

GENERAL SPECIFICATION

FOR

DRAINAGE INSTALLATION

IN

GOVERNMENT BUILDINGS

OF

THE HONG KONG SPECIAL ADMINISTRATIVE REGION

2017 EDITION



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, and operation and maintenance as well as requirements on document submissions for Drainage Installation in Government Buildings of the Hong Kong Special Administrative Region (HKSAR).

The 2017 edition of this General Specification was developed from the 2012 edition (incorporating Corrigendum No. GSPD02-2012) of the General Specification for Plumbing and Drainage Installation in Government Buildings 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, this General Specification puts emphasis on green features and green practice for construction as well as initiatives for enhancement of client satisfaction on completed projects.

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

The draft of the 2017 edition has been circulated to stakeholders within and external to the Government before finalisation. Nevertheless, the ArchSD welcomes comments on its contents at any time 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 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 Drainage Installation 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 Supervising Officer.

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 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:-

A/C	Air Conditioning
A/C General Specification	General Specification for Air-conditioning, Refrigeration, Ventilation and Central Monitoring & Control System Installation in Government Buildings of the HKSAR issued by ArchSD
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ArchSD	Architectural Services Department, the Government of the Hong Kong Special Administrative Region

ASTM	American Society for Testing and Materials
BD	Buildings Department, the Government of the Hong Kong Special Administrative Region
BS	British Standards, including British Standard Specifications and British Standard Codes of Practice, published by the British Standards Institution
BS EN	European Standard adopted as British Standard
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
CIBSE	The Chartered Institution of Building Services Engineers
Conditions	The “Conditions of Contract” as defined in the Contract. For Nominated Sub-contract works, the “Main Contract Conditions” and the “Sub-contract Conditions” as defined in the Nominated Sub-contract as appropriate
Drainage 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
DSD	Drainage Services Department, the Government of the Hong Kong Special Administrative Region
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

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.	Galvanised Iron
GRP	Glass Reinforced Plastics
HOKLAS	The Hong Kong Laboratory Accreditation Scheme
IEC	International Electrotechnical Commission
Installations	The works or services for the 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 Organization for Standardization
L.V.	Low Voltage
LALG certificate	Certificate of test and thorough examination of lifting appliances under Factories and Industrial Undertakings (Lifting Appliances and Lifting Gears) Regulations
OD	Outside Diameter
or equivalent standards	Means internationally recognised standards acceptable to the Supervising Officer having similar requirements and specification as regards to the type of construction, functions, performance, general appearance and standard of quality of manufacture and approved by the Supervising Officer
O&M	Operation and Maintenance
Particular Specification	The specifications drawn up specifically for the Installations of a particular project
PI General Specification	General Specification for Plumbing Installation in Government Buildings of the HKSAR issued by ArchSD

PN	Practice Notes for Authorised Persons, Registered Structural Engineers and Registered Geotechnical Engineers issued by Buildings Department
PVC	Polyvinyl Chloride
Proprietary brand name products or materials	The phrase “or alternative products or materials having equivalent functions or performance” is deemed to be included wherever products or materials are specified by proprietary brand names in the Contract. Alternative products or materials of different brands or manufacture having equivalent functions or performance may be submitted for the consideration of the Supervising Officer
Supervising Officer	The Supervising Officer or the Maintenance Surveyor defined in the Contract as appropriate
SCCU	Statutory Compliance Checking Unit established within ArchSD
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 of United Kingdom (UK)
WSD	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 Drainage Contractor's attention is drawn to the followings:

- (a) Buildings 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 Services Ordinance (Cap. 95), and other subsidiary legislation made under the Ordinance;
- (i) Electricity Ordinance (Cap. 406), and other subsidiary legislation made under the Ordinance;
- (j) Noise Control Ordinance (Cap. 400), and other subsidiary legislation made under the Ordinance;
- (k) Water Pollution Control Ordinance (Cap. 358), and other subsidiary legislation made under the Ordinance;
- (l) Air Pollution Control Ordinance (Cap. 311), and other subsidiary legislation made under the Ordinance;
- (m) Ozone Layer Protection Ordinance (Cap. 403), and other subsidiary legislation made under the Ordinance;

- (n) Waste Disposal Ordinance (Cap. 354), and other subsidiary legislation made under the Ordinance;
- (o) Environmental Impact Assessment Ordinance (Cap. 499), and other subsidiary legislation made under the Ordinance;
- (p) Land (Miscellaneous Provisions) Ordinance (Cap. 28), and other subsidiary legislation made under the Ordinance;
- (q) Buildings Energy Efficiency Ordinance (Cap. 610), and other subsidiary legislation made under the Ordinance; and
- (r) Energy Efficiency (Labelling of Products) Ordinance (Cap. 598).

A2.1.2 Other Requirements

- (a) Practice Notes for Authorised Persons, Registered Structural Engineers and Registered Geotechnical Engineers issued by BD;
- (b) Practice Notes of Professional Persons Environmental Consultative Committee 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) Requirements and Circular Letters of FSD;
- (g) Code of Practice for Fire Safety in Buildings published by BD;
- (h) Code of Practice for the Electricity (Wiring) Regulations published by EMSD;
- (i) Code of Practice for Energy Efficiency of Building Services Installation, issued by EMSD; hereinafter referred as the “Building Energy Code” or “BEC”;
- (j) General Specification for Building issued by ArchSD;
- (k) General Specification for Air-conditioning, Refrigeration, Ventilation and Central Monitoring & Control System Installation in Government Buildings of the HKSAR, issued

by ArchSD;

- (l) General Specification for Electrical Installation in Government Buildings of the HKSAR, issued by ArchSD;
- (m) General Specification for Fire Service Installation in Government Buildings of the HKSAR, issued by ArchSD;
- (n) General Specification for Plumbing Installation in Government Buildings of the HKSAR, issued by ArchSD;
- (o) Design Manual: Barrier Free Access 2008 published by BD;
- (p) Technical Memorandum to issue Air Pollution Abatement Notice to control Air Pollution from Stationary Processes issued by EPD;
- (q) Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites issued by EPD;
- (r) Technical Memorandum - Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters issued by EPD;
- (s) Technical Memorandum on Environmental Impact Assessment Process issued by EPD;
- (t) Code of Practice for Prevention of Legionnaires' Disease issued by the Prevention of Legionnaires' Disease Committee, the Government of the HKSAR;
- (u) The Supply Rules and other requirements issued by the relevant local electricity supplier and Water Authority;
- (v) A Guide to the Water Pollution Control Ordinance issued by EPD;
- (w) Grease Trap for Restaurant and Food Processors issued by EPD;
- (x) Guidelines for the Design of Small Sewage Treatment Plants issued by EPD; and
- (y) Guidelines on Maintenance and Repair of Drainage System and Sanitary Fitments issued by BD.

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);
- (e) Construction Site Safety Manual issued by the Development Bureau, the Government of the HKSAR;
- (f) Code of Practice on Working near Electricity Supply Lines published by EMSD; and
- (g) Code of Practice on Avoiding Danger from Gas Pipes published by EMSD.

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 of weights and measures shall be used for all materials, equipment and measurements.

A3.2 PROGRAMME OF INSTALLATIONS

The Drainage Contractor shall submit to the Supervising Officer 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, e.g. electricity supply, water and town gas.
- (g) Dates of 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 Supervising Officer. Programmes shall be regularly updated to reflect the actual progress and to meet the Drainage Contractors' obligations under the Contract.

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

A3.3 BUILDER'S WORK

All building works includes drainage works shall be in compliance with the Building Ordinance and its regulations.

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, manholes, chambers, gullies and channels, 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 Drainage Contractor has submitted full details of such requirements within a reasonable time to the Supervising Officer 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 Supervising Officer, the Drainage 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 Drainage 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 Drainage Contractor. The Drainage 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 Drainage Contractor's failure to comply with the above requirements are recoverable by the Employer from the Drainage 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 Drainage 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 Drainage 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 Drainage 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 Drainage 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 Drainage Contractor that any builder's works completed by the Building Contractor does not comply with his requirements in any respect whatsoever, the Drainage Contractor shall forthwith give notice in writing to the Supervising Officer and specify in details the extents and effects of such non-compliance in that notice. The Drainage 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 Supervising Officer 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 Drainage 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 Drainage Contractor shall coordinate the Installations with those works of the Building Contractor and any other contractors and sub-contractors of the Building Contractor.

The Drainage 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 Drainage 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 Drainage Contractor's control, shall promptly be reported to the Supervising Officer.

A3.5 COOPERATION WITH OTHER CONTRACTORS

The Drainage 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 and keep the Site in a clean and tidy condition.

Any significant problems beyond the Drainage Contractor's control shall promptly be reported to the Supervising Officer.

A3.6 SITE SUPERVISION

The Drainage Contractor shall keep on the Site a competent and technically qualified site supervisor to control, supervise and manage all his Installations on Site. The site supervisor shall be vested with suitable powers to receive instructions from the Supervising Officer and his Representative.

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 Drainage Contractor shall also refer to the Particular Specification for other specific requirements, if any, on site supervision.

Approval by the Supervising Officer shall be obtained prior to the posting of the site supervisor on Site. The Drainage Contractor shall immediately replace the site supervisor whose experience, skill or competency is, in the opinion of the Supervising Officer, 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 Supervising Officer. In this connection, the Drainage Contractor's attention is drawn to the Special Conditions of Contract under the Contract for the requirements relating to Qualified Tradesmen/Qualified Skilled Workers and Intermediate Tradesmen/Qualified Semi-skilled Workers.

