted as required in Section 3 of the General Specification for Building.

Trench supports shall be removed as filling proceed. No vibrating extractors shall be used to remove trench supports.

When backfilling over pipes with concrete bedding or surround, the backfilled trench shall not be used for traffic within 72 hours of placing concrete.

Backfill for subsoil and cut off drains shall be Types A or B material as Table B3.6.2 or other material as specified. Filter materials to consist of hard, clean, crushed rock or gravel having a grading within the limits of Table B3.6.2. The aggregate crushing value of the material shall not exceed 30%. The material passing the 425µm BS sieve shall be non-plastic when tested in accordance with BS 1377-2: 1990.

Table B3.6.2 - Range of Grading

BS Sieve Size (Metric)	% by Weight Passing	
	Type A	Type B
64 mm	-	100
37.5 mm	100	85 – 100
20 mm	-	0 – 20
10 mm	45 – 100	0 – 5
3.35 mm	25 – 80	-
600 µm	8 – 45	-
75 µm	0 – 10	-

When Type A material is used with perforated pipes, at least 15% shall be larger in particle size than twice the maximum dimension of the perforations.

## **B3.7 CUTTING PIPES**

### **B3.7.1 General**

Pipes and pipe ends shall be cut and prepare in accordance with the manufacturer's recommendations by using purpose made equipment recommended by the manufacturer or otherwise approved and: -

- (a) Cut ends of pipes square or to the correct angle;
- (b) Do not damage the pipe coatings;
- (c) Trim and chamfer the cut ends to suit the type of joint; and
- (d) Cut pipes which terminate at the inside face of underground structure such that the end of the pipe is flush with the face.

### **B3.7.2 Elastomeric Joints**

Pipe ends shall be trimmed and chamfer in such a manner that elastomeric joint rings will not be damaged by them.

### B3.7.3 Closing Lengths

Do not cut pipes requiring to be cut to form closing lengths until adjacent pipes have been laid and jointed and the length to be cut can be accurately measured.

### B3.7.4 Precast Concrete Pipes

Cut reinforcement in precast concrete pipes which are to be cut, back flush with the concrete and protect with epoxy resin or by other approved methods.

## **B3.8 JOINTING PIPES AND FITTINGS**

### B3.8.1 General

Pipes shall be jointed in accordance with the manufacturer's recommendations, using approved equipment and materials recommended by the manufacturer and: -

- (a) Inspect the pipes, joints, fittings and valves, including internal and external coatings, immediately before and after jointing. Remove deleterious material immediately before and after jointing. Clean surfaces which are to be jointed immediately before jointing and clean out pipes with clean water;
- (b) Ensure all joints in pipelines are watertight;
- (c) Ensure the width of gaps at joints are in accordance with the manufacturer's recommendations and achieved by marking the outside of the pipe, by using metal feelers or by other approved methods. Check the position of elastomeric joint rings with by using metal feelers after jointing; and
- (d) Protect gaps at joints in pipes, after jointing, using approved methods, to prevent dirt, stones or other material from entering the joint.

Joint pipes and fittings of different materials with adaptors as recommended by the pipe manufacturer.

Proprietary flexible joints shall be made in accordance with manufacturer's instructions.

Junction pipes if not connected up immediately shall be closed with a temporary watertight plug. The position of all such junctions shall be clearly marked and labeled.

### B3.8.2 Jointing of Cast Iron Pipes and Fittings

Cast iron pipes and fittings shall have either lead run joints or cold caulking joints as follows as specified: -

- (a) For lead run joints each pipe shall be properly lined and brought to the correct level, the spigot end shall be wedged up concentrically with its respective socket and the socket tightly caulked with tarred yarn leaving unfilled the required depth of socket for lead. The depth of tarred yarn caulking shall not exceed one quarter of the total depth of the socket. When the tarred yarn has been tightly caulked home, a jointing ring shall be placed around the barrel and against the face of the socket. Molten pig lead is then poured in to fill the remainder of the socket. The lead is then solidly caulked all round joint with suitable tools and hammers of not less than 1.8 kg weight. Pipes shall be perfectly dry before the run lead joints are made. The weight of the lead used in jointing the various sizes of pipes shall not be less than the following:

- 100 mm Internal diameter 2.70 kg (6 lbs.)
- 150 mm Internal diameter 4.10 kg (9 lbs.)

- (b) Cold caulking shall be an approved proprietary brand. Cut cast iron pipes with suitable wheel type cutters to give a clean end square with the axis of the pipe.

### B3.8.3 Jointing of Grey Iron Pipes and Fittings

Grey iron pipes and fittings and ductile iron pipes and fittings shall have flexible joints of an approved gasket type.

### B3.8.4 Jointing of Plastic Pipes and Fittings

Plastic pipes shall be jointed and fitted in accordance with manufacturer's recommendations.

## **B3.9 THRUST AND ANCHOR BLOCKS**

### B3.9.1 General

Use thrust and anchor blocks to resist forces at bends, branches and stopends in pressure pipelines, except where self anchoring joints are used.

### B3.9.2 Excavation

Cast the bearing faces or other faces as indicated on the drawings, directly against undisturbed ground and: -

- (a) Trim the faces of excavations to remove all loose material before concreting;
- (b) Carry out any excavation required for the block beyond the trench width after the pipe or fitting has been jointed;
- (c) Fill any excess excavation beyond the face of the block with concrete of the same grade as the block.

### B3.9.3 Applying Pressure

Do not apply internal pressure to the pipeline until thrust and anchor blocks have developed the specified grade strength.

## B3.10 CONNECTION OF PIPES

### B3.10.1 Connection to Structures

Ensure that the joints between pipes and structures into which they are built are watertight. Remove protective coatings over the length to be built in and do not build pipe collars and sockets into structures.

Provide two flexible joints in pipelines adjacent to the outside faces of the structures into which they are built, with the distances from the outside face of the structure to the first joint and from the first joint to the second joint as specified in Table B3.10.1.

Table B3.10.1 - Flexible Joints at Structures

Diameter of Pipe	Position of First Flexible Joint from Structure		Distance of Second Flexible Joint from First Flexible Joint
	Minimum	Maximum	
Not exceeding 450 mm	150 mm	500 mm or diameter of pipe whichever is less	450 mm to 800 mm
Exceeding 450 mm but not exceeding 1050 mm			900 mm to 1200 mm
Exceeding 1050 mm			1500 mm to 1800 mm

Temporarily seal the ends of pipes which are built in to structures with a blank flange, brickwork or timber boarding as instructed by the Architect. The temporary seals shall be left in position until the Architect instructs their removal.

#### B3.10.2 Saddle Connections to Concrete and Clay Pipes

Connect the saddle to concrete and vitrified clay pipes by bedding the saddle on a cement mortar bed and forming a cement mortar fillet to provide at least 50 mm cover to the base of the saddle.

#### B3.10.3 Splay Cut Connections to Concrete and Clay Pipes

The following shall be followed where pipes are to be connected to concrete or clay pipes without a Y-junction or purpose made pipe saddle: -

- (a) Cut the pipe on the splay to form a junction such that the incoming pipe is at an angle of between 30° and 60° to the main pipe, upstream of the joint. Cut the hole in the main pipe to an elliptical shape suited to the cut end of the branch pipe. Cut the branch pipe to a length such that:
  - The cut end of the pipe rests on the outside barrel of the main pipe; and
  - The cut pipe does not project inside the main pipe;
- (b) Seal the joint between the cut pipe and the main pipe externally and unless otherwise approved, internally flush with the main pipe, with mortar.

#### B3.10.4 Saddle Connections to UPVC Pipes

Fix UPVC pipe saddles to UPVC pipes using a purpose-made mechanical clip or solvent cement of a type recommended by the manufacturer and approved.

#### B3.10.5 Branch Pipelines

Unless otherwise approved, connect branch pipelines to main pipelines using Y-junctions of the same type and strength as the stronger of the pipes being jointed and of an angle between 30° and 45°.

#### B3.10.6 Recording Positions of Junctions

Measure the positions of pipe junctions relative to the manhole or structure immediately downstream and record before backfilling.

B3.10.7 Connecting Pipes not Required for Immediate Use

Seal the ends of connecting pipes not required for immediate use with a blank flange, brickwork or other approved methods and measure and record their positions before backfilling.

**B3.11 MANHOLES, CHAMBERS, GULLIES AND CHANNELS**

B3.11.1 Manholes, Chambers and Gullies

Concrete work for manholes, inspection chamber, gullies, catchpits, surface channels etc. cast in-situ shall be structural concrete grade 20/20 as General Specification of Building. All internal faces of these structures shall be rendered with cement mortar so as to provide a smooth and impervious surface.

Step irons and ladders shall be built in as work proceeds.

Set precast concrete units for manholes and chambers vertically with step irons staggered and vertically aligned above each other.

Seal joints between precast units and lifting holes with cement mortar, removing any excess and pointing the joints.

Drop pipes to manholes shall be coated cast iron, provided with bolted access doors, or swept tee fitted with a capped end. If the pipe is external it shall be surrounded with concrete grade 20/20, if internal it shall be secured with holderbats.

Fill concrete surround to gullies up to the sides of the excavation.

Set the frames for manhole covers and gully gratings to the same level of the surrounding surface, allowing for falls and cambers, using brickwork or concrete as shown on the drawings. Do not exceed three courses of brickwork below frames. Concrete shall be of minimum grade 20/20.

Provide two keys for each pattern of cover used.

B3.11.2 Filling Around Manholes and Chambers

Fill excavations around manholes and chambers in carriageways using grade 10/40 concrete.

Fill around other manholes and chambers with fine fill material.

B3.11.3 Channels

Provide and prepare formed joints in surface channels at maximum 10 m intervals and as specified.

Construct the top surfaces of side walls of concrete open channels to the same levels as the adjoining permanent works. Fill any excess excavation beyond the channel walls with grade 10/40 concrete.

Surface channels on walkways shall be positioned away from tactile guide paths and other essential markings on the walkway surface.

Channel covers shall be securely fixed and flush with the adjacent walkway surface.

Cover grating slots should run perpendicular to the dominant direction of travel.

## **B3.12 VALVES**

### **B3.12.1 General**

Valves shall be installed in accordance with the manufacturer's recommendations and in the closed position.

### **B3.12.2 Box-Outs and Rebates**

Fill box-outs and rebates for valve frames and other gaps between frames and concrete surfaces with cement mortar.

### **B3.12.3 Cleaning and Checking**

After installation, clean valves, lightly grease moving parts and check for ease of operation. Leave valves in the closed position.

### **B3.12.4 Air Valves**

Provide air valves with isolating gate valves.

## **B3.13 PIPES AND MANHOLES TO BE ABANDONED**

### **B3.13.1 Installations Less Than 1m Deep**

If the top of a pipe or culvert, or the bottom of a manhole, chamber or gully, which is to be abandoned is 1 m or less below the finished ground level, they shall be removed and disposed unless otherwise approved. Fill the void with foam concrete, granular fill material or special fill material as approved by The Architect. Recycled aggregate may be used for filling the void subject to the Architect's approval.

### B3.13.2 Installations Over 1 m Deep

If the top of a pipe or culvert, or the bottom of a manhole, chamber or gully, which is to be abandoned is more than 1 m below the finished ground level: -

- (a) Demolish manholes, chambers and gullies to 1 m below finished ground level unless otherwise indicated on the drawings;
- (b) Seal the lowest points of abandoned pipelines with concrete, bricks or other approved methods; and
- (c) Fill abandoned pipes, culverts, manholes, chambers and gullies with foam concrete or grout, by pumping or by gravity, starting at the lowest point on the system and continuing until all voids are completely filled.

### B3.14 WORKS OUTSIDE SITE BOUNDARY

The PD Contractor shall make all necessary provisions for the connection of the last manholes of the drainage system to existing public sewer. The requirements by the Drainage Services Department for the connection shall be complied with.

### B3.15 PROTECTION

#### B3.15.1 Hot Dip Galvanizing

Unless otherwise specified, galvanized coatings to be applied by hot-dip galvanizing to be in accordance with BS EN ISO 1461: 2009. The coating thickness to comply with Table B3.15.1.