The Drainage Contractor shall also employ a full time competent foreman on Site for each trade. All trade foremen shall be registered tradesmen/skilled workers 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 Drainage Contractor shall submit to the Supervising Officer for approval a sample board of essential components proposed to be used in the Contract. However, the Drainage Contractor may request the Supervising Officer 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 labelling, 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 Supervising Officer shall be replaced as soon as possible. Upon approval of all items, the Supervising Officer will endorse the list on the sample board and the Drainage Contractor shall deliver the board to the site office of the Supervising Officer's Representative 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 Supervising Officer 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; and
- (b) Valves.

Additional items may be required by the Supervising Officer and/or specified in the Particular Specification.

A3.8 ADVICE OF ORDER PLACED

The Drainage Contractor shall submit copies of all orders placed for major items of equipment and materials to the Supervising Officer 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 Supervising Officer's Representative on Site. Such materials and equipment shall not be removed from Site without the prior approval of the Supervising Officer 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 and equipment. In this case, the Drainage Contractor shall comply with the Building Contractor's arrangements.

The Drainage Contractor shall print the major technical details on equipment/materials or supporting documents (e.g. delivery note), or else submit a written declaration to confirm compliance of the equipment/materials with the approved technical details so as to facilitate checking of equipment/materials delivered on site.

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 Drainage Contractor shall be responsible for the safe custody of all materials and equipment as stored or installed by him. In addition, the Drainage 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 Supervising Officer and his Representative on Site with full details.

Where necessary the Drainage 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 Drainage 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 Drainage Contractor.

A3.11 SERVICE CONDITION

The following service conditions shall apply to materials and equipment

- (a) Climate : Hong Kong (tropical);
- (b) Ambient temperature : Peak -5°C to $+40^{\circ}\text{C}$ (continuously 4 hours)
Average 0°C to $+35^{\circ}\text{C}$ (over 24 hours);
- (c) Altitude : up to 2000 m above sea level; and
- (d) Relative humidity : 99% maximum.

A3.12 VOLTAGE COVERED BY THIS GENERAL SPECIFICATION

Unless otherwise specified, all apparatus, equipment, materials and wiring shall be suitable for use with a 3-phase and neutral, 4-wire, 380/220 V $\pm 6\%$, 50 Hz $\pm 2\%$.

A3.13 LABEL

In order to make cross reference to the Operation/Maintenance/Service Manuals and Schematic Drawings, etc., the Drainage Contractor shall provide labels for marking all valves, pipework, filtration tanks, fuses, terminals, lamps, switches, handles, keys, instruments, gauges, control and other equipment, etc. and elsewhere to facilitate maintenance or as directed by the Supervising Officer with engraved multi-layer laminate or similar material. Wording shall be submitted to the Supervising Officer for approval before manufacture.

All labels shall be of adequate size as to give clearance between lettering and fixings to ensure an aesthetic arrangement on completion. Pipeline labels shall generally be not smaller than 100 mm x 20 mm. Where applicable, labels shall be fixed utilising non-ferrous round head bolts and nuts or woodscrews. Adhesives or self tapping screws are not acceptable.

For pipelines or valves, where applicable, labels shall be fixed by means of a key ring attached to the upper corner of the pipe mounting bracket or the hand wheel of valves. The labels shall be suspended from brass or stainless steel chain loops over the relevant pipe.

The Drainage Contractor shall submit a schedule for all labels, notices, identifications for the Supervising Officer's approval prior to order and installation. The information of the schedule shall include the description of the items, height and font type of the text, dimensions of the labels and material used.

All English lettering used on labels shall be "Bold" capitals (except otherwise directed) with black letters on white labels for normal purposes. Where special colours or details are required these shall be as specified or directed.

All labels shall be in English complete with translation in Chinese characters. The Chinese translations shall be referred to the “Glossaries of Terms Commonly Used in Government Departments” issued by Civil Service Bureau of the Government of the HKSAR. Sample of label and notice shall be submitted to the Supervising Officer for agreement. In general, height for the English lettering shall be of 8mm with that for Chinese characters to match.

For electrical panels or other items, lettering shall be:-

- (a) Black on white for normal purposes;
- (b) Red letters on white where connected to essential supply; and
- (c) Green letters on white where operated by direct current.

A3.14 WARNING NOTICE

Warning notices shall be provided as required by the Electricity Ordinance (Cap. 406) and the Code of Practice for the Electricity (Wiring) Regulations (Cap. 406E). In addition, the following warning notices in English and Chinese shall be provided at the appropriate positions :-

- (a) A label having minimum size of 65 x 50 mm marked with the words ‘DANGER - HIGH VOLTAGE’ in red lettering not less than 5 mm high to be fixed on every container or enclosure of equipment for operating at voltages exceeding "Low voltage"; and
- (b) A label to be fixed in such a position that any person may gain access to any moving parts of an item of equipment or enclosure will notice or be warned of such a danger.

A3.15 GUARD AND RAILING FOR MOVING OR ROTATING PARTS OF EQUIPMENT

All moving or rotating parts of equipment shall be provided with an approved guard and railing complying with the Factories & Industrial Undertakings (Guarding and Operation of Machinery) Regulations, (Cap. 59Q), together with any amendments made thereto.

Guards shall be rigid and of substantial construction and shall consist of heavy galvanised mild steel angle frames, hinged and latched with either heavy galvanised mild steel wire crimped mesh securely fastened to frames or galvanised sheet metal of 1.2 mm minimum thickness. All apertures shall be such that finger access to dangerous part is not possible. All sections shall be bolted or riveted. Railings shall be made of 32 mm dia. galvanised mild steel pipe and railing fittings.

A3.16 EQUIPMENT DEVIATIONS

Subsequent to the acceptance of his Tender, and only in exceptional circumstances where it is demonstrated in writing by the Drainage Contractor that the original equipment offered cannot be obtained, the Supervising Officer may, subject to the Conditions, consider and approve, in writing, alternative equipment and materials proposed by the Drainage Contractor provided always that these are fully in compliance with the relevant Specification and Drawings and do not impose any additional contractual or financial liabilities onto the Employer.

A3.17 WATERPROOFING

Where any work requires piercing waterproofing layers or structures, the method of installation must have prior approval, in writing, from the Supervising Officer.

Unless otherwise specified or instructed, the Drainage Contractor shall provide all necessary sleeves, puddle flanges, caulking and flashing as appropriate to make these penetrations absolutely watertight.

A3.18 SURVEYS AND MEASUREMENTS

The Drainage Contractor shall carry out checking of underground utilities for potential uncharted services underneath and shall relate all horizontal and vertical measurements taken and/or applied, to establish bench marks such as design drawing grid lines, finished floor levels, etc. and shall thus establish satisfactory lines and levels for all work.

All works shall be installed to these established lines and levels and the Drainage Contractor shall verify all measurements on Site and check the correctness thereof as related to the Installations.

Primary bench base line, datum level, horizontal reference grid, secondary grid and transferred bench mark on each structural level will be provided by the Building Contractor. The Drainage Contractor shall co-ordinate with the Building Contractor to obtain all necessary datum and reference grids prior to their surveys and measurements.

SECTION A4

DRAWINGS AND MANUALS

A4.1 DRAWINGS IN ELECTRONIC FORMAT

The Drainage Contractor shall provide drawings in electronic format as required in the following clauses. These drawings shall conform to the latest version of CAD Standard for Works Projects (CSWP) as posted in the website of the Development Bureau and in accordance with the latest version of CAD Manual for ArchSD 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 Drainage Contractor shall submit a detailed installation drawing submission schedule and programme to the Supervising Officer. The Drainage Contractor shall allow reasonable time in the programme for vetting of the installation drawings by the Supervising Officer and for drawing resubmissions as necessary.

The Drainage Contractor shall submit to the Supervising Officer 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 Supervising Officer. The Drainage Contractor shall ensure that the installation drawings and builder’s work drawings are progressively submitted in accordance with the approved “Submission Schedule”.

The Drainage 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 Supervising Officer for distribution.

A4.2.2 Size of Installation Drawings

Drawings submitted by the Drainage Contractor shall only be of standard sizes from A0 to A4 or B1 size as stipulated in ISO 5457:1999+A1:2010.

Drainage Contractor’s installation drawings and/or shop drawings shall be prepared to such scales that will clearly show all necessary details.

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 Supervising Officer.

The Drainage Contractor shall ensure all installation drawings are accurate representation of the Installations, before submitting them to the Supervising Officer. 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 Employer's own Contract 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 gratings, cleaning eyes, access points, manholes, etc.;
- 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 Drainage Contractor shall submit to the Supervising Officer 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 Supervising Officer'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 motorised valves, solenoids, etc.

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

(c) Special Plant Rooms Co-ordination Work

Unless otherwise stated in the Contract, in the case of a plant room where the Drainage Contractor's equipment constitutes the major item involved (i.e. as in the case of pump room), the Drainage Contractor shall allow in the Tender for taking effective responsibility for the coordination of other services/building details within these specific areas. Furthermore the Drainage 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 Drainage 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 Supervising Officer, the Drainage Contractor shall submit to the Supervising Officer 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 Supervising Officer, the Drainage Contractor shall forward to the Supervising Officer 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 Supervising Officer.

A4.2.6 Drawings for Submission to other Authorities

The Drainage Contractor shall submit drainage plans, certificate on completion of drainage work, certificate of completion of drain tests, etc. with all necessary drawings and information approved by the Supervising Officer, to the SCCU established under ArchSD, Building Authority or DSD where appropriate for approval/inspection.

A4.2.7 Checking Drawings of Other Trades

The Drainage Contractor shall follow the design intent of the Contract 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 are to be installed.

If directed by the Supervising Officer, the Drainage 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 the Installations. 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 Supervising Officer wherever such a requirement is justified.

A4.3 AS-BUILT DRAWINGS

A4.3.1 Submission of As-built Drawings

The Drainage Contractor shall submit to the Supervising Officer as-built drawings, including the draft prints and revised draft prints for checking and the final approved drawings for record in accordance with the requirements set out in the contract documents.

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+A1:2010. Smaller size (A2 to A4) is accepted for installation drawings.

A4.3.3 Content of As-built Drawings

The Drainage Contractor shall ensure all as-built drawings are accurate representation of the Installations, before submitting them to the Supervising Officer.

"As-built" drawings shall complete with all details such as design water flow rates 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 Supervising Officer.

A4.3.4 Framed Drawings

The Drainage 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, etc. including all electrical and control schematics and diagrams.

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 AND USER MANUAL

A4.4.1 General

The Drainage Contractor shall provide two types of manuals to the Supervising Officer with all changes made to the installation during the course of the Contract suitably incorporated.

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.

The User Manual seeks to give users of the completed Installations an overview of the essential information of the Installations. The contents of the manual should be concise and succinct for ease of comprehension by people with a non-technical background.

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 Supervising Officer'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 Drainage Contractor shall submit to the Supervising Officer the draft of O&M Manuals and User Manual for checking and approval and the approved O&M Manual and User Manual for record according to the requirements as specified in the contract documents.

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.

A.4.4.5 Structure and Contents of User Manual

The detailed requirements, structure and contents of the User Manual shall include, where applicable, the following information:-

(a) Project Information

This shall include:-

Project title, site address, contract no., contract title, contract commencement date, substantial completion date and expiry date of Maintenance Period.

(b) System Description

- Type(s) of system(s) and equipment installed, and their purposes;
- Locations of the major plant rooms and pipe ducts; and
- Brief description of the operation and functions of the systems and equipment.

(c) Schedule of Major Plant Rooms and Installed Equipment

- Schedule of major plant rooms and riser ducts including their locations; and
- Schedule of major equipment and plants including their locations and serving areas.

(d) Safety Precautions for Operation

Any safety precautions and warnings signals that the users shall be aware of in the daily operation of the various systems and equipment in the Installations including:-

- Mandatory requirements relating to safety;
- Features or operational characteristics of the installed systems or equipment which may cause hazard and the related safety precautions.
- Protective measures and safety precautions for operation; and
- List of warning signals and the related meanings that the user shall be aware of and the actions to be taken.

(e) Operation Instructions

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

- An outline of the operating mode;
- Step by step operation instructions for systems and equipment that are to be operated by the user, including at least procedures for start-up and shut-down;
- Means by which any potentially hazardous equipment can be made safe; and
- Cleaning and basic maintenance procedures.

(f) List of Statutory Periodic Inspections and Tests

A schedule of periodic inspections and tests that owner and/or user of the Installations have to arrange to achieve compliance with the requirements stipulated in the relevant Laws of Hong Kong. The frequency of such inspections and tests shall be expressed in specific time intervals.

(g) Drawings

A set of selected as-built drawings which shall be able to illustrate to the user the general layout of the completed Installations.

(h) Photographs

A set of photographs with suitable captions to illustrate to the user the appearance and locations of devices which require their setting and operation.

A4.4.6 Intellectual Property Rights

The Government shall become the absolute and exclusive owner of the Operation and Maintenance Manuals and the User Manual 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 Drainage Contractor, the Drainage 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 utilise 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

ABOVE GROUND DRAINAGE SYSTEMS

B1.1 GENERAL

B1.1.1 Foul water drainage above ground shall be installed generally to BS EN 12056-2: 2000.

B1.1.2 Surface water drainage above ground shall be designed and installed generally to BS EN 752: 2008.

B1.2 HANDLING AND STORAGE

B1.2.1 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.

B1.2.2 Store pipes, gutters and fittings under cover and clear of a levelled, well-drained and maintained hard-standing ground.

B1.2.3 Stack pipes without resting them on their sockets.

B1.2.4 Prevent entry of foreign matter into any system by sealing off ends of pipes and openings during construction.

B1.3 FIXING PIPES AND FITTINGS

B1.3.1 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 Supervising Officer, 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 Supervising Officer, 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.

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 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.

B1.3.3 Pipework Arrangement

Unless otherwise approved by the Supervising Officer, pipes shall not run over electrical switchgear; inside transformer room, switch room, generator room, meter room, telephone equipment room, PABX room, server room, riser duct for electrical services, or any other rooms containing electrical hazard or susceptible to water damage 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 the highest floor shall be the same size as soil stack at the 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.

B1.3.4 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).

B1.3.5 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.

B1.4 JOINTING PIPES AND FITTINGS

B1.4.1 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.

B1.4.2 Jointing of Cast Iron Spigot and Socket Pipes

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

B1.4.3 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.

B1.4.4 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 polyimide primer or red oxide primer and one coat compatible finish.

B1.4.5 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.

B1.4.6 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.

B1.4.7 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 Supervising Officer. 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.

B1.4.8 Joints Between Dissimilar Metals

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

The contact between following dissimilar materials 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 galvanised iron or steel pipes.

If unavoidable, use gunmetal joints between the dissimilar metals.

B1.5 PIPEWORK SUPPORT

B1.5.1 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: 2014 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.

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 standard length of pipe. 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 to 100	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

B1.6 PIPEWORK PENETRATING BUILDING STRUCTURE

B1.6.1 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.
- (d) If required to be water tight, point with approved mastic sealant.
- (e) No split PVC sleeves shall be permitted.

B1.6.2 Pipes Through Fire Barriers

- (a) For metal pipes pass through fire barriers:
- (i) The installation shall be as Clause B1.6.1 but
- Cast or built in fire rated pipe sleeve with 2 to 25mm clearance.
 - Firmly fix sealing system around the pipes to properly seal up the gaps between the pipes and the fire barriers to maintain the required FRR of the fire barriers and 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 and the installation of which shall be in accordance with the manufacturer's recommendations.
- (b) For non-metal or plastic pipes pass through fire barriers, 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 barriers 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 barriers or other locations around the pipes in accordance with the manufacturer's recommendations.

B1.6.3 Pipes Through Basement Wall

Where pipes pass through external basement walls:

- (a) Cast or build in cast iron or 2.5 mm galvanised 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.

B1.6.4 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.

B1.6.5 Pipes Through Flat Roofs

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

- (a) Cast or build in fire rated pipe sleeves with 2 to 12 mm clearance projecting 150 mm above roof finish.
- (b) Fill the annular space between pipe and sleeve and caulk all spaces and voids at both ends for the full length with approved fire rated materials and sealant, e.g. mastic sealant, add waterproof protection and sealant where necessary;
- (c) Cover tops of sleeves with stainless steel collars or cover as per roofing specification or as specified by pipe manufacturer.

SECTION B2

UNDERGROUND DRAINAGE SYSTEMS

B2.1 GENERAL

- B2.1.1 This Section covers surface and foul water drainage below ground level.
- B2.1.2 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.
- B2.1.3 During construction, plug open ends of pipes and maintain until completion, to prevent entry of debris.
- B2.1.4 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.

B2.2 HANDLING AND STORAGE

B2.2.1 General

The Drainage 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 with valid LALG certificate and recommended by the manufacturer and agreed by the Supervising Officer 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.

B2.2.2 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.

B2.2.3 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.

B2.2.4 Storage of Bolts and Nuts

Bolts and nuts shall be packed in sealed containers.

B2.2.5 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.

B2.2.6 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.

B2.2.7 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.

B2.2.8 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 be 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.

B2.2.9 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.

B2.3 SETTING OUT

B2.3.1 The centreline of trench shall be set out accurately. Top width of trench shall be marked by means of suitable pegs and offset side check pegs.

B2.3.2 Temporary benchmarks in stable positions shall be established. Erect strong site rail, planed true, painted in contrasting colours fixed to rigid posts across centre of each manhole. Indicate the centreline 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.

B2.3.3 Before commencing excavation, invert levels of existing drains, sewers and manholes shall be checked against levels shown on drawings.

B2.4 EXCAVATION OF TRENCH

B2.4.1 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 Supervising Officer.

B2.4.2 Trench Width

Trench widths measured at the crown level shall not exceed those specified in Table B2.4.2. 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 B2.4.2 - 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.

Localised 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.

B2.5 BEDDING AND LAYING OF PIPES

B2.5.1 General

Pipes 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.

B2.5.2 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 25mm BS sieve, but shall be retained on a 5mm 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 2.5.2.

Table 2.5.2 - 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.

B2.5.3 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.

B2.5.4 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 Supervising Officer. 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.

B2.5.5 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.

B2.6 BACKFILLING OF TRENCH

B2.6.1 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.

B2.6.2 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 B2.6.2 or other material as specified. Filter

materials to consist of hard, clean, crushed rock or gravel having a grading within the limits of Table B2.6.2. 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 B2.6.2 - 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.

B2.7 CUTTING PIPES

B2.7.1 General

Pipes and pipe ends shall be cut and prepared 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.

B2.7.2 Elastomeric Joints

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

B2.7.3 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.

B2.7.4 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.

B2.8 JOINTING PIPES AND FITTINGS

B2.8.1 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 labelled.

B2.8.2 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.

B2.8.3 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.

B2.8.4 Jointing of Plastic Pipes and Fittings

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

B2.8.5 Jointing of Vitrified Clay Pipes and Fittings

Vitrified clay pipes and fittings for surface water drainage shall be jointed and fitted in accordance with BS 65:1991.