Table B3.15.1 - Requirements of Hot Dip Galvanizing

Article Thickness	Minimum Mean Coating Thickness
$\geq 6$ mm	85 $\mu$ m
3 mm to $< 6$ mm	70 $\mu$ m
1.5 mm to $< 3$ mm	55 $\mu$ m
$< 1.5$ mm	45 $\mu$ m

Unless otherwise approved, all components are to be galvanized after welding, drilling and cutting operations are complete.

All hot dip galvanizing, including the galvanizing work specified in other sections of this Specifications, is to be carried out by galvanizers with accreditation of BS EN ISO 9001: 2008 or equivalent quality management system. The name of galvanizers shall be submitted for approval.

Original invoice, delivery note and galvanizing certification for each delivery shall be provided for examination. These documents shall include the following information:

- (a) Project title /contract number
- (b) Name of galvanizer
- (c) Types and dimensions of articles
- (d) Quantities

A durable identification tape shall be attached to each batch of galvanized articles indicating the project title, galvanizing certification number and name of galvanizer.

#### B3.15.2 Anti-Corrosion Tape

Anti-corrosion tape shall be applied to all valves, flanged joints, slip-on couplings and flange adapters.

### **B3.16 CLEANING OF SYSTEM**

#### B3.16.1 General

After completion of the drainage system, and after testing, draw through each completed section of pipeline not greater than 300 mm diameter a mandrelm 750 mm long and 12 mm less in diameter than diameter of the pipe. Remove any obstructions in the pipeline and make good any unevenness in the invert.

For pipelines greater than 300 mm, clean internally by high pressure water jetting, pigging or by other approved methods and clean and wash manholes and chambers.

On completion of work, flush out all manholes and drains from end to end with water and leave clean and free from obstruction.

#### B3.16.2 Time of Cleaning

The cleaning shall be carried out when: -

- (a) After the pipeline has been tested;

- (b) After temporary works required for testing have been removed and any parts of the pipeline removed for testing have been reconnected; and
- (c) Not more than 7 days before the pipeline is handed over.

## **SECTION B4**

### **PAINTINGS, FINISHINGS AND IDENTIFICATION**

#### **B4.1 GENERAL**

All surfaces except otherwise specified, other than those indicated to be left self finished such as stainless steel, anodized aluminium, or otherwise approved by the Architect, shall be finished in first class paint work as appropriate. All metallic surfaces shall be wire-brushed and cleaned to make it free from rust, scale, dirt and grease prior to painting. Primer shall be applied to metal surface on the same day as they have been clean. All work shall be carried out by qualified tradesmen.

Pipework concealed in false ceiling or pipe ducts not normally accessible need not be painted, unless otherwise specified but appropriate colour code identifications shall be applied.

All paint shall comply with the requirement in General Specification for Building and shall be approved by the Architect.

All painting works shall be completed and left in ventilated environment for at least one week, or the curing period recommended by the paint manufacturer whichever is longer, before occupation or handover of the renovated area.

All surfaces shall be painted and finished as specified to meet and match the aesthetic architectural design as required.

#### **B4.2 NUMBER OF PAINT COATS REQUIRED**

All painted surfaces are to receive at least one primer coat and two coats of the finishing colour. For external installation/ equipment installation, polyurethane paint shall be used for finishing colour to provide better UV resistance unless otherwise specified. Ferrous surfaces shall receive one coat of rust inhibiting primer, one under-coat and two finishing coats.

Where painting is carried out in occupied areas with central air-conditioning or areas without good natural ventilation, pre-painting preparation and primer coat shall be carried out off-site and only the finishing coats shall be painted on-site.

#### **B4.3 IDENTIFICATION OF PIPELINES**

All pipework in the pump rooms shall be finished generally in accordance with BS ISO 3864-1: 2011. All pipework, where exposed on surfaces outside the pump room, shall be painted either as in the pump room or to match the surrounding surface with distinguishing colour code bands plus flow arrows in the specified colour scheme as directed by the Architect.

Pipes and pipelines shall be painted in colours either in accordance with BS ISO 3864-1: 2011 or as directed by the Architect completed with the identification colour code indicators. The basic identification colour or the decoration colour shall be applied over the whole length of the pipe with colour code indicators placed at all junctions, at both sides of valves, wall penetrations and at any other places where identification is necessary as directed by the Architect.

Valves may be painted in the same colour as the associated pipework. However, if the pipeline is part of the fire service installation and has been coded only with the safety colour, the valves involved shall be fully painted "safety-red".

The direction of flow of fluid shall be indicated by an arrow over the basic identification colour and painted white or black in order to contrast clearly with the basic identification colour.

Schedule of paint colours shall be to BS 4800: 2011.

## **PART C**

### **MATERIAL AND EQUIPMENT SPECIFICATION**

#### **SECTION C1**

##### **PLUMBING SYSTEMS**

#### **C1.1 GENERAL**

- C1.1.1 All material and equipment shall be constructed of materials suitable for the required working and test pressures and temperatures of the fluid carried. They shall be capable of withstanding concerned working pressure and maximum static pressure that may arise upon failure of the associated pressure reducing devices.
- C1.1.2 All material and equipment shall be of standard products. On-site fabricated products shall not be used unless otherwise approved by the Architect.
- C1.1.3 All material and equipment shall be approved by the Water Authority for the intended application. Type test reports and certificates to the required standards issued by recognized accredited laboratories shall be submitted to prove compliance with this Specification.
- C1.1.4 The internal lining of pipes, pipe fittings, joints and gaskets for portable water applications shall be certified safe for potable water use. Test reports or certificates demonstrate compliance to BS 6920-1: 2000 for non-metallic components shall be provided.
- C1.1.5 Pipes and fittings shall have marking in accordance with manufacturing standard and the make.

#### **C1.2 PIPES, JOINTS AND FITTINGS**

##### **C1.2.1 General**

The application of pipework types to the various plumbing systems shall be as stated in Table C1.2.1 if not specified in the Contract. All pipes and fittings shall comply with the relevant Standards and shall have suitable markings to indicate the Standards.

Table C1.2.1 - Application of Pipework Types

Application	Type
Cold water potable and non-potable water supply systems	<p><u>For mains supply and up feed riser:</u> Ductile iron to BS EN 545: 2010 with internal cement lining</p> <p><u>For down feed pipes:</u> Copper to BS EN 1057: 2006 with amendment A1: 2010 or Stainless Steel to BS EN 10312: 2002 with amendment A1: 2005 (&lt;50 mm dia.) and BS EN 10217-7: 2005 (&gt;50 mm dia.)</p>
Fire service mains supply	To the requirements of General Specification for Fire Service Installation in Government Buildings
Hot water potable and non-potable water supply systems	Copper to BS EN 1057: 2006 with amendment A1: 2010 or Stainless Steel to BS EN 10312: 2002 with amendment A1: 2005 (<50 mm dia.) and BS EN 10217-7: 2005 (>50 mm dia.)
Flushing water supply system	<p><u>For mains supply and up feed riser:</u> Ductile iron to BS EN 545: 2010 with internal cement lining</p> <p><u>For down feed pipes:</u> Ductile iron to BS EN 545: 2010 with internal cement lining or UPVC to BS EN ISO 1452-2: 2009 series S8 or above, or UPVC to BS 3505: 1986 Class D.</p>

C1.2.2 Copper Pipes, Joints and Fittings

Copper pipe shall be of hard drawn temper copper tubes to BS EN 1057: 2006 with amendment A1: 2010. For pipe sizes with nominal diameter equal to or below 22 mm, half hard temper copper tubes to BS EN 1057: 2006 with amendment A1: 2010 is acceptable.

Copper and copper alloy fittings such as end feed capillary, integral solder capillary and compression type bushes, reducers, bends and tees shall comply with BS EN 1254-1: 1998, BS EN 1254-2: 1998, BS EN 1254-4: 1998 and BS EN 1254-5: 1998.

Copper pipes for cold water application shall be encapsulated with factory applied moisture resistant polyethylene sheath.

Joints and fittings, such as end feed capillary, integral solder capillary and compression type bushes, reducers, bends and tees for cold water application shall be encapsulated with moisture resistant polyethylene sheath or other approved type sheath for protection.

Copper pipes for hot water application above 30°C but below 80°C shall be pre-insulated with factory applied thermal insulation polyethylene sheath with internal profile to entrap air and provide thermal barrier. Thermal insulation for pipework install inside plant room and pipe duct shall refer to other section of this Specification.

The polyethylene sheath shall be Low Smoke Zero Halogen (LSOH) type. Where required, the sheath shall be fire retardant to the requirements of FSD.

#### C1.2.3 Stainless Steel Pipes, Joints and Fittings

Stainless steel pipe shall be to BS EN 10312: 2002 with amendment A1: 2005 light gauge stainless steel tubes for pipe size up to 50 mm diameter.

Stainless steel pipe shall be to BS EN 10217-7: 2005 for pipe size greater than 50 mm diameter.

#### C1.2.4 Ductile Iron Pipes, Joints and Fittings

Ductile iron pipe shall be to BS EN 545: 2010 with internal cement lining and external bitumen coating.

#### C1.2.5 UPVC Pipes, Joints and Fittings

UPVC pipe shall be to BS 3505: 1986 Class D or to BS EN ISO 1452-2: 2009 series S8 or higher to suit system pressure.

UPVC pipe fittings shall comply with BS EN ISO 1452-3: 2009 or BS 4346-1: 1969.

Jointing compound shall be of type recommended by the manufacturer.

### **C1.3 EXPANSION JOINTS AND FLEXIBLE CONNECTORS**

#### C1.3.1 Stainless Steel Type Expansion Joint

Stainless steel type expansion joint shall be used for potable water application. It shall be of axial pattern bellow type and able to withstand horizontal and vertical movement.

The expansion joint shall be screwed or flanged ends as appropriate to suit application.

The expansion joint shall be manufactured from stainless steel to relevant parts of BS EN 10088 number 1.4301 or SAE Grade 304. It shall be manufactured to withstand the test pressure of the system and maximum static pressure that may arise upon failure of the associated pressure reducing devices. In any case, the working pressure shall not be less than 16 bar with a minimum test pressure of 150% of the working pressure and a minimum burst pressure of 40 bar.

The expansion joint shall be equipped with guide rod assembly which consists of guide rod plates, guide rods, resilient neoprene sleeves, resilient neoprene washers and steel washers.

Test report and certificate shall be provided to prove suitability for potable application if install for potable water supply system.

#### C1.3.2 Rubber Type Expansion /Flexible Joint

Rubber type expansion /flexible joint shall be used for flush water application. It shall be of double or multiple arch/sphere type, non-toxic, corrosion and abrasion resistant and of sufficient length for effective isolation of vibration.

The expansion /flexible joint shall be fitted with galvanized steel or ductile iron floating flanges to BS EN 1092-1: 2007 or BS EN 1092-2: 1997 wherever applicable. It shall include a flexible tube made of multiple layers of high tensile fabric reinforcement with EPDM, neoprene or synthetic rubber cover and liner. Tube end shall be of locked bead construction with steel wire bead ring and raised face.

The expansion /flexible joint shall be equipped with control rod/cable assembly to prevent damage from excessive movement. The assembly shall consist of control rod/cable plates, control rods/cables, resilient neoprene sleeves, resilient neoprene washers and steel washers to prevent metal to metal contact between the rod/cable and the connector flange.

### **C1.4 PIPE SLEEVES**

C1.4.1 Diameter of pipe sleeves shall be as shown on Drawings, otherwise at least one size larger than the pipe that pass through.

C1.4.2 For pipes passing through walls, slabs etc. which separate different fire compartments, use sleeves of galvanized steel to BS EN 10255: 2004 medium grade and carbon steel to BS EN 10217-1: 2002 for pipe diameter up to and above 150 mm respectively.

C1.4.3 For pipes passing through walls, slabs etc. within the same fire compartment, use sleeves of UPVC pipe to BS 3505: 1986 or BS EN ISO 1452-1: 2009.

- C1.4.4 Where UPVC pipe passes through fire rated walls and floor slabs, provide an approved type fire collar to BS EN 1366-3: 2009 or BS 476-20: 1987 with equal or higher fire resistant rating than that of the walls and slabs.
- C1.4.5 Puddle sleeves shall be used for pipe passing through external basement walls where there is ground water pressure.
- C1.4.6 Puddle flanges for fresh water systems shall be of gunmetal to BS EN 1982: 2008. Puddle flanges for salt water systems shall be of cast iron to BS EN 1561: 2011.

## **C1.5 STRAINERS**

- C1.5.1 Strainer shall be of Y-type with minimum free flow area ratio of 2 and the maximum aperture size to be of diameter 1.5 mm for strainers of nominal size 100 mm or below and of diameter 3 mm for strainers of nominal size 150 mm or above.
- C1.5.2 Strainer shall have the same nominal sizes as the pipes in which they are connected and shall be suitable for both working and test pressures of the piping system in which they are installed.
- C1.5.3 The construction of fresh water application strainer with nominal sizes up to and including 50 mm shall be as following: -
- (a) Body & cover: copper alloy to BS EN 1982: 2008 CuSn5Zn5Pb5; and
  - (b) Screen: austenitic chromium nickel stainless steel or austenitic chromium nickel molybdenum stainless steel to BS EN 10088-1: 2005 number 1.4301 or 1.4401.
- C1.5.4 The construction of flush water application strainer with nominal sizes up to and including 50 mm shall be of UPVC or gunmetal type.
- C1.5.5 The construction of fresh water and flush water application strainer with nominal sizes above 50 mm shall be as following: -
- (a) Body & cover: grey cast iron to BS EN 1561: 2011 EN-GJL-250, or spheroidal graphite cast iron to BS EN 1563: 2011 EN-GJS-400-15;
  - (b) Screen: austenitic chromium nickel stainless steel or austenitic chromium nickel molybdenum stainless steel to BS EN 10088-1: 2005 number 1.4301 or 1.4401;
  - (c) Drain plug: malleable iron or copper alloy; and
  - (d) Cast iron components shall be coated with an epoxy based material.

- C1.5.6 All bronze type strainers shall be of screwed female end connection to BS 21: 1985 and all cast iron type strainers shall be of flanged end connection to BS EN 1092-2: 1997 PN16.

## **C1.6 VALVES**

### **C1.6.1 General**

Valves shall be designed and constructed of materials suitable for both the working and test pressure of the piping system in which they are installed and the temperature of the fluid carried. Unless otherwise specified, all valves shall have a working pressure of not less than 16 bar.

Valves shall be pressure tested in accordance with the relevant standards by the valve manufacturer before leaving the factory. Unless otherwise approved by the Architect, valves of the same type and same size shall be from the same manufacturer.

Valves shall be of the same nominal size as the pipe in which they are installed except those for flow or pressure control such as modulating float valves or pressure reducing valves as shown on the Drawings.

Manually operated valves shall be closed by turning the handwheel in a clockwise direction when facing the handwheel.

Isolation valves shall be of the full-way solid or split-wedge disc-type and handwheel operated.

All valves shall be provided with or fitted with an indicator to show the open and shut position.

Valves shall generally comply with the following standards: -

- (a) Cast iron globe valve shall be to BS EN 13789: 2010.
- (b) Copper alloy gate, globe and non-return valve shall be to BS 5154: 1991 or BS EN 12288: 2010.
- (c) Cast iron non-return valve shall be to BS EN 12334: 2001.
- (d) Cast iron gate valve for fresh potable water application, street fire hydrant system and underground pipework system for fresh/flush water application shall be to BS 5163-1: 2004 and BS 5163-2: 2004 in conjunction with BS EN 1074-1: 2000 and BS EN 1074-2: 2000.

Valves shall be of the type approved by the Water Supplies Department. The PD Contractor shall submit type test certificates/reports issued by accredited laboratories confirming that the valves have been tested in conformity with this Specification. Wherever appropriate, the following type test certificates/reports shall be provided upon the request by the Architect: -

- (a) Test certificates for valves in compliance with the standards quoted in this Specification.
- (b) Test certificates on composition analysis, chemical, physical and mechanical properties of the metallic materials for valves.
- (c) Test certificates for resilient seating material and epoxy coating showing compliance with the physical property and thickness requirements of this Specification.
- (d) In case of valves in potable water application, test certificates issued by WRAS or an equivalent organization for non-metallic materials including resilient seating material and epoxy coating, showing compliance with the full tests of effect on water quality to BS 6920-1: 2000 and suitable for potable water usage.

All bronze valves shall be of the screwed female-end connections and all cast iron valves to be of the flanged-end connections.

Threads in screwed-end connections shall comply with BS 21: 1985 and flanges of flanged-end connections to comply with BS EN 1092-2: 1997 PN 16.

Cast iron parts of all valves shall be coated with an epoxy based material both on internal and external surfaces. The minimum thickness of epoxy coating shall comply with Table C1.6.1. The coating for use in fresh potable water shall comply with the requirement laid down in BS 6920-1: 2000 and shall be approved by WSD.

Table C1.6.1 - Minimum Thickness of Epoxy Coating for Cast Iron Parts of Valve

	Electrostatically Fusion Powder Coated (µm)	Airless Sprayed Application (µm)
Flat and pressurized parts	250	400
Convex outer edges	150	300

### C1.6.2 Valves for Fresh Water and Fire Service Application

For nominal sizes up to and including 50 mm: -

- (a) Body, bonnet and disc: copper alloy to BS EN 1982: 2008 CuSn5Zn5Pb5;
- (b) Stem: brass to high tensile brass or leaded brass to BS EN 12163: 2011.

For nominal sizes above 50 mm:

- (a) Body and bonnet: grey cast iron to BS EN 1561: 2011 EN-GJL-250, or spheroidal graphite cast iron to BS EN 1563: 2011 EN-GJS-400-15;
- (b) Disc and seat:
  - Solid or trimmed with bronze to BS EN 1982: 2008 CuSn5Zn5Pb5;
  - Resilient material to BS EN 681-1: 1996, Type WA, Hardness Category "70" with nominal thickness of minimum 1.5 mm on the non-seating areas and 4.0 mm on the seating areas, and in case for potable water application, showing compliance with full tests of effect on water quality to BS 6920-1: 2000.
- (c) Stem
  - For underground application as well as cast iron gate valve installed in fresh potable water or street fire hydrant system, stainless steel to BS EN 10088-3: 2005 number 1.4057.
  - For applications other than that mentioned in above clause, brass to high tensile brass or leaded brass to BS EN 12163: 2011 or stainless steel to BS EN 10088-3: 2005 number 1.4301, 1.4401, 1.4006, 1.4005, 1.4021 or 1.4057.

### C1.6.3 Valves for Flush Water Application

For nominal sizes up to and including 50 mm:

- (a) Plastic Type Valve
  - Body, bonnet and disc: PVC or UPVC;
  - Stem: one-piece with O-ring for positive sealing of the body;

- Valve shall be operated by wrench turned in a clockwise direction to close when facing the wrench;
- Suitable stops for both fully open and fully closed positions of valve shall be provided;
- Socket or union shall be suitable for direct connecting to pipe to which it is installed;
- It shall be suitable for both the working pressure and test pressure of the piping system in which it is installed with working pressure of at least 10 bar at 35°C unless otherwise specified.

(b) Metallic Type Valve

- Body, bonnet and disc: copper alloy to BS EN 1982: 2008 CuSn5Zn5Pb5;
- Stem: brass to high tensile brass or leaded brass to BS EN 12163: 2011.

For nominal sizes 65 mm and above:

(a) Body and bonnet: grey cast iron to or BS EN 1561: 2011 EN-GJL-250, or spheroidal graphite cast iron to BS EN 1563: 2011 EN-GJS-400-15;

(b) Disc and seat:

- Solid or trimmed with zinc free bronze to BS EN 1982 CuSn10 or trimmed with austenitic chromium nickel stainless steel or austenitic chromium nickel molybdenum stainless steel to BS EN 10293: 2005.
- Resilient material to BS EN 681-1: 1996, Type WA, Hardness Category "70" with nominal thickness of minimum 1.5 mm on the non-seating areas and 4.0 mm on the seating areas.

(c) Stem: stainless steel to BS EN 10088-3: 2005 number 1.4301 or 1.4401 or 1.4057.

#### C1.6.4 Non-return Valves

Non-return valves shall be of hinged swing type or wafer spring type suitable for vertical or horizontal installations unless otherwise specified.

Non-return valves shall be designed to close before reversal of flow starts.

Spring type non-return valves shall have a flow area not less than the cross-sectional area of the connected pipework and shall be non-slam in operation. The valves shall be designed to close before reversal of flow starts. Hinge pins and springs shall be of stainless steel.

Cast iron swing non-return valves shall have the cap and body bolted together to ensure a strong, tight closure.

Bronze swing non-return valves shall have screwed type cap.

Flange end connections shall be to BS EN 1092-1: 2007, BS EN 1092-2: 1997 and BS EN 1092-3: 2003 whenever applicable.

#### C1.6.5 Gate and Globe Valves

Gate valve shall be full way solid or split wedge disc type with rising or non-rising stem.

Globe valve shall be of straight globe type with rising stem.

The valves shall be provided with an indicator to show the open and shut position at critical locations for cast iron valves as shown on Drawings.

For bronze type valves, the bonnet shall be of the screwed type with ample threads to ensure positive sealing to the body.

All bronze valves shall be of the screwed female end connection to BS 21: 1985 and all cast iron valves shall be of the flanged end connections to BS EN 1092-2: 1997 PN16.

For cast iron type valve, the body and bonnet shall be bolted together and the disc shall be guided. The gland shall be fitted with non-asbestos packing and shall be bolted for cast iron valves.

#### C1.6.6 Control Valves of Flushing Cisterns

Plastic type ball valve shall be used. It shall be ball center-pivoted, smooth and spherical with a circular orifice, and seated on resilient seating suitable for tight shut off.

At fully open position of valve, wrench shall be mounted parallel to the flow of passage through the valve. The valve shall be fully closed with the wrench operates at a quarter turn.

The valve shall be suitable for both the working and test pressure of the piping system in which it is installed with working pressure of at least 10 bar at 35°C unless otherwise specified.

#### C1.6.7 Ball Float Valves for Water Tanks

Ball float valves shall be of the slow closing type unless otherwise specified. The valve body shall be robust and shaped to give a good flow pattern.

The valve piston shall close in the direction of flow such that the pressure in the water supply mains shall tend to keep the valve closed and that the piston seal is afforded protection from the flow by the piston.

All internal parts shall be easily removable for maintenance with the face and piston seals easily replaceable.

Ball floats shall be of tinned copper to BS 1968: 1953 and BS 2456: 1990 or of stainless steel to relevant parts of BS EN 10088: 2005 for fresh water application and of neoprene coated copper for flush water application. All ball floats shall be spherical.

Lever arms shall be of stainless steel for flush water application.

Ball float valves of sizes 50 mm and under shall be copper alloy to BS 1212-1: 1990 suitable for high pressure application.

Ball float valves for tanks for sizes over 50 mm shall be cast iron body with gunmetal piston, seat and guide, suitable for high pressure. For salt water systems ball valves shall be of cast iron body with zinc free bronze piston, seat and guide.

Ball float valves shall be of zinc-free bronze or stainless steel type for salt water application.

#### C1.6.8 Ball Float Valve for Flushing Cisterns

Ball float valve for flushing cisterns shall be of diaphragm type float operated valve to BS 1212-2: 1990 with rubber or plastic diaphragm, unless otherwise approved by the Architect and be suitable for high, medium or low pressure as required. It shall be suitably coated to prevent corrosion on metal parts. Valve sample shall be submitted for approval prior to installation.

#### C1.6.9 Flushing Valves

Flushing valve shall be corrosion resistant, made of brass, stainless steel or high grade thermoplastics and activated by simply pressing on a push-button or lever.

The flow rate of the flush water shall be adjustable. The flushing valve shall maintain a minimum of 1.5 litres/second flow rate.