Vitrified clay pipes and fittings for foul water drainage shall be jointed and fitted in accordance with relevant parts of BS EN 295.

B2.9 THRUST AND ANCHOR BLOCKS

B2.9.1 General

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

joints are used.

B2.9.2 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.

B2.9.3 Applying Pressure

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

B2.10 CONNECTION OF PIPES

B2.10.1 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 B2.10.1.

Table B2.10.1 - 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 Supervising Officer. The temporary seals shall be left in position until the Supervising Officer instructs their removal.

B2.10.2 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.

B2.10.3 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.

B2.10.4 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.

B2.10.5 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°.

B2.10.6 Recording Positions of Junctions

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

B2.10.7 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.

B2.11 MANHOLES, CHAMBERS, GULLIES AND CHANNELS

B2.11.1 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.

B2.11.2 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.

B2.11.3 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.

B2.12 VALVES

B2.12.1 General

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

B2.12.2 Box-outs and Rebates

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

B2.12.3 Cleaning and Checking

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

B2.12.4 Air Valves

Provide air valves with isolating gate valves.

B2.13 PIPES AND MANHOLES TO BE ABANDONED

B2.13.1 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, it 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 Supervising Officer. Recycled aggregate may be used for filling the void subject to the Supervising Officer's approval.

B2.13.2 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.

B2.14 WORKS OUTSIDE SITE BOUNDARY

The Drainage 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.

B2.15 PROTECTION

B2.15.1 Hot Dip Galvanising

Unless otherwise specified, galvanised coatings to be applied by hot-dip galvanising to be in accordance with BS EN ISO 1461: 2009. The coating thickness to comply with Table B2.15.1.

Table B2.15.1 - Requirements of Hot Dip Galvanising

Article Thickness	Minimum Mean Coating Thickness
≥ 6 mm	85 µm
3 mm to < 6 mm	70 µm
1.5 mm to < 3 mm	55 µm
< 1.5 mm	45 µm

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

All hot dip galvanising, including the galvanising work specified in other sections of this Specifications, is to be carried out by galvanisers with accreditation of ISO 9001:2008/ Corr1:2009 or equivalent quality management system. The name of galvanisers shall be submitted for approval.

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

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

A durable identification tape shall be attached to each batch of galvanised articles indicating the project title, galvanising certification number and name of galvaniser.

B2.15.2 Anti-Corrosion Tape

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

B2.16 CLEANING OF SYSTEM

B2.16.1 General

After completion of the drainage system, and after testing, draw through each completed section of pipeline not greater than 300 mm diameter a mandrel 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.

B2.16.2 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 B3

WASTE WATER HANDLING EQUIPMENT

B3.1 GENERAL

The installation details should be in accordance with the instruction prepared by the manufacturer.

Pumps shall be "Type-tested" in accordance with the requirement of BS EN ISO 9906: 2012. Test certificates with performance curves shall be submitted to the Supervising Officer.

Pumps and their drives shall be segregated such that failure of pump seals shall not result in damage to the drive motors.

B3.2 STORAGE

The equipment should be stored in a dry space when they are delivered to Site. Special rust preventive measures to protect the internal parts of pumps shall be applied if the equipment must be stored for an extended period of time. Such provisions shall be removed completely before final installation and the bearings should then be re-lubricated.

B3.3 PUMPS

(a) Centrifugal Water Pumps

Common Installations for Waste Water Pumps, Storm Water Pumps and Sewage Pump

(i) Driving Arrangements

The pump and motor shall be direct coupled and mounted on a substantial machined bedplate; accurately aligned, and fitted with guards. The whole assembly including the bedplate shall be designed and supplied by the pump manufacturer. Coupling with spacer shall be used for end suction pumps so that the impeller may be dismantled from the motor side for servicing without neither disrupting the pipe-work nor dismounting the motor.

(ii) Stand-By Pumps Arrangement

Where stand-by pumps are specified with automatic changeover provision, the changeover shall be initiated by means of flow sensing devices of an approved pattern. The necessary non-return valves shall be incorporated in the pipe-work to interconnect such pumps.

(b) Sump Pumps

The sump pumps shall be of vertical centrifugal design suitable for dry sump or wet sump installation. Each pump shall be constructed with double mechanical shaft seal and close-coupled to a submersible electric motor.

The sump pumps should operate automatically under level control with an alarm to alert the operator when extra low or high water level is being exceeded.

Each pump shall be equipped with factory built-in suspension device and a factory mounted discharge elbow should be provided for wet sump installation, and cast iron or steel base for dry sump installation to provide correct pump alignment for wet sump pump installation, the disconnection shall simply consist of easy removal of each pumping unit for inspection, repairs and services. The pumps when lowered into the pits shall automatically be connected to the discharge piping. There shall be no need for the maintenance or operation personnel to enter the wet well to carry out the work. Each pump shall be complete with guide bars, cable supports and lifting chains.

The pump discharge shall be fitted with a resilient seal that provides a positive hydraulic seal for maximum pump efficiency. Each impeller shall be trimmed to meet the specified flow requirements.

For installation in flammable zones, each sliding guide bracket shall have non-sparking material to prevent ignition of explosive wet well gases.

(c) Sewage Pump

The pumps shall be designed for handling sewage containing solid particles up to 60 mm diameter.

The pumps shall be designed for operation in completely or partially submerged conditions.

B3.4 PLANT ROOM LOCATION

The Drainage Contractor shall check and assure that adequate working space must be provided to access for maintenance and sufficient headroom to lift the parts for repairing. For large pumps, a hoist with travelling crane or other facility shall be provided over the pump location.

For an open loop system, the location of pump should be sited so that it will use the shortest and most direct suction and smallest vertical lift. Where possible, the pump centreline should be placed below the level of the liquid in the suction tank.

B3.5 VENTING VALVES FOR PUMP-SET

Venting valves shall be installed at one or more points of the pump-casing waterway to provide a means to escape for air or vapour trapped in the casing. These valves shall be connected so as not to endanger the operation staff in handling toxic, inflammable or corrosive liquid.

B3.6 INSTRUMENTATION

Each pump installation shall include flow meters cum transmitters, pressure gauges and a gas cock to measure the system pressures and pressure drop.

All measuring and isolation instruments, such as the pressure gauges, check valves, globe valves, gate valves and strainers, etc., or as specified in the Particular Specification shall be installed properly to maintain a close check on control on the performance and condition of the pumps.

Instruments shall be mounted in a suitable location so that they can be easily observed.

SECTION B4

PAINTINGS, FINISHING AND IDENTIFICATION

B4.1 GENERAL

All surfaces except otherwise specified, other than those indicated to be left self finished such as stainless steel, anodised aluminium, or otherwise approved by the Supervising Officer, 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/ qualified skilled workers.

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 submitted for the approval of the Supervising Officer.

The volatile organic compound (VOC) content, in grams per litre, of all paint and primer shall not exceed the prescribed limit under the Air Pollution Control (Volatile Organic Compounds) Regulation or the limit set by EPD, whichever is more stringent.

VOC content of paint shall be determined by methods stipulated in Air Pollution Control (Volatile Organic Compounds) Regulation or other methods acceptable to EPD.

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 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 Supervising Officer.

Pipes and pipelines shall be painted in colours either in accordance with ISO 3864-1: 2011 or as directed by the Supervising Officer 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 Supervising Officer.

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

ABOVE GROUND DRAINAGE SYSTEMS

C1.1 PIPES AND FITTINGS FOR SURFACE WATER DRAINAGE

C1.1.1 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.

C1.1.2 UPVC Rainwater Pipes, Gutters and Fittings

UPVC rainwater pipes, gutters and fittings shall be to BS EN 1329-1: 2014 and BS 4514: 2001 where applicable.

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 galvanised or plastic coated. Combination of products from different manufacturers shall not be permitted unless otherwise approved.

C1.1.3 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: 2014 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: 2014 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: 2016. 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 with BS EN 10088-3: 2014 number 1.4301 or SAE Grade 304.

C1.1.4 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.

C1.2 PIPES AND FITTINGS FOR FOUL WATER DRAINAGE

C1.2.1 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-syphon 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.

C1.2.2 Galvanised Iron Pipes and Fittings

Galvanised 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.

C1.2.3 UPVC Pipes and Fittings

UPVC pipes and fittings shall be to BS 5255: 1989 or BS EN 1329-1: 2014 for nominal pipe sizes from 32 to 315mm except 80 mm diameter.

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

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 except the resealing type 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.

Waste outlets and traps including W-trap shall conform to BS EN 274-1: 2002.

C1.2.4 Balloon Grating and Vent Cowl

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

C1.2.5 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: 2014 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.

C1.2.6 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.

C1.3 CAST IRON SOCKETLESS PIPES AND FITTINGS FOR SURFACE WATER AND FOUL WATER DRAINAGE

C1.3.1 Cast iron socketless pipes, fittings and coupling shall comply with BS EN 877: 1999 + A1: 2006.

C1.3.2 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+ A1: 2006 for a minimum of 1000 hours if sea water is to be use in the flushing water system.

C1.3.3 Pipe and fittings shall be coated externally with anti-corrosive coating with minimum thickness of 40 microns or other form of approved protections.

C1.3.4 All joints must be mechanically connected. If such joints are subjected to thrust loads due to changes of direction and gradient, branches and plugs or overloading, grip collars or high pressure couplings shall be used to prevent misalignment or disconnection of the pipework.

C1.3.5 The coupling shall composed of stainless steel shield to BS EN 10088-3: 2014 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.

- C1.3.6 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.
- C1.3.7 The piping system shall be properly supported and restrained in full accordance with the manufacturer's recommendations. Additional supporting brackets shall be provided for change of direction and gradient.

SECTION C2

UNDERGROUND DRAINAGE SYSTEMS

C2.1 PIPES AND FITTINGS

C2.1.1 Precast Concrete Pipes and Fittings

Precast concrete pipes and fittings shall be to BS 5911-1: 2002 + 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 C2.1.1.

Table C2.1.1 - 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	Unrein	
	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.

C2.1.2 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.

C2.1.3 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 pressurised 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.

C2.1.4 Ductile Iron Pipes and Fittings

Ductile iron pipes and fittings shall be to BS EN 598: 2007 + A1: 2009 with high alumina cement mortar lining internally and zinc coating with a finishing layer of a synthetic resin (epoxy, polyurethane, etc.) externally.

Unless otherwise specified, ductile iron pipework shall be of push-in type flexible joint with rubber sealing gasket. It shall be capable to withstand a minimum angular deflection complying with BS EN 598: 2007 + A1: 2009 and an allowable spigot withdrawal of minimum 38mm.

Flanged joints, if specified, shall be of PN16 rating complying with BS EN 1092-2: 2007+A1:2013.

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

C2.1.5 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 socket joint type with elastomeric joint rings.

UPVC pipes and fittings for use in pressurised 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 or BS EN ISO 1452-1:2009, BS EN ISO 1452-2:2009, BS EN ISO 1452-3:2010, BS EN ISO 1452-4:2009 or BS EN 1452-5: 2009.

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

C2.1.6 Sub-soil Drain Pipes and Fittings

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

- (a) For vitrified clay pipes and fittings, to BS 65: 1991 and of the normal glazed, chemical resistant type with plain ends and flexible sleeved joints;
- (b) For concrete porous pipes, to BS 5911-1: 2002 + A2: 2010;
- (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.

C2.2 VALVES

C2.2.1 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 according to manufacturer's recommendation.

C2.2.2 Gate Valves

Gate valves shall be of double flange ended and solid wedge type to BS EN 1171: 2015 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+A1:2003 or 1092-2: 1997 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 or stainless steel.

Stems shall be of aluminium bronze to BS EN 12163: 2016 grade CA 104 or stainless steel.

For valve size larger than 50mm diameter, an indicator to show the open and shut positions shall be provided.

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

C2.2.3 Flap Valves

Frame and flap shall be of cast iron to BS EN 1561: 2011 Grade EN-GJL-220 or ductile iron to BS EN 1563: 2011.

Sealing faces and hinge pins shall be of gunmetal to BS EN 1982: 2008 CuSn5Zn5Pb5 or stainless steel to BS EN 10088-2: 2014 number 1.4401 or SAE Grade 316.

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 1092-2: 1997.

C2.2.4 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: 2016 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.

C2.2.5 Air Valves

Air valves shall be of dual orifice elongated body type with small orifice valves 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 min. 3 bars.

The bodies and covers shall be of cast iron to BS EN 1561: 2011 Grade EN-GJL-220, or ductile iron to BS EN 1563: 2011 or stainless steel to BS EN 10088-2: 2014 number 1.4401 or SAE Grade 316.

The trim and float shall be of stainless steel to BS EN 10088-1: 2014 number 1.4401 or SAE Grade 316.

C2.3 MANHOLES, CHAMBERS AND GULLIES

C2.3.1 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 Supervising Officer 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.

C2.3.2 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.

C2.3.3 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.

C2.3.4 Vitrified Clay Gullies

Vitrified clay gullies shall be to BS 65: 1991.

C2.3.5 Step Irons

Manhole steps shall be to BS EN 13101: 2002 of malleable iron to BS EN 1562: 2012 hot dip galvanised in accordance with BS EN ISO 1461: 2009. Minimum zinc coating thickness shall be 610 g/m².

C2.3.6 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: 2014.

They shall have dimensions as indicated on the Drawings.

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 C2.3.6(1) to Table C2.3.6(3).

Table C2.3.6(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 C2.3.6(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 C2.3.6(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

C2.3.7 Ductile Iron Manhole Covers and Frames

Ductile iron manhole covers and frames shall comply with BS EN 124-1: 2015. 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: 2014 number 1.4301 or SAE Grade 304 with dimensions complying with BS 4190: 2014.

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. 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 be 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/mm².

The units shall be capable of withstanding the minimum test loads and having the minimum masses given in Table C2.3.7.

Table C2.3.7 - 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

SECTION C3

WASTE WATER HANDLING EQUIPMENT

C3.1 WASTE WATER PUMPS

C3.1.1 These pumps shall be utilised for pumping waste water or storm water or grey water/treated effluent water wherever these applications apply.

C3.1.2 Materials of Construction

Unless otherwise specified, the materials of construction for saline water pump shall be as follows:-

- | | | |
|--------------------------|---|--|
| (a) Casing | : | Cast iron |
| (b) Impeller | : | Zinc free bronze
(*Stainless Steel) |
| (c) Shaft | : | Stainless steel |
| (d) Sleeves | : | Bronze (*stainless steel) |
| (e) Casing rings | : | Stainless steel |
| (f) Shaft nuts | : | Bronze |
| (g) Stuffing box housing | : | Cast iron |
| (h) Glands | : | Carbon steel |
| (i) Lantern rings | : | Bronze |

*Alternative materials subject to the approval of the Supervising Officer

Note 1: Stainless steel shall be used for water with temperature >28°C.

C3.1.3 Standards

(a) Casing

Unless otherwise indicated, the casing shall be of cast iron to BS EN 1561:2011 or ISO 185:2005 or better and approved.

(b) Impeller and Shaft Sleeve

Impeller and shaft sleeve of waste water pumps shall be of one of the materials as below:-

- (i) Zinc-free bronze to BS EN 1982:2008 CuSn11 or CuSn10; or ISO 197-4:1983;

- (ii) Austenitic cast iron to BS EN 13835:2012 Number 5.1500; or ISO 2892: 2007/Cor 1:2009; or
- (iii) Stainless steel to BS EN 10095:1999, AISI 316.

(c) Shaft and Sleeves

The shaft shall be of stainless steel to BS EN 10095:1999, BS EN 10084:2008 and BS EN 10087:1999, AISI 316, ground and polished.

Bronze sleeves shall comply with BS EN 1982:2008 or ISO 197-4:1983 and shall be provided through the sealing glands to protect the shaft from wear. The sleeves shall be keyed to prevent rotation and secured against axial movement.

(d) Stuffing Boxes and Drain Piping

Stuffing boxes shall be of cast iron housing and ample length completed with bronze lined gland and necks bushes, fitted with approved packing and bronze lantern ring water seal. Drain piping to the nearest builder's drain for gland leakage shall be provided. Alternatively, a mechanical seal may be offered. Mechanical seals shall be of leak free operation. The mechanical seal shall be the product of specialist proprietor and the materials used shall be suitable for the pumped liquid.

C3.2 SUMP PUMPS

C3.2.1 Materials of Construction of Dry Pit Pumps

Unless otherwise specified, the materials for dry pit non-clog pumps areas shall be as follows:-

- (a) Pump casing : Cast iron
- (b) Impeller : Cast iron (*stainless steel)
- (c) Shaft : Stainless steel
- (d) Shaft sleeve : Stainless steel (*bronze)
- (e) Packing gland : Ductile iron (*bronze)
- (f) Casing bolts : Steel
- (g) Cap screw and washer, impeller : Stainless Steel
- (h) Key, impeller : Steel

*Alternative materials subject to the approval of the Supervising Officer.

C3.2.2 Materials of Construction of Submersible Pumps

Unless otherwise specified, the materials for submersible non-clog pumps shall be as follows:-

- (a) Pump casing : Cast iron
- (b) Impeller : Cast iron (*stainless steel)
- (c) Motor casing : Cast iron
- (d) Shaft : Stainless steel
- (e) Impeller screw : Stainless steel
- (f) Mechanical seals : Carbon (*ceramic faces)
- (g) Base plate : Steel
- (h) Discharge elbow : Cast iron
- (i) O-ring seal : Neoprene

*Alternative materials subject to the approval of the Supervising Officer.

C3.2.3 General Requirements

The stainless steel material shall comply with BS EN 10084:2008, BS EN 10087:1999, BS EN 10088, BS EN 10095:1999 and BS EN 10250-1: 1999 & 4:2000 Grade 316.

All bolts, nuts and fasteners shall be of stainless steel and electric cable entry shall be of watertight construction.

Sump pumps for storm water application shall generally be of materials complying with Standards as specified in Clause C3.1.3. Sump pumps for pumping other fluids shall be of materials compatible with the fluid that is being handled. The sump pumps shall operate automatically by float level control.

The guide bars and brackets for wet sump installation shall be of stainless steel to AISI 316.

Cable supports shall be of stainless steel. A safety provision shall be incorporated for automatic electrical disconnection of the supply in case of cable entry seal failure.

Pumps for flammable zones shall be equipped with flameproof submersible motor in compliance with BS EN 60079-0:2012 +A11: 2013 and BS EN 60079-1:2014.

C3.3 SEWAGE PUMPS

C3.3.1 Materials of Construction of Sewage Pumps

- (a) Pump casing : Cast iron
- (b) Impeller : Austenitic cast iron
(*stainless steel)
- (c) Shaft : Stainless steel
- (d) Bearing : Ball/Ball, no regreasing shall be
required until after 3 years of
continuous operation
- (e) Seals : Carbon/Tungsten Carbide
- (f) Bolts, nuts, screw washer : Stainless Steel
- (g) Hold-down bolts : Stainless Steel

*Alternative materials subject to the approval of the Supervising Officer.