The valve shall have such feature to allow it to go through the complete flush cycle and then shut off automatically, regardless of whether the handle is held down or released. Such automatic closure to take place slowly and progressively without hammering effect.

The volume of water per flushing cycle shall match with the sanitary fitments.

## **C1.7 PRESSURE REDUCING VALVES**

### **C1.7.1 Fixed Ratio Type Pressure Reducing Valves**

Fixed ratio type pressure reducing valve shall be able to maintain the outlet pressure as a fixed ratio of the inlet pressure, independent of the magnitude of the inlet pressure and the water flow across the valve.

It shall be of a size and pressure ratio as specified on the Drawings.

The operating pressure range of the valve shall be suitable for the particular application and it shall have a rated working pressure of not less than 16 bar.

Each valve shall be hydraulic tested at 1.5 times the nominal pressure of the valve for a period of not less than 1 minute at the factory.

Details of the pressure reduction against flow rate and inlet pressure performance curve and test certificates /reports issued by accredited laboratories confirming that the valve has been tested in accordance with the requirements of this Specification shall be submitted to the Architect for examination and approval of use.

The valve body shall be of gunmetal to BS EN 1982: 2008 CuSn5Zn5Pb5 or stainless steel to BS EN 10088-1: 2005 number 1.4401.

The valve shall have a piston of straight through design, constructed of stainless steel at least to BS EN 10088-3: 2005 number 1.4301 for fresh water and BS EN 10088-3: 2005 number 1.4401 for flush water application unless otherwise approved by the Architect.

The valve shall with seats and O-ring seals of high grade synthetic rubber.

The valve shall be provided with an arrow on the exterior to indicate the direction of flow.

The valve shall with end connections of thread-in screw type to BS 21: 1985 or flanged type to BS EN 1092-1: 2007.

### C1.7.2 Pilot Type Pressure Reducing Valves

Pilot type pressure reducing valve shall be hydraulically operated, pilot-controlled and of diaphragm or piston-actuated type. The whole valve shall be assembled and tested by the manufacturer.

The valve shall be provided with a strainer in the pilot control system. It shall be of flanged-end connection with flange to BS EN 1092-2: 1997 PN16. The main valve and its pilot control system shall contain no packing glands or stuffing boxes.

The valve shall be capable to reduce a higher inlet pressure to a steady downstream pressure regardless of fluctuations in flow rate and/or varying inlet pressure. The downstream pressure shall be adjustable and could be reduced down to a pressure suitable for the application. The valve shall be selected by the PD Contractor in such way that no cavitation shall occur within the anticipated flow and pressure ranges.

Means shall be provided for adjusting the response of the valve to changes in inlet pressure without the use of special tools.

The valve, when in operation, shall not cause any noise nuisance. Otherwise, a suitable acoustic enclosure to cover the valve shall be provided.

The operating pressure range of the valve shall be suitable for the particular application. Unless otherwise specified, the minimum rated working pressure of the valve shall not less than 16 bar.

Each valve shall be hydraulic tested at 1.5 times the nominal pressure of the valve for a period of not less than 1 minute at the factory.

The valve shall be of the type approved by the Water Authority as in accordance with its application. Details of the pressure reduction against flow rate and inlet pressure performance curve within the specified pressure range and test certificates /reports issued by accredited laboratories confirming that the valve has been tested in accordance with the requirements of this Specification shall be submitted to the Architect for examination and approval of use.

The valve shall have the minimum standard as specified below for its intended purposes: -

- (a) Body and bonnet: cast iron to BS EN 1561: 2011 EN-GJL-250 or ductile iron to BS EN 1563: 2011. The body shall be epoxy or polyester coated both inside and outside.

- (b) Disc:
- Solid or trimmed with bronze to BS EN 1982: 2008 CuSn5Zn5Pb5, or with stainless steel to BS EN 10088-2: 2005 number 1.4301, or with ductile iron to BS EN 1563: 2011; or trimmed with rubber compound for use in fresh water.
  - Solid or trimmed with zinc free bronze to BS EN 1982: 2008 CuSn10 or stainless steel to BS EN 10088-2: 2005 number 1.4301 or ductile iron to BS EN 1563: 2011 with epoxy /polyester coated; or trimmed with rubber compound for use in flush water.
- (c) Seat:
- Bronze trimmed as disc for use in fresh water.
  - Zinc free bronze or stainless steel trimmed as disc for use in flush water.
- (d) Stem:
- High tensile brass or leaded brass to BS EN 12163: 2011 or stainless steel to BS EN 10088-3: 2005 number 1.4006, 1.4005 or 1.4021 for use in fresh water.
  - Stainless steel to BS EN 10088-3: 2005 number 1.4301 or 1.4401 for use in flush water.

## **C1.8 CISTERNS AND TANKS**

- C1.8.1 Cisterns and tanks for intended applications shall comply with the requirements by the Water Authority.
- C1.8.2 Galvanized low carbon steel cisterns and lids, tanks and cylinders shall be manufactured to comply with BS 417-2: 1987 of Grade A thickness. Joints between sections of cistern lids to have weatherproof standing welt type laps.
- C1.8.3 Glass fibre reinforced plastic cistern shall be to BS EN 13280: 2001.

## SECTION C2

### ABOVE GROUND DRAINAGE SYSTEMS

#### **C2.1 PIPES AND FITTINGS FOR SURFACE WATER DRAINAGE**

##### **C2.1.1 Cast Iron Rainwater Pipes, Gutters and Fittings**

Cast iron rainwater pipes and fittings for use internally shall be to BS 416-1: 1990 with Type A or B sockets without ears.

The pipes and fittings shall be coated internally and externally to prevent corrosion. When cold applied bitumen-based coating is proposed, the coating material should comply with BS 3416: 1991 or other equivalent international standards. External coating shall contain anti-corrosion inhibitors normally used on metallic structures.

The pipes shall be in a state to permit the application of additional external finishing coatings.

Branch and bend fittings shall have bolted access doors or inspection units with gunmetal bolts and rubber gaskets fitted into the fittings.

Trap shall be of anti-siphon type with bolted access door.

Gutters shall be to BS 416-1: 1990 with half round or ogee section or as specified.

##### **C2.1.2 UPVC Rainwater Pipes, Gutters and Fittings**

UPVC rainwater pipes, gutters and fittings shall be to BS 5255: 1989 or BS EN 1329-1: 2000 for pipe size not exceeding 80 mm diameter.

UPVC rainwater pipes, gutters and fittings shall be to BS 4514: 2001 for pipe size exceeding 80 mm diameter.

UPVC pipes and fittings shall have solvent welded spigot and socket joints.

Colour of plastic pipes gutters and fittings shall be black, "terra-cotta", light grey, or white as specified. All metal fittings shall be galvanized or plastic coated. Combination of products from different manufacturers shall not be permitted unless otherwise approved.

### C2.1.3 Rainwater Outlets

Cast iron rainwater outlets shall be to BS 416-1: 1990 with removable dome shape strainer or flat grating to stainless steel BS EN 10088-2: 2005 number 1.4401 or SAE Grade 316. The strainer or flat grating shall be screwed onto a cast iron collar fitted into the cast iron rainwater outlet body. Assembly of the collar to the rainwater outlet body shall be by stainless steel bolts and nuts.

Cast iron rainwater two-way side outlets shall be to BS EN 1561: 2011 grade 150 with removable stainless steel to BS EN 10088-2: 2005 number 1.4401 or SAE Grade 316 elbow grating. The grating shall be screwed onto a cast iron clamping collar fitted into the cast iron rainwater outlet body. Assembly of the collar to the rainwater outlet body shall be by stainless steel screws.

UPVC rainwater outlet shall be to BS EN 12200-1: 2000. It shall be an approved proprietary type complete with sealing flange and screw fixed flat or domed grating.

Stainless steel rainwater outlet shall be of flat removable grating type. The body and base frame shall comply BS EN 10088-3: 2005 number 1.4301 or SAE Grade 304.

### C2.1.4 Surface Channels

Cast iron channel gratings shall be of BS EN 1561: 2011 Grade EN-GJL-150.

The slots in the channel cover gratings as well as the gap between grating segments shall be less than 13 mm wide so as to avoid trapping wheelchairs and canes.

## **C2.2 PIPES AND FITTINGS FOR FOUL WATER DRAINAGE**

### C2.2.1 Cast Iron Soil, Waste and Ventilating Pipes and Fittings

Cast iron pipes and fittings of size not exceeding 150 mm diameter shall be to BS 416-1: 1990 with Type A or B sockets without ears.

Cast iron pipes and fittings of size exceeding 150 mm diameter shall be to BS 437: 2008 or BS 4622: 1970.

The pipes and fittings shall be coated internally and externally to prevent corrosion. When cold applied bitumen-based coating is proposed, the coating material should comply with BS 3416: 1991 or other equivalent international standards. External coating shall contain anti-corrosion inhibitors normally used on metallic structures.

The pipes shall be in a state to permit the application of additional external finishing coatings.

Other than ventilating and anti-siphon pipes, branch and bend fittings shall have bolted access doors or inspection units with gunmetal bolts and rubber gaskets fitted into the fittings.

Trap shall be of anti-siphon type with bolted access door.

#### C2.2.2 Galvanized Iron Pipes and Fittings

Galvanized iron pipes and fittings shall be to BS EN 10255: 2004 medium grade and hot dip zinc coated.

Fittings for steel pipes shall be of malleable cast iron screwed fittings to BS 143 and 1256: 2000 or BS EN 10242: 1995, and hot dip zinc coated.

Other than ventilating and anti-siphon pipes, branch and bend fittings shall have bolted access doors or inspection units with gunmetal bolts and rubber gaskets fitted into the fittings.

#### C2.2.3 UPVC Pipes and Fittings

UPVC pipes and fittings shall be to BS 5255: 1989 or BS EN 1329-1: 2000 for pipe size not exceeding 80 mm diameter.

UPVC pipes and fittings shall be to BS 4514: 2001 for pipe size exceeding 80 mm diameter.

UPVC pipes and fittings shall have solvent welded spigot and socket joints.

The pipes and fittings shall be suitable for the intended use, particularly where non-domestic effluents or hot liquids in kitchens, laboratories etc. may be discharged into the system.

Anti-siphon traps shall be fitted with a one way valve disk of brass or stainless steel. The one way valve disk shall be affixed with a similar metal or alloy pin complete with a rubber gasket.

W-trap shall conform to BS EN 274-1: 2002.

#### C2.2.4 Balloon Grating and Vent Cowl

Unless otherwise approved, balloon grating and vent cowl shall be of approved proprietary products made of galvanized steel wire or copper wire.

#### C2.2.5 Cast Iron Floor Drain Outlet

Cast iron floor drain outlets shall be to BS 416-1: 1990 with removable flat grating to BS EN 10088-3: 2005 number 1.4401 or SAE Grade 316. The flat grating shall be screwed onto a cast iron collar fitted into the cast iron rainwater outlet body. Assembly of the collar to the rainwater outlet body shall be by stainless steel bolts and nuts.

The slots or holes in drain outlet grating shall be less than 13 mm.

#### C2.2.6 UPVC Two-Way Floor Drain Outlet

UPVC two-way floor drain outlet shall comprise of UPVC horizontal drain pipe with sealing flange, UPVC adaptor unit for vertical grating and UPVC adjustable horizontal grating unit with sealing flange.

The UPVC adaptor unit shall have built-in drainage fall towards downstream and shall allow easy removal of vertical grating by unscrewing the fixing screws after the installation for maintenance purpose. Its spigot connecting to the drain pipe may also be cut short to suit the thickness of the wall finishes.

The UPVC horizontal grating unit shall have removable horizontal grating and shall allow for cutting low to suit finished floor level.

The UPVC gratings for vertical and horizontal use shall be fixed with stainless steel screw.

### **C2.3 CAST IRON SOCKETLESS PIPES AND FITTINGS FOR SURFACE WATER AND FOUL WATER DRAINAGE**

C2.3.1 Cast iron socketless pipes, fittings and coupling shall comply with BS EN 877: 1999 with amendment A1: 2006.

C2.3.2 Pipes and fittings shall be coated internally with tar-free epoxy with minimum thickness of 120 microns and 40 microns respectively. The internal epoxy coating shall have a resistance to exposure of salt spray test to clause 5.7.2.1 of BS EN 877: 1999 with amendment A1: 2006 for a minimum of 1000 hours if sea water is to be used in the flushing water system.

C2.3.3 Pipe and fittings shall be coated externally with anti-corrosive coating with minimum thickness of 40 microns or other form of approved protections.

C2.3.4 All jointed must be mechanically connected.

- C2.3.5 The coupling shall composed of stainless steel shield to BS EN 10088-3: 2005 number 1.4401 or SAE Grade 316, clamp assembly and an elastomeric sealing sleeve conforming to the requirement of BS EN 681-1: 1996 and also can resist the normal domestic effluents with thermal effects up to temperature of 70°C.
- C2.3.6 The piping system including pipes, fittings, sealing gaskets, coupling, bolt and nuts shall be of single proprietary product with a minimum product guaranty for 10 years from the manufacturer.
- C2.3.7 The piping system shall be properly supported and restrained in full accordance with the manufacturer's recommendations

## SECTION C3

### UNDERGROUND DRAINAGE SYSTEMS

#### C3.1 PIPES AND FITTINGS

##### C3.1.1 Precast Concrete Pipes and Fittings

Precast concrete pipes and fittings shall be to BS 5911-1: 2002 with amendment A2: 2010 or BS EN 1916: 2002 with flexible joints of spigot and socket or rebated type. Concrete pipes shall have wall thickness and strength not less than those stated in Table C3.1.1.

Table C3.1.1 - Requirements of Concrete Pipes and Collars

Nominal Bore of Pipe (mm)	Minimum Crushing Test Load (kN/m of effective length) Extra Strength Pipes and Collars						Min. Thickness Of Pipe Wall and Collar Wall (mm)		Min. Length of Collar
	Class L		Class M		Class H		Reinf	Unreinf	
	Proof	Ult	Proof	Ult	Proof	Ult			
150	20	25	-	-	-	-	-	25	-
225	20	25	-	-	-	-	-	25	-
300	20	25	23	29	-	-	-	32	-
375	20	25	31	39	36	45	-	38	-
450	20	25	35	44	41	52	64	44	-
525	20	25	39	48	46	58	67	51	-
600	20	25	46	58	54	68	70	57	-
675	20	25	50	63	60	75	73	64	-
750	38	48	53	67	65	82	76	70	225
825	41	52	58	72	69	87	81	-	225
900	46	58	67	84	85	107	86	-	225
1050	54	64	76	95	96	120	95	-	225
1200	57	72	87	109	110	138	102	-	225
1350	63	79	95	120	120	153	114	-	225
1500	69	87	104	130	132	165	127	-	225
1650	75	94	116	145	146	183	140	-	300
1800	82	103	124	155	158	198	152	-	300
1950	88	110	135	169	169	212	165	-	300
2100	96	120	146	183	184	230	178	-	300
2250	102	128	155	194	195	244	190	-	300
2400	108	135	165	207	210	263	203	-	300
2550	116	145	177	222	223	279	216	-	300

Class and nominal internal diameter of concrete pipe shall be as specified.

##### C3.1.2 Vitrified Clay Pipes and Fittings

Vitrified clay pipes and fittings for surface water drainage shall comply with BS 65: 1991. The pipes and fittings shall be glazed and shall be the normal chemical resistant type.

Vitrified clay pipes and fittings for foul water drainage shall comply with relevant parts of BS EN 295 with flexible spigot and socket joints.

### C3.1.3 Cast Iron Pipes and Fittings

Cast iron pipes and fittings shall be to BS 437: 2008 with flexible joints of spigot and socket type.

Cast iron pipes and fittings for use in pressurized drainage system with pipe size larger than 150 mm diameter shall be to BS 4622: 1970 Class 1 with flexible joints of spigot and socket type.

The pipes and fittings shall be coated internally and externally to prevent corrosion. When cold applied bitumen-based coating is proposed, the coating material should comply with BS 3416: 1991 or other equivalent international standards. External coating shall contain anti-corrosion inhibitors normally used on metallic structures.

The pipes shall be in a state to permit the application of additional external finishing coatings.

Other than ventilating and anti-syphon pipes, branch and bend fittings shall have bolted access doors or inspection units with gunmetal bolts and rubber gaskets fitted into the fittings.

### C3.1.4 Ductile Iron Pipes and Fittings

Ductile iron pipes and fittings shall be to BS EN 598: 2007 with amendment A1: 2009 with cement mortar lining internally and zinc coating externally.

Unless otherwise specified, ductile iron pipework shall be of push-on type flexible joint with rubber sealing gasket. It shall be capable to withstand a minimum angular deflection of 4° and an allowable spigot withdrawal of minimum 38mm.

Flanged joints, if specified, shall be of PN16 rating complying with BS EN 1092-1: 2007.

Pipes that are to be built in to structures shall have puddle flanges welded on or cast on.

### C3.1.5 UPVC Pipes and Fittings

UPVC pipes and fittings for gravity sewage and surface water drainage shall be to BS 4660: 2000 or BS EN 13598-1: 2010 for pipe sizes from 110 to 160 mm diameter, and to BS EN 1401-1: 2009 for pipe sizes from 200 to 630 mm diameter. They shall be flexible spigot and socket joint type with elastomeric joint rings.

UPVC pipes and fittings for use in pressurized drainage system shall be to BS 3506: 1969 with class suitable for the designed pressure rating. Joints and fittings shall comply with relevant parts of BS 4346-1: 1969 and BS 4346-2: 1970 or BS EN ISO 1452-1: 2009.

Interchangeability shall not be allowed between different UPVC pipe manufacturer's products.

#### C3.1.6 Sub-soil Drain Pipes and Fittings

Unless otherwise specified, sub-soil drain pipes and fittings shall comply the following: -

- (a) For vitrified clay pipes and fittings, to BS 65: 1991 and of the normal glazed, chemical resistant type with plains ends and flexible sleeved joints; or
- (b) For concrete porous pipes, to BS 5911-1: 2002 with amendment A2: 2010; or
- (c) For unglazed clayware field drain pipes and junctions, to BS 1196: 1989; or
- (d) For perforated plastic pipes and fittings, to BS 4962: 1989.

### C3.2 VALVES

#### C3.2.1 General

Handwheels and tee keys shall turn in a clockwise direction to close the valve.

Handwheels shall have a smooth rim with the direction of opening and closing clearly cast in.

The opening effort required at any point on the handwheel shall not exceed 250N when operated against the full unbalanced pressure. If the full unbalanced pressure is greater than 250Nm, a gear box fitted in the valves shall be provided.

Extension stems shall be of the same grade of stainless steel as the stems and shall be connected by muff couplings.

Handwheels, tee keys, headstocks, guide brackets for stems, supporting brackets, surface boxes and other fittings shall be of cast iron to BS EN 1561: 2011.

Assembly bolts and nuts shall be of stainless steel to BS EN ISO 3506-1: 2009 of grade A4 and property class 80. Washers shall be of stainless steel equivalent to SAE grade 316 S31. For cast iron or

ductile iron valves, materials for assembly bolts and nuts shall be in accordance with manufacturer's recommendation.

#### C3.2.2 Gate Valves

Gate valves shall be of double flange ended and solid wedge type to BS EN 1171: 2002 or BS 5163-1:2004 in conjunction with BS EN 1074-1:2000 and BS EN 1074-2:2000, with a nominal pressure designation of PN16 and flange to BS EN 1092-1: 2007 PN16.

The bodies and wedges shall be of cast iron to BS EN 1561: 2011 Grade EN-GJL-250 or spheroidal graphite cast iron to BS EN 1563:2011 Grade EN-GJS-400-15 with removable seat rings made from gunmetal to BS EN 1982: 2008 CuSn5Zn5Pb5.

Stem nuts shall be made from gunmetal to BS EN 1982: 2008 CuSn5Zn5Pb5.

Stems shall be of aluminium bronze to BS EN 12163: 2011 grade CA 104 or stainless steel.

A fitted plate showing the position of the valve in the closed, quarter closed, half closed, three quarters closed and fully open positions shall be provided.

Chains for chain operated gate valves shall be of mild steel to BS EN 10095: 1999 and hot dip galvanized.

#### C3.2.3 Flap Valves

Frame and flap shall be of cast iron to BS EN 1561: 2011 Grade EN-GJL-220.

Sealing faces and hinge pins shall be of gunmetal to BS EN 1982: 2008 CuSn5Zn5Pb5.

The flap shall be hung with double hinges and secured with hinge pins.

Flange for mounting of flap valves shall be of PN16 to BS EN 1092-1: 2007.

#### C3.2.4 Sludge Valves

Bodies and valve sections shall be of cast iron to BS EN 1561: 2011 Grade EN-GJL-220.

Sealing faces and stem nuts shall be of gunmetal to BS EN 1982: 2008 CuSn5Zn5Pb5.

Stems shall be of aluminium bronze to BS EN 12163: 2011 grade CA 104. It shall be operated through non-rising stem nuts and housed in bridges bolted over the body sections.

The outlet flanges shall be of PN16 to BS EN 1092-2: 1997.

#### C3.2.5 Air Valves

Air valves shall be of dual orifice elongated body type with a small orifice valve for releasing air at working pressure and a large orifice valve for allowing air to pass at atmospheric pressure during emptying and filling of the pipework.

The pressure rating of the air valves shall be to 3 bars.

The bodies and covers of the small and large orifice valves shall be of cast iron to BS EN 1561: 2011 Grade EN-GJL-220.

The trim and float shall be of stainless steel to BS EN 10088-1: 2005 number 1.4401 or SAE Grade 316.

The small orifice valves shall have an adjustable orifice button to ensure positive sealing. The size of valve inlet and outlet sizes shall be of 75 mm and 25 mm respectively. The size of venting orifice shall be of 5 mm.

The large orifice valves shall have a buna-N seat. The size of valve inlet and outlet shall be of 75 mm.

### **C3.3 MANHOLES, CHAMBERS AND GULLIES**

#### C3.3.1 General

Cast iron covers, gratings, overflow weirs and frames shall be clean, free from air holes, sand holes, cold shuts and chill, neatly dressed and carefully fettled. Castings shall be free from voids, whether due to shrinkage, gas inclusions or other causes.

Particulars of the proposed materials for manholes, chambers, gullies and channels shall be submitted to the Architect for examinations and approvals: -

- (a) A certificate for each type of manhole and chamber unit, for each type of gully and for each type of channel accessories showing the manufacturer's name, the date and place of manufacture and showing that the materials comply with the requirements stated in the Contract and including results of tests required in accordance with the Contract;
- (b) A certificate for step irons showing the manufacturer's name, the date and place of manufacture and showing that the step irons comply with the requirements stated in the Contract, and including results of tests required in accordance with the Contract; and

- (c) A certificate for each type of manhole cover, gully grating, kerb overflow weir and channel cover showing the manufacturer's name, the date and place of manufacture and showing that the materials comply with the requirements stated in the Contract and including results of tests in accordance with the Contract.

#### C3.3.2 Precast Concrete Manholes

Precast concrete manholes shall be constructed to BS 5911-3: 2010 and BS EN 1917: 2002 with cover slabs and reducing slabs reinforced as required to comply with the load test requirements and with rebated joints.

#### C3.3.3 Precast Concrete Chambers and Gullies

Precast Concrete Chambers and Gullies shall be constructed to BS 5911-3: 2010 and BS EN 1917: 2002 with cover slabs reinforced as required to comply with the load test requirements.

Rebated joints shall be provided between precast units.

Types of cement used in manufacturing shall be either as stated in BS EN 1917: 2002 or a combination of precast concrete to BS EN 197-1: 2011 and PFA /PFAC in which the PFA does not exceed 40% by mass of the total cementations content.

#### C3.3.4 Vitrified Clay Gullies

Vitrified clay gullies shall be to BS 65: 1991.