C3.3.2 Standards

(a) Casing

Unless otherwise indicated, the casing shall be of cast iron to BS EN 1564: 2011 Grade 220.

(b) Impeller and Shaft Sleeve

Impeller and shaft sleeve of waste water pumps shall be of one of Austenitic cast iron to BS EN 13835: 2012 Grade L – Ni Cu Cr 1563

(c) The shaft shall be of stainless steel to BS EN 10084:2008, BS EN 10087:1999, BS EN 10088, BS EN 10095:1999, and BS EN 10250-1: 1999 & 4:2000 Grade 431S29

(d) Bolts, nuts, screw, washer and hold-down bolts shall be of stainless Steel to BS EN 10084:2008, BS EN 10087:1999, BS EN 10088, BS EN 10095:1999 and BS EN 10250-1: 1999 & 4:2000 Grade 316

C3.3.3 General Requirements

The stainless steel material shall comply with BS EN 10084:2008, BS EN 10087:1999, BS EN 10088, BS EN 10095:1999 and BS EN 10250-1: 1999 & 4:2000 Grade 316.

The sewage pump shall meet the designed capacity on normal

operation.

The sewage pump shall be arranged with flanged connection to the discharge pipe. Each pump shall be closely coupled to the totally enclosed built-in submersible electric motor suitably rated for the pump.

Two mechanical seals, made of the material specified in above, shall be provided to seal off the leakage of sewage from the pump to motor.

The hydraulic efficiency of the pump shall be within the highest efficiency range at the specified operating point.

Pumps for flammable zones shall be equipped with flameproof submersible motor in compliance with BS EN 60079-0:2012 +A11: 2013 and BS EN 60079-1:2014.

C3.3.4 Pump Motor

The motor shall comply generally with relevant parts of BS 4999 and shall operate on a 3 phase, 380 volt, 50 Hz supply.

The motor shall be of the squirrel cage, totally enclosed type with insulation of Class "F" to IEC60085:2007. Enclosure type of IP68 to IEC 60529:2013 shall be used.

The motor shall be capable of supplying its rated output at rated speed at any voltage in the range 94% to 106% of the nominal voltage and shall satisfactorily operate continuously at its rated duty without excess temperature rise within this range.

The motor shall have its own built-in cooling system which shall enable the motor to operate continuously at its rated current regardless of whether the electric motor is above or below the surface of the liquid.

C3.4 PUMP CONTROL PANEL

The cubicle of the pump control panel shall be vermin proof and lockable to prevent vandalism. The thickness of sheet steel shall not be less than 2 mm and shall be properly reinforced with angle iron. The cubicle shall be constructed to conform to IP44 to IEC 60529:2013 for indoor use and IP65 for outdoor use. All indicators, relays, control switches, push-buttons, fuses and other auxiliary apparatus shall be provided with labels clearly stating their function. The labels supplied shall be inscribed in English and Chinese characters.

C3.5 VIBRATION ISOLATORS

The bases shall be mounted on the raised housekeeping plinth using appropriate anti-vibration spring mountings that shall be individually selected according to load distribution and shall have an additional free travel equal to one half of the rated deflection as specified in Clause C8.4 of A/C General Specification.

C3.6 GAUGES

Pressure gauges shall comply with BS EN 837-1:1998 calibrated in kPa from zero to not less than 1.3 times and not more than twice the operating pressure of the respective equipment/system and shall be accurate to 1.5% of full scale reading, unless otherwise specified.

The dials of gauges shall not be less than 100 mm diameter and the cases shall be of polished brass or chromium-plated or anti-corrosive painted mild steel with optical sight glass.

Pressure gauges used solely to indicate the head and pressure of water shall be provided with an adjustable red pointer set to indicate the normal working pressure or head of the system.

C3.7 DRAIN AND VENT

The drain vent shall be built-in completed with a drain plug except where the pump is inherently self-venting, the drain and drip connection valves and air cock shall comply with Section C9 of A/C General Specification.

C3.8 FLANGED CONNECTIONS

Pumps shall have flanged connections conforming to the Table of BS EN 1515-1:2000, BS EN 1092-1:2007 +A1:2013, BS EN 1092-2:1997, ISO 7005-1:2011 or ISO 7005-2:1988 as appropriate to the maximum working pressure. Taper pieces shall be provided where necessary for connection to pipe-work.

PART D – INSPECTION, TESTING & COMMISSIONING DURING CONSTRUCTION PERIOD

SECTION D1

GENERAL REQUIREMENTS

D1.1 GENERAL

The inspection, testing and commissioning shall be carried out in accordance with the requirements specified in this Part and Testing and Commissioning Procedure for Drainage Installation in Government Buildings which shall be referred to and adopted where appropriate.

Throughout the execution of the installation, the Drainage Contractor shall be responsible for ensuring compliance with the statutory and related requirements included in Section A2 and shall notify the Supervising Officer of any infringement which directly or indirectly detracts from the safe and satisfactory operation of the Installations whether or not such infringement relates to the works covered in the Installations or to those associated with others. All substandard works or defects found during inspection, testing and commissioning shall be rectified or replaced to the satisfaction of the Supervising Officer.

D1.2 METHODS AND PROCEDURES

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

D1.3 NOTICES OF INSPECTION, TESTING AND COMMISSIONING WORKS

For items to be witnessed by the Supervising Officer or his Representative, the Drainage Contractor is required to provide advanced notice for inspection, testing and commissioning works, together with details of date, time and list of items to be inspected or tested, unless otherwise specified in the Conditions:-

(a) Off-site Inspection and Test

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 3 days before commencement of inspection, testing or commissioning of any part or parts of the Installations shall be provided.

D1.4 LABOUR AND MATERIALS

The Drainage Contractor is responsible for provision of all labour and both consumable and non-consumable materials for carrying out the inspection, testing and commissioning works at their expenses. Unless otherwise indicated in the Conditions, all electricity supply, water supply, smoke generator, chemicals, and other fuels, such as diesel, LP gas and town gas, during preliminary runs and for full adjustments and inspection and commissioning tests shall also be arranged and provided by the Drainage Contractor. The Drainage Contractor shall also properly drain the water and exhaust the gas during and after the inspection, testing and commissioning works as required. The Drainage Contractor shall provide and adopt measures to avoid damage to the building, Installations, decorations and fixtures during the inspection, testing and commissioning works for any of the Installations.

The Drainage Contractor shall also provide all necessary equipment, apparatus and tools for carrying out the inspection, testing and commissioning works.

The Drainage Contractor shall despatch competent and experienced commissioning personnel to carry out the inspection, testing and commissioning works.

D1.5 INSPECTION, MEASURING AND TESTING EQUIPMENT

The Drainage Contractor is required to supply the calibrated equipment and instrument for the inspection, testing and commissioning works in accordance with the requirements as specified in the Particular Specification for supply of inspection, measuring and testing equipment. Certified true copy of calibration certificates shall be submitted. The period between calibration and testing shall not exceed the calibration period as recommended by the equipment/instrument manufacturer or 12 months whichever is shorter.

D1.6 READINESS FOR INSPECTION, TESTING AND COMMISSIONING

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

D1.7 "TYPE-TEST" CERTIFICATE

"Type-test" for materials and equipment, where specified, shall be carried out at the manufacturer's works, recognised institutions or accredited laboratories, or elsewhere as approved in order to demonstrate their compliance with the specified requirements. "Type-test" certificates together with the corresponding drawings, sketches, reports and any other necessary documents shall be submitted to the Supervising Officer for approval before delivery of the materials and equipment.

D1.8 OFF-SITE TESTS / FACTORY TESTS

Factory tests and off-site tests as required shall be carried out at the manufacturer's works, laboratories by independent regulatory/testing bodies, independent accredited laboratories or elsewhere as approved. This shall include quality control tests and general inspection tests in factory recommended by the manufacturer or for compliance with relevant standards.

Where collection of test samples on the Site is required for the off-site tests, the Drainage Contractor shall submit the sampling and analysis methodology, including but not limited to the proposed independent accredited laboratory and the procedures for collection and analysis of test samples and submission of test results, for the Supervising Officer's approval. The Drainage Contractor shall notify in advance the date for collection of test samples to the Supervising Officer's Representative, who shall supervise the sampling, transport and delivery of the test samples. Collection of test samples shall be conducted by the independent accredited laboratory unless otherwise agreed by the Supervising Officer. The collected test samples shall be kept in sealed and locked containers inaccessible to unauthorised persons at all times. The test results in sealed envelope shall be submitted by the independent accredited laboratory to the Supervising Officer directly.

Where specified, performance tests shall be carried out in factory for each or some of the offered equipment before delivery. After the performance tests, factory test report/certificate certified by a qualified factory engineer shall be submitted in duplicate to the Supervising Officer for approval immediately after the tests and before the equipment is dispatched from the manufacturer's works.

Factory tests shall be witnessed by an independent approved agency where specified. The Drainage Contractor shall note that the Supervising Officer may require witnessing the test and inspection of locally and/or overseas manufactured equipment during construction at the manufacturer's works.

D1.9 SITE TESTS

The Drainage Contractor shall carry out site tests for all static systems during construction period for individual components and/or part of the installed works to ensure safe and proper operation of the complete installation according to the specified requirements. Such tests shall include integrity test

of welds and pressure test on the hydraulic systems where applicable. Any component or equipment set to operate at or below the test pressure shall be isolated or removed prior to applying the pressure test. Site tests for electrical works in the Installations shall comply with the COP for the Electricity (Wiring) Regulations unless otherwise specified. Registered or suitably qualified workers shall be deployed to conduct site tests, where applicable, for the Installations.