#### C3.3.5 Step Irons

Manhole steps shall be to BS EN 13101: 2002 of malleable iron to BS EN 1562: 1997 hot dip galvanized in accordance with BS EN ISO 1461: 2009. Minimum zinc coating thickness shall be 610  $\mu\text{g}/\text{m}^2$ .

#### C3.3.6 Cast Iron Manhole Covers, Gully Gratings and Overflow Weirs

Cast iron manhole covers, gully gratings and overflow weirs shall be to BS EN 1561: 2011 Grade EN-GJL-150. They shall be cleanly casted and free from air holes, sand holes, voids due to shrinkage, gas inclusions or other causes.

Nuts and bolts shall comply with BS 4190: 2001.

They shall have dimensions as indicated on the Drawings.

Manufacturer's name shall be casted integrally with the unit in a raised form protected with bituminous coating. Covers shall have the raised design as shown on the Drawings.

The units shall be coated with 2 layers of black non-toxic water-based bituminous coating to BS 3416: 1991 or 2 layers of black non-toxic coal-tar based coating to BS 4164: 2002 after thoroughly cleaned to remove moulding sands, rust or any other impurity. The coating shall be free of bare patches or lack of adhesion.

The test loads which the covers and gratings are required to withstand, and the minimum masses of covers gratings and weirs, shall be as stated in Table C3.3.6(1) to Table C3.3.6(3).

Table C3.3.6(1) - Minimum Test Load and Mass of Manhole Cover and Frame

Type	Minimum Mass (kg)	Grade (Duty)	Test Requirements	
			Diameter of Block (mm)	Test Load (t)
Manhole cover and frame	180	Medium	100	5
Manhole cover for sewers	130	Heavy	300	30
Frame	105	Heavy	300	30
Desilting manhole cover for sewers	290	Heavy	300	30
Frame	165	Heavy	300	30
Double seal terminal manhole for sewers				
Type MA2-29/29A & B	-	Heavy	300	20
Type MA2-45/45A & B	-	Heavy	300	20
Type MC2-29/29A & B	-	Medium	100	5
Type MC2-45/45A & B	-	Medium	100	5

Table C3.3.6(2) - Minimum Test Load and Mass of Gully Grating and Frame

Type	Minimum Mass (kg)	Grade (Duty)	Test Requirements	
			Diameter of Block (mm)	Test Load (t)
Grating for hinged gully grating Type GA2-325	28.0	Heavy	300	20
Frame	24.5	Heavy	300	20
Grating for gully grating Type GA1-450	57.5	Heavy	300	20
Shallow frame				
- Adjacent to kerb	33.5	Heavy	300	20
- Away from kerb	36.5	Heavy	300	20
Deep frame				
- Adjacent to kerb	40.5	Heavy	300	20
- Away from kerb	44.0	Heavy	300	20
Grating for hinged gully grating Type GA2-450	61.5	Heavy	300	20
Frame	37.0	Heavy	300	20

Table C3.3.6(3) - Details of Kerb Overflow Weirs

Type	Minimum mass (kg)
1-325	39.5
3-325	31.5
1-450	44.0
3-450	36.5
4-450	33.0

### C3.3.7 Ductile Iron Manhole Covers and Frames

Ductile iron manhole covers and frames shall comply with BS EN 124: 1994. Grade of ductile iron shall be of EN-GJS-500-7 to BS EN 1563: 2011.

Bolts for loosely coupling separate sections of covers shall be stainless steel hexagon headed complete with hexagon nuts to BS EN 10088-1: 2005 number 1.4301 or SAE Grade 304 with dimensions complying with BS 4190: 2001.

The units shall be cleanly cast, free from air holes, sand holes, voids due to shrinkage, gas inclusions or other causes, cold shuts, chill and any surface defects and neatly dressed and fettled.

The units shall have dimensions as indicated on the Drawings and have sharp edges removed.

Covers shall have the raised design as shown on the Drawings with manufacturer's name cast integrally with the unit in a raised form. All markings shall be clearly legible.

The units shall be coated with 2 layers of black non-toxic water-based bituminous coating to BS 3416: 1991 or 2 layers of black non-toxic coal-tar based coating to BS 4164: 2002 after thoroughly cleaned to remove moulding sands, rust or any other impurity. The coating shall be free of bare patches or lack of adhesion.

The units shall compatible with their seatings which shall be manufactured in such a way to ensure stability and quietness in use.

Bedding material for manhole frames shall be non-shrinkage with compressive strength exceeding 30 N/mm<sup>2</sup>.

The units shall be capable of withstanding the minimum test loads and having the minimum masses given in Table C3.3.7.

Table C3.3.7 - Minimum Test Load and Mass of Ductile Iron Manhole Cover and Frame

Type	Minimum Mass (kg)	Test Requirements	
		Diameter of Block (mm)	Test Load (t)
Class E600 standard 675 square ductile iron manhole cover	110	250	600
Frame	58	250	600

## PART D

### INSPECTION, TESTING & COMMISSIONING

#### **D1 GENERAL**

Throughout the execution of the installation, the PD Contractor shall be responsible for ensuring compliance with the Regulations included in Section A2 and shall notify the Architect of any infringement which directly or indirectly detracts from the safe and satisfactory operation of the installation(s) whether or not such infringement relates to the works covered in the Contract or to those associated with others.

D1.1 Standards and requirements for the testing and commissioning works are listed shall be in accordance to:-

- (a) Statutory Obligations and other requirements, Specifications and Standards specified in Section A2 of Part A;
- (b) Building Services Branch Testing and Commissioning Procedure for Plumbing and Drainage Installation in Government Buildings Hong Kong; and
- (c) Manufacturers' recommendations and specifications.

D1.2 The PD Contractor is required to appoint a competent and experienced testing and commissioning engineer responsible for the overall planning, organizing, coordinating, supervising and monitoring of the testing and commissioning works and also certifying all results and reports from the testing and commissioning works. The PD Contractor shall submit, at the commencement of the Contract, information detailing qualification and experience of the testing and commissioning engineer for the Architect's approval.

D1.3 It is necessary to require the PD Contractor to provide, at no cost to the Employer, all necessary equipment, apparatus, tools and materials for carrying out of testing and commissioning works.

- (a) Master Programmed of Testing and Commissioning Works

The PD Contractor is required to submit a programme for testing and commissioning works shall be submitted at the commencement of the Contract, usually within the first three months. The programme shall indicate the tentative dates of all tests and commissioning works that will be carried out throughout the whole contract and all necessary

submissions and approval relating to testing and commissioning and ensure that the testing and commissioning programme matches the master programme for construction and that all testing and commissioning works are complete before the completion date of the Contract.

(b) Inspection, Testing and Commissioning Methods and Procedures

The PD Contractor is required to submit detailed inspection, testing and commissioning methods and procedures together with report formats for reporting inspection, testing and commissioning results for the Architect's approval at least four months before commencement of testing and commissioning works, or four months after the commencement of the Contract, whichever is earlier.

(c) Labor and Materials

The PD Contractor is required to be responsible for provision of all labour and both consumable and non-consumable materials for carrying out testing and commissioning works at their expenses. Electricity supply, water and LP gas and town gas for carrying out of testing and commissioning works shall also be arranged and provided by the PD Contractor at no cost to the Employer.

(d) Supply of Inspection, Measuring and Testing Equipment

The PD Contractor is required to supply the calibrated equipment and instrument for testing and commissioning works in accordance with the requirements as specified.

(e) Readiness for Commissioning and Testing

The PD Contractor is required to check the completion of the works to be tested or commissioned, the associated builder's works and the associated building services installations to ensure that testing and commissioning can be proceeded in a safe and satisfactory manner without obstruction.

(f) "Type-test" Certificate

"Type-test" for equipment shall be carried out at the manufacturers' works or elsewhere appropriate in order to demonstrate their compliance with the Regulation or requirements. "Type-test" certificates

together with the corresponding drawings, sketches, reports and any other necessary documents shall be submitted to the Architect for approval before delivery of the equipment.

D1.4 Prior to the testing and commissioning works, the PD Contractor shall check the completion of the installation works, associated builder's work and related building services installations, to ensure that commissioning can be proceeded without obstruction. Before any installation is subjected to commissioning and site testing, it shall be thoroughly cleaned both internally and externally. All pipes shall be thoroughly cleaned and flushed before filling with water.

The PD Contractor shall be responsible for initially setting the plants to work including: -

- (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) Carrying out pressure test, hydraulic test and other tests required before energising the equipment and plant;
- (d) Checking the proper functioning of the protective devices and safety valves in the installation and carrying out all necessary safety testing;
- (e) Energising and setting to work on all plants; and
- (f) Initial regulation and demonstration that the installation delivers the correct rate of flow at the conditions specified in the Contract.

For specialist plant or equipment, the PD Contractor shall arrange for it to be commissioned, certified and tested by the manufacturer's skilled commissioning engineer and/or technician.

Where the tests involved other plumbing and drainage installations already in operation in other parts of the building outside the Site or works area, the PD Contractor shall co-ordinate with relevant parties, where necessary, on the temporary suspension of other plumbing and drainage installations for the tests.

D1.5 The PD Contractor is required to provide advanced notice for inspection, testing and commissioning works as follows:-

(a) Off-site Inspection and Testing

An advanced notice of at least one week before commencement of the inspection or test shall be provided.

(b) On-site Inspection, Testing and Commissioning

An advanced notice of at least 4 calendar days before commencement of inspection, testing or commissioning shall be provided.

D1.6 Documentation and Deliverables

The PD Contractor shall record all commissioning information and testing results at the witness of the Architect or his representatives. Commissioning and testing record shall be properly checked and certified by contractor's Testing and Commissioning Engineer and signed by the Architect or his representative who has witnessed the testing or commissioning before submission to the Architect. The PD Contractor shall submit full commissioning and testing report to the Architect within 14 calendar days after completion of commissioning and testing of the installation.

## **D2 TESTING AND COMMISSIONING - DEFINITIONS**

For the purpose of this General Specification the following definitions shall apply:-

D2.1 Commissioning: the advancement of an installation from the stage of static completion to full working conditions and to meet the specified requirements. This will include setting into operation and regulation of the installation.

D2.2 Setting to work: the process of setting a static system into motion.

D2.3 Off-site Tests: tests carried out on items of equipment at manufacturer's works or elsewhere to ensure compliance with the requirements of Specifications and/or relevant Standards or Codes of Practice (or other standards specified).

D2.4 Site Tests: tests on static plant and systems (e.g. inspection and testing of welds, hydraulic testing of pipe work, etc.) to ensure correct and safe installation and operation.

D2.5 Regulation: the process of adjusting the rates of fluid flow and heat transfer in a distribution system within specified tolerances as stated in the relevant CIBSE Commissioning Code.

D2.6 Performance Testing: the measuring and recording of the performance of the commissioned installation.

### **D3 TESTING AND COMMISSIONING - GENERAL**

- D3.1 Any defects of workmanship, materials and performance, maladjustments or other irregularities which become apparent during commissioning or testing shall be rectified by the PD Contractor at no cost to the Employer and the relevant part of the commissioning or testing procedure shall be repeated at the PD Contractor's expenses.
- D3.2 The entire testing and commissioning procedure shall be undertaken by the PD Contractor's own competent specialist staff or by a competent Independent Commissioning Specialist nominated by and acting for the PD Contractor and approved by the Architect.
- D3.3 Where specified, the PD Contractor shall nominate a competent independent Specialist to conduct commissioning work.
- D3.4 Where specified, the PD Contractor shall employ an approved specialist testing and commissioning firm who shall be named in the returned Tender Documents.
- D3.5 At the appropriate time in the Contract, usually within the first three months, the PD Contractor shall furnish the Provisional Testing and Commissioning Programme, methods, procedures and formats of test records to the Architect. This shall be updated as the work progresses towards completion.
- D3.6 Unless otherwise indicated, all electricity, main water and other fuels, such as town gas, necessary for the operation of the plant during preliminary runs and for full adjustments and commissioning tests will be provided at no cost by the PD Contractor unless otherwise specified in the Contract.
- D3.7 If considered appropriate, the PD Contractor shall be required to carry out demonstration to dismantle those parts/components of the installation which are considered difficult/impossible for maintenance access. The PD Contractor shall be responsible for carrying out all necessary modification work at no extra charge to the Employer to alleviate the difficulties associated with dismantling or maintenance access.

### **D4 OFF-SITE TESTS**

Where the specified Standards or Codes of Practice stipulate, "type-tests" on items of equipment to demonstrate compliance shall be carried out at the manufacturer's works or elsewhere as appropriate. In all cases, "type-tests" Certificates shall be submitted in duplicate to the Architect.

## **D5 SITE TESTS**

- D5.1 The PD Contractor shall carry out "on-site" tests in respect of all static systems to ensure safe and proper operation as conforming to the design intent. Such tests shall include test of welds and pressure tests on the hydraulic systems.
- D5.2 On completion of cleaning operations described in Clauses 3.6.1 and 4.1.5.5 of the T&C Procedure for Plumbing and Drainage Installation, each water distribution system shall be re-charged with clean water and then subjected to a hydraulic test as required by Clause 4.1.5.7 of T&C Procedure for Plumbing and Drainage Installation. Any items of equipment set to operate at or below the test pressure shall be isolated or removed prior to applying this test.

## **D6 INSPECTION AND TESTING DURING CONSTRUCTION PERIOD**

### **D6.1 Periodic Site Tests**

Site inspections of "work in progress" will be made by the Architect or the representative from time to time. The PD Contractor shall keep such inspection record for checking from time to time. Installations to be permanently covered up shall be subjected to inspection and test before cover up. During the inspection, if the Architect discovers any work that has been covered up before inspection and testing, this work shall be uncovered for inspection and testing to the Architect's satisfaction. The cost involved in uncovering the work, inspecting, testing and re-concealing the work together with any consequential losses shall be paid by the PD Contractor at no additional cost to the Employer.

### **D6.2 Test at Factory**

The PD Contractor shall note that the Architect may require witness of tests and inspections of locally and/or overseas manufactured equipment during construction at the manufacturer's works. Where this requirement is indicated in the Contract, the PD Contractor shall allow for making the necessary arrangements; including and indicating the Architect's travel and subsistence expenses in the Contract.

### **D6.3 Factory Test Certificates**

Certificates of all hydraulic and other manufacturers' tests carried out at the manufacturers' works shall be forwarded in duplicate to the Architect for approval. This approval shall normally be required before the materials or apparatus are dispatched from the manufacturer's works.

Where specified, the PD Contractor shall subject certain materials and equipment to be tested by the recognized institutions or laboratories and submit the type test certificates to the Architect for approval.

#### D6.4 Sampling and Analysis of Potable Fresh Water

The PD Contractor shall conduct sampling and analysis for the quality of potable fresh water upon substantial completion of the plumbing installation. The sampling and analysis methodology shall be submitted to the Architect for approval. Notwithstanding, the samples shall be taken at all farthest points of use in the plumbing system from the storage tank, and shall include sampling for each water supply tank in the building as minimum.

The water quality test shall be conducted by an independent body accredited by The Hong Kong Laboratory Accreditation Scheme (HOKLAS).

The sampling and analysis of potable fresh water for physical, chemical and bacteriological examinations shall be collected, preserved and handled using the standard techniques as listed below: -

- (a) BS EN ISO 5667-1: 2006, BS EN ISO 5667-3: 2003 and BS ISO 5667-5: 2006, or equivalent standards;
- (b) Annex 4 of the World Health Organization (WHO) Guidelines for Drinking Water Quality 2<sup>nd</sup> Edition Volume 3; and
- (c) Section 1060 of the American Public Health Association (APHA) Standard Methods for the Examination of Water and Wastewater 20<sup>th</sup> Edition.

### **D7 DOCUMENTS AND DATA REQUIRED FOR HAND-OVER**

#### D7.1 General

The PD Contractor shall note that the system cannot be handed over until all the foregoing requirements (where applicable) have been carried out to the satisfaction of the Architect.

#### D7.2 Test Certificates

Before the handover inspection, the PD Contractor shall provide the follow test/record certificates where applicable:-

- (a) Copies of manufacturer's works tests/record certificates on plant items comprising heat generating plant, heat exchangers, chillers units, packaged air

conditioning units, tanks, vessels, motors, fans, pumps, etc.;

- (b) Copies of hydraulic and pressure test/record certificates for works carried out on Site;
- (c) Copies of boiler plant efficiency test/record certificates;
- (d) Copies of Registered Surveyor's test/record certificates for pressure vessels (if any);
- (e) Copies of all performance test/record certificates including water test, air test etc. These certificates shall be accompanied with all appropriate charts and diagrams; and
- (f) Copies of all noise test/survey records on every noise emitting plant and machineries, individual room/space and a statement of compliance with the statutory requirements under the current Noise Control Ordinance.

#### D7.3 "As-built" Drawings

All necessary copies of "As-built" drawings as detailed in the Contract and this General Specification shall be provided upon handover.

#### D7.4 Operation and Maintenance Manuals

All necessary copies of Operating and Maintenance Manuals as detailed in the Contract and this General Specification shall be provided upon handover.

#### D7.5 Manufacturer's Name Plate

Every item of plant supplied by a manufacturer shall be fitted with a clearly engraved, stamped or cast manufacturer's name plate properly secured to the plant item and showing :-

- Manufacturer's Name;
- Serial and/or Model No.;
- Date of Supply;
- Rating/Capacity; and
- Test and Working Pressure (where applicable).

#### D7.6 Labels and Related Instructions

Labels and notices shall be supplied and installed for all valves and piping to facilitate operation and proper maintenance of the Installation. All labels shall make cross reference to the operation and maintenance manuals and as-built drawings.

All wording shall be in both Chinese and English. All labels shall be of adequate size as to give clearance between lettering and fixings to ensure an aesthetic arrangement on completion, and meeting with all relevant statutory requirements.

### **D8 TESTING AND COMMISSIONING PROCEDURES**

For Testing and Commissioning Procedures, please refer to:-

Testing and Commissioning Procedure for Plumbing and Drainage Installation in Government Buildings of the Hong Kong Special Administrative Region.

## **PART E**

### **OPERATION AND MAINTENANCE**

#### **E1 GENERAL**

During the Maintenance Period, the PD Contractor shall supply and install, without additional cost to the Employer, replacements for all and any equipment or parts thereof, which may, in the opinion of the Architect, become unserviceable, especially where the causes are attributable to faulty materials, workmanship, or inadequate performance.

In the execution of servicing and maintenance, repair and operation work on Site, apart from transportation, necessary labour, tools, equipment and testing instruments, the PD Contractor shall also be responsible for keeping adequate stocks of spare parts/equipment and other items necessary to maintain all emergency repair in an efficient, satisfactory and safe operation condition at all time.

The interruption of plumbing and drainage services to the existing installations during execution of works shall be kept to the minimum and shall only be allowed with the prior approval of the Architect or his representative.

#### **E2 MAINTENANCE SCHEDULE**

The PD Contractor shall prepare, submit and seek endorsement on the maintenance program before the commencement of the Contract Maintenance Period. The maintenance programme should include Monthly Routine Service, Quarterly, Half-Yearly Service and Annual Maintenance.

Upon the approval of the above maintenance program, the PD Contractor shall prepare a comprehensive maintenance schedule for all installations and indicate dates for routine maintenance of the installations before the commencement of the Maintenance Period.

#### **E3 MAINTENANCE WORKS**

E3.1 The PD Contractor shall furnish free maintenance services for the complete plumbing and drainage services installation work in the Contract for the whole Maintenance Period unless otherwise specified. This free maintenance services shall include the following:

- (a) Maintain the entire Installations included in the Contract, taken into account the Employer's operational requirement.

- (b) Replace or repair all components of equipment and pipework as necessary to maintain the installation in good working order including supply of material, all normally consumable items.
- (c) Maintain a log book where every attendance and details of work done for the installation shall be entered into the log book by the PD Contractor so as to form a comprehensive repair record and evidence to certify that the PD Contractor has accomplished the works.
- (d) Provide regular maintenance services on monthly, quarterly, half-yearly and annual basis.
- (e) Carry out all necessary documentary and site works for applying, fulfilling and maintaining the Quality Water Recognition Scheme for Buildings of WSD.

## E3.2 Regular Maintenance Services

### E3.2.1 Monthly Routine Maintenance Services

- Check the general condition of the whole installation to ensure the system are satisfactorily performed as required by the Contract;
- Clean internally all water tanks according to the Fresh Water Plumbing Maintenance Guide issued by WSD;
- Clean internally all water tanks according to Clause B1.11 of this Specification;
- Check proper positioning of all manhole, gully and channel covers;
- To check any water leakage from the pipework and to repair if required;
- To examine the condition of joints, stop valves, covers and seals for leaks, repair as required; and
- To check drains are not clogged and rectify if necessary.

### E3.2.2 Quarterly Maintenance Services

- Clean all strainers;

- To check manholes and gully and rectify clogged conditions if necessary;
- Same as E3.2.1.

E3.2.3 Half-yearly Maintenance Services

- To inspect the condition of pipe fittings, supports etc for sign of corrosion. Remove the rust and repaint with primer and finish coating as necessary;
- Same as E3.2.1 and E3.2.2.

E3.2.4 Annual Maintenance Services

- To conduct drain test to verify the drainage performance at selected stacks, branches and underground drainage;
- Same as E3.2.1, E3.2.2 and E3.2.3.

**E4 CONTRACTOR'S RESPONSIBILITIES FOR EMERGENCY CALL-OUT**

E4.1 The PD Contractor shall offer efficient and prompt response to emergency call-out for the installation/equipment failure. The expedition of response shall be in accordance with the following categories:-

- (a) VERY URGENT for pipe burst and water leakage, the PD Contractor shall respond and attend to the Very Urgent calls immediately of not more than 30 minutes;
- (b) URGENT for clogging of drain pipe and drainage overflow, the PD Contractor shall respond and attend to the Urgent calls within 1 hour from the receipt of the calls; or
- (c) NON URGENT for minor pipe cracking, malfunction of valve and strainer clog, the PD Contractor shall respond and attend the fault within 4 hours.

Investigation report and proposal for repair/improvement/modification shall be submitted.

E4.2 The PD Contractor shall promptly complete any repair necessary for resuming the breakdown installation. In case immediate permanent repair is not possible due to safety related reason, the following "time for repair" targets counted from the receipt of breakdown or fault call shall be complied with:-

- (a) Complete temporary repair for resumption of the suspended or breakdown services to a safe operating condition within 24 hours; and
- (b) Complete permanent rectification works within 3 and 7 working days unless long component and parts delivery time is required.

**E5 MONITORING MECHANISM ON CONTRACTOR'S PERFORMANCE**

Every attendance and details of work done on each installation should be entered into the log book as required in Clause E3.1 by the PD Contractor to form a works record, and/or to certify his attendance visits as required by the Contract. In addition to this log book record, the PD Contractor shall also keep maintenance record in his own office. On the request of the Architect or his representative, the PD Contractor shall be required to forward his own maintenance record for checking.

**E6 FINAL INSPECTION BEFORE THE EXPIRY DATE OF MAINTENANCE PERIOD**

The PD Contractor shall, in addition to the routine maintenance, make further visit to the Site one month before the expiry date of the Maintenance Period to check and, if necessary, re-adjust the systems to meet the actual operation conditions.

The PD Contractor shall attend inspections to the Installations before the expiry date of the Maintenance Period in order to facilitate the acceptance and handing over of the installation to the Employer's representatives.

**E7 SPARE PARTS AND SPECIAL TOOLS**

E7.1 For equipment and parts included in the tender, the PD Contractor shall provide the types of spare parts generally wherever these are appropriate to the plant and/or equipment involved plus any additional items for the particular plant and/or equipment.

Unless otherwise specified, within four months of signing the Contract, or in such period of time as has been agreed by the Architect in writing, the PD Contractor shall submit in respect of the proposed plant and/or equipment a list of the manufacturer's recommended spare parts that are likely to prove necessary to service the plant and/or equipment during the first year's operation and parts required immediately following the completion of the Contract Maintenance Period.