Works to be permanently covered up shall be subject to inspection and testing before covering up. If the Supervising Officer or his Representative discovers any work that has been covered up before inspection and testing, this work shall be uncovered for inspection and testing to the satisfaction of the Supervising Officer or his Representative.

SECTION D2

INSPECTION

D2.1 INSPECTION OF MATERIALS AND EQUIPMENT DELIVERED TO SITE

The Drainage Contractor shall provide details of materials and equipment delivered to the Site including, but not limited to, brand name, model number, country of origin (if specified), their tested standards and record of Supervising Officer's approval, purchase order, delivery order, record of delivery, payment vouchers, ex-factory certificate and shipping voucher, and all other relevant documents as applicable to the Supervising Officer for identification and verification of the materials and equipment delivered to the Site are in compliance with the approved submissions.

D2.2 VISUAL INSPECTION AND CHECKING

The Drainage Contractor shall be responsible for arranging adequate provisions to facilitate visual inspections and checking of the work in progress to be carried out by the Supervising Officer or his Representative from time to time during the construction period. The Drainage Contractor shall keep such inspection record for checking from time to time. Any defective works or sub-standard works found during visual inspection and checking shall be rectified or replaced before proceeding with further tests.

Visual inspection and checking shall include but not limited to the inspection and verification of the installed equipment being the approved brands and models and checking of any visible damages (such as scratches or dents, or painting problems) found on the equipment surface.

D2.3 HANDOVER INSPECTION

The Drainage Contractor shall carry out detailed inspections for all components and equipment installed by him and make all necessary checking including operational settings for all equipment and systems in accordance with the instructions and recommendations from the manufacturer and to the satisfaction of the Supervising Officer before the handover of the Installations.

If it is considered difficult or impossible to gain access to a part or parts of the complete installation for dismantling or maintenance purposes, the Drainage Contractor shall be required to carry out demonstrations on dismantling and assembling those parts of the installation to confirm the provisions are adequate. The Drainage Contractor shall be responsible for carrying out all necessary modification work at no additional cost to the Employer to alleviate the difficulties associated with dismantling or maintenance access.

The Drainage Contractor shall note that the Installations cannot be handed over until all the foregoing requirements where applicable have been carried

out to the satisfaction of the Supervising Officer.

The Drainage Contractor shall provide the following documents and data before the handover inspection:-

(i) Test Certificates

Test records/certificates where applicable shall be provided:-

- (a) Copies of manufacturer's works tests records/ certificates on plant items comprising tanks, vessels, motors, pumps, etc.;
- (b) Copies of hydraulic and pressure test records/ certificates for works carried out on Site;
- (c) Copies of all performance test records/certificates including water test, air test etc. These certificates shall be accompanied with all appropriate charts and diagrams; and
- (d) Copies of works completion certificates for electrical works.

(ii) "As-built" Drawings

"As-built" drawings as detailed in the contract documents shall be provided.

(iii) Operation and Maintenance Manuals and User Manual

O&M Manuals and User Manual as detailed in the contract documents shall be provided.

(iv) Manufacturer's Name Plate

Every item of plant/equipment/apparatus supplied by a manufacturer, if any, shall be fitted with a clearly engraved, stamped or cast manufacturer's name plate properly secured to the plant/equipment/apparatus and showing:-

- Manufacturer's Name;
- Serial and/or Model No.;
- Date of Supply;
- Rating/Capacity; and
- Test and Working Pressure (where applicable).

(v) Labels and Related Instructions

Labels and the related instructions shall be provided according to relevant clause(s) of this General Specification.

D2.4 INSPECTIONS REQUIRED BY AUTHORITY / MANDATORY INSPECTIONS

The Drainage Contractor shall carry out all mandatory inspections, examination and testing, to meet the statutory requirements and to the satisfaction of the relevant Authorities, including Building Authority, DSD and EPD. The Drainage Contractor shall make all necessary applications to the Authorities well in advance and attend inspections conducted by their representatives for the purpose of these inspections, examination and testing.

SECTION D3

TESTING AND COMMISSIONING

D3.1 GENERAL

Where testing and commissioning works for the Installations are required to be witnessed by the Supervising Officer or his Representative, the Drainage Contractor shall carry out the proper testing and commissioning works to his satisfaction before inviting them to witness the works. The Drainage Contractor shall arrange to enable the Supervising Officer or his Representative to witness the complete testing and commissioning. Unless otherwise approved by the Supervising Officer, testing and commissioning works carried out by the Drainage Contractor in the absence of the Supervising Officer or his Representative shall not be accepted as the approved test record.

Any defects of alignment, adjustment, workmanship, materials and performance or other irregularities which become apparent during commissioning or testing shall be rectified by the Drainage Contractor and the relevant part of the commissioning or testing procedure shall be repeated at the Drainage Contractor's own expense.

D3.2 PROCEDURES, STANDARDS AND REQUIREMENTS

The Drainage Contractor shall follow relevant approved standards, procedures, guidelines in the testing and commissioning works, which shall include but not limited to:-

- (a) Statutory obligations and requirements, specifications and standards specified in Part A;
- (b) Testing and Commissioning Procedure for Drainage Installation in Government Buildings of the Hong Kong Special Administrative Region issued by BSB, ArchSD;
- (c) Detailed inspection, testing and commissioning methods and procedures approved by the Supervising Officer; and
- (d) Equipment manufacturers' recommendations and specifications, if any.

D3.3 MASTER PROGRAMME FOR TESTING AND COMMISSIONING WORKS

The Drainage Contractor is required to submit a programme for testing and commissioning works within the first three months after acceptance of his Tender. The programme shall indicate the tentative dates of all tests and commissioning works that will be carried out throughout the Conditions and

all necessary submissions and approval relating to testing and commissioning. The Drainage Contractor shall ensure that the testing and commissioning programme matches the master programme for construction and that all testing and commissioning works are complete before the prescribed or extended date for completion of the Works. The programme shall also be updated as the Installations progress towards completion.

The programme shall detail the types of testing and commissioning works required, the breakdown of the programme into floor-by-floor and/or area-by-area basis, the tests that are required during construction and before completion of the Installations, the period of each test with float time allowed, the milestone dates for the key activities of works etc. Critical path programme shall be submitted. The Drainage Contractor shall plan the programme so as to minimise the overlapping of different tests arranged simultaneously in different locations of the Site.

A detailed checklist of all the Installations to be commissioned and tested shall be submitted at the same time. The checklist will be used for progress monitoring and shall be updated from time to time as the Installations progress towards completion.

D3.4 DOCUMENTATION AND DELIVERABLES

The Drainage Contractor shall submit full commissioning and testing report to the Supervising Officer within 14 days after completion of the commissioning and testing of the Installations. The report shall be in accordance with the requirements approved by the Supervising Officer.

PART E – TRAINING, INSPECTION, ATTENDANCE, OPERATION AND MAINTENANCE DURING MAINTENANCE PERIOD

SECTION E1

GENERAL REQUIREMENTS

E1.1 GENERAL

Unless otherwise specified in the Particular Specification, the Drainage Contractor shall provide training, inspection, attendance and operation and maintenance services for the Installations during maintenance period as specified in this General Specification.

The Drainage Contractor shall supply and install, without additional cost to the Employer, replacements for any equipment or parts thereof, which may, in the opinion of the Supervising Officer, 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 Drainage 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 electricity supply and functioning of the Installations during execution of works shall be kept to the minimum. Such interruption shall only be allowed with the prior approval of the Supervising Officer or his Representative.

E1.2 COMPLETION OF OUTSTANDING AND DEFECTIVE WORKS

After receiving the list of defects and outstanding works issued with the Certificate of Completion, the Drainage Contractor shall complete the outstanding works and rectify the defects concerned to the satisfaction of the Supervising Officer within the agreed time frame during the Maintenance Period. The Drainage Contractor shall also rectify as soon as practicable any defects identified within the Maintenance Period.

The Drainage Contractor shall submit periodic report on the progress of outstanding and defective works to the Supervising Officer and attend inspection with the Supervising Officer's Representative to verify satisfactory completion of the outstanding and defective works.

E1.3 REPAIR AND MAINTENANCE RECORDS

The Drainage Contractor shall be responsible for maintaining a log book in each of the specific locations (e.g. switch room, plantroom, etc.) agreed with the Supervising Officer or his Representative. Every attendance and details of work done for the Installations including but not limited to repair, servicing and maintenance shall be entered into the log book by the Drainage Contractor so as to form a comprehensive record of attendance and works done. In addition, the Drainage Contractor shall also keep repair and maintenance records for the Installations in his own office and shall be required to forward such records for checking if so requested by the Supervising Officer.