The spare parts submission shall include diagrams or catalogue details of the parts concerned.

E7.2 Unless specified in detail, the criteria by which the PD Contractor shall judge the need for spare parts to be included in the Schedule shall be any part or component of the Plumbing and Drainage Installations that is subject to frictional wear, vibration or temperature fatigue, corrosion, erosion, unacceptable deposits and/or saturation by contaminants (such as for filters or strainers), normal fair wear and tear and is likely to fail or reach an unacceptably low performance level within a period of three years or less from its installation and/or commencement of operation.

Additionally the PD Contractor shall submit within the same period a priced schedule for the supply of any special tools necessary for servicing and maintenance of any part of the Installations.

E7.3 Instructions for purchase of any special tool shall be issued separately but the basis for charging shall be similar to that for the PD Contractor's equipment manufacturer's recommended spare parts.

The purchase of the needed spare parts and tools shall be secured by Architect's Instruction for which a provisional sum shall be provided in the Contract.

The exact types and quantities shall be determined by the Architect based on the PD Contractor's best advice and at the most appropriate time during the Contract Period when requirements can be most realistically assessed taking account of the installation as installed or still being installed.

## ANNEX I

### LIST OF TECHNICAL STANDARDS AND QUALITY STANDARDS QUOTED IN THIS GENERAL SPECIFICATION

The following is a list of technical standards and quality standards quoted in this General Specification. The technical standards and quality standards indicate the basic requirements. The PD Contractor may offer products, materials and equipment complying with alternative internationally recognized equivalent standards acceptable to the Architect and demonstrated to be equivalent in terms of construction, functions, performance, general appearance and standard of quality to the relevant standards or other standards specified in this General Specification to the Architect for approval.

<b>Standard</b>	<b>Description</b>
BS 21: 1985 (Partially replaced by BS EN 10226-1: 2004)	Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions)
BS 65: 1991	Specification for vitrified clay pipes, fittings and ducts, also flexible mechanical joints for use solely with surface water pipes and fittings
BS 143 and 1256: 2000	Threaded pipe fittings in malleable cast iron and cast copper alloy
BS 416-1: 1990	Discharge and ventilating pipes and fittings, sand-cast or spun in cast iron. Specification for spigot and socket systems
BS 417-2: 1987	Specification for galvanized low carbon steel cisterns, cistern lids, tanks and cylinders. Metric units
BS 437: 2008	Specification for cast iron drain pipes, fittings and their joints for socketed and socketless systems
BS 476-20: 1987	Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles)
BS 1196: 1989	Specification for clayware field drain pipes and junctions
BS 1212-1: 1990	Float operated valves. Specification for piston type float operated valves (copper alloy body) (excluding floats)

BS 1212-2: 1990	Float operated valves. Specification for diaphragm type float operated valves (copper alloy body) (excluding floats)
BS 1377-2: 1990	Methods of test for soils for civil engineering purposes. Classification tests
BS 1968: 1953	Specification for floats for ballvalves (copper)
BS 2456: 1990	Specification for floats (plastics) for float operated valves for cold water services
BS 3416: 1991	Specification for bitumen-based coatings for cold application, suitable for use in contact with potable water
BS 3505: 1986	Specification for unplasticized polyvinyl chloride (PVC-U) pressure pipes for cold potable water
BS 3506: 1969 (Replaced by BS EN 1452-1 to 5: 1999 but remains current)	Specification for unplasticized PVC pipe for industrial uses
BS 4164: 2002	Specification for coal-tar-based hot-applied coating materials for protecting iron and steel, including a suitable primer
BS 4190: 2001	ISO metric black hexagon bolts, screws and nuts. Specification
BS 4346-1: 1969 (Replaced by BS EN 1452-1 to 5:1999 but remains current)	Joints and fittings for use with unplasticized PVC pressure pipes. Injection moulded unplasticized PVC fittings for solvent welding for use with pressure pipes, including potable water supply
BS 4346-2: 1970 (Replaced by BS EN 1452-1 to 5: 1999 but remains current)	Joints and fittings for use with unplasticized PVC pressure pipes. Mechanical joints and fittings, principally of unplasticized PVC
BS 4514: 2001	Unplasticized PVC soil and ventilating pipes of 82.4 mm minimum mean outside diameter, and fittings and accessories of 82.4 mm and of other sizes. Specification
BS 4622: 1970	Specification for grey iron pipes and fittings
BS 4660: 2000 (Partially replaced by BS EN 13598-1: 2010)	Thermoplastics ancillary fittings of nominal sizes 110 and 160 for below ground gravity drainage and sewerage
BS 4800: 2011	Schedule of paint colours for building purposes

BS 4962: 1989	Specification for plastics pipes and fittings for use as subsoil field drains
BS 5154: 1991 (Partially replaced by BS EN 12288: 2003)	Specification for copper alloy globe, globe stop and check, check and gate valves
BS 5163-1: 2004	Valves for waterworks purposes. Predominantly key-operated cast iron gate valves. Code of practice
BS 5163-2: 2004	Valves for waterworks purposes. Stem caps for use on isolating valves and associated water control apparatus. Specification
BS 5255: 1989 (Partially replaced by BS EN 1329-1: 2000 BS EN 1455-1: 2000 BS EN 1519-1: 2000 BS EN 1565-1: 2000 and BS EN 1566-1: 2000)	Specification for thermoplastics waste pipe and fittings
BS 5911-1: 2002 with amendment A2: 2010	Concrete pipes and ancillary concrete products. Specification for unreinforced and reinforced concrete pipes (including jacking pipes) and fittings with flexible joints (complementary to BS EN 1916:2002)
BS 5911-3: 2010	Concrete pipes and ancillary concrete products. Specification for unreinforced and reinforced concrete manholes and soakaways
BS 6920-1: 2000	Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water. Specification
BS 8558: 2011	Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages.
BS EN 124: 1994	Gully tops and manhole tops for vehicular and pedestrian areas. Design requirements, type testing, marking, quality control
BS EN 197-1: 2011	Cement. Composition, specifications and conformity criteria for common cements
BS EN 274-1: 2002	Waste fittings for sanitary appliances. Requirements
BS EN 295-1: 1991	Vitrified clay pipes and fittings and pipe joints for drains and sewers. Requirements

BS EN 295-10: 2005	Vitrified clay pipes and fittings and pipe joints for drains and sewers. Performance requirements
BS EN 295-2: 1991	Vitrified clay pipes and fittings and pipe joints for drains and sewers. Quality control and sampling
BS EN 295-3: 1991	Vitrified clay pipes and fittings and pipe joints for drains and sewers. Test methods
BS EN 295-4: 1995	Vitrified clay pipes and fittings and pipe joints for drains and sewers. Requirements for special fittings, adaptors and compatible accessories
BS EN 295-5: 1994	Vitrified clay pipes and fittings and pipe joints for drains and sewers. Requirements for perforated vitrified clay pipes and fittings
BS EN 295-7: 1996	Vitrified clay pipes and fittings and pipe joints for drains and sewers. Requirements for vitrified clay pipes and joints for pipe jacking
BS EN 545: 2010	Ductile iron pipes, fittings, accessories and their joints for water pipelines. Requirements and test methods
BS EN 598: 2007 with amendment A1: 2009	Ductile iron pipes, fittings, accessories and their joints for sewerage applications. Requirements and test methods
BS EN 681-1: 1996	Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications. Vulcanized rubber
BS EN 877: 1999 with amendment A1: 2006	Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings. Requirements, test methods and quality assurance
BS EN 1057: 2006 with amendment A1: 2010	Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications
BS EN 1074-1: 2000	Valves for water supply. Fitness for purpose requirements and appropriate verification tests. General requirements
BS EN 1074-2: 2000	Valves for water supply. Fitness for purpose requirements and appropriate verification tests. Isolating valves
BS EN 1092-1: 2007	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges
BS EN 1092-2: 1997	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Cast iron flanges

BS EN 1092-3: 2003	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Copper alloy flanges
BS EN 1171: 2002	Industrial valves. Cast iron gate valves
BS EN 1254-1: 1998	Copper and copper alloys. Plumbing fittings. Fittings with ends for capillary soldering or capillary brazing to copper tubes
BS EN 1254-2: 1998	Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with copper tubes
BS EN 1254-4: 1998	Copper and copper alloys. Plumbing fittings. Fittings combining other end connections with capillary or compression ends
BS EN 1254-5: 1998	Copper and copper alloys. Plumbing fittings. Fittings with short ends for capillary brazing to copper tubes
BS EN 1329-1: 2000	Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Unplasticized poly(vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system
BS EN 1366-3: 2009	Fire resistance tests for service installations. Penetration seals
BS EN 1401-1: 2009	Plastic piping systems for non-pressure underground drainage and sewerage. Unplasticized poly(vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system
BS EN 1561: 2011	Founding. Grey cast irons
BS EN 1562: 1997	Founding. Malleable cast irons
BS EN 1563: 2011	Founding. Spheroidal graphite cast iron
BS EN 1916: 2002	Concrete pipes and fittings, unreinforced, steel fibre and reinforced
BS EN 1917: 2002	Concrete manholes and inspection chambers, unreinforced, steel fibre and reinforced
BS EN 1982: 2008	Copper and copper alloys. Ingots and castings
BS EN 10088-1: 2005	Stainless steels. List of stainless steels
BS EN 10088-2: 2005	Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes

BS EN 10088-3: 2005	Stainless steels. Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes
BS EN 10095: 1999	Heat resisting steels and nickel alloys
BS EN 10217-1: 2002	Welded steel tubes for pressure purposes. Technical delivery conditions. Non-alloy steel tubes with specified room temperature properties
BS EN 10217-7: 2005	Welded steel tubes for pressure purposes. Technical delivery conditions. Stainless steel tubes
BS EN 10226-1: 2004	Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation
BS EN 10242: 1995	Threaded pipe fittings in malleable cast iron
BS EN 10255: 2004	Non-alloy steel tubes suitable for welding and threading. Technical delivery conditions
BS EN 10293: 2005	Steel castings for general engineering uses
BS EN 10312: 2002 with amendment A1: 2005	Welded stainless steel tubes for the conveyance of aqueous liquids including water for human consumption. Technical delivery conditions
BS EN 12056-2: 2000	Gravity drainage systems inside buildings. Sanitary pipework, layout and calculation
BS EN 12163: 2011	Copper and copper alloys. Rod for general purposes
BS EN 12200-1: 2000	Plastics rainwater piping systems for above ground external use. Unplasticized poly (vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system
BS EN 12288: 2010	Industrial valves. Copper alloy gate valves
BS EN 12334: 2001	Industrial valves. Cast iron check valves
BS EN 13101: 2002	Steps for underground man entry chambers. Requirements, marking, testing and evaluation of conformity
BS EN 13280: 2001	Specification for glass fibre reinforced cisterns of one-piece and sectional construction, for the storage, above ground, of cold water

BS EN 13598-1: 2010	Plastics piping systems for non-pressure underground drainage and sewerage. Unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE). Specifications for ancillary fittings including shallow inspection chambers
BS EN 13789: 2010	Industrial valves. Cast iron globe valves
BS EN ISO 1452-1: 2009	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly(vinyl chloride) (PVC U). General
BS EN ISO 1452-2: 2009	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly(vinyl chloride) (PVC U). Pipes
BS EN ISO 1452-3: 2009	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly(vinyl chloride) (PVC U). Fittings
BS EN ISO 1461: 2009	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
BS EN ISO 3506-1: 2009	Mechanical properties of corrosion-resistant stainless steel fasteners. Bolts, screws and studs
BS EN ISO 5667-1: 2006	Water quality. Sampling. Guidance on the design of sampling programmes and sampling techniques
BS EN ISO 5667-3: 2003	Water quality. Sampling. Guidance on the preservation and handling of water samples
BS EN ISO 9001: 2008	Quality management systems. Requirements
BS ISO 3864-1: 2011	Graphical symbols. Safety colours and safety signs. Design principles for safety signs and safety markings
BS ISO 5667-5: 2006	Water quality. Sampling. Guidance on sampling of drinking water from treatment works and piped distribution systems