SECTION E2

TRAINING TO USERS AND OPERATION AND MAINTENANCE AGENTS

E2.1 GENERAL

Training for the operation and maintenance of system and equipment shall be provided and arranged by the Drainage Contractor. The training shall include all training facilities, material and handouts etc. The Drainage Contractor shall submit a "Training Schedule" at least 3 months prior to the prescribed or extended date for the completion of Works for the Supervising Officer's approval. The schedule shall include but not limited to the following requirements:

- (a) Facilities and training programmes to ensure that the users and operation and maintenance agents acquire full knowledge and appreciation of all aspects of the design, day-to-day operation, breakdown and routine maintenance, diagnosis and hence capable to effectively and efficiently operate and maintain the system/equipment;
- (b) All aspects of operation and maintenance of the plant including the use of special tools, and equipment portfolio for major systems covering quantity of equipment, equipment cost, recommended serviceable life by the manufacturer and cycle of major overhaul;
- (c) Details and duration of the training course(s), qualifications of the instructor and the qualification requirements for the trainee(s);
- (d) Full details of the training syllabus, including principles, theory and practical "hands-on" demonstration to reach the required depth of appreciation;

SECTION E3

INSPECTION, ATTENDANCE, OPERATION AND MAINTENANCE REQUIREMENTS

E3.1 RESPONSE AND ATTENDANCE TO EMERGENCY AND FAULT CALLS

The Drainage Contractor shall attend to emergency, fault and complaint calls arising from defective work materials and/or system operation at any time or as specified in accordance with the following categories during the Maintenance Period and rectify all defects leading to fault or breakdown of the equipment and/or system as required. The costs for the attendance, labour, materials and spare parts for repair, submission of fault/breakdown reports, etc. are deemed to have been allowed for in the Tender.

- (a) VERY URGENT for pipe burst and water leakage, the Drainage Contractor shall respond and attend to the Very Urgent calls immediately within 30 minutes;
- (b) URGENT for clogging of drain pipe and drainage overflow, the Drainage 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 Drainage Contractor shall respond and attend the fault within 4 hours.

Investigation report and proposal for repair/improvement/ modification shall be submitted.

The Drainage 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 working days unless long component and parts delivery time is required.

E3.2 MAINTENANCE SCHEDULE

The Drainage Contractor shall prepare and submit the maintenance programme before the commencement of the Maintenance Period for the approval of the Supervising Officer.

Upon the approval of the above maintenance programme and before the commencement of the Maintenance Period, the Drainage Contractor shall prepare a comprehensive maintenance schedule for all installations and indicate dates for routine and periodic inspection, servicing and maintenance of the installations.

The schedule shall include but not limited to the following:

(a) Monthly Routine Maintenance Services

- Check the general condition of the whole installation to ensure the system are satisfactorily performed as required by the Contract;
- Check proper positioning of all manhole, gully and channel covers;
- Check any water leakage from the pipework and to repair if required;
- Examine the condition of joints, stop valves, covers and seals for leaks, repair as required; and
- Check drains are not clogged and rectify if necessary.

(b) Quarterly Maintenance Services

- Clean all strainers;
- Check manholes and gully and rectify clogged conditions if necessary;
- Same as (a) above.

(c) 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 (a) and (b) above.

(d) Annual Maintenance Services

- To conduct drain test to verify the drainage performance at selected stacks, branches and underground drainage;
- Same as (a), (b) and (c) above.

E3.3 INSPECTION DURING MAINTENANCE PERIOD

The Drainage Contractor shall, in addition to the routine maintenance, make further inspections for the Installations to check and, if necessary, re-adjust the equipment/systems to meet the actual operation conditions and to test the installations to meet statutory requirements including the submission of test reports and certificates.

E3.4 JOINT INSPECTION AT THE END OF MAINTENANCE PERIOD

The Drainage Contractor shall attend inspections to the Installations at the expiry of the Maintenance Period in order to facilitate the acceptance and handing over of the Installations to the Employer's operation and maintenance agents. The Drainage Contractor shall conduct site checking and make necessary adjustments to the equipment/systems one month before expiry of the Maintenance Period to ensure that the Installations are in good working order, safe and satisfactory operation condition for handover.

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 Drainage Contractor may offer products, materials and equipment complying with alternative internationally recognised equivalent standards acceptable to the Supervising Officer 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 Supervising Officer for approval.

Standard	Description
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 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 1377-2: 1990	Methods of test for soils for civil engineering purposes. Classification tests
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: 2014	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 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 4999-103: 2004	General requirements for rotating electrical machines. Specification for symbols
BS 4999-141: 2004 +A1:2010	General requirements for rotating electrical machines. Specification for standard dimensions
BS 4999-147:1988	General requirements for rotating electrical machines. Specification for dimensions of brushes and brush-holders for electrical machinery
BS 4999-145:1987	General requirements for rotating electrical machines. Specification for winding terminations
BS 4999-140:1987	General requirements for rotating electrical machines. Specification for voltage regulation and parallel operation of a.c. synchronous generators
BS 5163-1: 2004	Valves for waterworks purposes. Predominantly key-operated cast iron gate valves. Code of practice

<p>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)</p>	<p>Specification for thermoplastics waste pipe and fittings</p>
<p>BS 5911-1: 2002 + A2: 2010</p>	<p>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)</p>
<p>BS 5911-3: 2010</p>	<p>Concrete pipes and ancillary concrete products. Specification for unreinforced and reinforced concrete manholes and soakaways</p>
<p>BS EN 124-1: 2015</p>	<p>Gully tops and manhole tops for vehicular and pedestrian areas. Part 1: Definitions, classification, general principles of design, performance requirements and test methods</p>
<p>BS EN 197-1: 2011</p>	<p>Cement. Composition, specifications and conformity criteria for common cements</p>
<p>BS EN 274-1: 2002</p>	<p>Waste fittings for sanitary appliances. Requirements</p>
<p>BS EN 295-1: 2013</p>	<p>Vitrified clay pipes and fittings and pipe joints for drains and sewers. Requirements</p>
<p>BS EN 295-2: 2013</p>	<p>Vitrified clay pipes and fittings and pipe joints for drains and sewers. Quality control and sampling</p>
<p>BS EN 295-3: 2012</p>	<p>Vitrified clay pipes and fittings and pipe joints for drains and sewers. Test methods</p>
<p>BS EN 295-4: 2013</p>	<p>Vitrified clay pipes and fittings and pipe joints for drains and sewers. Requirements for special fittings, adaptors and compatible accessories</p>
<p>BS EN 295-5: 2013</p>	<p>Vitrified clay pipes and fittings and pipe joints for drains and sewers. Requirements for perforated vitrified clay pipes and fittings</p>
<p>BS EN 295-7: 2013</p>	<p>Vitrified clay pipes and fittings and pipe joints for drains and sewers. Requirements for vitrified clay pipes and joints for pipe jacking</p>
<p>BS EN 295-10: 2005</p>	<p>Vitrified clay pipes and fittings and pipe joints for drains and sewers. Performance requirements</p>

BS EN 598: 2007 + 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 752: 2008	Drain and sewer systems outside buildings
BS EN 837-1: 1998	Pressure gauges. Bourdon tube pressure gauges. Dimension, metrology, requirements and testing
BS EN 877: 1999 + 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 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 + A1: 2013	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 1171: 2015	Industrial valves. Cast iron gate valves
BS EN 1329-1: 2014	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 1515-1: 2000	Flanges and their joints. Bolting. Selection of bolting
BS EN 1561: 2011	Founding. Grey cast irons
BS EN 1562: 2012	Founding. Malleable cast irons
BS EN 1563: 2011	Founding. Spheroidal graphite cast iron
BS EN 1564: 2011	Founding. Ausferritic spheroidal graphite cast irons.

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 10084: 2008	Case hardening steels. Technical delivery conditions
BS EN 10087: 1999	Free cutting steels. Technical delivery conditions for semi-finished products, hot rolled bars and rods
BS EN 10088-1: 2014	Stainless steels. List of stainless steels
BS EN 10088-2: 2014	Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes
BS EN 10088-3: 2014	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 10242: 1995	Threaded pipe fittings in malleable cast iron
BS EN 10250-1: 1999	Open steel die forgings for general engineering purposes. General requirements
BS EN 10250-4: 2000	Open steel die forgings for general engineering purposes. Stainless steels
BS EN 10255: 2004	Non-alloy steel tubes suitable for welding and threading. Technical delivery conditions
BS EN 12056-2: 2000	Gravity drainage systems inside buildings. Sanitary pipework, layout and calculation
BS EN 12163: 2016	Copper and copper alloys. Rod for general purposes
BS EN 12200-1: 2016	Plastics rainwater piping systems for above ground external use. Unplasticized poly (vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system
BS EN 13101: 2002	Steps for underground man entry chambers. Requirements, marking, testing and evaluation of conformity
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 13835: 2012	Founding. Austenitic cast irons
BS EN 60079-0: 2012 +A11:2013	Explosive atmospheres. Equipment - General requirements
BS EN 60079-1: 2014	Explosive atmospheres. Equipment protection by flameproof enclosures “d”
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: 2010	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 1452-4: 2009	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly(vinyl chloride) (PVC U). Valves
BS EN ISO 1452-5: 2009	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly(vinyl chloride) (PVC U). Fitness for purpose of the system
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 9906: 2012	Rotodynamic pumps - Hydraulic performance acceptance tests - Grades 1, 2 and 3
IEC 60085: 2007	Electrical insulation – Thermal evaluation and designation
IEC 60529: 2013	Degrees of Protection Provided by Enclosures (IP Code)
ISO 185: 2005 Ed2(R10)	Grey cast iron. Classification
ISO 197-4: 1983	Copper and copper alloys. Terms and Definitions. Castings

ISO 2892: 2007 Ed2(R10)	Austenitic cast iron. Classification
ISO 3864-1: 2011	Graphical symbols. Safety colours and safety signs. Design principles for safety signs and safety markings
ISO 5457:1999 +A1:2010	Technical product documentation. Sizes and layout of drawing sheets
ISO 7005-1: 2011	Pipe flanges. Steel flanges for industrial and general service piping systems
ISO 7005-2: 1988	Metallic flange. Cast iron flanges
ISO 9001: 2008/Corr1: 2009	Quality management systems. Requirements